Discourse Processing Treatment and Attention Process Training 2 in Adults with Traumatic Brain Injury

By Amy Henderson

April, 2019

Director: Dr. Heather Harris Wright

Major Department: Communication Sciences and Disorders

Persons with traumatic brain injury (TBI) often present with relatively preserved lexical and grammatical skills but exhibit discourse level deficits which negatively affect functional communication. Discourse following TBI has been characterized as disorganized, tangential and uninformative. Cognitive deficits experienced by individuals with TBI may underlie these discourse deficits. A context sensitive approach to rehabilitation holds that linguistic and cognitive deficits should be targeted through functional tasks. By contrast, in a process specific approach to rehabilitation, discrete cognitive skills are trained through decontextualized tasks with the assumption that improvements in discrete cognitive skills will cause generalized improvements in functional tasks which rely on these cognitive skills.

The purpose of the present study was to compare the effectiveness of a context sensitive approach, Discourse Processing Treatment (DPT) with a process specific approach, Attention Process Training 2 (APT-2) in improving discourse and cognition. DPT targeted discourse deficits with structured cues (comprehension questions and a visual story guide which depicted story grammar elements), metacognitive and metalinguistic strategies, and functional training in

the form of narrative practice. APT-2 is a hierarchical, multilevel treatment program which targets five levels of attention (sustained, selective, alternating and divided attention) through decontextualized laboratory tasks. The research questions addressed by the present study were as follows:

1. Will the individual and combined effects of DPT and APT-2 improve performance on measures of discourse informativeness and coherence?
2. Do the individual and combined effects of DPT and APT-2 generalize to improvements on standardized measures of attention and memory?
3. Are the individual and combined treatment effects of DPT and APT-2 maintained for informativeness, coherence and cognitive measures following the entire treatment cycle (both DPT and APT-2) for a one month period?

The results of this study suggest that DPT by itself had a greater effect on discourse informativeness and coherence than APT-2 by itself. However, DPT and APT-2 in combination resulted in greater gains in discourse informativeness for untreated picture stimuli. Additionally, all participants showed improvements in attention, as measured by raw completion times on the Comprehensive Trail Making Test (CTMT) following treatment but there was inter subject variability in terms of which treatment yielded the best effect; Participant 1 improved following APT-2, Participant 4 improved following DPT, and Participant 2 improved from both. Overall, our results suggest that DPT may improve discourse informativeness and coherence in adults with TBI but focused cognitive training in addition to DPT may maximize generalization. Our results also suggest that both APT-2 and DPT may result in improvements in attention.

# Discourse Process Training and Attention Process Training 2 in Adults with Traumatic Brain Injury

A Dissertation

Presented to the faculty of the Department of Communication Sciences and Disorders

East Carolina University

In Partial Fulfillment for the Requirements for the PhD in Communication Sciences and Disorders

By Amy Henderson

April, 2019

© 2019, Amy Henderson

Discourse Processing Treatment and Attention Process Training 2 in Adults with Traumatic Brain Injury

by

Amy Henderson

APPROVED BY:

DIRECTOR OF
DISSERTATION: ______________________________________________
Heather Harris Wright, PhD, CCC-SLP

COMMITTEE MEMBER: ______________________________________________
Charles Ellis Jr., PhD, CCC-SLP

COMMITTEE MEMBER: ______________________________________________
Lucía I. Méndez, PhD, CCC-SLP

CHAIR OF THE DEPARTMENT
OF COMMUNICATION SCIENCES AND DISORDERS: ______________________
Jamie L. Perry, PhD, CCC-SLP

DEAN OF THE
GRADUATE SCHOOL: ______________________________________________
Paul J. Gemperline, PhD

ACKNOWLEDGEMENTS

I would like to thank my advisor, Dr. Heather Harris Wright for her excellent mentorship over the past few years as well as my committee members, Dr. Charles Ellis and Dr Lucía I. Méndez for their assistance with this project. Additionally, I would like to thank all of my supervisors in the East Carolina University for helping me schedule my time in the clinic around my research and Sherri Winslow for helping me schedule my internships around this project. I would also like to thank my parents, Janice and Mike Henderson and my fiancée, Sean Kern for all of the encouragement and support they have given me while I completed this program.

TABLE OF CONTENTS

LIST OF TABLES

# CHAPTER 1: INTRODUCTION

Traumatic brain injuries (TBIs) may be classified as open (penetrating) injuries or closed head injuries. In both open and closed injures there are several mechanisms that contribute to the damage of brain tissue in a TBI. In an open head injury, penetration of the skull and meninges occurs. In this type of injury, the penetrating object can cause focal contusions as well as structural damage to adjacent tissues (Greve & Zink, 2009). In a closed head injury, the skull remains intact and the meninges are not penetrated. Both diffuse and focal injuries can occur with a closed head injury. Diffuse axonal injury occurs when the acceleration, deceleration, or rotation of the brain results in shearing of axons. Focal contusions can result from the impact of the brain against the skull. In both CHI and PHI, the damage to brain tissue caused by the primary injury can trigger metabolic and physiological changes that result in secondary effects such as edema, increased intracranial pressure, and reduced cerebral perfusion. These secondary effects, can, in turn, cause further tissue damage (Graham et al., 2009). Brain regions that demonstrate increased vulnerability to injury after TBI are the orbitofrontal, anterotemporal, and lateral temporal surfaces (Stierwalt & Murray, 2002).

Following traumatic brain injury, individuals typically experience deficits in a wide variety of cognitive domains. Deficits in attention, working memory, and executive functions are common. Additionally, persons with TBI often present with discourse level communication impairments. Discourse refers to language that is above the single sentence level. Discourse consists of multiple connected utterances that convey a message (Galski, Tompkins, & Johnston, 1998). Discourse production is a demanding task that involves the integration of multiple cognitive and linguistic processes. Thus, any disruption in cognitive processing can potentially lead to discourse level impairments. Discourse level impairments can occur even in absence of lexical and grammatical impairments; persons with TBI often do not present with aphasia yet they still demonstrate discourse level deficits. Discourse following TBI has been characterized as disorganized and tangential (Alexander, Benson & Stuss, 1989) as well as uninformative (Hartley & Jensen, 1991). Discourse produced by persons with TBI also has been shown to be more dysfluent, less efficient, and less cohesive (Hartley & Jenson, 1991).

These discourse level deficits have significant functional consequences. Conversations with persons with TBI have been rated as less interesting, less appropriate, less rewarding and more effortful than conversations with neurologically healthy individuals (Bond & Godfrey, 1997). Discourse level deficits have been associated with social isolation, decreased independence, and difficulties returning to work, school, and other preinjury activities (Coelho, Youse, & Le 2002).

**Models of Discourse**

Many of the current models of discourse are focused on discourse comprehension. These models describe how an individual forms a mental model of an event called a *situation model*. Comprehension of a discourse involves more than the comprehension of isolated utterances or isolated units of information. Thus, most models of discourse comprehension posit that these situation models are developed by integrating the information from the discourse with knowledge structures in long term memory which are developed through world experience. In Kintsch and van Djik's Construction-Integration model (1978), bottom-up processes and top down processes interact to allow one to comprehend discourse. In this model, discourses are understood at three interacting levels: 1) surface; 2) semantic; 3) situational; and 4) structural. At the surface level, propositions consisting of a verb and its arguments, are constructed from the linguistic information in the discourse. At the semantic level, connections between propositions are established. Establishing these connections will often involve inferential processes in order to fill in information not explicitly stated in the discourse. The propositions from the discourse activate schemas associated with the propositions and these schemas will facilitate inferencing. Kintsch and van Djik noted that these schemas must be applied in a flexible way; if they are applied too rigidly, it would not be possible to comprehend novel discourses. Instead, the linguistic information in the discourse and the information from the schemas is integrated in such a way so that the discourse can be interpreted as a coherent whole. At the situational level, a mental model of what the discourse is about is established. At this level, the information in the discourse is reduced to macro propositions which contain the essential information of the discourse. This allows the overall gist of the discourse to be comprehended. The structural level of discourse specifies the type of information that discourses within a specific genre should have. For example, a narrative discourse must have information about the setting, problem, the plan to resolve the problem, and the resolution. This structural information allows a comprehender to know what type of discourse is being produced. Additionally, it provides a constraint for the situational level by specifying what information is relevant for a particular discourse task (Kintsch & van Dijk, 1978).

In a similar way, Gernsbacher's (1997) Structure Building Framework provides an explanation of how pieces of information in a discourse are integrated to form a coherent whole. First, comprehenders use information that is presented early on to lay the foundation for representing new information. Subsequent information is then mapped onto that framework if it is coherent. This happens because coherent information will activate the same memory nodes as the information which forms the foundation. If the information is not coherent, a different set of memory nodes will be activated to form a new substructure. When memory nodes are activated, then they are able to enhance or suppress the activation of other memory nodes. The activation of a memory node is enhanced when the information represented by the node is needed for further structure building. The activation of a memory node is suppressed when it is no longer needed for structure building.

The Event Indexing Model (Zwaan, Langston, & Graessler, 1995) holds that story events and intentional actions of characters are the focal points of the situation models. According to the Event Indexing Model, the comprehender tracks story events and actions along five indices: 1) the time period in which they occur; 2) the spatial location in which they occur; 3) the protagonists that are involved; 4) The causal links between the current event and previous events; and, 5) the relationship between the current event and the protagonist's goals. The comprehender must continuously monitor whether or not any of these indexes need to be updated as the discourse progresses. For example, when information indicates that an event takes place in a different time period, the time index must be updated. When an event takes place in a location that is different than the previous event, the spatial index must be updated. When a new event is casually unrelated to previous events, the causal index must be updated. When a new event is not related to the previously established goals of the protagonist, the goal index must be updated. The model assumes that continued activation of the current event node is the default mechanism in discourse comprehension. However, when a discontinuity is introduced in any of the five indices, the current event node must be deactivated and either a new event node is activated, or an older event node will be reactivated.

In summary, models of discourse comprehension describe how a situation model of a discourse is developed as discourse is comprehended. Mar (2014) noted that cognitive models of comprehension describe narrative processes that fall under three broad categories: 1) memory encoding and retrieval; 2) integration; and, 3) elaboration or simulation. Additionally, it appears that cognitive models of comprehension also address how attention is modulated as comprehension occurs; in order for comprehension to occur efficiently, a comprehender's attention must be directed towards the story information that is most relevant for the story gist. Conversely, information that does not aid comprehension must be inhibited.

Neurocognitive models of discourse comprehension predict that the frontal lobes will be heavily involved in the comprehension process. Since comprehension of discourse involves the integration of discourse information instead of just comprehension of individual words and utterances, it makes sense that processing will occur in areas beyond the traditional language areas of the brain. Ferstl, Neumann, Bogler, and von Cramon (2008) refer to the spreading of activation beyond the left perisylvian areas as the "extended language network". Comprehension of discourse involves a greater processing load than comprehension of single words and utterances because in order to construct the story gist and in order to track distant pieces of information, information must be maintained in memory for longer periods of time (Mar, 2014). Mar noted that maintenance of information over relatively long periods of time is made possible by continued firing of neurons following the removal of eliciting stimuli and that the frontal lobe is the area of the brain that best performs this function. Specifically, neurons in both the dorsolateral prefrontal cortex have been associated with cross-temporal and cross-modal processing.

Mar (2014) noted that Grafman's (2003) theory of prefrontal function is relevant for story comprehension. In this model, the prefrontal cortex represents structured event sequences known as *Structured Event Complexes* that are goal-oriented and schematic. Grafman predicted that the right prefrontal cortex is involved in processing loosely associated information (such as story themes and morals). Grafman also predicted that the ventromedial prefrontal cortex is involved in processing social event sequences and that the medial prefrontal cortex is involved in processing predictable event sequences. Frith and Frith (1999, 2000, 2001) have noted that the medial prefrontal cortex also appears to be involved in making mental inferences.

Neuroimaging studies have offered empirical evidence that the frontal lobes are involved in discourse comprehension. Using positron emission tomography (PET), Fletcher and colleagues (1995) compared brain activation in participants while they read three different types of texts: 1) stories that required inferencing about the character's mental states (Theory of Mind stories); 2) that did not require inferencing about the character's mental states (physical stories); and, 3) groups of unrelated sentences. Based on the patterns of activation observed in these conditions, the researchers concluded that the prefrontal region is involved in making inferences about mental states. They also concluded that the temporal pole is involved in linking propositions to create story representations and that the posterior superior temporal gyrus is involved in discourse level processing. In a similar PET study, Mazoyer and colleagues (1993) compared activation associated with comprehension of single words to comprehension of stories to determine brain regions involved in macro-level processing. The researchers found increased activation in the middle temporal gyrus, the temporal poles, and the left superior prefrontal region in the stories condition. Based on the results of a meta-analysis of ten neuroimaging studies, Ferstl and colleagues (2008) found that activation in the posterior cingulate cortex, inferior precuneus, and dorso-medial cortex was associated with the coherence building process. Overall, the results of neuroimaging studies suggest that a bilateral processing network comprised of the medial prefrontal areas and the precuneus is involved in the process of binding the information contained in a discourse into a cohesive whole (Ferstl & von Cramon, 2001; Xu, Kemeny, Park, Frattali, & Braun, 2005).

There has been comparatively little attention focused on the development of models of discourse production. However, the previously described models of discourse comprehension are also relevant for understanding the processes involved in discourse production. In order to understand a narrative, one has to integrate the information found in individual utterances in order to determine the gist of the story. Similarly, in order to produce an efficient, well-constructed narrative, one must be able to determine the overarching main topic of the narrative since this will inform both how the discourse should be structured and which pieces of information are most relevant. Additionally, in order to communicate accurately about events, one must be able to interpret those events correctly which would require the ability to make inferences about the mental states of others and about causality. This could possibly be related to one's ability to form mental models or schemas. Mar (2004) noted that since stories are, in part, a coherent causal-temporal ordering of select information, a person must be able to distinguish between story-significant and story-insignificant information to comprehend and to produce narratives. Mar also identified the ability to sequence events as a process that would be involved in both discourse comprehension and production.

Traditional psycholinguistic models of speech production are useful for elucidating the processes involved in discourse production. According to Levelt's (1989) model, there are three processing stages involved in language production: 1) a prelinguistic conceptual phase; 2) a phase of linguistic formulation; and, 3) a phase of linguistic expression. In the prelinguistic conceptual phase, the speaker needs to generate a motivation to speak and a mental model of the intended message. When the speaker is producing discourse instead of single sentences, this will involve retrieving a conceptual frame structure for the appropriate discourse genre (e.g.

narrative, procedural, etc.) from long-term episodic memory and embedding it with the conceptual information from the situation model (Marini & Andreeta, 2016). For example, a narrative discourse will have a frame structure with a beginning, middle, and end and it will be embedded with information about the setting, problem, response, and resolution. The speaker will also need to integrate what he/she wishes to say with what has previously been said and with the demands of the communicative context. Thus, the speaker will need to consider what types of utterances are appropriate for the situation and the information that the listener will need to fully comprehend the message. This will require the speaker to make inferences about the comprehender's beliefs and about the level of background information the speaker has. In the next phase, the phase of linguistic formulation, the lexical items that will be used to relay the speaker's message will be accessed. Through this, the speaker also accesses the morphosyntactic features of the selected lexical items. This morphosyntactic information guides utterance generation first by the assignment of thematic roles by thematic roles and phrase generation and then by generating grammatical relations among the phrases. At this point, the speaker has access to the syllabic and phonological representations of the word during this phase of linguistic expression. This information is then sent to the output system to be articulated.

In summary, the production of discourse involves a cognitively demanding planning process that includes the interaction of multiple cognitive and linguistic skills. The individual must be able to generate an appropriate conceptual model which involves selecting story relevant information and organizing that information appropriately. Additionally, the speaker must make inferences about the comprehender's mental state and about the communicative context. Then, the speaker must engage in lexical selection and sentence planning in order to express the conceptual information.

## Discourse in TBI

Persons with TBI often demonstrate relatively preserved lexical and grammatical skills. However, they may present with problems in social communication which prevents them from communicating effectively. Since persons with TBI often do not demonstrate difficulty at the single word or single utterance level, they may score within the normal range on a standardized aphasia battery. However, when producing longer and more complex utterances such as discourse in natural communication settings, a person with TBI may demonstrate difficulty with communicating in an appropriate, informative, and efficient way. It is thought that this difficulty with functional communication does not occur as a result of a primarily linguistic deficit but instead occurs, at least in part, because of deficits in other cognitive processes (i.e., Galetto, Andreeta, Zettin, & Marini, 2013; Hinchliffe, Murdoch, & Chenery, 1998).

Persons with TBI often present with normal language functioning based on performance on standardized aphasia batteries. Studies that include discourse-based measures have helped researchers characterize the discourse abilities of persons with TBI and identify impairments at this higher linguistic processing level. These measures have consistently shown differences between persons with TBI and healthy controls. These measures are more sensitive than standardized aphasia batteries because they allow language abilities to be measured at multiple levels. Analysis can occur at the microlinguistic, microstructural, macrostructural, and superstructural levels (Coelho, 2007).

### Microlinguistic/microstructural abilities in TBI.

The microlinguistic level of analysis occurs at the within-utterance level and includes lexical and grammatical analyses. Measures that may be used include productivity measures (e.g. words or c-units per narrative, words per c-unit), grammatical complexity (e.g. subordinate clauses per c-unit or proportion of agrammatical c-units), or tallies of information units. Although many persons with TBI do not present with aphasia symptoms, they may still have subtle microlinguistic deficits. For example, researchers have demonstrated that persons with TBI communicate less efficiently based on the number of words produced per minute (i.e., Marini et al., 2011). Additionally, persons with TBI have been shown to produce more disruptions of ongoing utterances (e.g. /the man is staring at .../the man is watching the dog) (Marini et al, 2011) and verbal mazes (Peach 2012).

The microstructural level of analysis occurs at the between-utterance level. At this level, discourse cohesion may be analyzed. In discourse, words known as cohesive markers are utilized to signal the relationship between utterances. Researchers have found that persons with TBI have difficulty using cohesive markers (Coelho, Liles, & Duffy, 1994; Hartley & Jensen, 1991). Others have found that the task influenced whether or not persons with TBI could use these markers effectively; persons with TBI who used cohesive markers comparably to that of controls in a story retell task showed deficits in using cohesive markers in a story generation task (Liles, Coelho, Duffy, & Zalagens, 1989).

**Macrostructural abilities in TBI.**

Discourse macrostructure refers to the global topic of the discourse. Macrostructural analyses often include measures of coherence and organization (Coelho, 2007). Coherence refers to the thematic unity of a narrative (Coelho, 2007). Glosser and Deser (1991) reported levels of coherence referred to as global coherence and local coherence. Global coherence refers to the degree to which an utterance reflects the overall topic of the discourse; whereas, local coherence refers to the degree to which the topic is maintained from utterance to the subsequent utterance.

Previously, researchers have shown that persons with TBI exhibit deficiencies with regards to both local and global coherence with global coherence often more impaired than local coherence.

In one study of local versus global coherence in participants with TBI, Hough and Barrow (2003) elicited discourses by asking participants to describe their family and to describe a work experience from their past. Local and global coherence were rated on two different five point scales. Based on their analysis, participants with TBI exhibited impairments in both local and global coherence with greater impairment in global coherence. In this group, there were no significant differences in local versus global coherence when the two elicitation tasks were compared. By contrast, the error rates for lexical errors were comparable between the TBI and control groups. This suggests that the coherence deficits in the TBI group were not driven by problems with lexical access.

In a similar study, Marini et al. (2011) analyzed global coherence in narrative discourses produced by participants with TBI and healthy controls. Marini and colleagues found that participants with TBI produced more global coherence errors than healthy controls due to frequent disruptions of utterances, derailments, and tangential utterances. The researchers noted that these errors made the discourses produced by participants with TBI appear vague and ambiguous. Like Hough and Barrow (2003), Marini and colleagues found that the participants with TBI exhibited adequate microlinguistic skills. Based on these results, Marini and colleagues concluded that persons with TBI show deficits in the ability to organize information and that this likely reflects a deficit at the interface of cognitive and linguistic processing rather than a specific linguistic deficit.

Davis and Coelho (2004) introduced the concept of logical coherence, which they noted is difficult to categorize as either global or local. Statements in a discourse often have causal relationships with one another such as when an action causes another action or when a mental state motivates an action (Trabasso & Sperry, 1985). Davis and Coelho noted that logical coherence may be somewhat related to the idea of local coherence since local coherence considers the relationship of one utterance to the next utterance. However, they also note that Glosser and Deser's (1992) definition of local coherence only considers the relationship of utterances that are adjacent to one another and that causal relationships may be expressed between non-adjacent utterances. Davis and Coelho found that in a story retell task, participants with TBI showed impairments in logical discourse relative to healthy controls.

Discourse superstructure refers to the organization of information within a discourse. Story grammar refers the organization of information within a narrative which establishes logical and temporal relationships among units of information. Story grammar includes information about the setting of a narrative as well as the story episodes which contain information about initiating events (the action or event signifying change), the internal response (goals or cognitions motivating behavior); the attempt (goal-directed behaviors); the direct consequence (outcome of attempt); and the reactions (response to consequence) (Stein & Glenn, 1979). Previous studies have shown that persons with TBI produce fewer complete episodes than healthy controls and fewer correct propositions within each episode (Mozeiko, Le, Coelho, Krueger, & Grafman, 2011).

