STORY COMPREHENSION BY ADULTS WITH RIGHT HEMISPHERE BRAIN DAMAGE

by

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Submitted to the Faculty of

University of Pittsburgh in partial fulfillment

of the requirements for the degree of

Bachelor of Philosophy

University of Pittsburgh

2009

UNIVERSITY OF PITTSBURGH

SCHOOL OF HEALTH AND REHABILITATION SCIENCES

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STORY COMPREHENSION BY ADULTS WITH RIGHT HEMISPHERE BRAIN DAMAGE

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University of Pittsburgh, 2009

Background: Right hemisphere brain damage (RHD) manifests itself in many ways. The repercussions affecting language function are distinct; studies in discourse comprehension in RHD groups suggest that this population struggles with the mental structures necessary for processing, leading to difficulty when a task requires that participants modify their established mental models or alter first interpretations. The current investigation was based on an experiment in Rapp et al.'s (2001) study that suggests that trait-based models of discourse processing affect online reading. Participants' response times slowed when the final sentences of the story stimuli were inconsistent with character traits instantiated in the beginning of the stories.

Aims: The current study examined the nature of discourse comprehension difficulties in adults with right hemisphere brain damage, specifically observing how participants with RHD performed in accuracy and response times when presented stories with inconsistencies in character trait portrayal.

Methods and Procedures: Participants included eight adults with RHD and five with no brain damage (NBD). Participants listened to 20 stimuli featuring either a neutral or trait-instantiating first portion (describing a specific trait of a character), followed by a trait-consistent or trait-inconsistent final sentence. Asked to make a rapid judgment concerning whether the final sentence of each story fit with the personality of the character featured in that story, the subjects chose “yes” or “no” on a manual response box. Ancillary tasks were used to assist in classifying the clinical characteristics of participants and to provide potential alternative interpretations of participants’ performances.

Outcomes and Results: The results of this study suggest that when character traits are strongly negative and/or strongly implied, adults with RHD appear to incorporate these character biases in their narrative processing, though these biases do not improve their judgments of trait-inconsistent information. As predicted, there were no group differences in trait-instantiating stories with the trait-consistent endings, but the participants with RHD were less accurate in the trait-inconsistent condition than the group with NBD. Supporting the study’s main hypothesis, results indicate that adults with RHD are as able as control participants to accurately judge trait-consistent information, but are at a disadvantage when dealing with incongruity.

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PREFACE

This thesis would not have been possible without the expertise and support of several people. Dr. Tompkins possesses all of the qualities of an ideal mentor; she has guided me through this two year process with patience, compassion, selflessness, and an encyclopedia-caliber knowledge base. I am honored to have had the opportunity to work one-on-one with such a brilliant professor. Kimberly's mellifluous voice, E-prime skills, and macro-writing mastery made the stimuli's creation and presentation, as well as the data analysis, accomplishable. My family and friends' encouragement and love were unfailing.

Generous funding from the School of Health and Rehabilitation Science's Research Fund allayed the costs involved in conducting this study, enabling me to access subjects by car who could not come to the lab for testing. Lastly, but most importantly, I am extremely grateful to the subjects, some of whom went to great lengths to participate in this study.

1.0 INTRODUCTION

The correlation between brain anatomy and language processing has fascinated and perplexed scientists for years, inspiring researchers to pursue a better understanding of this astounding organ and its effect on our ability to communicate. Many regions and functions of the brain are still only explainable at the vaguest of levels. Though the left hemisphere continues to be described as containing the primary language regions of the brain for most individuals, the right hemisphere has more recently been acknowledged as playing a critical albeit less definable role in communication as well.

In the 1970s, researchers began to explore how the two hemispheres collaborate and integrate information for comprehensive language comprehension (Brownell, 2004). The left hemisphere addresses the concepts of phonology, morphology, and syntax; the right hemisphere reportedly involves the more abstract domains of pragmatics, metaphor comprehension, prosody, and discourse in forms such as narratives (Brownell, 2004). Supplementing the information that the left hemisphere processes, the right hemisphere reportedly forms looser interpretations and builds upon the established input of language and communication (Tompkins & Fassbinder, 2004).

1.1 RIGHT HEMISPHERE BRAIN DAMAGE AND ITS EFFECTS ON LANGUAGE

The language consequences of right hemisphere brain damage (RHD) manifest in a variety of ways, both expressively and receptively, that are more elusive than those associated with damage to the left hemisphere. When a person suffers from a stroke, also known as a cerebrovascular accident, in the right cerebral hemisphere, the repercussions affecting language function are distinct (Tompkins, 1995). Specifically, evidence of pragmatic effects can be seen in the person's social skills (Tompkins et al., 1998). As senders in communication, individuals with RHD may struggle in supplying information appropriate to the present situation (Tompkins, 1995). They often make incorrect assumptions concerning the knowledge base of the listener, or they tell stories that are inappropriate, though the nature of the disordered processing varies from being too wordy, too concise, too detailed, or too vague (Tompkins, 1995).