**Measures of information content.**

Information content may be assessed by considering such measures as content units, correct information units, and propositions. Measures of information content do not fit neatly into the microlinguistic and macrolinguistic distinction because producing adequately informative discourses involves both micro and macrolinguistic skills (Armstrong, 2000). At the microlinguistic level, adequate lexical access and syntactic skills are needed to accurately relay the information in the narrative. However, adequate macrolinguistic skills are needed to produce the information of a discourse in a meaningful context. This will involve determining what information is needed to express the main ideas of the discourse and organizing that information in an appropriate way. The degree to which a measure of information content reflects microlinguistic skills versus macrolinguistic skills will thus depend on the degree to which the measure reflects simple lexical access skills versus the skills involved in communicating that information in an efficient, organized and meaningful way. With this in mind, it is not surprising that studies on discourse informativeness in persons with TBI have yielded different results depending on the specific measure that is used. Hartley and Jensen (1991) found that persons with TBI produced less informative discourses as measured by the number of accurate content units produced. They hypothesized that this may have been due to failure to interpret the stimulus correctly. In another study, McDonald (1993) investigated whether persons with TBI were able to meet the informational needs of the speaker by rating the discourses on aspects of Grice's maxims of quantity and manner. MacDonald found that the discourses produced by persons with TBI were deficient in both the informational content and how the content was organized. One participant's narratives did not contain adequate detail; MacDonald noted that this could possibly be due to an inability to determine what background information the interlocutor was privy. The other participant produced narratives that were repetitive and poorly organized. Marini and colleagues (Marini et al., 2011) found that persons with TBI produced a similar number of main concepts as controls but that the information was not organized appropriately. Persons with TBI also have been found to produce more irrelevant propositions compared to healthy controls (Coelho, 2007) and more inaccurate information compared to controls (Hartley & Jensen, 1991; Stout, Yorkston, & Pimentel, 2000; Tucker & Hanlon, 1998). The production of discourse is a complex process that involves the interaction of both linguistic and cognitive skills. Adults with TBI present with deficits in all aspects of discourse production with greater deficits at the macrostructural and superstructural levels. The processes involving microlinguistic abilities are likely to be primarily linguistic in nature. By contrast, macrolinguistic processes likely involve the interaction of cognitive and linguistic skills. With this in mind, it is likely that the discourse deficits observed in persons with TBI are related to the cognitive impairments.

**Cognition in TBI**

Attention consists of both basic and complex cognitive functions that allow one to select and manipulate internal or external stimuli for varying periods of time (Park & Ingles, 2001; Posner & Peterson, 1990). Sohlberg and Mateer's Attention Process Model (1987) divides attention into four hierarchically organized levels. Sustained attention refers to the ability to maintain attention over time during continuous or repetitive activities. Selective attention refers to the ability to attend to target stimuli while ignoring competing nontarget stimuli. Alternating attention refers to the ability to switch between two or more tasks that have differing cognitive demands. Divided attention refers to the ability to attend to multiple tasks simultaneously.

Impairments in attention are widely reported following TBIs, regardless of the level of severity. There is evidence that the areas of the brain that are particularly vulnerable to the effects of TBI- the orbitofrontal, anteriotemporal, and lateral temporal surfaces- are also areas that subserve attention functions. Attention forms the basis for more complex cognitive functions. Thus, when attention is impaired there will also be impairments in other cognitive skills (Stierwalt & Murray, 2002). It is not surprising, then, that attention impairments are associated with poor functional outcomes in persons with TBI (Brooks & McKinlay, 1987).

Although problems with attention abilities, such as vigilance, tend to resolve rapidly following the post traumatic amnesia (PTA) period, problems with more complex attentional processes often persist following TBI. Persons with mild TBI may experience persistent deficits with sustained attention (Parasuraman, Mutter, & Molloy, 1991), alternating attention (Bohnen, Jolles, & Twijnstra, 1992) and divided attention (Pare, Rabin, Fogel, & Pepin, 2008). These deficits appear most often in situations where the person must engage in a cognitively demanding task. However, these impairments can also appear in less cognitively demanding contexts.

Attention impairments are likely to cause problems in discourse comprehension and production. The ability to maintain the topic of a discourse involves both sustained attention as well as selective attention since an individual must inhibit irrelevant information in order to maintain topic. Additionally, producing a narrative discourse would involve shifting from one episode to the next in order for the narrative to progress. Similarly, other types of discourse (procedural, expository, etc) would also involve shifting from one unit of information to the next in order to avoid redundancy and perseveration errors. This ability to shift among units of information could presumably involve alternating attention. When producing a discourse, many types of information (lexical, syntactic, and pragmatic) must be integrated. This could potentially require good divided attention abilities as well.

Working Memory (WM) can be conceptualized as a limited capacity and temporary memory buffer that temporarily stores, processes, and manipulates information. Baddeley's (2001) updated multi-component model of working memory includes a central executive system that allocates attentional resources to three slave systems: (1) phonological loop; (2) visuospatial sketchpad; and (3) episodic buffer. The phonological loop is responsible for the rehearsal and maintenance of verbal information. The visuospatial sketchpad stores visual and spatial information. The episodic buffer acts as a unitary multimodal storage center that acts as a bridge among the phonological loop, the visuospatial sketchpad, and long-term memory.

Working memory and attention are closely related cognitive processes. Baddeley even noted that the central executive may be aptly characterized as "working attention". In Baddeley's (2001) model of working memory, the central executive functions as an attentional control system which directs one's ability to focus, divide and switch attention. Thus, the functions of the central executive align well with the different levels of attention in Sohlberg and Mateer's Attention Process Model. Engle (2002) has argued that working memory capacity is not directly about memory. Rather, it is about the ability to use attention to maintain needed information or suppress unneeded information. Engle notes that individual differences in working memory do not relate to differences in the number of items that can be stored per se but instead relate to differences in the ability to control information in an active, quickly retrievable state. Thus, persons with greater working memory capacity can hold more representations in mind because they are better able to control attention to avoid distraction.

There have only been a few studies which have investigated the relationship between working memory and discourse production in persons with TBI. In one of these studies, Hartley and Jensen (1991) found significant correlations between measures of working memory and measures of productivity and efficiency in persons with TBI. Hartley and Jenson also found significant correlations between measures of cohesion and measures of working memory.

Deficits in working memory and executive function are likely to be related to the discourse deficits observed in TBI. Executive dysfunction could contribute to problems with planning and monitoring behavior, which in turn, could cause problems with adhering to the traditional discourse structure. (McDonald & Pearce, 1998). Previous evidence has also established a link between executive function and story grammar ability (Coelho, 2002; Mozeiko et al., 2011; Tucker & Hanlon, 1998). In one study, Mozeiko et al. (2011) found that there were significant correlations between story grammar measures and scores on the sorting test of the Delis-Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001). This measure involves initiation, concept formation, and cognitive flexibility (Miyake, Emerson, & Friedman, 2000).  Mozeiko and colleagues (2011) noted that episode generation relies on similar goals since it required the identification of goals, identification of an intended plan and evaluation of the success or failure of the plan. Executive dysfunction may also negatively affect an individual's ability to make the inferences that are necessary for discourse to proceed successfully.  Successful communication involves making inferences about the social context as well as the beliefs and knowledge state of one's conversational partner. It is possible that reduced information content that is sometimes seen in the discourses of persons with TBI is related to difficulties in making pragmatic inferences. In order to determine how much and what sort of information must be provided in discourse, one must make inferences about both the communicative goal of the discourse and about how much background knowledge one's conversational partner has. Discourses without adequate information may be a result of an inability to consider the informational needs of conversation partners. Similarly, the tendency of persons with TBI to produce discourses that are not appropriate for the context may be a result of an inability to make inferences about the setting in which the discourse takes place as well as the conversational participants.

Finally, it is also possible that the cognitive deficits seen in TBI could affect the microlinguistic level of discourse. Although some researchers have posited that microlinguistic deficits in TBI occur as a result of linguistic deficits that affect online sentence processing (Ellis & Peach, 2009), it has also been suggested that these deficits could occur due to a cognitive deficit which affects the semantic organization of sentences (Marini et al., 2011). Marini and colleagues argued that since their participants produced the same number of grammatical sentences as the control participants which suggests that that they do not present with an impairment in online processing. Additionally, the participants with TBI did not produce more phonological or semantic errors compared to controls which suggests that they had normal phonological and lexical selection abilities. A principle components analysis showed that a single factor accounted for speech rate and cohesion errors and the researchers argued that this may suggest that the reduced speech rate was caused by interruptions in the flow of thought instead of by specific linguistic deficits.

**Cognitive Rehabilitation in TBI**

Cognitive rehabilitation refers to interventions that aim to improve cognitive skills by retraining previously learned skills and residual skills, teaching compensatory strategies, increasing one's awareness of deficits, and improving meta cognitive and self-monitoring skills (Cicerone et al., 2005). Cognitive rehabilitation may target attention, memory, executive function, language, and/or visual perceptual skills. Systematic reviews have supported the effectiveness of cognitive rehabilitation (Cicerone et al., 2000; Cicerone, et al., 2005). Cicerone et al. (2000) used these reviews to develop evidence based practice standards, guidelines and options for professionals who work with patients with TBI on cognitive skills. Practice guidelines are based on evidence from class I or class II studies which suggested that strategy training to improve attention and memory and interventions which target functional communication and conversation skills are effective for this population. Practice guidelines were based on evidence from class studies and included recommendations for attention training (using various modalities, levels of complexity and response demands), methods to improve reading comprehension and language, and training in problem solving strategies. Practice options were based on evidence from class II and class III studies and included the use of external aids for memory and the use of methods of self-instruction, self-questioning and self-monitoring to improve executive function.

The traditional approach to cognitive rehabilitation is a process specific approach. In this approach, distinct cognitive skills are trained by repeatedly administering hierarchically organized treatment tasks. These tasks themselves are decontextualized tasks and are not functional in nature. The decontextualized nature of the tasks in a process specific approach to rehabilitation means that a very specific aspect of cognition can be isolated and trained. Functional tasks that reflect the tasks we perform in our day-to-day life are typically complex in nature and involve multiple cognitive skills. Using functional tasks means that it is difficult to isolate one specific cognitive skill to be trained. The assumption underlying process specific rehabilitation is that the improvements in these specific cognitive skills will cause generalized improvement in functional skills that rely on the trained cognitive skills.

One example of a process specific intervention is Sohlberg and Mateer's Attention Process Training Program (APT, Sohlberg & Mateer, 1987). The Attention Process Training Program (Sohlberg & Mateer, 1987) is a hierarchical, multilevel treatment program. The program focuses on the five levels attention described in Sohlberg and Mateer's (1987) Attention Process Model (focused, sustained, selective, alternating and divided attention). Within each of these levels, tasks are administered in a hierarchical fashion so that the participant moves onto more difficult tasks only after mastering the easier tasks. Sohlberg, Johnson, Paule, Raskin, and Mateer (2001) noted that this hierarchical administration of tasks allows for repeated stimulation and activation of the target underlying process or facilitate mastery of a new skill. The tasks utilized in the APT program are “laboratory tasks” that do not mirror functional tasks. This is due to the fact that in complex, functional tasks, many other cognitive skills would be utilized in addition to attention skills and the APT program is designed to provide focused, specific, attention training. In order to ensure that improvements in attention generalize to functional tasks, however, the APT program includes activities designed to facilitate generalization.

In the initial study with the APT program, Sohlberg and Mateer (1987) utilized a multiple baseline across behaviors design to investigate the effectiveness of the program. Four participants, who presented with brain injuries with varying etiologies, received APT in one condition and a visual processing treatment in the second condition. Based on the process specific approach to rehabilitation, the researchers hypothesized that APT should result in improvements on measures of attention but not on visual processing and visual processing treatment should show the opposite pattern. At baseline, two participants showed mild to moderate attention deficits and two participants showed serve attention impairments as measured by the Paced Auditory Serial Addition Test (PASAT; Grownwall, 1977). Following APT, the participants who initially presented with mild to moderate attention deficits obtained PASAT scores that were within normal limits. The two participants who initially presented with severe attention deficits obtained PASAT scores in the mildly impaired range following APT. These effects were maintained for up to 8 months after treatment. As expected, significant gains in attention were not found following the visual processing treatment and significant gains. The activities used for the APT program were developed in such a way that they simulated the attentional requirements of the PASAT tasks but did not utilize the specific procedures of the PASAT tasks. Thus, the researchers argued that the increases on the PASAT scores that followed treatment reflected improvements in attentional processing ability and not merely improvements on specific tasks.

In a later study, Sohlberg, McLaughlin, Pavese, Heidrich, and Posner (2000) evaluated the effectiveness of APT versus a control task in a crossover design. Fourteen participants with stable acquired brain injuries completed 10 weeks of APT and ten weeks of brain injury education. Before and after treatment, participants completed a neuropsychological attention battery and questionnaires which assessed the impact of their attention impairment on daily functioning. Additionally, participants were given a structured interview following both the APT and the brain injury education condition. Responses to interview questions were coded according to whether they reflected a change in a) everyday functioning, b) psychosocial functioning, or c) cognitive functioning.  The participants showed more changes on standardized measures of memory and attention measured following APT compared with brain injury education. In particular, measures of executive attention showed improvement following APT while measures of vigilance showed similar improvement following both APT and brain injury education. Additionally, analysis of the structured interviews revealed that the participants reported more changes in cognitive functioning following APT. Participants who reported more changes in cognitive functioning in the structured interviews also showed higher scores on the PASAT, demonstrating a relationship between the participant's perception of their cognitive abilities and their performance on cognitive tasks. By contrast, participants showed greater improvements of self-reported psychosocial functioning following brain injury education compared with APT.

These results suggest that APT may be beneficial in remediating complex aspects of attention which relate to executive functioning.

The Attention Process Training-II (APT-2, Sohlberg, Johnson, Paule, Easkin, & Mateer, 2002) is an extension of the original APT program and contains more demanding tasks appropriate for individuals who present with mild cognitive impairments as a result of TBI. In a study (Palmese & Raskin, 2009) that evaluated the effectiveness of the APT-2 program, three participants diagnosed with Mild TBI and deficits in attention received 10 weeks of APT-2 followed by 6-7 weeks of brain injury education. All three participants showed improvements in measures of attention and performance speed. The treatment effects were maintained for up to six weeks following the cessation of treatment.

Only one study to date has investigated the efficacy of utilizing APT-2 to improve both attention and discourse deficits in TBI. Youse & Coelho (2009) used a single subject multiple treatments design to compare how APT-2 and Interpersonal Process Recall (IPR), a social skills treatment protocol, affect attention and discourse. In IPR treatment, the participant was videotaped while conversing with the examiner or an unfamiliar communication partner. Following the interaction, the participant and the examiner reviewed the video together and discussed the dynamics of the interaction. The examiner helped the participant identify deficient conversational skills and then provided a model of how those skills could be remedied. The participant then practiced the skills modeled by the examiner. Prior to and after treatment, the participant completed a battery of standardized attention tests and produced discourses in conversation. The conversational discourses were then analyzed for response appropriateness. For one participant, neither treatment produced a meaningful change in attention or discourse abilities. For the other participant, minor gains in attentional abilities were observed following treatment but these gains did not appear to affect his discourse abilities. Although this study did not show evidence of the ability of APT to improve discourse skills, the researchers noted that the participants possibly did not have a lot of incentive to change their conversational behavior due to the fact that both lived in environments that were accommodating to their deficits.

A context sensitive approach to cognitive rehabilitation differs from a process specific approach in that cognitive skills are trained in functional tasks. Context sensitive rehabilitation involves a combination of task-specific training, interventions for compensatory behaviors and interventions for strategic thinking. Ylvisaker (2003) noted two theoretical premises that support a context sensitive approach to cognitive rehabilitation. First, cognitive functioning is essentially connected to a person's goals, emotions, and contexts of action and domains of content. Secondly, different aspects of cognition are interconnected such that the functioning of one cognitive skill will often affect the functioning of other cognitive skills. Ylvisaker noted that since any given cognitive skill can affect other skills and is also, in turn, affected by other cognitive skills, the premise that there are discrete, hierarchically ordered cognitive processes and sub processes may not be accurate.

One potential advantage of a context specific approach to rehabilitation is that it may facilitate transfer to new contexts more effectively than a process specific approach. According to Anderson's (1983) information processing theory of cognition, transfer of learned cognitive skills is more likely to occur when the training context and the application context share similar features. Similarly, Sternberg and Frensch (1993) maintain that transfer is more likely to occur when four conditions are met. First, flexible transfer is facilitated when training occurs in many different contexts. Second, the way that information is organized in memory affects transfer. Because of this, when cognitive strategies are encoded as a routine component of functional tasks will be more likely to be transferred to novel functional tasks in that domain than will tasks that are trained in a decontextualized manner. Third, learned information will be applied to a new situation only if the learned information is recognized as being relevant to the application context. Thus, cognitive strategies must be learned along with the conditions of their application. Lastly, transfer is more likely to occur if the individual is motivated during training. Thus, transfer would be more likely to occur when training occurs in contexts that are meaningful to the individual.

**Discourse Based Treatment in TBI**

Many empirical treatment studies at the discourse level have addressed pragmatic deficits in TBI and have included conversational and social skills training. Though pragmatics and social skills training is distinct from discourse processing treatment, both are aimed at the functional goal of improved communication. . In one randomized control study, Dalhberg and colleagues (2007) investigated the effectiveness of social skills training in a group therapy setting. Fifty-two participants with TBI participated in 12 group sessions in which participants set individual communication goals, learned goal-specific strategies, and practiced the skills needed to achieve goals. Goals were focused on the cognitive, interpersonal, language, speech, and self-awareness skills that are needed to be an effective communicator. There was a focus on self-monitoring and participants were also expected to give feedback to other group members. Home practice and the involvement of family members was utilized to encourage generalization. Following treatment, participants showed significant improvement on 9 of the 10 subscales of The Profile of Functional Communication Impairment (PFCI; Linscott, Knight, & Godfrey, 1996), The Social Communication Skills Questionnaire-Adapted (SCSQ; McGann, Werven, & Douglas, 2006), and the Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1995).

Additionally, Goal Attainment Scaling (Malec, Smigielski, Depompolo, & Thompson, 1993) was utilized to measure attainment of the participant's individual communication goals; participants showed significant improvement on this measure as well. These gains were maintained at the six-month follow-up. The researchers concluded that group social skills training improved the functional communication skills of the participants with TBI and that this improvement was linked to greater life satisfaction.

Gajar, Schloss, Schloss, and Thompson (1984) investigated the efficacy of using corrective feedback and self-monitoring to improve the conversation skills of two young adults with TBI. An A1-B1-C1-A2-C2-B2 design was used to investigate the efficacy of the feedback (B) and self-monitoring (C) phases of treatment. At the beginning of treatment, the experimenters demonstrated positive and negative conversational behaviors through roleplay. Negative conversational behaviors included remaining silent following another participant's questions/statements, using three words or less to respond, failing to maintain the topic of conversation, mumbling, joking, and interrupting. Positive conversational behaviors included adding to the conversation with a relevant statement, agreeing or disagreeing with another group member's statement by providing a rationale, and asking relevant questions. In each treatment session, the two participants conversed about an article read by the experimenter. In the feedback condition, the experimenter used red lights and green lights to alert participants to negative (red) and positive (green) conversational behaviors. After the red light was used to alert participants of negative conversational behaviors, the participant was required to explain why the behavior was considered negative. In the self-monitoring condition, a similar procedure was used but the participants themselves used the red and green lights to indicate positive and negative conversational behaviors. Both interventions were effective in increasing the positive conversational behaviors of the participants and these improvements were found to generalize to less structured conversations as well.

Wiseman-Hakes, Stewart, Wasserman, and Schuller (1998) investigated the efficacy of a pragmatics skills training program in a group of adolescents with TBI. A commercially available pragmatics training program *Improving Pragmatics skill in Persons with Head Injury* (Sohlberg, et al., 1992) was modified for use in a group setting. Hierarchically organized modules which covered Initiation, Topic Maintenance, Turn Taking, and Active Listening were utilized for treatment. Each module consisted of an awareness phase, practice phase, and generalization phase. Additionally, the program was modified to include role playing as well as opportunities for group members to self-monitor and monitor other group member's conversational behavior. Participants were taught to provide feedback and cues to other group members, to rate their own communication behavior as well as other, and to use tracking sheets to quantify conversational behaviors. Following treatment, participants showed significant increased on four subscales (Nonverbal Communication, Use of Linguistic Context, Organization of a Narrative, Conversational Skills) of the Rehabilitation Institute of Chicago Rating Scale of Pragmatic Communication Skills (CRSPCS; Burns, Halper, & Mogil, 1985). Participants also showed significant changes on the Communication Performance Scale (CPS; Erlich & Sipes, 1985), a behavioral rating scale which addresses 13 pragmatic communication skills that persons with TBI often find difficult. These gains were maintained at the one year follow up.

Gabbatore and colleagues (2015) developed a treatment for pragmatic difficulties following TBI which focused on the development of inferential skills in addition to executive function and self-awareness. The authors assert that with their program differed from social skills training in that it focused on the mental representations underlying one's communicative behavior instead of on teaching patients how to handle everyday life situations. The Cognitive Pragmatic Training (CPT program) consisted of 24 1.5 hour small group therapy sessions which focused on different modalities of communication (linguistics, extra linguistic, paralinguistic, social appropriateness, and conversational abilities) as well as cognitive skills needed for effective communication (awareness, theory of mind, planning abilities). Therapy sessions included both comprehension and production activities. A particular focus of the therapy activities was providing participants with the skills to infer meanings which go beyond the literal utterance. Following treatment, participants demonstrated improvements on the Assessment Battery for Communication (Sacco et al., 2008) which evaluates pragmatic skills in both comprehension and production. Additionally, the participants demonstrated improvements on the Wisconsin Card Sorting Task (WCST; Nelson, 1976) and the Immediate and Deferred Recall test for long term verbal memory. The authors concluded that the results support the efficacy of the CPT program in improving pragmatic communication and that the CPT program may also improve cognitive flexibility and executive function.

In addition to the studies that have focused on group conversation skills training, there are a small number of studies that have targeted monologic discourse performance. In a case study with a 39-year-old male with severe TBI, Cannizzaro and Coelho (2002) investigated the effectiveness of a treatment program designed to target story grammar deficits. Cannizzaro and Coelho's treatment was focused on facilitating the participant's ability to produce complete episodes. A complete episode includes an initiating event, an action or response and a consequence of that action. The treatment included two conditions: story retelling and story generation. For story retelling, the participant was presented with either a film strip or a sequence of pictures and was asked to retell the story. Then, the participant was guided through training steps intended to facilitate the ability to identify the episodes within the story. For story generation, the participant was presented with pictures and was guided through training steps intended to aid him in producing a story with multiple complete episodes. Over the course of the treatment, the participant increased production of complete episodes and reduced production of incomplete episodes. However, the participant did not maintain the treatment effects at the one and three-month follow ups. Additionally, the researchers noted that although the participant produced more complete episodes as treatment progressed, the quality of the participant's stories remained poor. The participant continued to produce tangential utterances which made his discourses difficult to follow. Moreover, the participant tended to produce heap or sequence stories that focused on specific details of the story rather than and making inferences to integrate story information.

Penn, Jones, and Joffe's (1997) developed a hierarchical discourse treatment based on the idea that hierarchical, strategy-based learning can help persons with mild cognitive linguistic impairments develop better text management skills which, in turn, may lead to more coherent discourse production. One participant with a closed head injury and one participant who had suffered a cerebrovascular accident (CVA) participated in a study of the treatment's effectiveness. Prior to beginning therapy, the participants were assessed on a series of measures in order to determine their current level of text management. Levels of text management range from basic understanding of content with no logical connections to the ability to problem solve based on information and inferences that must be made from the text (Biggs & Collins, 1982). Initially, both of the participants produced disorganized stories that focused on commenting on small bits of information provided in the picture instead of integrating that information in a coherent story. Treatment was focused on using different types of texts to extend the participant's level of understanding. Treatment also included a metacognitive component which encouraged the participants to identify their own cognitive style, recognize the problems that this cognitive style caused, and develop strategies for overcoming these problems. After treatment, participants were able to make the necessary inferences and to integrate information to tell a coherent story. The researchers hypothesized that this form of treatment allowed participants to compensate for reduced linguistic flexibility by enhancing the variety of effective cognitive strategies as well as increasing awareness of cognitive-linguistic processes.

**Statement of the Purpose**

Although there is evidence that APT-2, a process-specific approach, is effective in improving different aspects of attention, there is little evidence that these improvements generalize to more complex cognitive tasks or to functional skills. Since attention is likely to affect the production of discourse the question of whether treating attention impairments can also result in improvements in discourse production has important clinical implications for intervention. If the assumption that improvement in specific cognitive abilities can result in generalized improvements to more complex skills is correct, then attention training should result in improvements in discourse production. If, however, generalization is facilitated through training in functional tasks, then process specific attention training will not result in improvements in discourse production. According to the context sensitive approach to cognitive rehabilitation, improvements in discourse production will be more likely to occur if discourse production is used as both a training context and an outcome. The purpose of this study, then, is to determine the effectiveness of APT-2 and a discourse processing treatment (DPT) in improving discourse informativeness and coherence in participants with TBI.

The specific research questions this study will address are as follows:

4. Will the individual and combined effects of DPT and APT-2 improve performance on measures of discourse informativeness and coherence?
5. Do the individual and combined effects of DPT and APT-2 generalize to improvements on standardized measures of attention and memory?
6. Are the individual and combined treatment effects of DPT and APT-2 maintained for informativeness, coherence and cognitive measures following the entire treatment cycle (both DPT and APT-2) for a one month period?

## CHAPTER 2: METHODS

### Participants

Participants consisted of adults with mild or moderate TBI. Inclusionary criteria were as follows: a) at least 6 months post TBI; b) no history of neurodegenerative disorders; c) corrected or uncorrected normal visual acuity (Beukelman & Mirenda, 1998); d) aided or unaided hearing ability within normal limits; and e) English as their first language. Participants were not receiving speech therapy services during the time of their participation.

Participant 1 was a 27 year old biracial Hispanic female who was 7 years post TBI from a motor vehicle accident. She obtained a score of 111 for the *Scales of Traumatic Brain Injury* (*SCATBI*; Adamovich & Henderson, 1992) higher functioning composite, indicating mild impairment. She had a total of 14 years of education and indicated that she planned to return to college to complete her degree during the upcoming fall. She was not employed at the time of the study and lived with her mother. Participant 2 was a 33 year old white male who was 7 years post TBI from a motor vehicle accident. He obtained a score of 83 for the SCATBI higher functioning composite, indicating moderate impairment. Participant 2 had a total of 12 years of education and was employed part time as a janitor. Participant 2 lived in a group home for adults with TBI. Participant 3 was a 36 year old white male who was 17 years post TBI from a motor vehicle accident. He obtained a score of 93 for the SCATBI higher functioning composite, indicating moderate impairment. He had 12 years of education. Participant 3 was employed part time as a janitor and lived with his parents. Participant 3 withdrew before the study was completed for personal reasons. He completed the APT-2 treatment and follow up but did not complete DPT. Participant 4 was a 36 year old white male who was 22 years post TBI from a collision between his bicycle and a motor vehicle. He obtained a score of 91 on the SCATBI higher functioning composite indicating moderate impairment. Participant 4 had 12 years of education. He was not employed at the time of the study and lived in a group home for adults with TBI. Participant 5 was a 30 year old white male who was 11 months post TBI from a motor vehicle accident. He had 14 years of education. He was not employed at the time of this study but regularly did volunteer work. He lived with his wife, parents, and four children. See Table 1 for participants' demographic and medical information.

## Measures

### Scales of Cognitive Ability in Traumatic Brain Injury.

The *Scales of Cognitive Ability in Traumatic Brain Injury* (*SCATBI*; Adamovich & Henderson, 1992) was administered to quantify the severity of the participant's cognitive impairment. The SCATBI consists of five subtests (Perception/Discrimination, Orientation, Organization, Recall and Reasoning) which measure cognitive abilities that, based on both research and clinical observation, are likely to be impaired following TBI. This test was normed on a group of head injured patients and an age matched group of neurologically healthy participants. This test demonstrates sound psychometric properties. Internal consistency coefficients are high (.90 or higher) for all subtests. Significant correlations are reported between SCATBI scores and levels of the Rancho Los Amigos Scales, which demonstrates concurrent validity. Discriminant Analysis shows that the SCATBI correctly classified 79.2% of the head injured participants and 95.7% of the neurologically healthy participants in the normed sample. This test will be used in the present study to provide information regarding the participant's level of cognitive impairment. Since the present study targeted persons with mild to moderate TBI, this test was appropriate because it measures several higher-level abilities (e.g., reasoning and problem solving skills) that many commercially available assessments do not measure.

**STROOP Test.**

The *STROOP Color-Word Test (*Golden & Freshwater, 2002), provided a measure for estimating selective attention and the ability to inhibit irrelevant information. The STROOP Test is based on the observation that individuals can read words more quickly than they can identify and name colors. In the first task of the STROOP Test, the participant read color names (“RED”, “GREEN”, “BLUE”), which were printed in black ink, as quickly and as accurately as possible. In the second task of the STROOP Test, the item “XXX” is printed in different colored ink (red, green, blue), appears repeatedly, and participants were asked to name the color of the ink as quickly and as accurately as possible. In the third task of the STROOP task (the interference task), the words “RED,” “GREEN,” and “BLUE” are printed in red, green, or blue ink—but in no case do the words and the colors in which they are printed match. For example, “BLUE” may be printed in either green or red ink. For the interference task, the participant was asked to say the name of the ink color as quickly and as accurately as possible. The STROOP test has been used in a previous study to measure changes in selective attention in response to Attention Process Training (APT; Sohlberg et al., 2000). Thus, this test was used for both the purpose of characterizing the participant’s degree of cognitive impairment as well as for the purpose of determining whether the APT-2 treatment and the DPT resulted in improvements in selective attention. The STROOP Test was administered during the initial testing session, during the one week follow up sessions for each treatment phase and during the one month follow up.

**Wechsler Working Memory subtests.**

The Letter-Number Sequencing, Spatial Span Forward, and Spatial Span Backward subtests of the *Wechsler Memory Scale-Third Edition* (*WMS-III*; Wechsler, 1997) were administered as the measure for estimating working memory. The Letter-Number sequencing task provided a measure of auditory working memory. For this task, the participant was presented with an alternating list of letters and numbers (e.g., 8-Y-2-U) and was asked to repeat first the letters in alphabetical order and then the letters in ascending order (e.g., U-Y-2-8). In the spatial span forward task, the experimenter pointed to a series of blocks on a 3-D board at a rate of approximately one block per second and the participant replicated the same pattern. In the spatial span backwards task, the participant pointed to the series of blocks in reverse order. The Letter-Number Sequencing and Spatial Span Backwards subtests required the participant to simultaneously remember and manipulate information. The manipulation of stimuli in short term memory underlies the concept of working memory (Wechsler, 1997). This test was used for both the purpose of characterizing the participant's degree of cognitive impairment as well as for the purpose of determining whether the APT-2 treatment and the discourse processing treatment resulted in improvements in working memory. Thus, the working memory subtests of the *WMS-III* were administered during the initial testing session, during the one week follow up sessions for each treatment phase and during the one month follow up.

**Comprehensive Trail Making Test.**

*The Comprehensive Trail Making Test* (*CTMT*; Reynolds, 2002) consists of a standardized set of five visual search and sequencing tasks that are affected by attention, concentration, resistance to distraction, and the ability to shift sets. In each of the five tasks, the participant connected a series of stimuli (numerals, numbers expressed in word form and letters) in a specified order as quickly and accurately as possible. Though the basic task is the same for all five trails, there are differences in the cognitive demands of each trail. In Trail 1, the participant simply connects a series of numerals, each contained in a plain black circle, as quickly and as accurately as possible. In Trails 2 and 3, the task is similar but there are distracter items on the page that the participant must ignore. In Trail 4, the task is similar but 11 of the numbers are presented in numerical form and the remaining numbers are presented in word form (e.g., "nine"). In Trail 5, the participant connects, in alternating sequence, the numbers 1-13 and the letters A through L. Thus, the participant begins with the number 1 then draws a line to A, then 2, then B, and so on until all letters and numbers are connected. The CTMT is regarded as being especially useful in assessing dysfunction in mild cases of brain injury, detecting attention deficits, and frontal activation deficits (Lezak, 1995; Mitrushina, Boone, & D'Elia, 1999; Storandt, Botwinick, Danziger, Berg, & Hughes, 1984). This assessment was particularly useful for the present study because it allowed assessment of the varying aspects of attention targeted by the APT-2 program. Trail 1 functioned as a measure of sustained attention, Trails 2 and 3 as measures of selective attention, and Trails 4 and 5 as measures of alternating attention. This test was used for both the purpose of characterizing the participant's degree of cognitive impairment as well as for the purpose of determining whether the APT-2 treatment and the discourse processing treatment resulted in improvements in these aspects of attention. Thus, the CTMT was administered during the initial testing session, during the one week follow up sessions for each treatment phase, and during the one month follow up.

## Stimuli Development and Selection

### Sequential Pictures.

Twenty picture sequences were used as stimuli for the DPT. The picture sequences were cartoon-strip style sequential pictures that do not contain words. These picture sequences were colored manually using Microsoft Paint™. Eleven of the picture sequences were used in previous studies (Frisco & Wright, 2015; Kintz, Hibbs, Henderson, Morgan, & Wright, 2018; Henderson, Kim, Kintz, Frisco, & Wright, 2017) and 10 additional sequential pictures were chosen for this study. The new sequential pictures were chosen to be of comparable complexity and difficulty as the ones used previously. The new sequential pictures were presented to a group of 17 neurologically healthy undergraduate students who were asked to tell a story that goes with the pictures and had a beginning, middle, and end. The stories produced by this group were then transcribed and reviewed in order to ensure that the individuals in this group told consistent stories. If the stories that the neurologically healthy group told in response to the sequential pictures were not consistent, it was assumed that the sequential picture stimulus was vague and difficult to interpret and thus, should not be used for the treatment study. One sequential picture stimulus was removed due to the inconsistency in the stories that were told in response to it. Thus, 20 picture sequences were used for the treatment study.

## Development of Comprehension Questions and Thematic Units

### Comprehension questions.

Comprehension questions were developed for each sequential picture stimulus. Comprehension questions for eleven of the pictures were developed for a previous study (Frisco & Wright, 2015, Kintz et al, 2018). Comprehension questions for the remaining nine pictures were developed for this study. The comprehension questions were designed to target and highlight important aspects of the visual scene that are needed to tell a complete story. Some of the questions were literal in nature and could be answered by looking at the picture stimulus (e.g., what is the man doing at the beginning of the story?) while some were inferential questions (e.g., Why do you think the man is on the island?). Following initial question development, the comprehension questions were randomized and presented to 20 undergraduate students with no known neurological impairments. The students were asked to answer each comprehension question twice, once before viewing the picture stimuli and then again while viewing the picture. Answers were then scored from 0-2. A score of 0 indicated an unacceptable answer or the question was unanswered, a score of 1 indicated a partially correct answer, and a score of 2 indicated a fully correct answer. If a question had a mean score above 1.5 before viewing the stimulus condition, it was assumed that the question could be easily answered by chance or by using context clues from the question and were eliminated or re-written. If a question had a mean score below 1.5 after viewing the stimulus condition, it was assumed that the question was not easy to answer from the available information and these questions were also eliminated. A total of 66 questions were developed for the nine new pictures. Three were eliminated leaving a total of 63 questions that were used in the study (3-7 questions per picture).

**Thematic units.**

Thematic units are considered the main concepts of the story. Thematic units included elements (the characters and concepts depicted in the story) and actions (the actions displayed in the stimuli) that are coded as either essential or detail in the generation of a coherent story. Essential units are needed for the story to be clear and complete; whereas, detail units are not required for the story to be complete but add extra information.

Thematic units for 11 of the pictures were developed for the previous studies (i.e., Frisco & Wright, 2015; Kintz et al., 2018). Nine of the pictures were new stimuli that did not have thematic units identified. The thematic units for the new pictures were obtained by eliciting discourses from neurologically healthy undergraduate students. The students were asked to tell a story with a beginning, middle, and end for each picture. Their stories were transcribed and coded by a trained undergraduate volunteer. Elements and actions that were produced by 80% of the students were considered to be essential thematic units. Elements and actions that were produced by less than 80% of the students but were semantically appropriate were considered to be detail thematic units.

**Materials and Settings**

Treatment took place in a quiet, well-lit room in the participant's homes. Sessions were held 3-4 times weekly for approximately one hour for 4-5 weeks for a total of 32 sessions (16 sessions of DPT, 16 sessions of APT-2). Study materials for the DPT condition included the sequential pictures, a visual story guide, and audio and video recorders. Study materials for the APT-2 treatment condition included the stimuli materials from the APT-2 treatment and video and audio recorders.

**Experimental Design**

A crossover design was utilized to compare the effectiveness of APT-2 versus DPT Participants were randomly assigned to one of two groups. Participants in the first group received the APT-2 first and the DPT treatment second (B-C design). Participants in the second group received the DPT treatment first and the APT-2 treatment second (C-B design). The phases of the study included baseline (A), the first assigned intervention (B), baseline (A), the second assigned intervention (C), baseline (A), and a one month follow up to assess maintenance of treatment effects. The independent variables were the two treatment conditions (DPT and APT-2 treatment).

The primary dependent variable was the percentage of correct and complete essential and detail thematic units produced in response to the sequential pictures. This variable was the measure of informativeness and was chosen based on previous evidence which suggests that persons with TBI produce discourses that are less informative (Cannizzaro & Coelho, 2002;

Galetto et al., 2013) and less accurate (Marini et al., 2011) than those produced by controls. The thematic units measure evaluated the participant's ability to derive essential information from the discourse and to produce the information needed for a structurally sound narrative discourse. Deficits in processes related to both comprehension and production may cause reduced thematic informativeness. If an individual misinterprets the visual stimuli, this may result in an increase in the production of inaccurate thematic units or result in thematic units not produced at all. Similarly, an inability to determine the gist of the story may affect the individual's ability to distinguish between story relevant and story irrelevant propositions which could result in discourses that contain fewer essential elements. Finally, problems with discourse planning can affect the ability to effectively organize discourse information which could potentially result in less informative narratives.

The percentage of words in the discourse which reflected global coherence errors was utilized as a secondary outcome variable and was used to analyze the Cookie Theft picture and the expository discourses. Global coherence refers to the extent to which the main topic of the narrative is maintained. Errors of global coherence included conceptually congruent, filler, tangential, and repetitive utterances. This variable was chosen based on previous research which indicates that persons with TBI produce less coherent narratives than healthy controls (Coelho, Ylvisaker, & Turkstra, 2005; Marni et al., 2011). Errors of global coherence can reflect deficits in both discourse comprehension and production. A high number of conceptually incongruent utterances would likely reflect difficulties in integrating information and making inferences in order to develop a correct schema of the discourse, thus reflecting processes related to comprehension. A high number of filler, tangential, and repetitive utterances would likely reflect processes related to organizing the information needed for efficient and effective production.

Scores on the STROOP, the working memory subtests of the WMS, and the CTMT were also used as outcome variables. These variables were used to determine whether the DPT and the APT-2 result in improvements in underlying cognitive processes related to attention and memory.

## Procedures

All participants provided informed consent according to East Carolina University's IRB (Protocol UMCIRB 14-000803) guidelines prior to enrolling in the study. All treatment and testing sessions were audio and video recorded.

### Initial testing.

Initial testing occurred prior to the baseline phase. In this session, informed consent and demographic and medical history information was obtained from each participant. The SCATBI, STROOP color-word test, WMS-III, and CTMT were administered as well as hearing and vision screenings.

### Baseline probes.

Baseline data for the discourse measures were obtained over three or four sessions in order to ensure a stable baseline. The sequential pictures were used as baseline probes for the discourse measures.  Each picture was administered twice across three sessions. Participants were instructed to "Tell a story that goes along with the pictures with a beginning, middle and end". The examiner did not comment or provide feedback during baseline probe testing aside from answering basic questions about the task and providing generic phrases for encouragement (i.e. "Good job''). Additionally, two tasks were administered as generalization probes. In one of the tasks, participants were asked to provide expository discourses to two prompts: 1. "Can you please tell me if you are for or against the legalization of marijuana and please explain why?"

and 2. "Can you please tell me if you are for or against gay marriage and please explain why?" In the second task, participants were instructed to tell a story with a beginning, middle, and end in response to the single picture "Cookie Theft" from the Boston Diagnostic Aphasia Exam (BDAE; Goodglass & Kaplan, 1983). These tasks were included to determine whether treatment effects would generalize to a different discourse genre (expository) and different type of narrative discourse (single picture description) that presumably have different cognitive demands.

**Treatment.**

***Discourse processing treatment condition (DPT).***

Treatment consisted of a total of 16 treatment sessions for approximately one hour each over the course of a 4-5week period. For each participant, 16 of the 20 pictures administered during baseline testing were randomly selected as treatment items. The remaining four pictures served as untreated probes. For each participant, eight of the pictures were selected for treatment on odd numbered treatment days and eight of the pictures were selected for treatment on the even numbered treatment days. The presentation order of the pictures was randomized.

The treatment was based upon the principles which underlie Penn, Jones, and Joffe's (1997) Hierarchical Discourse Treatment. This treatment protocol was based on the notion that hierarchical, strategy based learning can help persons with mild cognitive linguistic impairments develop better text management skills which in turn would lead to more coherent discourse production. Therapy was focused on training participants to more effectively integrate discourse information and make inferences in order to understand texts on a deeper level. The therapy also included a metacognitive skills training which encouraged the participants to identify their own cognitive style, recognize the problems that this cognitive style caused, and develop strategies for overcoming these problems. The researchers hypothesized that this form of treatment allowed participants to compensate for reduced linguistic flexibility by enhancing the variety of effective cognitive strategies as well as increasing awareness of cognitive-linguistic processes.

The treatment phase included a four-step procedure designed to improve the participant's discourse management skills. In Step 1, the clinician presented the stimuli to the participant and asked the participant comprehension questions to probe for level of understanding. Scaffolding, prompting, and repetitions were provided to the participant during responses to ensure that correct information was obtained for the questions. In Step 2, the participant told a story that went with the presented picture. The clinician verbally prompted the participant by saying, "Look at the pictures and tell me a story that has a beginning, middle, and end." The participants were provided with a story guide which depicted six elements used to tell a good story. These elements were *setting, problem, internal response, action/plan, result*, and *resolution*. The participant's stories were audio recorded during this step. In Step 3, the clinician played the audio recording of the participant's story back to the participant and instructed the participant to listen and identify any missing elements, errors or unnecessary information (tangential utterances, repeated utterances, utterances about minor elements that are not important to the story). Next, the clinician corrected any misinformation the participant included and provided additional information the participant did not state utilizing prompts, scaffolding, and repetition to ensure production of a coherent and detailed story. In Step 4, the visual story board was removed and the participant was instructed to tell the story again utilizing the feedback that had been previously given. The same procedure was followed for the subsequent picture sequences to complete the session. Treated pictures were probed once weekly. During probe trials, the participant produced the discourses without feedback and without the story board.

***Attention Processing Treatment-2 condition.***

Treatment consisted of a total of 16 treatment sessions for approximately one hour each over the course of a 4-5 week period. The Attention Process Training Program, 2nd edition (APT-2; Solberg, Johnson, Paule, Raskin, & Mateer, 2005) is designed to address attention deficits following brain injury. It includes hierarchically organized intervention activities designed to address sustained attention, alternating attention and divided attention. The APT-2 tasks that were chosen for each participant were based on the participant's deficit profile. Participants 1 and 2 completed higher level sustained attention tasks with working memory demands and alternating attention tasks. Participant 3 completed basic sustained attention tasks and higher level sustained attention tasks with working memory demands. Participant 4 completed basic sustained attention tasks. Participant 5 completed alternating and divided attention tasks. The pictures that were selected as treated probes were probed during the APT-2 condition. During probe trials, the participant produced the discourses without feedback and without the story board.

**Generalization and maintenance probes.**

The four untreated sequential pictures were used in order to assess whether the skills learned during treatment generalized to untreated stimuli. These pictures were presented to the participant who was instructed to tell a story that goes with the picture and has a beginning, middle, and end. The "Cookie Theft" picture was used to assess whether the skills learned in treatment generalized to a different narrative discourse type with different cognitive demands. The picture was presented to the participant and the participant was instructed to tell a story which goes with the picture and has a beginning, middle, and end. It is possible that this task may be more cognitively demanding than the sequential picture task since the sequence of story events is not explicitly visualized in a single picture. Two expository discourse prompts were used to assess whether the skills learned in treatment generalized to a different discourse genre. Participants were asked to respond to the following two prompts: (1) "Can you please tell me if you are for or against the legalization of marijuana and please explain why?" and (2) "Can you please tell me if you are for or against gay marriage and please explain why?". If the participant stopped talking before 15 seconds elapsed, the examiner prompted the participant by saying "Is there anything else you would like to add?" The untreated picture sequences, the Cookie Thief picture and the expository discourse task were probed twice during each of the treatment phases, one week following the completion of each treatment phase, and one month following the end of treatment.