In the role of receiver, RHD adults often find it difficult to decipher emotions and comprehend subtle implications, including ambiguous information and language that is open to multiple interpretations, such as humor or irony (Tompkins & Fassbinder, 2004). Adults with RHD may not extract the essence of a story from a lengthy narrative (Brownell, 2004). Studies in discourse comprehension in RHD groups also suggest that patients with RHD may struggle with building or revising the mental structures necessary for processing, leading to difficulty when a task requires that they modify their established mental models or alter first interpretations. They are often unable to suppress mental activity that is incompatible with what has already been established (Tompkins & Fassbinder, 2004).

1.2 FACTORS AFFECTING DISCOURSE COMPREHENSION

In 1995, Zwaan, Langston, & Graesser published an article proposing an event-indexing model in an attempt to explain narrative discourse comprehension. This model suggests that events are the main focus of a story. Each event features five dimensions that are instantiated in the reader's memory: protagonist, time, space, causality, and intentionality. The study indicates that reading time increased as the number of discontinuities, covering the five event indices, increased. When there is a discontinuity in any of the five dimensions, the index requires updating. Stories that lacked consistency and logic due to discontinuities produced longer reading times for participants, while stories with coherence posed less difficulty in comprehension.

As proposed by the Event-Indexing Model, character plays a key role in narrative discourse; however, there is only minimal research exploring how the RHD population performs when integrating contextual clues concerning characters. Blake (2008) conducted a preliminary study of discourse-level difficulties and personal preferences involving characters for a group of adults with RHD, observing whether and how participants were biased by the portrayal of a character. Blake hypothesized that the RHD group's struggle would stem from errors in compiling and deciphering the presented contextual clues and an inability to develop suitable interpretations. Her hypothesis was informed by Rapp and Gerrig (2006), who conducted similar studies in a young adult population with no brain damage, and hypothesized "that the [readers'] preferences will have an impact on the ways in which readers encode the likely outcomes of narratives" (56).

Blake found that personal preferences had a significant effect on the expectation outcomes of the control group, consisting of individuals with no brain damage (NBD). This was especially evident for negative character biases, where participants did not want unsympathetic characters to experience positive outcomes. The RHD group was slower in judging the possibility of outcomes when contradictions concerning character biases were present versus when they were not; thus, these participants were sensitive to the character biases. However, they rated the various endings of the stories, both positive and negative, as equally likely to occur. Generalizing the results, Blake hypothesized that when making off-line judgments, individuals with RHD may struggle to incorporate character biases. She also suggested that adults with RHD may experience difficulty in answering the task question, “How likely is the outcome of the story?” Prone to concrete interpretations, the individuals with RHD may struggle to judge the likelihood of an outcome if this outcome, whether probable or not, has already occurred in the story they are presented.

Additionally, in a grant application, Tompkins (2008) proposes to explore the critical issue of incongruity resolution deficits in the RHD population. Incongruity resolution, or IR, involves the creation of an appropriate, revised model when a conflict of information occurs in a mental representation during language processing (Tompkins, 2008). When a narrative has a prominent, clear, and singular interpretation, RHD adults perform well in comprehension. However, difficulties in discourse comprehension arise when a narrative requires revisions of previously established ideas. For example, when a protagonist’s goal changes in a narrative, the comprehender must suppress activation concerning the previous goal and revise it to adjust to the new information, even when the original goal is abruptly changed without being achieved (Linderholm et al., 2004).

It is Tompkins’ (2008) prediction that adults with RHD will be challenged by inhibiting information that was activated prior to a change in a character’s goal. The group with NBD is anticipated to successfully use IR to suppress activation of the prior goal with the introduction of the new, conflicting goal. If this prediction is accurate, the NBD subjects will respond with a delay to a probe of the original goal once the new goal has been presented and instantiated. On the basis of preliminary evidence considering the site of the lesion within the right hemisphere, Tompkins hypothesizes that individuals with lesions in right inferior frontal cortex and/or connected subcortical regions will not suppress activation of the original goal information when the new goal is presented. This would result in no reaction time differences to the probes of original and new goals (Tompkins), contrary to findings for NBD adults (Linderholm et al., 2004).

1.3 TRAIT-BASED MODELS OF COMPREHENSION: RAPP ET AL. (2001)

In a study by Rapp and colleagues (2001), Experiment 3 focused on evaluating how information about character traits, such as rudeness, affected real time reading of narratives with trait-consistent and trait-inconsistent sentences. It was predicted that readers would instantiate the information presented in the stories to a level that would cause a confound when the story began to lose coherence, specifically when events did not match trait-based expectations. Incorporating the research of O'Brien et al. (2001) concerning memory-based approaches to processing stories along with their own findings, Rapp et al. suggested that both involuntary and intentional cognitive processes would be utilized in such circumstances. They argued that the application of their "trait-based model" of reading comprehension was purposeful; while memory-based resonance (O'Brien et al., 2001) offers the continuity to follow a coherent story, the identification of trait-based inconsistencies requires effort on the part of the receiver.