**Data collection.**

The discourses produced during the baseline, probe, 1 week follow up, and one month follow up sessions were videotaped and transcribed by trained research assistants into the Computerized Language Analysis program (CLAN; MacWhinney, 2000). CLAN is a program where language samples can be transcribed and analyzed. For the thematic units analysis, the data was coded following the scoring system developed by Marini et al (2005). Thematic units were coded as accurate and complete, accurate but incomplete, inaccurate, or missing/absent. A thematic unit that was scored as accurate and complete was one that does not contain inaccurate information and contains all of the information necessary for that concept. A thematic unit that was scored as accurate but incomplete is one that did not contain inaccurate information but also did not contain all of the information necessary for that concept (e.g., producing "the woman is standing there" instead of "the woman is doing dishes"). A thematic unit that was scored as inaccurate was one where one or more parts of the essential information is inaccurate (ex:

producing “another person approached the farmer for directions” instead of “the couple returned because the directions were wrong”.) A thematic unit that was scored as missing was one where none of the essential information is produced.  The number of accurate and complete units was totaled and the percentage of accurate and complete units by obtaining the ratio of accurate and complete thematic units to total thematic units. For the coherence analysis, trained research assistants coded global coherence errors using the procedures described by Marini, Boewe, Caltagirone, and Carlomagno (2005). Global coherence errors consisted of filler, tangential, conceptually incongruent, and repetitive utterances. For the productivity analysis, values for the number of correct words, correct utterances, number of utterances, and utterance length were obtained.

**Reliability.**

Ten percent of each of the participant’s sessions were randomly selected for review for inter- and intra-rater agreement for transcription and scoring of thematic units. Intra-rater reliability was 95.42% for transcription,94.96% for thematic units, and 98.14% for coherence analysis. Inter-rater reliability was 89.49% for transcription, 90.33% for thematic units amd 88.83% for coherence analysis.

The researchers followed a study checklist to ensure procedures were followed during baseline, treatment, and follow up phases. An independent observer, who was trained in both the DPT and APT-2 procedures viewed 10% of randomly selected trials from each participant’s baseline, treatment, and follow up trials to ensure that study procedures were followed for treatment fidelity determination. Treatment fidelity and procedural reliability were both judged to be 100%.

# CHAPTER 3: RESULTS

Data were collected for a) the percentage of correct and complete essential and detail thematic units produced for the picture stimuli during baseline and follow-up phases, b) the percentage of words which represented global coherence errors for the generalization tasks during baseline and follow-up phases, and c) standardized test scores for the CTMT, WMS, and STROOP tasks during baseline and follow-up phases. Effect sizes for the thematic units' data were calculated using the procedure described by Beeson and Robey (2006), whereby the *d* statistic values of 2.6, 3.9, and 5.8 correspond to small, medium, and large treatment effects, respectively. Effect sizes were not calculated for the generalization tasks because they were only administered once during the baseline period. Raw data for the percentage of global coherence errors produced for the generalization tasks are reported. Standardized test data were analyzed by multiplying the standard error of measurement (SEM) by 1.96 to calculate a 95% confidence interval. For the CTMT, the raw data for the time to complete each trail are reported in addition to the *t* scores for each trail to assess practical significance as well as statistical significance.

## Participant 1

For Participant 1, composite index scores for the CTMT and the working memory subtest of the WMS for baseline and follow up phases are reported. T scores and raw times are reported for the individual trails of the CTMT for baseline and follow up phases. The percentage of thematic units are reported for both treated and untreated sequential picture stimuli at baseline and follow up. The percentage of words which make up global coherence errors are reported for the generalization probes (expository discourses and Cookie Theft picture) for baseline and follow up phases.

**Comprehensive Trail Making Test (CTMT).**

At baseline, Participant 1 obtained a composite index score of 17 on the CTMT. She obtained *t* scores of 18 on all of the individual trails at baseline. Her raw times (in seconds) for the trails at baseline were as follows: Trail 1: 121 s, Trail 2: 120 s, Trail 3: 120 s, Trail 4: 132 s, Trail 5: 181 s. One week post APT-2 training, (treatment 1), her composite index score was 18. She obtained the following *t* scores for individual trails: Trail 1: t=23, Trail 2: t=19, Trail 3: t=18, Trail 4: t=25, Trail 5: t=21. Her raw times (in seconds) for the trails were as follows: Trail 1: 66 s, Trail 2: 88 s, Trail 3: 87 s, Trail 4: 63 s, Trail 5: 109 s. Based on a 95% confidence interval, there were no significant differences between her *t* scores at baseline and her t scores following APT-2. However, Participant 1's raw completion time decreased for all trails. One week post DPT training (treatment 2), Participant 2 obtained a composite index score of 23. She obtained the following *t* scores for individual trails: Trail 1: t=19, Trail 2: t=18, Trail 3: t=23, Trail 4: t=28, Trail 5: t=40. Her raw times (in seconds) for the trails were as follows: Trail 1: 80 s, Trail 2: 95 s, Trail 3: 72 s, Trail 4: 55 s, Trail 5: 115 s. Based on a 95% confidence interval, there were no significant differences between her *t* scores before DPT and her *t* scores after DPT. Her raw times for Trails 1, 2, and 5 increased from the first follow up (post APT-2) to the second follow up (post DPT). However, her raw times still remained below her initial baseline. Her raw times for Trail 3 and Trail 4 decreased slightly from the first follow up (post APT-2) to the second follow up (post DPT). At the one month follow up, Participant 1 obtained a composite index score of 23. Her scores on the individual trails were as follows: Trail 1: t=23, Trail 2: t=27, Trail 3: t=26, Trail 4: t=24, Trail 5: t=29. Her raw times (in seconds) for the trails were as follows: Trail 1: 67 s, Trail 2: 62 s, Trail 3: 61 s, Trail 4: 67 s, Trail 5: 85 s. Based on a 95%

confidence interval, there were no significant differences between her *t* scores at baseline and her *t* scores at the one month follow up. However, her raw completion time remained lower relative to baseline on all trails.

**STROOP Test.**

*STROOP* test scores were not analyzed for Participant 1 because her Color and Word scores were below average by more than one standard deviation. Interference scores for the *STROOP* test are generally not considered valid when Color Scores or Word scores are below average by more than one standard deviation except for in the case of substantial interference in the presence of low Word and normal Color scores (Golden & Freshwater, 2002).

**Wechsler Memory Scale-III.**

At baseline, Participant 1 obtained a composite index score of 79 based on performance on the working memory subtests of the WMS-III. Following APT-2 (treatment 1), she maintained an index score of 79. Following DPT (treatment 2), her working memory index score decreased to 69. At the one month follow up, she obtained a working memory index score of 81. Based on a 95% confidence interval calculated from SEM, there were no significant changes in Participant 1's working memory index scores.

**Thematic units.**

At baseline, Participant 1 produced a mean of 63% of the essential thematic units and a mean of 43.52% total thematic units essential plus detail. Since Participant 1 received the APT-2 treatment first, all the stimuli were considered untreated at this point in the treatment cycle. One week after Participant 1 completed the APT-2 treatment (treatment 1), she produced 69.30% of the essential thematic units and 46.11% of total thematic units. For the essential thematic units, an effect size of .82 was obtained indicating a negligible treatment effect. For total thematic units, an effect size of 1.7 was obtained indicating a negligible treatment effect.

Before beginning the DPT condition of the treatment cycle, baseline measures were re-established. For all of the picture stimuli, she produced a mean of 66.33% of the essential thematic units and a mean of 48.35% of the total thematic units. For the stimuli selected as treated stimuli, Participant 1 produced a mean of 63.87% of the essential thematic units and a mean of 43.95% of total thematic units. For the stimuli selected as untreated stimuli, Participant 1 produced a mean of 76.46% of the essential thematic units and 61.11% of total thematic units. At the one week follow-up after DPT (treatment 2), Participant 1 produced 98.42% of the essential thematic units and 89.24% of the total thematic units for the treated stimuli. For the untreated stimuli, Participant 1 produced 77.35% of the essential thematic units and 61.73% of the total thematic units. An effect size of 7.9 was obtained for essential thematic units produced for treated stimuli, indicating a large treatment effect. An effect size of 11.95 was obtained for total thematic units produced for treated stimuli, indicating a large treatment effect. An effect size of .7 was obtained for essential thematic units produced for untrained stimuli indicating a negligible treatment effect. An effect size of .14 was obtained for total thematic units produced for untrained stimuli indicating a negligible treatment effect.

To assess the combined effect of DPT and APT-2, the percentage of essential and total thematic units produced at the second follow-up was compared to the percentage of essential and thematic units produced at the initial baseline. For essential thematic units produced in response to treated stimuli, an effect size of 8.68 was obtained, indicating a large treatment effect. For total thematic units essential plus detail produced in response to treated stimuli, an effect size of 9.25 was obtained, indicating a large treatment effect. For essential thematic units produced in response to untreated stimuli, an effect size of .85 was obtained indicating a negligible treatment effect. For total thematic units essential plus detail produced in response to untreated stimuli, an effects size of 2.5 was obtained, also indicating a negligible treatment effect.

At the one month follow-up, Participant 1 produced 99% of essential thematic units (*d*=8.9) and 85% of total thematic units (*d*=8.4) for the treated stimuli. For the untreated stimuli, Participant 1 produced 73.58% of the essential thematic units (*d*=.57) and 58.78% of the total thematic units (*d*=2.59)

**Coherence errors.**

The percentage of words which made up global coherence errors was calculated for the generalization tasks (Cookie theft picture and expository discourses). During the initial baseline session, Participant 1 produced 4% coherence errors for the expository discourses and 0% global coherence errors for the cookie theft picture. Following APT-2, 2.6%, of the words produced in response to the expository discourses represented coherence errors. Participant 1 did not make any global coherence errors in response to the Cookie Theft picture. Following DPT, Participant 1 did not produce any global coherence errors in response to the expository prompts. Following DPT, 8.8% of the words that Participant 1 produced in response to the Cookie Theft picture represented global coherence errors. At the one month follow-up, Participant 1 did not produce any global coherence errors in response to the expository prompts. At the one month follow-up, 19.2% of the words that she produced in response to the "Cookie Theft" picture represented global coherence errors.

## Participant 2

For Participant 2, composite index scores for the Comprehensive Trail Making Test (CTMT) and the working memory subtest of the Wechsler Memory Scale (WMS) are reported for baseline and follow up phases. T scores and raw times are reported for the individual trails of the CTMT for baseline and follow up phases. STROOP interference scores are reported for baseline and follow up phases. The percentage of thematic units are reported for both treated and untreated sequential picture stimuli at baseline and follow up. The percentage of words which make up global coherence errors are reported for the generalization probes (expository discourses and Cookie Theft picture) for baseline and follow up phases.

**Comprehensive Trail Making Test (CTMT).**

At baseline, Participant 2 obtained a composite index score of 29 on the CTMT. He obtained the following *t* scores for the individual trails: Trail 1: t=33, Trail 2: t=40, Trail 3: t=30, Trail 4: t=34, Trail 5: t=18). His raw times (in seconds) at baseline for the individual trails were as follows: Trail 1: 50 s, Trail 2: 48 s, Trail 3: 60 s, Trail 4: 46 s, Trail 5: 328 s. One week post DPT (treatment 1), His composite index score was 30. He obtained the following *t* scores for individual trails: Trail 1: t=41, Trail 2: t=36, Trail 3: t=32, Trail 4: t=36, Trail 5: t=18. His raw times (in seconds) for the individual trails were as follows: Trail 1: 36 s, Trail 2: 46 s, Trail 3: 53 s, Trail 4: 43 s Trail 5: 189 s. Based on a 95% confidence interval, there was no significant change in his composite index scores. However, his raw score on the divided attention trail (Trail 5) declined (i.e., 328 s to 189 s). One week post APT-2 (treatment 2), Participant 2 obtained a composite index score of 29. He obtained the following *t* scores for individual trails: Trail 1: t=36, Trail 2: t=29, Trail 3: t=27, Trail 4: t=28, Trail 5: t=36.  His raw times (in seconds) for the individual trails were as follows: Trail 1: 45s, Trail 2: 66s, Trail 3: 68s, Trail 4: 66s, Trail 5: 67s. Based on a 95% confidence interval, there was no significant change in his composite index scores. However, his raw time on the divided attention trail (Trail 5) continued to decline. At the one month follow up, Participant 2 obtained a composite index score of 34. His scores on the individual trails were as follows: Trail 1: t=40, Trail 2: t=37, Trail 3: t=33, Trail 4: t=37, Trail 5: t=33. His raw times (in seconds) were as follows: Trail 1: 38, Trail 2: 45, Trail 3: 51, Trail 4: 40, Trail 5: 78. Based on a 95% confidence interval, there was no significant change in his *t* scores but the raw time for the divided attention task (Trail 5) remained below baseline thus suggesting that he maintained treatment effects for divided attention.

**STROOP Test.**

At baseline, Participant 2 obtained an interference *t* score of 50. After receiving DPT (treatment 1), Participant 2 obtained an interference *t* score of 56. After receiving APT-2 (treatment 2), Participant 2 obtained an interference *t* score of 60. At the one month follow up, Participant 2 obtained an interference *t* score of 51. A ten point difference between t scores is considered to be a significant difference (Golden & Freshwater, 2002). Thus, there was no significant difference between Participant 2's interference score at baseline and his interference score at the first follow up (one week post APT-2). There was also no significant difference between Participant 2's interference score at the first follow up and his score at the second follow up (one week post DPT). However, there was a significant difference between Participant 2's interference score at the second follow up and his score at the initial baseline. This suggests that APT-2 and DPT in combination resulted in improved selective attention as measured by the STROOP test. At the one month follow up, however, his interference score declined to 51 which suggests that treatment effects for selective attention were not maintained.

**Wechsler Memory Scale-III.**

At baseline, Participant 2 obtained an index score of 76 on the working memory subtests of the WMS-III. Following DPT (treatment 1), his index score decreased to 74. Following APT (treatment 2), his index score for the working memory subtests returned to 76. At the one month follow up, he maintained an index score of 76 on the working memory subtests of the Wechsler

Memory Scale. Based on a 95% confidence interval calculated from SEM, there were no significant changes in Participant 2's index scores on the working memory subtests of the WMS.

**Thematic units.**

At baseline, Participant 2 produced a mean of 50.22% of the essential thematic units and a mean of 34.08% of the total (essential plus detail) thematic units for the stimuli selected to be treated stimuli. For the stimuli selected to be untreated stimuli, Participant 2 produced a mean of 58.4% of the essential thematic units and a mean of 43.3% of the total thematic units at baseline. One week after Participant 2 completed DPT, he produced a mean of 85% of the essential thematic units and 64% of the total thematic units for the treated stimuli. For the essential thematic units produced for treated stimuli, an effect size of 6.7 was obtained indicating a large treatment effect. For total thematic units produced for treated stimuli, an effect size of 7.83 was obtained indicating a large treatment effect. One week following DPT, he produced 58.40% of essential thematic units for untreated stimuli, thereby maintaining his baseline level of performance His production of total thematic units increased to 47.3 resulting in a 4.08 (medium) treatment effect.

Before beginning the APT condition of the treatment cycle, baseline measures were re-established. For the treated stimuli, Participant 2 produced a mean of 88.1% of the essential thematic units and a mean of 68.6% of total thematic units at baseline. For the untreated stimuli, Participant 2 produced a mean of 64.6% of the essential thematic units and 49.49% of total thematic units at baseline. At the one week follow up after APT-2, Participant 2 produced 87.2% ($d= -.16$) of the essential thematic units and 69.4% of the total thematic units for the treated stimuli ($d=.1$). For the untreated stimuli, Participant 2 produced 66.7% of the essential thematic units and 52.1% of the total thematic units. An effects size of .70 was obtained for essential thematic units produced the untreated stimuli, indicating a negligible treatment effect. An effect size of .5 was obtained for total thematic units produced for untreated stimuli indicating a negligible treatment effect.

To assess the combined effect of DPT and APT-2, the percentage of essential and total thematic units produced at the second follow-up was compared to the percentage of essential and thematic units produced at the initial baseline. For treated stimuli, an effects size of 3.93 was obtained for the percentage of essential thematic units produced indicating a small treatment effect. An effect size of 8.00 was obtained for the percentage of total thematic units produced for treated stimuli, indicating a medium treatment effect. For untreated stimuli, an effect size of 2.88 was obtained for the percentage of total thematic units produced indicating a medium treatment effect. For untreated stimuli, an effect size of 8.97 was obtained for the percentage of total thematic units produced, indicating a large treatment effect.

At the one month follow up, Participant 2 produced 85.6% of essential thematic units and 67% of total essential plus detail thematic units for the treated stimuli, thus demonstrating that he had maintained treatment effects for treated stimuli. For untreated stimuli, Participant 2 produced 59% of essential thematic units and 47.9% of total thematic units. At the one month follow-up, Participant 2's production of essential thematic units for untreated was similar to his production of essential thematic units at baseline. However, his production of total thematic units for untreated stimuli remained above baseline suggesting that Participant 2 had partially maintained treatment effects for untreated stimuli.

**Global coherence errors.**

The percentage of words which made up global coherence errors was calculated for the generalization tasks. During the initial baseline session, Participant 2 produced 27% coherence errors for the expository discourses and 5% global coherence errors for the cookie theft picture. Following DPT, 8%, of the words that Participant 2 produced in response to the expository discourses represented coherence errors. Participant 2 did not make any global coherence errors in response to the Cookie Theft picture. Following APT, Participant 2 did not produce any global coherence errors in response to the expository prompts or in response to the Cookie Theft picture. At the one month follow-up, Participant 2 did not produce any global coherence errors in response to the Cookie Theft picture or in response to the expository prompts, indicating that treatment effects were maintained.

**Participant 4**

For Participant 4, *t* scores and raw times are reported for individual trails on the CTMT that he was able to complete at baseline and the follow up phases. A composite score for the CTMT is not reported for Participant 4 because he was unable to complete all of the trails. Index scores for the Wechsler Memory Scale (WMS) are reported for baseline and follow up phases. The percentage of thematic units are reported for both treated and untreated sequential picture stimuli at baseline and follow up. The percentage of words which make up global coherence errors are reported for the generalization probes (expository discourses and Cookie Theft picture) for baseline and follow up phases.

**Comprehensive Trail Making Test (CTMT).**

At baseline, Participant 4 completed Trail 1 in 7 minutes and 40 seconds and Trail 2 in 5 minutes and 30 seconds. Trails 3 and 4 were attempted but he became agitated and refused to complete them. After receiving DPT (treatment 1), Participant 4 completed Trails 1-4. He did not comprehend the instructions for Trail 5 and thus, this trail was not completed. His times for

Trails 1-4 were as follows: Trail 1: 6 minutes and 18 seconds, Trail 2: 8 minutes and 15 seconds, Trail 3: 7 minutes and 9 seconds, Trail 4: 3 minutes and 30 seconds. After receiving APT, Participant 4 refused to complete Trail 1. Trails 2 and 3 were not attempted but Trail 4 was administered since he performed best on this trail during the previous follow up. He completed part of Trail 4 but became frustrated and refused to complete the remainder of the trail after 7 minutes and 20 seconds elapsed. At the one month follow-up, he again refused to complete Trail 1. Trail 4 was again administered and he completed this trail in 6 minutes and 40 seconds.

**STROOP Test.**

*STROOP* test scores were not analyzed for Participant 4 because his Color and Word scores were below average by more than 1 standard deviation. Interference scores for the *STROOP* test are generally not considered valid when Color Scores or Word scores are below average by more than one standard deviation except for in the case of substantial interference in the presence of low Word and normal Color scores (Golden & Freshwater, 2002).

**Wechsler Memory Scale III.**

At baseline, Participant 4 obtained an index score of 60 on the working memory subtest of the WMS. After receiving DPT, he maintained an index score of 60. After receiving APT, his index score declined slightly to 57. At the one month follow up, his index score increased to 69. Based on a 95% confidence interval, there were no significant changes in his index scores on the working memory subtest of the WMS.

**Thematic units.**

At the initial baseline, Participant 4 produced a mean if 48.12% of the essential thematic units and a mean of 30.83% of the total thematic units for the stimuli selected as treated stimuli. For the stimuli selected as untreated stimuli, he produced an average of 38.77% of the essential thematic units and 27.56% of the total thematic units. After receiving DPT (treatment 1), he produced 81.53% of the essential thematic units and 58.68% of the total essential plus detail thematic units for the treated stimuli. For the percentage of essential thematic units produced for treated stimuli, an effect size of 8.85 was obtained, indicating a large treatment effect. An effect size of 6.89 was obtained for the percentage of total thematic units produced for treated stimuli, indicating a large treatment effect. For untreated stimuli, he produced 50% of the essential thematic units and 40.23% of the total thematic units. An effect size of 1.29 was obtained for the percentage of essential thematic units produced for untreated stimuli, indicating a negligible treatment effect. An effect size of 1.94 was obtained for the percentage of total thematic units produced for untreated stimuli, indicating a negligible treatment effect.

Following DPT, baseline measures for the percentage of essential and total thematic units produced were reestablished. At baseline, Participant 4 produced a mean of 75.96% of the essential thematic units and a mean of 55.19% of the total thematic units for treated stimuli. For untreated stimuli, he produced 62.25% of the essential thematic units and a mean of 46.55% of the total essential plus detail thematic units. Following APT-2, he produced a mean of 77.84% of the essential thematic units and 55.56% of the total thematic units for treated stimuli. An effect size of .69 was obtained for the percentage of essential thematic units produced for treated stimuli indicating a negligible treatment effect. An effect size of .20 was obtained for the percentage of total thematic units produced for treated stimuli, indicating a negligible treatment effect.  For untreated stimuli, Participant 4 produced 72.91% of the essential thematic units and 51.7% of the total thematic units for untreated stimuli. An effect size of 2.46 was obtained for the percentage of essential thematic units produced indicating a negligible treatment effect. An effect size of 2.11 was obtained for the percentage of total thematic units produced indicating a negligible treatment effect.

To assess the combined effect of DPT and APT-2, the percentage of essential and detail thematic units produced at the second follow up was compared to the percentage of essential and detail thematic units produced at the initial baseline. For treated stimuli, an effect size of 7.87 was obtained for the percentage of essential thematic units produced, indicating a large treatment effect. For treated stimuli, an effects size of 6.12 was obtained for the percentage of total essential plus detail thematic units produced, indicating a large treatment effect. For untreated stimuli, an effect size of 3.94 was obtained for the percentage of essential thematic units produced, indicating a small treatment effect. For untreated stimuli, an effects size of 3.71 was obtained for the percentage of total thematic units produced, indicating a small treatment effect.

**Global coherence errors.**

The percentage of words which made up global coherence errors was calculated for the generalization tasks (Cookie theft picture and expository discourses). At baseline, Participant 4 did not produce any global coherence errors for the "Cookie Theft" picture. For the expository task, 30.98% of the words that he produced represented global coherence errors. One week after receiving DPT, he did not produce any global coherence errors for the "Cookie Theft" picture or for the expository task. The decrease in the number of global coherence errors produced during the expository task from baseline to the first follow up suggests that treatment effects from DPT may generalize to untreated discourse types. After receiving APT, 50% of the words that Participant 4 produced in response to the "Cookie Theft" picture represented global coherence errors. After receiving APT-2, Participant 4 did not make any global coherence errors in response to the expository prompts. At the one month follow up, Participant 4 did not make any global coherence errors in response to the Cookie Theft picture. At the one month follow up, 1.49% of the words Participant 4 produced in response to the expository prompts represented global coherence errors.

## Participant 5

### Comprehensive Trail Making Test (CTMT).

At baseline, Participant 5 obtained a composite index score of 17 on the CTMT. He obtained *t* scores of 18 on all of the individual trails at baseline. His raw times (in seconds) for the trails at baseline were as follows: Trail 1: 104 s, Trail 2: 120 s, Trail 3: 121 s, Trail 4: 105 s, Trail 5: 160 s.  Following APT-2, Participant 5 obtained a composite index score of 17 on the CTMT. He obtained t scores of 18 on all individual trails. His raw times (in seconds) for the Trails at the first follow up were as follows: Trail 1: 131, Trail 2: 129, Trail 3: 142, Trail 4: 118, Trail 5:135. Following DPT, he obtained a composite index score of 18 on the CTMT. His raw times (in seconds) for the Trails at the second follow up were as follows: Trail 1: 93S, Trail 2: 106 s, Trail 3: 110 s, Trail 4: 85 s, Trail 5: 110 s. At the one month follow up, he obtained a composite index score of 18 on the CTMT. His raw completion times (in seconds) for the Trails were as follows: Trail 1: 69 s, Trail 2: 79 s, Trail 3: 71 s, Trail 4: 56 s, Trail 5: 83 s.

### STROOP Test.

*STROOP* test scores were not analyzed for Participant 5 because his Color and Word scores were below average by more than one standard deviation. Interference scores for the *STROOP* test are generally not considered valid when Color Scores or Word scores are below average by more than one standard deviation except in the case of substantial interference in the presence of low Word and normal Color scores (Golden & Freshwater, 2002).

**Wechsler Memory Scale-III.**

At baseline, Participant 5 obtained an index score of 91 on the working memory subtest of the WMS. Following APT-2, he maintained a score of 91 on the working memory subtest of the WMS. Following DPT, he obtained an index score of 118 on the working memory subtest of the WMS. Based on a 95% confidence interval, this score was significantly different than his baseline score. At the one month follow up, his index score increased again to 124.

**Thematic units.**

At baseline, Participant 5 produced a mean of 84.06% of the essential thematic units and a mean of 58.22% total thematic units essential plus detail. Since Participant 5 received the APT-2 treatment first, all the stimuli were considered untreated at this point in the treatment cycle. After receiving APT-2 (treatment 1), he produced 80.05% of the essential thematic units and 55.16% of the total essential plus detail thematic units. An effect size of -0.6 was obtained for the percentage of essential thematic units produced indicating no treatment effect. An effect size of -0.6 was also obtained for the percentage of total essential plus detail thematic units produced indicating no treatment effect

Following APT-2, baseline measures for the percentage of essential and total thematic units produced were reestablished. At baseline, Participant 4 produced a mean of 85.45% of the essential thematic units and a mean of 59% of the total essential plus detail thematic units for the stimuli designated to be treated stimuli. For the stimuli designated as untreated stimuli, he produced a mean of 74.54% of the essential thematic units and a mean of 53.7% of the total essential plus detail thematic units. Following DPT, he produced a mean of 97.34% of the essential thematic units and 79.74% of the total thematic units for treated stimuli. An effect size of 4.42 was obtained for the percentage of essential thematic units produced for treated stimuli indicating a medium treatment effect. An effect size of 19.94 was obtained for the percentage of total (essential plus detail) thematic units produced for treated stimuli, indicating a large treatment effect. For untreated stimuli, Participant 4 produced 83.64% of the essential thematic units and 62.2% of the total thematic units following DPT. An effect size of 1.76 was obtained for the percentage of essential thematic units produced for untreated stimuli indicating a negligible treatment effect. An effect size of 2.98 was obtained for the percentage of total thematic units produced for untreated stimuli indicating a small treatment effect. The combined effect of APT-2 and DPT was not calculated because in contrast to the other participants, Participant 5 declined slightly in his production of thematic units following APT-2.

**Global coherence errors.**

The percentage of words which made up global coherence errors was calculated for the generalization tasks. During the initial baseline session, Participant 5 produced 4.1% coherence errors for the expository discourses and 65% global coherence errors for the cookie theft picture. Following APT-2, 15% of the words that Participant 5 produced in response to the Cookie Theft picture represented global coherence errors. Participant 5 did not make any global coherence errors in response to the expository prompts. Following DPT, Participant 5 produced 27% global coherence errors in response to the Cookie Theft picture. He produced 6.1% coherence errors for the expository prompts. At the one-month follow-up, Participant 5 produced 44% global coherence errors in response to the Cookie Theft picture. He produced 4.2% global coherence errors in response to the expository prompts.

# CHAPTER 4: DISCUSSION

The purpose of the current study was to determine if the individual and combined effects of DPT and APT-2 will: 1) result in improved discourse production, as measured by narrative informativeness and global coherence; 2) result in improved cognition, as measured by standardized assessments of attention and working memory; and 3) result in improvements that are maintained one month after the conclusion of the treatment cycle. DPT utilized structured cues (comprehension questions and story guide), metacognitive and metalinguistic strategies, and functional training in the form of narrative practice (Kintz et al., 2018). APT-2 utilized hierarchically arranged activities which targeted specific aspects (sustained, alternating, selective, divided) of attention (Sohlberg et al., 1994). The results of this study suggest that DPT by itself had a greater effect on discourse informativeness and coherence than APT-2 by itself. However, DPT and APT-2 in combination resulted in greater gains in discourse informativeness for untreated picture stimuli for most participants. All participants reduced their raw completion times on the CTMT following treatment but there was inter-subject variability as to which treatment yielded the largest effect; Participant 1 improved following APT-2, Participant 4 improved following DPT, and Participant 2 and 5 improved following both.

## Narrative Informativeness and Global Coherence following Treatment

All participants exhibited improvements in narrative informativeness for treated stimuli as measured by the percentage of thematic units produced. All participants produced a greater percentage of both essential and total (essential plus detail) thematic units following treatment. For the untreated stimuli, results were less straightforward. Participant 2 showed a medium treatment effect for total thematic units produced for untreated stimuli following DPT. His production of essential thematic units for untreated stimuli remained at baseline level at the first follow up. However, when the untreated pictures were probed during treatment, Participant 2 produced more essential thematic units and total thematic units relative to baseline. Thus, it is possible that withdrawing treatment for a week caused his performance to decline slightly and that a longer treatment period may have been needed for more consistent generalization effects. Participant 5 showed a small treatment effect for total thematic units produced following DPT. Similar to Participant 2, Participant 4 exhibited a pattern of improved performance on untrained stimuli during probes but a slight decline relative to the probes at follow up. Participant 4 produced more essential and total thematic units at follow up compared to baseline but the treatment effect was below the benchmark for a meaningful treatment effect. Participant 1 also produced more essential and total thematic units at follow up than baseline, but the treatment effect was negligible and she did not show as much of an increase in performance during probes that Participants 2 and 4 did.

APT-2 by itself did not cause significant changes in the percentage of essential and total thematic units produced for any of the participants. However, when the cumulative effect of both APT-2 and DPT combined was assessed, two of the four participants showed significant treatment effects for the untreated stimuli. The improvement in the percentage of thematic units produced for trained and untrained stimuli as a result of the entire treatment cycle supports and extends results of a previous study which investigated the effectiveness of DPT (Kintz et. al, 2018). Kintz and colleagues found increases in the percentage of thematic units produced for trained and untrained stimuli following DPT. One difference between the current study and the Kintz et al. study is that the Kintz et al study found greater gains for generalization of treatment effects to untrained stimuli from DPT by itself than the current study did. This may have been due to differences in the participant's degree of cognitive impairment. The participants in the current study had lower scores on the SCATBI, WMS-III, and the CTMT compared to the participants in the Kintz et al. study. In particular, the participants in the current study had greater impairments in attention with three of the four scoring in the severely impaired range on the CTMT. Kintz and colleagues hypothesized that "since discourse requires the use of several cognitive systems to maintain representations and organize the narrative, individuals with moderate-to-severe TBI may require treatments that focus on these cognitive problems before language and discourse abilities are treated" (p. 57). The fact that larger gains were observed for untreated stimuli when the cumulative effect of DPT and APT-2 combined partially supports Kintz et al's hypothesis that persons with more severe cognitive deficits may require both focused cognitive training as well as discourse training for the greatest effect; although, both Participant 2 and 4 received DPT first.

Participant 5's results differed from the other participants in that his production of thematic units declined after receiving APT-2 and thus, he did not exhibit a benefit for the combination of APT-2 and DPT. He also did not show the same degree of maintenance of treatment effects as the other participants. This could possibly be due to the fact that his treatment schedule was less intense than that of the other participants. Due to scheduling conflicts, Participant 5 was unable to maintain the 3-4 day a week treatment schedule and was seen on average 1-2 times a week instead.

Interestingly, Participant 1 did not show as much generalization to the untrained stimuli as Participants 2 and 4 did despite the fact that she exhibited the largest treatment effects for trained stimuli of all three participants. Participant 1 started producing accurate discourses very early in the treatment cycle. For most pictures, she exhibited high accuracy after receiving feedback one time. Thus, it is possible that the treatment became less challenging for her as treatment progressed since every picture was targeted four times. Because of this, she exhibited large treatment effects for the treated stimuli, but since she was presumably not challenged in later sessions, her ability to generalize to new stimuli may have been negatively affected. For the untreated stimuli, she made several incorrect inferences which resulted in the production of inaccurate thematic units. The DPT treatment does target inferencing and problem solving by encouraging participants to utilize cues from the pictures as well as from the structure of a story to interpret the pictures. However, it is possible that Participant 1 did not have adequate practice with applying these inferencing skills because she recalled and produced the discourses accurately after one round of feedback. If she was able to recall the discourses after one session of feedback, then it would logically follow that she would not have to do much inferencing and problem solving to interpret the pictures during subsequent sessions since she could produce most of the discourse from memory. It is also possible that she began to approach the tasks as memorization tasks instead of discourse planning and problem solving tasks. By contrast, Participants 2 and 4 often did not remember the stories from session to session and did not start to show high accuracy for the treated pictures until later in the therapy cycle. Thus, they both had lower accuracy percentages for treated pictures than Participant 1. However, it is possible that they got more practice with inferencing and discourse planning than Participant 1 because they could not easily produce the discourses from memory and thus had to put more effort into utilizing contextual cues to inference and problem solve than she did. Like Participant 1, Participants 2 and 4 both made many errors of interpretation at baseline which resulted in the production of inaccurate thematic units. However, by the last follow up, both had revised their original interpretation of several of the pictures which allowed them to produce more accurate thematic units.

Following DPT, Participants 2 and 4 showed generalization to the untrained discourse genre (expository) based on the percentage of global coherence errors produced at baseline. At baseline, Participant 4 exhibited difficulty with topic maintenance. When responding to the legalization of marijuana prompt, he was initially on topic but then produced tangential utterances about an unrelated topic (the music he enjoys, playing guitar with his brother) and did not establish a connection between these utterances and the main topic. Following DPT, he did not make any coherence errors. Following APT-2, his percentage of global coherence errors increased but remained below baseline and remained fairly stable at the one month follow up. At baseline, Participant 2's discourse was initially clear and on topic but was very short. When the examiner prompted him, per protocol, by asking "Anything else?", the remainder of his response was confusing; he initially argued for the legalization of marijuana but after the prompt, he produced vague and unclear arguments that were more representative of the opposite side. After DPT, he produced one statement that was circular, but the remainder of his argument was coherent. Following APT-2 he did not produce any coherence errors and also did not produce coherence errors at the one month follow up. Participant 1 also showed a reduction in global coherence errors for the expository prompts. However, her error rate was very low at baseline so there was little room for further improvement. At baseline, her discourses were logical and showed appropriate topic maintenance. Her only global coherence error was one repetitive utterance. Although an expository discourse has a different structure than a narrative discourse, it is possible that the skills that participants learn are transferrable to other discourse genres. Through DPT, participants practice producing goal directed discourses and self-monitoring. This may have facilitated the participant's ability to produce coherent discourses, regardless of discourse genre.

Participant 5 was the only participant who produced a large number of global coherence errors in response to the Cookie Theft picture at baseline. His errors decreased following APT-2. Following DPT, his errors increased but remained below baseline. Participant 1 showed an increase in global coherence errors after receiving DPT but she increased the complexity of her discourse. At baseline, she did not acknowledge a salient aspect of the picture (that the water was overflowing). Following DPT, she talked about this part of the picture but made an incorrect inference about the sequence of events. Following APT-2, Participant 4 showed an increase in global coherence errors in response to the Cookie Theft picture. This was surprising because he did not produce any global coherence errors in response to this picture at baseline and because he continued to show improvements when responding to the untreated sequential pictures following APT-2. However, Participant 4's performance on discourse tasks was often inconsistent. This variability in performance was observed both during treatment sessions and during probe and follow up sessions as well. Thus, it is possible that this increase in global coherence errors was in part due to performance variability. At the one month follow up, his error rate once again returned to zero.

The results from the Cookie Theft picture were unexpected. It was initially expected that producing discourses in response to the Cookie Theft picture would be more cognitively demanding than producing discourses in response to the sequential pictures due to the fact that the sequence of events is not explicitly laid out in a single picture. Previous research (Wright, Koutsoftas, Capilouto, & Fergadiotis, 2014) has shown that healthy younger and older adults have lower coherence on single pictures compared with sequential pictures. Our participants, with the exception of Participant 5, produced minimal or no global coherence errors in response to this picture at baseline. However, the stories produced by the participants were simple; they described the actions of the mother and the children but there were no attempts to establish a connection between the mother's actions and the children's actions (i.e. the mother is washing dishes and is not paying attention so the children are stealing cookies). Participant 5, by contrast, told more complex stories but made erroneous inferences about antecedent events and about how the characters and their actions are connected. Similarly, Participant 1 only started making global coherence errors when she started producing more complex stories. Coelho and Cannizzarro (2002) also used single pictures as a discourse elicitation task for an adult with TBI and noted that the participant tended to be stimulus bound and had difficulty making inferences about how characters and events are connected. Our results suggest that global coherence errors may not become apparent unless the participants produce discourses that are sufficiently complex. The fact that the participants made few global coherence errors in response to the Cookie Theft picture was unexpected in part because the participants made frequent errors of interpretation when responding to the sequential pictures which caused their discourses to be both incomplete and inaccurate. It is possible that the sequential pictures were more challenging than the single pictures because the sequential pictures contained more information that must be integrated for the story to be comprehended. With the Cookie Theft picture, it may have been possible to tell a simplified story that is still accurate. This may not have been possible with the sequential pictures which contained more events which must be connected for the story to make sense.

Overall, these results suggest that DPT can help persons with TBI produce more accurate and informative discourses but that for maximal generalization, attention may need to be targeted as well. DPT targeted discourse comprehension with comprehension questions that highlighted salient aspects of the picture stimuli and a visual story guide to encourage meta-analysis of the story. DPT targeted discourse production with functional practice, self-monitoring strategies, and also incorporating meta linguistic and metacognitive strategies. The comprehension questions and story guide encouraged meta linguistic analysis of the story. The clinician targeted meta cognitive skills by drawing the participant's attention to their characteristic response patterns and explaining the problems those response patterns cause (e.g., Penn et al, 1997). Common errors seen were misinterpretation of stories and incomplete stories. To facilitate correct story interpretation, the clinician utilized scaffolding techniques to guide participants toward the correct interpretation of the story. To facilitate the production of adequately informative discourses, the clinician encouraged participants to use the story guide both when planning their discourses and when self-monitoring their discourses during playback. APT-2 may have enhanced the effectiveness of DPT by targeting attention skills. Improved attention may have improved both the participant's ability to attend to salient parts of the stimulus, thereby improving interpretation of the story as well as the participant's ability to maintain topic while producing a complex discourse.

## Cognitive Performance following Treatment

### Attention processes.

Based on the participant's raw completion times on the CTMT, both APT and DPT appear to have some potential to improve complex attention. Following APT-2, all participants showed reductions on either Trail 4 or Trail 5 of the CTMT which measure complex executive aspects of attention. Participant 1 showed gains in simple attention in addition to complex attention, but all other participants only showed gains in complex attention. Following DPT, two of the four participants showed reductions in either Trail 4 or Trail 5 of the CTMT. Additionally, Participant 4 was able to complete Trail 4 after receiving DPT which was a task he was not able to do at baseline.

Participant 4 was the only participant who did not show improvement in complex attention following APT-2**.** One reason that Participant 4 may not have made gains in attention following APT-2 may be because he did not progress beyond the simpler sustained attention tasks at the beginning of the program. By contrast, the other participants completed higher level sustained attention and alternating attention tasks (Participants 1 and 2) and alternating and divided attention tasks (Participant 5) which may be why they showed improvements following APT-2.

Participant 1 was the only participant who did not show improvement in complex attention following DPT. Since Participant 1 received the APT-2 treatment first, it is possible that she reached her maximum level of improvement following APT-2. Additionally, it is possible that DPT was not sufficiently challenging for Participant 1 to further improve her attention abilities. For the treated pictures, she started producing very accurate and complete discourses early in the treatment cycle. Possibly, then for individuals who provide accurate discourses early on, the treatment needs added complexity to further improve cognitive processes. Participants 2 and 4 by contrast, did not begin producing discourses with high accuracy and informativeness until later in the treatment cycle which suggests that the treatment was adequately challenging for them. Interestingly, Participant 5 also began producing informative discourses early in the treatment cycle as well. However, he exhibited problems with tangential and filler utterances throughout the treatment cycle despite producing discourses with a high percentage of thematic units. The fact that he had to monitor his speech for tangential and filler utterances throughout the treatment cycle may have made the treatment sufficiently challenging for him even though he did not have a difficulty in producing informative discourses. Participants 2, 4, and 5 may have made improvements in complex attention following DPT because discourse production involves high level attention skills. Selective attention skills are needed in order to maintain topic and to focus on the important aspects of the discourse rather than on irrelevant details. Moreover, discourse comprehension involves the integration of multiple pieces of information into a coherent whole. This process could potentially involve divided attention skills.

Our results partially support the results from previous studies (e.g. Palmese & Raskin, 2000; Pero, Incoccia, Caracciolo, Zoccolotti, Formisano, 2006; Sohlberg & Mateer, 1987; Sohlberg, McLaughlin, Pavese, Heidrich, Posner, 2010;) which suggest that Attention Process Training may improve attentional abilities in persons with TBI. Since our participants did not all benefit equally from ATP-2, however, our results suggest that APT-2 may not be beneficial for all patients. Alternately, it is possible that results were confounded by deficits in processing speed since the CTMT is a timed test. Greater gains were seen in complex attention than in simple attention which is similar to the results of two previous studies (Pero, Incoccia, Caracciolo, Zoccolotti, Formisano, 2006; Sohlberg, McLaughlin, Pavese, Heidrich, Posner, 2010). This suggests that APT-2 may be more effective in improving executive attention than processing speed.

Few studies have investigated whether discourse training leads to improvements in nonlinguistic cognitive domains. Gabbatore et al. (2015) included cognitive measures following discourse level treatment and found that adults with TBI improved on the Wisconsin Card Sorting Task (WCST; Nelson, 1976) after receiving Cognitive Pragmatic treatment. They attributed these improvements to greater cognitive flexibility and improved executive function. This is similar to our findings with Participants 2 and 4 in that they both showed improvement in complex executive attention following DPT. It is possible that DPT resulted in improvements in complex attention due to increased cognitive flexibility and improved self-monitoring skills. Cognitive flexibility refers to the ability to shift cognitive set or attention in order to perceive, process or respond to situations in different ways when task conditions change (Eslinger & Gratan, 1993; Richards, Cote & Stern, 1993). It is possible that DPT helped participants increase cognitive flexibility by targeting their ability to integrate multiple pieces of information in order to interpret the story. Many of the pictures depicted abstract or unexpected scenarios. Presumably then, interpreting these pictures correctly would require the ability to think creatively and to revise one's initial interpretation of early events in the story when this interpretation is not coherent with later events in the story. Additionally, DPT may have improved the participant's ability to self-monitor since one of the treatment steps required the participants to listen to a recording of their discourse and to identify missing, irrelevant and erroneous information. Thus, the results of the current study add and extend previous findings that discourse processing training can cause generalized improvements in high level attention skills. This has important clinical implications; if high level attention can potentially be improved through functional tasks instead of through laboratory tasks which focus on discrete aspects of attention, clinicians will potentially be able to target attention through tasks that are more similar to naturalistic tasks and may have greater ecological validity. Further, if attention can be targeted alongside language, treatment may be completed more efficiently than it would if different cognitive skills are targeted separately.

**Working memory.**

Only Participant 5 exhibited significant improvements on the WMS-III despite the fact that several of the APT-2 tasks require working memory skills (e.g. the number and letter sequencing tasks) and the fact that working memory is thought to be implicated in discourse comprehension and production. It is possible that working memory requires more targeted intervention. Additionally, it is possible that the DPT tasks do not have the same working memory demands as other discourse types or genres. The stimulus pictures were kept in front of the participants while they produced the discourses and this likely reduced the working memory demands of the task. In a study which investigated the relationship between working memory and discourse performance in adult with moderate to severe TBI, Youse and Coelho (2005) found a significant correlation between story grammar ability and working memory in a story retell task which required the participant to view a story presented via film strip then retell the story. By contrast, there was no significant correlation between any of the story grammar measures and working memory in a story generation task which required the participant to view a single picture and generate a story in response to the picture. This may suggest that working memory demands are minimal in tasks where the participant is permitted to view the stimulus while telling the story.

It is also possible that the WMS-III subtests may not have been ideal working memory tasks for these participants. During the APT-2 tasks, it was noted that three of the four participants exhibited significant difficulty with putting words in alphabetical order. These participants often exhibited this difficulty even when words were written down to minimize memory demands. Since the Letter-Number Sequencing subtest required participants to put both letters and number in alphabetical order, it is possible that the participant’s difficulty with ordering could have been a confounding factor. Notably, Participant 5 was the only participant who did not exhibit difficulty with alphabetizing words during the APT-2 treatment tasks and he was also the only participant who made significant gains in working memory.

**Maintenance of Treatment Effects**

For treated stimuli, all participants maintained treatment effects for the percentage of essential and total (essential and detail) for treated stimuli. For untreated stimuli, Participant 2 maintained large treatment effects for total thematic units produced but his percentage of essential thematic units produced returned to close to his baseline level. For untreated stimuli, Participant 4 maintained small treatment effects for essential thematic units produced and for total thematic units produced. For untreated stimuli, Participant 1 and Participant 5's production of both essential and total thematic units decreased relative to the second follow up but remained above baseline. However, the treatment effect did not reach the threshold for a meaningful treatment effect. For expository discourses, Participant 2 and Participant 4 maintained treatment effects at the one month follow up.

These results extend those from Kintz and colleagues (2018) who found that following DPT, participants maintained treatment effects for the percentage of thematic units produced at the one month follow up. Unlike the participants in the Kintz et al study, however, the participants in the current study received APT-2 in addition to DPT and this additional treatment may have been necessary for treatment effects to be maintained for the untreated stimuli. During DPT (treatment 1) both Participant 2 and Participant 4 showed increases in the percentage of thematic units produced for untreated stimuli during both probes but then showed declines from the second probe to the first follow up. Participant 2 showed large treatment effects for the percentage of total (essential plus detail) thematic units produced for untreated stimuli at the first and second probes but a small treatment effect at the first follow up. Additionally, his percentage of essential thematic units fell to baseline levels at the first follow up despite increasing during the first and second probes. Participant 4 showed small treatment effects for the percentage of essential thematic units produced in response to untreated stimuli during the first and second probes but only a negligible treatment effect at the first follow up. It is unlikely that the participant's performance during probes was due to practice or recency effects because untreated stimuli were only probed twice and these probes were separated by approximately two weeks. By contrast, the second probe and the first follow up were separated by only one week. Thus, the data suggest that withdrawing the treatment for a week contributed to the decline. Both participant's performance on the untreated stimuli began increasing again after APT-2 was initiated and both showed small to large treatment effects at the second follow up (one week post APT-2) and the third follow up (one month post entire treatment cycle). This suggests that for participants with more severe deficits, a longer treatment period may be needed for treatment effects to be maintained. At this point it is unclear whether APT-2 specifically offered this benefit or if the same effect could have been attained by simply extending DPT. Our results are in contrast to those from Cannizzaro and Coelho (2002) who found treatment effects for a story grammar treatment were not maintained at the one month and three month follow ups. It is possible that the participants in our study were able to better maintain treatment gains due to either the intensive nature of the treatment or due to the fact that they received both cognitive and discourse-based treatment. Through DPT, which used a context sensitive approach to rehabilitation, participants received functional practice in a task which required multiple interacting cognitive systems. Through APT-2, participants received specific, targeted training of a cognitive skill which presumably underlies all complex cognitive activities, including discourse production.

For the cognitive variables, Participants 1 maintained treatment effects for simple attention and complex attention as measured by the CTMT and Participants 2 and 5 maintained treatment effects for complex attention as measured by the CTMT. This supports findings from Palmese and Raskin (2009) who found that participants maintained treatment effects for attention and processing speed for at least six weeks following APT-2 treatment. They hypothesized that treatment effects were maintained because the repetition of tasks and the hierarchical arrangement of treatment tasks may facilitate the establishment of new neural organization. Additionally, Participant 5 maintained treatment effects for working memory at the one month follow up.

**Conclusions**

The current study investigated the effectiveness of a high intensity meta-cognitive discourse processing treatment (DPT) and the effectiveness of a published attention training program, APT-2 in improving discourse informativeness and discourse coherence. Additionally, the present study investigated the effectiveness of DPT and APT-2 in improving cognition as measured by standardized measures of attention and memory. Following DPT, participants demonstrated large treatment effects for discourse informativeness in response to treated stimuli and small effects for discourse informativeness in response to untreated stimuli. Following the combination of DPT and APT, two of the four participants demonstrated small to large treatment effects for untreated stimuli. Additionally, two participants produced more coherent discourses in response to expository discourse prompts following DPT. Improvements in attention, as measured by performance on the CTMT were observed for all participants following treatment but inter-subject variability was observed with regards to which treatment was more effective for remediating attention.

**Limitations**

There were several limitations to this study. First, the sample size for this study was small and the participants were heterogeneous in their degree of cognitive impairment. Thus, a study that includes a larger N is needed to strengthen the conclusions and to determine how the treatments effect participants with differing cognitive profiles. Additionally, three of the four participants in this study were several years post injury. It is possible that the time post injury could affect results and thus, this study provides limited information on how persons with more recent TBIs may respond to treatment.

It is possible that the standardized tests of attention used were not ideal for participants with slowed speed of processing. The STROOP test results were invalid for three of the four participants due to the fact that these participants' Color and Word scores were more than one standard deviation below the mean. Similarly, the CTMT may not be the most ideal test for participants with slow processing speed. Unlike the STROOP test, results of the CTMT are still valid even in circumstances where the participant cannot complete the task efficiently. However, slowed processing speed and problems with visual tracking are possible confounding factors that can affect CTMT scores. Thus, it is difficult to know the degree to which the CTMT scores were affected by speed of processing versus the degree to which they were affected by attention. Additionally, the slowed processing speed of the participants made it difficult to interpret CTMT t scores. Many of the participants had raw scores that were well above the cutoff point for the lowest t score of 18. Thus, there were situations where participants substantially reduced their completion times yet showed minimal to no change in t score. Because of this, raw completion times were used to analyze the CTMT results in addition to the t scores in order to assess practical significance. Thus, a standardized test of attention with less of a speed of processing burden may be preferable for this population. Furthermore, the SCATBI is not a test that can easily be repeated due to time constraints and potential practice effects. Because of this, the SCATBI was only given once at the initial baseline and was not used as an outcome variable. Thus, the current study only provides information on how attention and working memory processes are affected by the treatments but does not provide comprehensive information on the overall level of cognitive impairment.

Additionally, noted are limitations with applying Marini's global coherence analysis to the expository discourses. Participants 2 and 4 often produced arguments that were weak, illogical, or circular that affected the quality of their discourse. However, these types of errors do not neatly fit into the error categories that the Marini analysis utilizes. Thus, the analysis provided limited information on how the quality of arguments changed in response to treatment.

Another limitation of the study is that one of the participants (Participant 5) was not able to maintain the intensive 3-4 day a week treatment schedule due to scheduling conflicts. Since treatment intensity can potentially affect treatment results, it is possible that his results may have been different had he been able to maintain the intensive treatment schedule.

Finally, two of the Participants (Participant 2 and Participant 4) noted that it was difficult for them to simultaneously attend to both the story guide and the stimuli pictures. On a few occasions, Participant 4 asked if the cards could be removed because "this is too much to look at". Participants 2 and 4 both showed gains from DPT despite their reported difficulties with using the story guide cards but perhaps the treatment would have been less frustrating for them if another method was used to teach story structure.

## Future Directions

Future investigations of DPT and APT-2 should include a larger sample size of patients with varying degrees of cognitive impairment to strengthen the conclusions of the study and to investigate how differing baseline cognitive profiles affect responsiveness to treatment. Future investigations should also include differing levels of intensity to determine whether treatment intensity affects results. Since maintaining an intensive treatment schedule may not be possible for all patients in a clinical setting, it would be useful to know if the same treatment effects could be obtained with a less intense treatment schedule. Due to problems with slowed processing, future investigations should use measures of attention that are not confounded by speed of processing. A coding scheme should also be developed which can assess argument strength should be used in place or in addition to the Marini analysis when assessing global coherence for expository discourses.

It may also be beneficial for future investigations to include more stimuli, particularly for individuals with less severe cognitive impairments. Kintz and colleagues (2018) noted that increasing the number of picture stimuli could potentially affect results by giving participants more opportunities to produce discourses and by reducing learning effects. Thus, the number of picture stimuli was increased from 8 pictures to 16 pictures for the current study. However, for participants with a milder cognitive impairment, this increase may still not be enough to keep the discourse treatment challenging. As previously discussed, Participant 1 began producing accurate and informative discourses very early in the treatment cycle. Thus, the repetition of the stimuli may have caused DPT to not be adequately challenging for her. Future investigations could add additional stimuli and discontinue using pictures once participants reach specified scores for information content.  Additionally, future investigations could probe deeper levels of understanding in order to increase task complexity (e.g. Penn et al., 1997).

Finally, future investigations should include a different cognitive test battery. Specifically, future investigations should use attention measures that are less affected by processing speed and working memory measures that do not require alphabetizing letters. Finally, future investigations should use a measure of overall cognitive impairment that can be repeated multiple times, like the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS; Randolph, 1998) in order to provide more complete information on the potential for DPT and APT-2 to improve differing aspects of cognition.

## References


Adamovich, B., & Henderson, J. (1992). *Scales of Cognitive Ability for Traumatic Brain Injury*. Austin, TX: Pro-Ed.

Alexander, M. P., Benson, D. F., & Stuss, D. T. (1989). Frontal lobes and language. *Brain and language*, *37*(4), 656-691.

Anderson, J.R. (1983). The architecture of cognition. Cambridge, MA: Harvard University Press.

Armstrong, E. (2005). Language disorder: A functional linguistic perspective. *Clinical linguistics & phonetics*, *19*(3), 137-153.

Baddeley, A.D. (1986). Working Memory. New York: Oxford University Press.

Biggs, J. B., & Collis, K. F. (1982). *Evaluation the quality of learning: the SOLO taxonomy (structure of the observed learning outcome)*. Academic Press.

Bohnen, N., Jolles, J., & Twijnstra, A. (1992). Neuropsychological deficits in patients with persistent symptoms six months after mild head injury. *Neurosurgery*, *30*(5), 692-696.

Bond, F., & Godfrey, H. P. (1997). Conversation with traumatically brain injured individuals: A controlled study of behavioural changes and their impact. *Brain injury*, *11*(5), 319-330.

Brooks, N., McKinlay, W., Symington, C., Beattie, A., & Campsie, L. (1987). Return to work within the first seven years of severe head injury. *Brain injury*,*1*(1), 5-19.

Burns, M. S., Halper, A. S., & Mogil, S. I. (1985). *Clinical Management of Right Hemisphere Dysfunction: Rehabilitation Institute of Chicago Procedure Manual*. New York, NY: Aspen Publishers.

Cannizzaro, M. S., & Coelho, C. A. (2002). Treatment of story grammar following traumatic brain injury: A pilot study. *Brain Injury*, *16*(12), 1065-1073.

Cicerone, K. D., Dahlberg, C., Kalmar, K., Langenbahn, D. M., Malec, J. F., Bergquist, T. F., ... & Herzog, J. (2000). Evidence-based cognitive rehabilitation: recommendations for clinical practice. *Archives of Physical Medicine and Rehabilitation*, *81*(12), 1596-1615.

Cicerone, K. D., Dahlberg, C., Malec, J. F., Langenbahn, D. M., Felicetti, T., Kneipp, S., ... & Laatsch, L. (2005). Evidence-based cognitive rehabilitation: updated review of the literature from 1998 through 2002. *Archives of physical medicine and rehabilitation*, *86*(8), 1681-1692.

Coelho, C. A. (2002). Story narratives of adults with closed head injury and non-brain-injured adults: Influence of socioeconomic status, elicitation task, and executive functioning. *Journal of Speech, Language, and Hearing Research*, *45*(6), 1232-1248.

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

Coelho, C.A. Ylvisaker, M., Turkstra, L.S. (2005). Nonstandardized assessment approaches for individuals with traumatic brain injuries. *Seminars in Speech and Language*, *26*, 223-241.

Coelho, C. A., Youse, K. M., & Le, K. N. (2002). Conversational discourse in closed-head-injured and non-brain-injured adults. *Aphasiology*, *16*(4-6), 659-672.

Davis, G. A., & Coelho, C. A. (2004). Referential cohesion and logical coherence of narration after closed head injury. *Brain and Language*, *89*(3), 508-523.

Dahlberg, C. A., Cusick, C. P., Hawley, L. A., Newman, J. K., Morey, C. E., Harrison-Felix, C. L., & Whiteneck, G. G. (2007). Treatment efficacy of social communication skills training after traumatic brain injury: a randomized treatment and deferred treatment controlled trial. *Archives of Physical Medicine and Rehabilitation*, *88*(12), 1561-1573.

Delis, D.C., Kaplan, E., & Kramer, J.H. (2001a). *The Delis-Kaplan Executive Function System: Examiner's Manual*. San Antonio: The Psychological Corporation.

Diener, E. D., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of personality assessment*, *49*(1), 71-75.

Ehrlich, J. S., & Sipes, A. L. (1985). Group treatment of communication skills for head trauma patients. *Cognitive Rehabilitation, 3* (1), 32-37.

Ellis, C. & Peach, R.K. (2009) Sentence planning following traumatic brain injury. *Neurorehabilitation, 24(3), 255-266*

Engle, R. W. (2002). Working memory capacity as executive attention. *Current directions in psychological science*, *11*(1), 19-23.

Eslinger, P. J., & Grattan, L. M. (1993). *Frontal lobe and frontal-striatal substrates for different forms of human cognitive flexibility* doi:https://doi.org/10.1016/0028-3932(93)90077-D

Ferstl, E. C., Neumann, J., Bogler, C., & Von Cramon, D. Y. (2008). The extended language network: a meta- analysis of neuroimaging studies on text comprehension. *Human Brain Mapping*, *29*(5), 581-593.

Ferstl, E. C., & von Cramon, D. Y. (2001). The role of coherence and cohesion in text comprehension: an event-related fMRI study. *Cognitive Brain Research*, *11*(3), 325-340.

Fletcher, P. C., Happe, F., Frith, U., Baker, S. C., Dolan, R. J., Frackowiak, R. S., & Frith, C. D. (1995). Other minds in the brain: a functional imaging study of "theory of mind" in story comprehension. *Cognition*, *57*(2), 109-128.

Frisco, N., & Wright, H.H. (2015). *Discourse Processing Treatment for Adults with Aphasia*. http://search.proquest.com.jproxy.lib.ecu.edu/docview/1693997872?accountid=10639

Frith, U., & Frith, C. (2001). The Biological Basis of Social Interaction. *Current Directions in Psychological Science*, *10*(5), 151–155. https://doi.org/10.1111/1467-8721.00137

Gabbatore, I., Sacco, K., Angeleri, R., Zettin, M., Bara, B. G., & Bosco, F. M. (2015). Cognitive pragmatic treatment: a rehabilitative program for traumatic brain injury individuals. *The Journal of head trauma rehabilitation*, *30*(5), E14-E28.

Gajar, A., Schloss, P. J., Schloss, C. N., & Thompson, C. K. (1984). Effects of feedback and self-monitoring on head trauma youth's conversation skills. *Journal of Applied Behavior Analysis*, *17*(3), 353-358

Galetto, V., Andreetta, S., Zettin, M., & Marini, A. (2013). Patterns of impairment of narrative language in mild traumatic brain injury. *Journal of Neurolinguistics, 26*, 649-661.

Galski, T., Tompkins, C., & Johnston, M. V. (1998). Competence in discourse as a measure of social integration and quality of life in persons with traumatic brain injury. *Brain Injury*, *12*(9), 769-782.

Gernsbacher, M. A. (1997). Two decades of structure building. *Discourse processes*, *23*(3), 265-304.

Glosser, G., & Deser, T. (1990). Patterns of discourse production among neurological patients with fluent language disorders. Brain and Language, 40, 67-88.

Golden, C. (2002). Stroop color and word test. Austin, TX: Pro-Ed.

Goodglass, H & Kaplan, E. (1983). *The Assessment of Aphasia and Related Disorders*, (3rd ed.). Lea &Febiger: Philadelphia, PA.

Grafman, J. (2003). The structured event complex and the human prefrontal cortex. In N. Dimitri, M. Basili & I. Gilboa (Eds.), *Cognitive Processes and Economic Behaviour*, (pp.209-237). New York, NY: Routledge.

Graham, D. I., Ford, I., Adams, J. H., Doyle, D., Teasdale, G. M., Lawrence, A. E., & McLellan, D. R. (1989). Ischaemic brain damage is still common in fatal non-missile head injury. *Journal of Neurology, Neurosurgery & Psychiatry*, *52*(3), 346-350.

Greve, M. W., & Zink, B. J. (2009). Pathophysiology of traumatic brain injury. *Mount Sinai Journal of Medicine: A Journal of Translational and Personalized Medicine*, *76*(2), 97-104.

Grownwall, D.M. (1977). Paced Auditory Serial Addition Task: A measure of recovery from concussion. *Perceptual and Motor Skills, 44,* 367-73.

Hartley, L. L., & Jensen, P. J. (1991). Narrative and procedural discourse after closed head injury. *Brain injury*, *5*(3), 267-285.

Hawley, L., & Newman, J. (2006). Social skills and traumatic brain injury: a workbook for group treatment. *Denver, CO*.

Henderson, A., Kim, H., Kintz, S., Frisco, N., & Wright, H. H. (2017). Working Memory in Aphasia: Considering Discourse Processing and Treatment Implications. *Seminars in Speech and Language*, *38* (1), 40-51.

Hinchliffe, F.J., Murdoch, B.E., & Chenery, H.J. (1998). Towards a conceptualization of language and cognitive impairment in a closed head-injury: use of clinical measures. *Brain Injury*, 12, 109-132.

Hough, M.S. & Barrow, I. (2003). Descriptive discourse abilities of traumatic brain-injured adults. *Aphasiology*, *17*(2), 183-191

Kintsch, W., & Van Dijk, T. A. (1978). Toward a model of text comprehension and production. *Psychological review*, *85*(5), 363.

Kintz, S., Hibbs, V., Henderson, A., Andrews, M., & Wright, H. H. (2018). Discourse-based treatment in mild traumatic brain injury. *Journal of Communication Disorders, 76,* 47-59.

Lê, K., Mozeiko, J., & Coelho, C. (2011). Discourse analyses: Characterizing cognitive-communication disorders following TBI. *The ASHA Leader*, *16*(2), 18-21.

Levelt, W. J., Roelofs, A., & Meyer, A. S. (1999). A theory of lexical access in speech production. *Behavioral and brain sciences*, *22*(1), 1-38.

Lezak, M. (1995). *Neuropsychological Assessment (*3rd ed.). Oxford: Oxford University Press.

Liles, B. Z., Coelho, C. A., Duffy, R. J., & Zalagens, M. R. (1989). Effects of elicitation procedures on the narratives of normal and closed head-injured adults. *Journal of Speech and Hearing Disorders*, *54*(3), 356-366.

Linscott, R. J., Knight, R. G., & Godfrey, H. P. D. (1996). The Profile of Functional Impairment in Communication (PFIC): A measure of communication impairment for clinical use. *Brain Injury*, *10*(6), 397-412.

Mazoyer, B. M., Tzourio, N., Frak, V., Syrota, A., Murayama, N., & Levrier, O. et al., (1993). The cortical representation of speech. *Journal of Cognitive Neuroscience*, 5, 467–479.

MacWhinney, B. (2000). *The CHILDES project: The database* (Vol. 2). Psychology Press.

Malec, J. F., Smigielski, J. S., Depompolo, R. W., & Thompson, J. M. (1993). Outcome evaluation and prediction in a comprehensive-integrated post-acute outpatient brain injury rehabilitation programme. *Brain Injury*, *7*(1), 15-29.

Mar, R. A. (2004). The neuropsychology of narrative: Story comprehension, story production and their interrelation. *Neuropsychologia*, *42*(10), 1414-1434.

Marni, A. & Andreeta, S. (2016). Age-related effects on language production: A combined psycholinguistic and neurolinguistics perspective. In. H.H. Wright (Ed.), *Cognition, Aging and Language* (pp.55-79). Philadelphia, PA: John Benjamins Publishing Company.

Marini, A., Boewe, A., Caltagirone, C., & Carlomagno, S. (2005). Age-related differences in the production of textual descriptions. *Journal of psycholinguistic research*, *34*(5), 439-463.

Marini, A., Galetto, V., Zampieri, E., Vorano, L., Zettin, M., & Carlomagno, S. (2011). Narrative language in traumatic brain injury. *Neuropsychologia*, *49*(10), 2904-2910.

McDonald, S. (1993). Pragmatic language skills after closed head injury: Ability to meet the informational needs of the listener. *Brain and Language*, *44*(1), 28-46.

McDonald, S., & Pearce, S. (1998). Requests that overcome listener reluctance: Impairment associated with executive dysfunction in brain injury. *Brain and Language*, *61*(1), 88-104.

McDonald, S., Togher, L., & Code, C. (1999). The nature of traumatic brain injury: Basic features and neuropsychological consequences. *Communication disorders following traumatic brain injury*, 19-54.

McGann, W., Werven, G., & Douglas, M. M. (1997). Social competence and head injury: A practical approach. *Brain Injury, 11*(9), 621-628.

Mitrushina, M.N., Boone, K.B., & D'Elia, L. (1999). *Handbook of normative data for neuropsychological assessment.* New York: Oxford University Press.

Miyake, A., Emerson, M. J., & Friedman, N. P. (2000). Assessment of executive functions in clinical settings: Problems and recommendations. *Seminars in speech and language, 21(2)*,169--183.

Mozeiko, J., Le, K., Coelho, C., Krueger, F., & Grafman, J. (2011). The relationship of story grammar and executive function following TBI. *Aphasiology*, *25*(6-7), 826-835.

Nelson, H. E. (1976). A modified card sorting test sensitive to frontal lobe defects. *Cortex*, *12*(4), 313-324.

Nicholas, L. E., & Brookshire, R. H. (1995). Presence, completeness, and accuracy of main concepts in the connected speech of non-brain-damaged adults and adults with aphasia. *Journal of Speech, Language, and Hearing Research*, *38*(1), 145-156.

Palmese, C. A. & Raskin, S.A. (2000). The rehabilitation of attention in individuals with mild traumatic brain injury, using the APT-II programme. *Brain Injury, 14*(6), 535-548. doi:10.1080/026990500120448

Parasuraman, R., Mutter, S. A., & Molloy, R. (1991). Sustained attention following mild closed-head injury. *Journal of Clinical and Experimental Neuropsychology*, *13*(5), 789-811.

Paré, N., Rabin, L. A., Fogel, J., & Pépin, M. (2009). Mild traumatic brain injury and its sequelae: characterisation of divided attention deficits. *Neuropsychological*

*Rehabilitation, 19*(1), 110-137.

Park, N. W., & Ingles, J. L. (2001). Effectiveness of attention rehabilitation after an acquired brain injury: A meta-analysis. *Neuropsychology, 15*(2), 199-210.

Peach, R. K. (2012). The cognitive basis for sentence planning difficulties in discourse after traumatic brain injury. *American Journal of Speech-Language Pathology, 22*(2), S285-S297.

Penn, C., Jones, D., & Joffe, V. (1997). Hierarchical discourse therapy: a method for the mild patient. *Aphasiology, 11*(6), 601-613.

Pero, S., Incoccia, C., Caracciolo, B., Zoccolotti, P., & Formisano, R. (2006). Rehabilitation of attention in two patients with traumatic brain injury by means of 'attention process training'. *Brain Injury, 20*(11), 1207-1219. doi:10.1080/02699050600983271

Posner, M. I., & Petersen, S. E. (1990). The attention system of the human brain. *Annual review of neuroscience, 13*(1), 25-42.

Randolph, C. (1998). *Repeatable Battery for the Assessment of Neuropsychological Status.* San Antonio, TX: The Psychological Corporation.

Reynolds, C. R. (2002). *Comprehensive trail making test*. Austin, TX: Pro-Ed.

Richards, M., Cote, L. J., & Stern, Y. (1993). Executive function in parkinson's disease: Set-shifting or set-maintenance? *Journal of Clinical and Experimental Neuropsychology, 15*(2), 266-279. doi:10.1080/01688639308402562

Sacco, K., Angeleri, R., Bosco, F. M., Colle, L., Mate, D., & Bara, B. G. (2008). Assessment Battery for Communication–ABaCo: A new instrument for the evaluation of pragmatic abilities. *Journal of Cognitive Science, 9*(2), 111-157.

Sohlberg, M. M., & Mateer, C. A. (1986). Attention process training (APT). *Puyallup, WA: Association for Neuropsychological Research and Development*.

Sohlberg, M. M., Johnson, L., Paule, L., Raskin, S. A., & Mateer, C. A. (1994). Attention Process Training II: A program to address attentional deficits for persons with mild cognitive dysfunction. *Puyallup, WA: Association for Neuropsychological Research and Development*.

Sohlberg, M.M., McLaughlin, K. A., Pavese, A., Heidrich, A., & Posner, M. I. (2000). Evaluation of attention process training and brain injury education in persons with acquired brain injury. *Journal of Clinical and Experimental Neuropsychology, 22*(5), 656-676. doi:10.1076/1380-3395(200010)22:5;1-9;FT656

Sohlberg, M. M., Perlewitz, P. G., Johansen, A., Schultz, J., Johnson, L., & Hartry, A. (1992). Improving pragmatic skills in persons with head injury. *Communication Skill Builders, Tucson, AZ*.

Stein, N.L., &  Glenn, C.G. An analysis of story comprehension in elementary school children. In R. Freedle (Ed.), *New directions in discourse processing II.* Norwood, N.J.: Ablex 1979.

Sternberg, R.J., & Frensch, P.A. (1993). Mechanisms of transfer. In D.K. Detterman & R.J. Sternberg (Eds.), Transfer on trial: Intelligence, cognition, and instruction (pp. 25–38). Norwood, NJ: Ablex.

Stierwalt, J. A., & Murray, L. L. (2002). Attention impairment following traumatic brain injury. *Seminars in speech and language*, 23(2) , 129-138.

Storandt, M., Botwinick, J., Danziger, W. L., Berg, L., & Hughes, C. P. (1984). Psychometric differentiation of mild senile dementia of the Alzheimer type. *Archives of Neurology*, *41*(5), 497-499.

Stout, C. E., Yorkston, K. M., & Pimentel, J. I. (2000). Discourse production following mild, moderate, and severe traumatic brain injury. *Journal of Medical Speech-Language*

*Pathology*, *8*(1), 15-25.

Thompson, C. K. (2006). Single subject controlled experiments in aphasia: The science and the state of the science. *Journal of communication disorders*, *39*(4), 266-291.

Trabasso, T., & Sperry, L. L. (1985). Causal relatedness and importance of story events. *Journal of Memory and language*, *24*(5), 595-611.

Tucker, F. M., & Hanlon, R. E. (1998). Effects of mild traumatic brain injury on narrative discourse production. *Brain injury*, *12*(9), 783-792.

Wechsler, D. (1997). *Wechsler Memory Scale* (3rd ed.). San Antonio, TX: Psychological Corporation

Wiseman-Hakes, C., Stewart, M. L., Wassertnan, R., & Schuller, R. (1998). Peer group training of pragmatic skills in adolescents with acquired brain injury. *The Journal of head trauma rehabilitation*, *13*(6), 23-38.

Wright, H. H., Koutsoftas, A. D., Capilouto, G. J., & Fergadiotis, G. (2014). Global coherence in younger and older adults: Influence of cognitive processes and discourse type. *Aging, Neuropsychology, and Cognition*, *21*(2), 174-196. doi:10.1080/13825585.2013.794894

Xu, J., Kemeny, S., Park, G., Frattali, C., & Braun, A. (2005). Language in context: emergent features of word, sentence, and narrative comprehension. *Neuroimage*, *25*(3), 1002-1015.

Ylvisaker, M. (2003). Context-sensitive cognitive rehabilitation after brain injury: Theory and practice. *Brain Impairment*, *4*(1), 1-16.

Youse, K. M., & Coelho, C. A. (2009). Treating underlying attention deficits as a means for improving conversational discourse in individuals with closed head injury: A preliminary study. *Neurorehabilitation*, *24*(4), 355-364.

Youse, K. M., & Coelho, C. A. (2005). Working memory and discourse production abilities following closed-head injury. *Brain Injury, 19*(12), 1001-1009.

Zwaan, R. A., Langston, M. C., & Graesser, A. C. (1995). The construction of situation models in narrative comprehension: An event-indexing model. *Psychological science, 6*(5), 292-297.

Table 1

Participant Demographic Information

| Participant | Age | Race | Gender | Years of Education | Months Post Onset | SCATBI |
|---|---|---|---|---|---|---|
| 1 | 27 | biracial | F | 14 | 75 | 111 |
| 2 | 33 | white | M | 12 | 84 | 83 |
| 4 | 36 | white | M | 12 | 264 | 88 |
| 5 | 31 | white | M | 14 | 11 | 112 |

Table 2

*CTMT Composite Scores for Participants Receiving APT-2 First: Participants 1 and 5*

| Participant | BL | F1 | F2 | F3 |
|---|---|---|---|---|
| 1 | 17 | 18 | 23 | 23 |
| 5 | 17 | 17 | 18 | 18 |

Note: Comprehensive Trail Making Test (CTMT): Mean Score=50, SD=10 with scores less than 35 considered borderline/impaired

[a]BL=Baseline, F1=1st Follow up (1 week post APT-2), F2=2nd Follow up (1 week post DPT), F3=3rd Follow up (1 month post whole treatment cycle)

Table 3

*CTMT Composite Scores for Participants Receiving DPT First: Participants 2 and 4*

| Participant | BL | F1 | F2 | F3 |
|---|---|---|---|---|
| 2 | 29 | 30 | 29 | 34 |
| 4 | n/a | n/a | n/a | n/a |

Note: Composite scores for Participant 4 were not obtained because he was unable to complete all trails. Comprehensive Trail Making Test (CTMT): Mean Score=50, SD=10 with scores less than 35 considered borderline/impaired

[a]BL=Baseline, F1=1st Follow up (1 week post DPT), F2=2nd Follow up (1 week post APT-2), F3=3rd Follow up (1 month post whole treatment cycle)

Table 4

*Raw completion times for CTMT Trails for Participants Receiving APT-2 First: Participant 1 and Participant 5*

| | | P1 | P5 |
|---|---|---|---|
| Trail 1 | BL | 121 s | 104 s |
| Trail 1 | F1 | 66 s | 131 s |
| Trail 1 | F2 | 80 s | 93 s |
| Trail 1 | F3 | 67 s | 69 s |
| Trail 2 | BL | 120 s | 120 s |
| Trail 2 | F1 | 88 s | 129 s |
| Trail 2 | F2 | 95 s | 106 s |
| Trail 2 | F3 | 62 s | 79 s |
| Trail 3 | BL | 121 s | 121 s |
| Trail 3 | F1 | 87 s | 142 s |
| Trail 3 | F2 | 72 s | 110 s |
| Trail 3 | F3 | 61 s | 71 s |
| Trail 4 | BL | 132 s | 105 s |
| Trail 4 | F1 | 63 s | 118 s |
| Trail 4 | F2 | 55 s | 85 s |
| Trail 4 | F3 | 67 s | 56 s |
| Trail 5 | BL | 180 s | 160 s |
| Trail 5 | F1 | 109 s | 135 s |
| Trail 5 | F2 | 115 s | 110 s |
| Trail 5 | F3 | 85 s | 83 s |

Note: Raw completion times are given in seconds

[a]BL=Baseline, F1=1st Follow up (1 week post APT-2), F2=2nd Follow up (1 week post DPT), F3=3rd Follow up (1 month post whole treatment cycle)

Table 5

*Raw completion times for CTMT Trails for Participants Receiving DPT First: Participant 2 and Participant 4*

| | | P2 | P4 |
|---|---|---|---|
| Trail 1 | BL | 50 s | 460 s |
| Trail 1 | F1 | 36 s | 378 s |
| Trail 1 | F2 | 45 s | N/A |
| Trail 1 | F3 | 38 s | N/A |
| Trail 2 | BL | 48 s | 378 s |
| Trail 2 | F1 | 46 s | 495 s |
| Trail 2 | F2 | 66 s | N/A |
| Trail 2 | F3 | 45 s | N/A |
| Trail 3 | BL | 60 s | N/A |
| Trail 3 | F1 | 53 s | 429 |
| Trail 3 | F2 | 68 s | N/A |
| Trail 3 | F3 | 51 s | N/A |
| Trail 4 | BL | 46 s | N/A |
| Trail 4 | F1 | 43 s | 210 s |
| Trail 4 | F2 | 66 s | N/A |
| Trail 4 | F3 | 40 s | 401 s |
| Trail 5 | BL | 328 s | N/A |
| Trail 5 | F1 | 189 s | N/A |
| Trail 5 | F2 | 67 s | N/A |
| Trail 5 | F3 | 78 s | N/A |

Note: Raw completion times are given in seconds. P4 did not complete all trails; the trails that he did not complete are marked with 'N/A'.

[a]BL=Baseline, F1=1st Follow up (1 week post DPT), F2=2nd Follow up (1 week post APT-2), F3=3rd Follow up (1 month post whole treatment cycle)

Table 6

*WMS-III Working Memory Index Scores for Participants Receiving APT-2 First: Participant 1 and Participant 5*

| Participant | BL | F1 | F2 | F3 |
|---|---|---|---|---|
| 1 | 79 | 79 | 69 | 81 |
| 5 | 91 | 91 | 118 | 124 |

Note: Wechsler Memory Scale-3rd (WMS-III): Mean Score=100, SD=10 with scores less than 80 considered borderline/impaired

[a]BL=Baseline, F1=1st Follow up (1 week post APT-2), F2=2nd Follow up (1 week post DPT), F3=3rd Follow up (1 month post whole treatment cycle)

Table 7

*WMS-III Working Memory Index Scores for Participants Receiving DPT First: Participant 2 and Participant 4*

| Participant | BL | F1 | F2 | F3 |
|---|---|---|---|---|
| 2 | 76 | 74 | 76 | 76 |
| 4 | 60 | 60 | 57 | 69 |

Note: Participants 2 and 4 received DPT in the first treatment condition and APT-2 in the second treatment condition. Wechsler Memory Scale-3rd (WMS-III): Mean Score=100, SD=10 with scores less than 80 considered borderline/impaired

[a]BL=Baseline, F1=1st Follow up (1 week post DPT), F2=2nd Follow up (1 week post APT-2), F3=3rd Follow up (1 month post whole treatment cycle)

Table 8

*Mean Percentage of Essential Thematic Units Produced (Standard deviations) for Participants Receiving APT-2 First: Participant 1 and Participant 5*

| | Stimuli | BL1 | F1 | d1 | BL2 | F2 | d2 | d3 | F3 | d4 |
|---|---|---|---|---|---|---|---|---|---|---|
| P1 | Treated | 63.31 (4.02) | 69.30 | n/a | 63.87 (3.79) | 98.42 | 9.10*** | 8.73*** | 99.00 | 8.87*** |
| P1 | Untreated | 68.92 (11.94) | 73.58 | n/a | 76.46 (1.25) | 77.35 | .71* | .85* | 73.58 | .42* |
| P1 | All | 63.00 (6.08) | 70.24 | 1.19* | 66.33 | 93.41 | n/a | n/a | 91.76 | n/a |
| P5 | Treated | 85.12 (6.99) | 80.32 | n/a | 85.45 (2.78) | 97.34 | 4.42** | n/a | 97.34 | 2.18 |
| P5 | Untreated | 80 (7.71) | 80 | n/a | 74.54 (5.15) | 83.64 | 1.76 | n/a | 81.81 | .23 |
| P5 | All | 84.06 (6.71) | 80.05 | -.6 | 82.37 (.42) | 94.24 | n/a | n/a | 93.83 | n/a |

Note: Standard deviations for baselines are provided in parentheses. d1 was calculated using all stimuli since all stimuli were untreated at this point in the treatment cycle. d2 and d3 were calculated for treated and untreated stimuli.

[a]BL1=First baseline, F1=1st Follow up (1 week post APT-2), d1=effect size for APT-2, BL2=second baseline, F2=2nd Follow up (1 week post DPT), d2=effect size for DPT, D3=effect size for APT-2 and DPT combined, F3=3rd Follow up (1 month post whole treatment cycle), d4=effect size for APT-2 and DPT combined at one month follow up. *=small treatment effect, **-medium treatment effect, ***=large treatment effect

Table 9

*Mean Percentage of Total (Essential and Detail) Thematic Units Produced (Standard deviations) for Participants Receiving APT-2 First: Participant 1 and Participant 5*

| | Stimuli | BL1 | F1 | d1 | BL2 | F2 | d2 | d3 | F3 | d4 |
|---|---|---|---|---|---|---|---|---|---|---|
| P1 | Treated | 41.79 (5.12) | 46.11 | n/a | 43.95 (3.79) | 89.24 | 11.95*** | 9.27*** | 85.71 | 8.57*** |
| P1 | Untreated | 46.29 (6.12) | 56.79 | n/a | 61.11 (4.36) | 61.73 | .14 | 2.52 | 58.02 | 1.92 |
| P1 | All | 43.52 (5.77) | 48.25 | .82* | 48.35 (2.05) | 93.41 | n/a | n/a | 91.76 | n/a |
| P5 | Treated | 59.08 (5.9) | 55.94 | n/a | 59 (1.04) | 79.74 | 19.94*** | n/a | 78.14 | 3.23* |
| P5 | Untreated | 57.47 (4.88) | 51.72 | n/a | 53.7 (2.81) | 62.02 | 2.98* | n/a | 58.62 | .24 |
| P5 | All | 58.22 (5.07) | 55.16 | -.6 | 57.92 (1.4) | 75.63 | n/a | n/a | 73.9 | n/a |

Note: Standard deviations for baselines are provided in parentheses. d1 was calculated using all stimuli since all stimuli were untreated at this point in the treatment cycle. d2 and d3 were calculated for treated and untreated stimuli.

[a]BL1=First baseline, F1=1st Follow up (1 week post APT-2), d1=effect size for APT-2, BL2=second baseline, F2=2nd Follow up (1 week post DPT), d2=effect size for DPT, D3=effect size for APT-2 and DPT combined, F3=3rd Follow up (1 month post whole treatment cycle), d4=effect size for APT-2 and DPT combined at one month follow up. *=small treatment effect, **-medium treatment effect, ***=large treatment effect

Table 10

*Mean Percentage of Essential Thematic Units Produced (Standard deviations) for Participants Receiving DPT First: Participants 2 and 4*

| | Stimuli | BL1 | F1 | d1 | BL2 | F2 | d2 | d3 | F3 | d4 |
|---|---|---|---|---|---|---|---|---|---|---|
| P2 | Treated | 50.22 (5.17) | 85.00 | 6.70*** | 88.10 (5.85) | 87.20 | -.15 | 7.15*** | 85.6 | 6.84*** |
| P2 | Untreated | 58.40 (2.94) | 56.20 | -.74 | 64.60 (2.95) | 66.70 | .71* | 2.82* | 59.10 | .24 |
| P4 | Treated | 48.12 (3.87) | 81.50 | 8.63*** | 75.96 (2.72) | 77.84 | .69* | 7.67*** | 72.16 | 6.21*** |
| P4 | Untreated | 38.77 (8.67) | 50.00 | 1.29* | 62.25 (4.33) | 72.91 | 2.46* | 3.94* | 72.91 | 3.94* |

Note: Standard deviations for baselines are provided in parentheses

[a]BL1=First baseline, F1=1st Follow up (1 week post DPT), d1=effect size for DPT, BL2=second baseline, F2=2nd Follow up (1 week post APT-2), d2=effect size for APT-2, D3=effect size for APT-2 and DPT combined, F3=3rd Follow up (1 month post whole treatment cycle), d4=effect size for APT-2 and DPT combined at one month follow up. *=small treatment effect, **-medium treatment effect, ***=large treatment effect

Table 11

*Mean Percentage of Total (Essential and Detail) Thematic Units Produced (Standard deviations) for Participants Receiving DPT First: Participant 2 and Participant 4*

| | Stimuli | BL1 | F1 | d1 | BL2 | F2 | d2 | d3 | F3 | d4 |
|---|---|---|---|---|---|---|---|---|---|---|
| P2 | Treated | 34.08 (4.37) | 64.00 | 6.78*** | 68.3 (8.25) | 69.10 | .10 | 7.83*** | 85.60 | 11.70*** |
| P2 | Untreated | 43.30 (.98) | 47.3 | 4.08** | 49.49 (4.65) | 52.1 | .5 | 8.97*** | 50.68 | 7.53*** |
| P4 | Treated | 30.83 (4.10) | 58.68 | 6.79*** | 55.19 (1.80) | 55.56 | .20 | 6.03*** | 49.52 | 4.55** |
| P4 | Untreated | 27.59 (6.49) | 40.23 | 1.94 | 46.55 (2.44) | 51.70 | 2.11* | 3.71** | 47.12 | 3.00* |

Note: Standard deviations for baselines are provided in parentheses

[a]BL1=First baseline, F1=1st Follow up (1 week post DPT), d1=effect size for DPT, BL2=second baseline, F2=2nd Follow up (1 week post APT-2), d2=effect size for APT-2, D3=effect size for APT-2 and DPT combined, F3=3rd Follow up (1 month post whole treatment cycle), d4=effect size for APT-2 and DPT combined at one month follow up. *=small treatment effect, **-medium treatment effect, ***=large treatment effect

Appendix A:

IRB Approval

**EAST CAROLINA UNIVERSITY**
**University & Medical Center Institutional Review Board**
4N-64 Brody Medical Sciences Building· Mail Stop 682
600 Moye Boulevard · Greenville, NC 27834
Office **252-744-2914** · Fax **252-744-2284** ·
**www.ecu.edu/ORIC/irb**

## Notification of Continuing Review Approval: Expedited

From: Biomedical IRB
To: Heather Wright
CC:
Date: 4/5/2018
Re: CR00006789
UMCIRB 14-000803
Discourse Treatment for individuals with Brain Injury

The continuing review of your expedited study was approved. Approval of the study and any consent form(s) is for the period of 4/5/2018 to 4/4/2019. This research study is eligible for review under expedited categories #5, #6, and #7. The Chairperson (or designee) deemed this study no more than minimal risk.

Changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. The investigator must submit a continuing review/closure application to the UMCIRB prior to the date of study expiration. The Investigator must adhere to all reporting requirements for this study.

Approved consent documents with the IRB approval date stamped on the document should be used to consent participants (consent documents with the IRB approval date stamp are found under the Documents tab in the study workspace).

The approval includes the following items:

| Document | Description |
|---|---|
| COmmunity Resources_Depr.doc(0.01) | Additional Items |
| Depression Scale Scripts.doc(0.01) | Additional Items |
| GDS(0.01) | Surveys and Questionnaires |
| med & educ info.doc(0.01) | Surveys and Questionnaires |
| Protocol(0.02) | Study Protocol or Grant Application |
| revised consent form.doc(0.02) | Consent Forms |
| WAB(0.01) | Standardized/Non-Standardized Instruments/Measures |
| WMS.pdf(0.01) | Standardized/Non-Standardized Instruments/Measures |

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

Appendix B

Generalization Probes for Participant 1 at Baseline

@G: homeschool
*SUB: I am for homeschooling.
*SUB: I was homeschooled.
*SUB: and the students I know
that were homeschooled with me when they eventually got put into the
public school system they actually achieved higher grades than those
who didn’t receive homeschooling.
*SUB: I believe you get <one> [//] more one on one time and you get
to move at your own pace in a private setting opposed to being
forced to be pushed ahead when you’re not ready for it in a public
school system.
*SUB: and the public school system isn’t paid enough to really care what
our kids learn and do know and don’t know.
*SUB: <yeah teachers are not paid enough to care> [* s:per].

@G: marijuana
*SUB: I am for the legalization of marijuana.
*SUB: it shouldn’t have been banned in the first place because it was
banned for personal and financial gain.
*SUB: it’s a plant that has no harsh side effect and has every possibility
in curing a lot of different diseases.
*SUB: I think we should be studying it not banning it.

@G: cookie theft
*SUB: one spring morning a mother goes into the kitchen opens the window
and starts to wash dishes.
*SUB: unbeknownst to her her son decides to steal cookies from the cookie
jar for his younger sister.
*SUB: and while she's washing dishes she hears a crash behind her turns
around and sees the cookie jar open and <cookie> [//] children eating
cookies.

Appendix C

Generalization Probes for Participant 1 at F1 (One week post APT-2)

@G: homeschool
*SUB: I am for homeschooling.
*SUB: I think &s children have more one on one time <with student> [//]
with teachers.
*SUB: and <the learning> [//] the curriculum is more guided in <in> [* f]
customized to that individual child.
*SUB: so it allows a better learning capability for each individual.
*SUB: in the public school systems <who>
[//] <they>
[//] kids tend to get lost and slip through their fingers of over
crowded classrooms and not enough teachers.
*SUB: and I just think <private school>
[* exc] you just get a lot more out of it.
*SUB: <its more one on one and individualized> [* s:per]

@G: marijuana
*SUB: I am for the legalization of marijuana.
*SUB: it has multiple functions for medicinal herb and medicine.
*SUB: and even using it &recre &recreationally there are no harsh side
effects to where <it would make> [//] it would cause some person to
purposely or accidentally harm or injure another person.
*SUB: like with alcohol you might not be purposely trying to kill somebody
but if you get &be behind the wheel of your car or your truck you're
probably going to kill somebody.
*SUB: with marijuana &i it doesn't have the same side effects as alcohol
and some of these other drugs.
*SUB: even prescription drugs like sleep
aids and <stuff>
[* ppw] if you fall &n you can fall asleep behind the wheel of a car
and kill somebody or <injury> [//] seriously injure somebody.
*SUB: and marijuana doesn't do that.
*SUB: and to be outlawed uh it's supposed to
have no medical purposes whatsoever.
*SUB: and marijuana has several medical purposes.
*SUB: so I think it should be legal.
*SUB: and it's legal in our nation's capital recreationally.
*SUB: but yet they
don't want to &re they don't want to legalize it for the rest of the
country?

@G: cookie theft
*SUB: one spring day a mother is washing dishes <in front of the>
[//] <in the kitchen>
[//] &win at the kitchen sink.
*SUB: behind her her son is sneaking into
the cookie jar.
*SUB: he's standing on the stool to reach the cookie jar he
grabs one cookie down and hands it to his sister.
*SUB: and he reaches back
up to grab himself a cookie.
*SUB: the stool turns.
*SUB: and he falls.
*SUB: his mother
hears a big crash and turns around and yells at the two children
sneaking cookies.
*SUB: and they run off.

Appendix D

Generalization Probes for Participant 1 at F2 (One week post DPT)

@G:	homeschool
*SUB: I am for homeschooling.
*SUB: I think that the with homeschooling the
student gets more individual and customized approach to learning.
*SUB: and the focus is on them and not thirty other students in the
classroom or twenty other students in the classroom.
*SUB: so it's very
personal.
*SUB: and you're not forced to &cons to conform to public school
standards and testing.
*SUB: so I feel like it's easier <for the> [/] for the student to learn
and easier for the teacher to teach.
*SUB: and I think it’s a &lo a lot better and a more effective learning
experience opposed to with the public school it's overcrowded.
*SUB: and you have to conform to certain structures and learning
abilities.
*SUB: and not every student learns the same way.
*SUB: so homeschooling is a lot more flexible.

@G:	marijuana
*SUB: I am for the legalization of marijuana.
*SUB: I think it was wrongfully
outlawed in the first place because it was outlawed for financial
gain of other companies.
*SUB: and I think it has several medicinal uses
and can combat several different diseases.
*SUB: and I think that there are a lot of legal drugs out there that cause
a lot more harm than good.
*SUB: so I think having a drug that doesn't
cause very much harm but can treat so many things is wrong to
outlaw.

@G:	cookie theft
*SUB: one spring day a woman is washing dishes in &fr at the sink with the
window open with the breeze blowing in.
*SUB: behind her back her son is
standing on a stool getting into the cookie jar.
*SUB: her son hands his
sister a cookie.
*SUB: and when he gets himself a cookie he steps a little
too far back on the stool causing the stool to topple over and him
to fall on the ground.

*SUB: the big bang startles the mother.
*SUB: she stops washing dishes and turns around to tend to her children
<taking her focus off the dishes and the running water> [* exc].
*SUB: <when she [/] she turns back around she realizes she has made a huge
mess because the water has overfilled the sink and is now flowing
onto the floor> [* exc].
*SUB: she's frustrated that her children have gotten into
the cookie jar.
*SUB: and now she has a big mess to clean up.

Appendix E

Generalization Probes for Participant 1 at F3 (One month post entire treatment cycle)

@G: homeschool
*SUB: I am for homeschooling because it gives the student more individualized approach to learning.
*SUB: they get to learn at their pace.
*SUB: and <they> [//] the teacher can focus in on that individual's needs and unlike with public school.
*SUB: the classrooms are overcrowded.
*SUB: there's not enough teachers per classroom.
*SUB: so the students don't get any individual approach to and customized approach to learning.
*SUB: and they're forced to learn at the speed of everyone else which I don't see that as being fair.

@G: marijuana
*SUB: I am for the legalization of marijuana because there are several benefits to &mari using marijuana medicinally  opposed to using artificial man made medicines that &m al lot of times have do more harm than good and have very drastic and harmful side effects.
*SUB: I believe that those man made artificial drugs are made to mask the symptoms of your illness and not actually treat the cause of it when marijuana can treat a lot of different source of the illness and be effective way of treatment.

@G: cookie theft
*SUB: one spring morning a mother is washing dishes in front of an open window unknowing [* ofw] her children are behind her getting into the cookie jar <in the> [//] in the top cabinet.
*SUB: her son has climbed up on a stool and reaching up to the cookie jar gets a cookie down for his sister.
*SUB: when he reaches up to grab his cookie he loses balance and falls over crashing to the floor.
*SUB: his mother turns around to see what's going on and [* ofw] tend to her children.
*SUB: <but while she's distracted she doesn't realize she's left the water running in the sink> [* exc].
*SUB: <and it starts to flood on floor> [* exc].
*SUB: now she's &m caused a big mess.
*SUB: and she's frustrated and wants to discipline her children

Appendix F

Generalization Probes for Participant 2 at baseline

@G: homeschool

*SUB: should be &al a allowed to happen because some people uh when they
go to school and things the way they feel the things they
think are totally different by the &fe facts
being around other people makes them too nervous to speak up
in class or anything.

@G: marijuana
*SUB: I am for because it helps people with uh diabetes and things
that they have.
*SUB: pot's legal in some places by prescription.
*EXA: anything else?
*SUB: <and should be illegal
because the sell of it is legal to make money and growing marijuana
is illegal> [* exc].
*SUB: <you should not do them things> [* exc].
*SUB: <you get in trouble and go
to jail and think about it for the rest of your life> [* exc].

@G: cookie theft
*SUB: there's a woman washing dishes.
*SUB: they have spilled the sink way too
high with water.
*SUB: it's dripping down the &ca counters and on the floor.
*SUB: there's a boy xxx on a stool reaching up in the cabinet trying to
get some cookies.
*SUB: and the chair's falling out underneath him.
*SUB: <he's
going to fall> [* s:per]
*SUB: there's a girl reaching her hand up waiting on him to
give her some cookies.
*SUB: but he can't do that because he's about to
fall on the ground.

Appendix G

Generalization Probes for Participant 2 at F1 (One week post DPT)

@G: homeschool
*SUB: I'm for home &st schooling because there are students that when they go to a class in front of a lot of people around them they don't concentrate as well as they would with a person at their home.
*EXA: anything else?
*SUB: just the
fact that everything they do they don't have to worry about what other people will think or what the teacher will think that doesn't know them that well.

@G: marijuana
*SUB: against it because its an illegal drug..
*SUB: and there will be too many
people getting into that.
*SUB: and even children could get addicted to
doing marijuana.
*SUB: and that would not be right.
*EXA: anything else?
*SUB: just the fact that that it's the wrong thing to do.
*SUB: it's bad for you.

@G: cookie theft
*SUB: there's a woman standing at a sink washing dishes way too much water is spilling out all onto the floor.
*SUB: there's a boy
standing up on a chair big desk chair trying to get some cookies from the cookie jar with a &wo girl standing beside him the chair.
*SUB: he's on slips very badly.
*SUB: he falls and hits the ground very hard.
*SUB: and
the the woman say probably say I told you not to lean up there on that chair.
*SUB: that is so dangerous.

Appendix H

Generalization Probes for Participant 2 at F2 (One week post APT-2)

@G: homeschool
*SUB: for it because I know there's students when they're in the classroom
they're nervous about being around other people in the classroom.
*SUB: so
they stress out when they take quizzes and tests

@G: marijuana
*SUB: against it because it what it impairs people from doing the <things>
[* ppw] they should <not have to>
[* f] do.
*SUB: it can mess with your memory.
*SUB: <things> [* ppw] <they> [* mr] need to do it can
interfere with that.

@G: cookie theft

*SUB: there's a woman standing at a sink washing some dishes.
*SUB: way too much
water in the sink.
*SUB: it's overflowing all onto the floor.
*SUB: a boy standing on a stool reaching up trying to get some cookies out
of the cookie jar with his sister standing beside her.
*SUB: he's reaching up too high and actually tipping the chair back.
*SUB: so eventually he will fall down and hurt himself for trying to get
the cookie out of the cookie jar.

Appendix I

Generalization Probes for Participant 2 at F3 (One month post entire treatment cycle)

@G: homeschool
*SUB: I'm for it because I know there's a lot of students that are in school that get confused and very upset about doing things around other people because they don't think they're smart enough to do the same things others are.
*SUB: so being homeschooled makes them feel more comfortable about doing the work and filling the things they fill out.

@G: marijuana
*SUB: I'm actually I am against it because it is a drug.
*SUB: and it can cause harm to most people who try to use marijuana.
*SUB: it can cause anger issues about everything.
*SUB: people have marijuana they can be so confused about what's going on.
*SUB: people could get hurt from doing the drug.

@G: cookie theft
*SUB: there's a woman washes some dishes that were xxx.
*SUB: and the water had filled up so high in the sink.
*SUB: it's dripping onto the floor with a girl standing there with her probably her brother standing on the step on the bench seat thing reaching up in the cookie jar to get a cookie.
*SUB: and actually the chair he's standing on is leaning back.
*SUB: so you know he's going to fall down from trying to get the cookie out of the cookie jar.

Appendix J

Generalization Probes for Participant 4 at baseline

@G: homeschool
*SUB: <I'm glad you asked me that> [* uf].
*SUB: i am for that.
*SUB: <and ill tell you why> [* uf].
*SUB: it is because some families
are forced to rely on bus transit.
*SUB: and I don't mean school.
*SUB: <but its either> [//] <I'm talking> [/] I'm talking
about city and state bus transits such as C_A_T.
*SUB: and they have trouble commuting from home to a preset location by
the school
*SUB: and students are typically <they have more> [//] they feel more
comfort in their home than they do in a school setting.

@G: marijuana
*SUB: yes because marijuana while for decades now has been considered an
upper in the illegal sense medical researchers have found out that
the same drug can be used for medicinal purposes that would by far
out due and overcome other attempts.
*SUB: and I've even heard of it bringing a great number of people further
down from such a destructive mind set as suicide because it was used
medicinally instead of for fun.
*SUB: and I can give you a prime example of that.
*SUB: sometimes at home when I get to feeling down I just like what the
hell is this all about or what do I do where do I go you know <just>
[/] just a confusion state or destructive state of mind.
*SUB: you know what I do to calm me down?
*SUB: drink a beer that'll calm me down.
*SUB: you know &s so many different things while they have their bad view
they have far more medicinal purposes as well.
*SUB: <I have a good example for that one too music> [* tu].
*SUB: <I mean I can name one for you that would bring me down <off of> [//]
off of a near destructive phase of mind Stevie_Ray_Vaughan
Eric_Clapton The_Doors Eagles Pink_Floyd Skynyrd> [* tu].
*SUB: <and it keeps on
Going> [* tu].
*SUB: <and you know what else I have found that I can do with a guitar
back home> [* tu]?
*SUB: <I got together with my brother> [* tu].
*SUB: <he bought over his guitar amp and such> [* tu].
*SUB: <and> [//] <and he and I just sat down> [* tu].
*SUB: and <he> [//] <he was like okay NAME I understand you've been

practicing this in CITY> [* tu].
*SUB: <and I said yes> [* tu].
*SUB: <so he just hands me the guitar turns on the amp> [* tu].
*SUB: <and he’s <like> [* fil] xxx with some Stairway I just> [* tu] +...
*SUB: <it’s not that difficult at all> [* tu].

@G: Cookie Theft
*SUB: i see the mother over here standing by the window in the kitchen washing some dishes.
*SUB: and the problem is she left the water running.
*SUB: and its overflowing while her son is <putting some cleaning dishes up> [//] no not cleaning dishes getting some cookies standing on a stool.
*SUB: and its getting ready to falter beneath him.
*SUB: and hes not just getting some hes getting some to his sister as well.

Appendix K

Generalization Probes for Participant 4 at F1 (One week post DPT)

@G: homeschool
*SUB: I am because from personal experience once again a majority of students are more have a more set and sound state of mind at home.
*SUB: and they have no no others to raise disputes with yet they still learn.

@G: marijuana
*SUB: I am because as I understand it can be used for medicinal purposes.
*SUB: and that also would boot up and rather increase the watch from the police F_B_I et cetera so it could only be used for the right purposes.
*SUB: and it would only be given or allowed rather in certain in certain quantities certain quantities so no one could truly overdo it.
*SUB: they may believe they could misuse it to their pleasure.
*SUB: but no because by law they would only be given or allowed a certain amount.
*SUB: this goes back to the legalization of alcohol.
*SUB: it's it's a needed substance in some regions and cannot be there's nothing that could take its place successfully in the medicinal world.

@G: cookie theft
*SUB: we have a a son here attempting to stand on a stool to reach up in the cabinet to get some goodies while over here the mother is washing dishes and her attention goes elsewhere momentarily so the dishwater is draining onto the floor while it is a very nice day out

Appendix L

Generalization Probes for Participant 4 at F2 (One week Post APT-2)

@G: homeschool
*SUB: I am for because naturally not only do some children work better in a familiar territory such as home.
*SUB: <but some families cannot afford to get the child to school and back again in a day> [* exc].

@G: marijuana
*SUB: I am to a degree.
*SUB: but I'd like to understand why because you see though there is the potential for potheads to sell joints and reefer there could also be the the illegalization of that.
*SUB: and not to mention marijuana is not only does not only have that potential marijuana can also be used for medicinal &pus purposes.

@G: cookie theft
*SUB: well there were some dirty dishes from <a meal> [//] I mean a feast they had earlier and mom is washing up some dishes.
*SUB: and <her boy is> [//] I mean her daughter is drying them off handing them to her boy standing on a stool to put them up.
*SUB: and it's a nice day out.
*SUB: so the window's open.
*SUB: and no wait a minute the girl's not drying them.
*SUB: the girl is <giving them> [/] giving them to the boy to put up.
*SUB: it appears that mom is washing and drying the dishes.
*SUB: and she seems to be so set on getting them clean that the water's spilling over on the floor.
*SUB: but at least something is going to get clean.

## Appendix M

Generalization Probes for Participant 4 at F3 (One month post entire treatment cycle)

@G: homeschool

*SUB: <I am for because not every family unfortunately
enough contains the ability nor the how would you say the finances
to afford their xxx for the child or children xxx to and from school
as well as lunch money> [* exc].
*SUB: and if they were to have home based schooling
the individuals would far more understand their environment because
it would be their own home.
*SUB: and they would know literally where
everything is.
*SUB: not to mention whenever in a crisis or a difficult
time at home they may set a visual stimula to help them to remember
something regarding another region.
*SUB: and this could very well aid
trillions in recollection as well as how say this whatever

@G: marijuana

*SUB: yes I am for the legalization of marijuana not because of the
benefits it would have for the for youthful individuals that have or
that gain a an addiction.
*SUB: no I am for it because of its medical
<advantage>
[/] advantages <because they have been>
[//] because <they> [//] <several>
[//] I mean across the country they have been doing &s separate and
similar studies that have shown it does have some medicinal purpose
to it.

@G: cookie theft

*SUB: it seems that a that a woman is handwashing some dishes in the
kitchen one day.
*SUB: and she [/] she had the plug in to keep the water in the
sink.
*SUB: however she allowed the water to continue flowing.
*SUB: and the water
<flowed> [//] <over>
[//] overflowed I mean while behind her her son and daughter are
trying to get some cookies out of the cookie jar.
*SUB: her son is standing
on his stool while her daughter is on the floor reaching up to help
the son out

# Appendix N

## Generalization Probes for Participant 5 at Baseline

@G: cookie theft
*SUB: <looks like a kid has stuck cookies in the sink and stopped it up> [* exc].
*SUB: while the mom was not paying attention and obviously drying a dish that I need to be dried anymore.
*SUB: <im not quite sure why hes teeter tottering on that chair> [* uf].
*SUB: <it I make sense cause hes perfectly reaching for the cookie without falling> [* uf].
*SUB: its almost like hes reaching for the cookies and intentionally teeter tottering in the chair.
*SUB: and the little girl is just helpless <I guess> [* fil].

@G: Marijuana
*SUB: I lived in 119olorado where it is legal.
*SUB: um I guess I would be for because <it its> [/] um it its an herb.
*SUB: or <um I guess> [* fil] it could be considered a medicine because it has a lot of medical properties um.
*SUB: and if it didn’t uh pharmaceutical companies wouldn’t be trying to synthesize it into a pill.
*SUB: um <what am I supposed to say> [* uf].

@G: homeschool
*SUB: <I guess> [* fil] im like fifty-fifty.
*SUB: I think homeschooling is good but I [/] I only because you can focus on your kid and teach your kid the way they need to be taught because obviously you would know your kid better than someone else would.
*SUB: but at the same time I would be against it because your kid going to school gets social interaction with other kids.
*SUB: and they know how to um be affective in society <I guess> [* fil].

Appendix O

Generalization Probes for Participant 5 at F1 (one week post APT-2)

@G: marijuana
*SUB: uh um I would be &f for it um &m because it has a lot of &m benefits.
*SUB: and its natural.
*SUB: um and pills aren't natural.
*SUB: <and> [* fil] they have a long
list of side effects.
*SUB: one pill does fifteen different things.
*SUB: you have to take &a another pill to counteract what that
pill's doing.
*SUB: <um and> [* fil] marijuana is a plant.
*SUB: and it has no known deaths um so yeah.

@G: homeschool
*SUB: uh um torn between yes and no with that um because I would say no
that a child being homeschooled isn't going to be exposed to uh
bigger environment of communicating with people.
*SUB: um I mean I'm sure there's other things that the kids going to
miss out on.
*SUB: but I would be for it also because who else knows how to teach
their child better than the parent?

@G: cookie theft
*SUB: um this mom is +...
*SUB: <um oh wow the curtains got painted green like the
grass> [* uf].
*SUB: so this lady's washing dishes and obviously does not have a
care in the world because the sink is overflowing with water.
*SUB: and her
kids are in the &cook in the cabinet getting cookies.
*SUB: <and> [* fil] she doesn't
really care.
*SUB: whatever she's thinking about must be <really important> [/]
really important.

Appendix P:

Generalization Probes for Participant 5 at F2 (One Week Post DPT)

@G: cookie theft

*SUB: <this woman must have been having a bad day because she took way too many of her mind altering drugs> [* exc] because she's <cleaning a dish or> [//] drying a dish that's completely dry.

*SUB: and her sink is overflowing with water while <her kids are standing on a &s> [//] one of her kids is standing on a stool &i in the cabinet <raiding the cabinet> [//] raiding the cookie jar while she's standing right there.

@G: marijuana

*SUB: <I guess> [* fil] my &ch my stance has changed on this a little bit recently because my severe sleep apnea.

*SUB: um they want me to stop taking &m my medicine that has opiates in it because it depresses my lungs and and makes them shut off more.

*SUB: um but I have a rare neurological disease that causes chronic pain.

*SUB: <and Tylenol doesn't work> [//] um not even Tylenol and Ibuprofen <which is what I did for a long time because I had to go to work anyways without insurance because I had kids to take care of> [* tu].

*SUB: <um but> [* fil] since they're telling me this I actually +...

*SUB: my wife is the one that suggested that I start trying like a C_B_D oil.

*SUB: that is just the medicinal side of the plant to help with the pain because it has proven studies to help with blocking pain and whole bunch of other stuff too much for me to name.

*SUB: <um so I guess> [* fil] I would be for it because right now a few of my doctors that we've talked to about it they don't even want to talk to us about it because its still illegal in this state even though its legal in thirty other states.

*SUB: um but the federal law made C_B_D oil legal all over the U_S so I can buy that anywhere.

*SUB: <I just> [//] I'm not going to get the medicinal side information that I need from the doctor.

*SUB: its going to be more of whatever research I do and figure out what's best until they legalize it which it is supposed to be legal after this year in North_Carolina pretty happy about that.

@G: homeschool

*SUB: <um I guess uh> [* fil] I would be split on it because having your kid homeschooled you're able to pay attention more directly to your child.
*SUB: and while they're in school they don't get that attention like they would at home.
*SUB: <and> [* fil] you would be more lenient with how your child learns.
*SUB: um at school they're not like that at all either.
*SUB: but
then again not being in school the child doesn't get the the chance to build their character like they would xxx.
*SUB: if they're at home they
wouldn't get to do it like being at school like being around other children.
*SUB: <um and> [* fil] I [/] I think that's the only differences at least that I can think of that are important to me.
*SUB: there might be more but +..

@End

Appendix Q

Generalization Probes for Participant 5 at F3 (One Month Post Entire Treatment Cycle)

@G: homeschool
*SUB: like fifty fifty.
*SUB: um homeschooling you can individually teach your
kid because you know what's best for your kid how they should learn
how they're going to learn.
*SUB: and but they're missing out on important
stuff you can only get while you're at school like building your
character and being around other children and how to interact with
them.

@G: marijuana
*SUB: well I've actually been doing more research lately that I can
actually think better.
*SUB: um and I just come across this study that um
cannabis helps people with T_B_Is.
*SUB: and they did a mass study in in
Europe +/.
*SUB: uh and it just finished.
*SUB: +, &o of that exact study of cannabis
helping T_B_I patients.
*SUB: and um its supposed to promote new brain
grown.
*SUB: um and I can't remember what else.
*SUB: but its supposed to help a
whole lot um <unlike somebody that isn't doing anything>
[* exc] so I guess for.

@G: Cookie Theft
*SUB: <this lady's next door neighbor called her and told her that>
[//] <or she had bad news or>
[//] <she was really upset or something>
[* exc].
*SUB: <and her next door neighbor said well I've got a happy pill
that can help that>
[* exc].
*SUB: <so she brings it over> [* exc].
*SUB: <and the lady takes it> [* exc].
*SUB: and she's
washing the same dish for about twenty minutes now while the sink's
still on overflowing.
*SUB: the kids are in the background getting cookies
out of the cookie jar.