Rapp et al.'s (2001) data showed that participants averaged 705 ms slower in reading trait-inconsistent sentences than trait-consistent sentences, indicating a pronounced effect on reading times of the presented trait information. However, trait information had little effect once readers adjusted their narrative models. Even when there were unforeseen outcomes, participants were able to recover easily. The researchers asserted that the trait inference allows readers to reconcile differences with ease. Adjusting to unexpected outcomes and revising mental models, the undergraduates involved in this study were able to resolve problems that arose when there were alterations to the consistency of the narrative that upended their established expectations.

1.4 SPECIFIC AIMS

The current study was motivated by the lack of evidence about how narrative comprehension in adults with RHD is influenced by character information. Because character information is a central aspect of narratives, it is important to learn more about how brain damage affects its processing. The Rapp et al. (2001) study supplies intriguing evidence about the ways in which information about a character's traits can speed or slow discourse comprehension in adults without brain damage.

The current investigation was based on Rapp et al.'s (2001) study and applied the themes explored in their article with a RHD population. This study assessed the hypothesis that, in an explicit judgment task about stories that induce a personality trait about a main character (e.g., rudeness), adults with RHD would be poorer at comprehending information about the character when the story ended with a trait-inconsistent sentence, than when the story ended with a trait-consistent sentence. This difference was not expected for control stories, which did not contain trait information. Inherent in these hypotheses is the prediction that participants with RHD would be sensitive to trait information (Blake, 2008). Similar effects were hypothesized for a control group of adults without brain damage.

Additionally, in line with findings that adults with RHD perform well when processing internally-consistent stimuli (e.g., Brownell et al., 1986; Tompkins & Mateer, 1985), the group with RHD in this study was expected to perform similarly to the control group on stories that were coherent throughout, i.e., that included a trait-consistent final sentence. By contrast, participants with RHD were expected to perform more poorly than the control group when confronted with trait-inconsistent information (Tompkins & Fassbinder, 2004).

The task in the current study was for participants to make a speeded judgment after each story, answering whether the final action of the featured character fit his or her personality. It is well known that adults with RHD demonstrate deficits on explicit tasks while performing relatively normally on implicit tasks (e.g., Tompkins, 1990; Tompkins, Boada, & McGarry, 1992). The explicit judgment task in this study was chosen primarily to align this study's results with Blake's (2008) preliminary findings about RHD adults' potential difficulty incorporating character bias in offline judgments.

It remains for future studies to evaluate the more involuntary processing of character biasing information by adults with RHD. Rapp et al. (2001) used a reading time task to assess real time comprehension. However, adults with RHD can have a variety of visuospatial, visuoperceptual, and/or visual-attentional deficits that could invalidate results from a reading time task (Tompkins, 1995). Thus, for studies in which implicit measures of trait processing are desired, a different test format would be necessary. This issue is considered further in the Discussion section.

2.0 METHODS

2.1 PARTICIPANTS

Recruited from the Tompkins Language Laboratory Research Registry, thirteen individuals residing in Allegheny County participated in this study. To be included in the registry, all participants are between 40 and 85 years of age, have a minimum of eight years of education, and pass hearing and vision screens. According to self-report, all participants in this study met the prerequisites of being right-handed and learning only English in childhood. Once potential subjects from the registry had been contacted, they participated in a verbal screening by telephone in which they reported whether, since they entered the registry, they had any drug or alcohol problems, psychoses such as manic depression or schizophrenia, cognitively degenerative diseases, seizure disorders, or head injuries for which they were hospitalized. If a participant responded “yes” to any of the inquiries, he or she was excluded from the study.

Eight subjects with right hemisphere damage participated in the RHD group. Each of these participants had a lesion confined to the right cerebral hemisphere caused by a cerebrovascular accident. Lesion location was confirmed by CT or MRI scan reports. Subjects had no bilateral, brainstem, or cerebellar lesions. A control group consisted of five adults with no brain damage (NBD). To meet the NBD criteria, subjects were required never to have experienced a stroke or other neurological disorder that could affect their cognition. Table 1 presents demographic information, and Table 2 provides clinical data for the two participant groups. Members of the NBD group completed the Mini Mental Status Examination (Folstein, Folstein, & McHugh, 1975) as a cognitive screen, and also performed a delayed story recall task (Bayles & Tomoeda, 1993) to identify and exclude individuals with latent dementia.

Table 1. Demographic characteristics for subject groups.

Characteristics	**RHD** (N=8)	**NBD** (N=5)
Age (years)		
Mean (S.D.)	65.3 (12.4)	65.8 (8.3)
Range	47-81	55-78
Gender		
Male	6	3
Female	2	2
Education (years)		
Mean (S.D.)	12.6 (1.3)	12.8 (0.8)
Range	10.-14	12.-14
Months Post-Onset		Not Applicable
Mean (S.D.)	113.75 (66)	
Range	44-208	
Lesion Type		Not Applicable
Thromboembolic	3	
Hemorrhagic	5	
Lesion Site		Not Applicable
Right Cortical Posterior	3	
Right Cortical Anterior	1	
Right Subcortical Mixed	2	
Right Subcortical Basal Ganglia	2	

RHD = Right Hemisphere Damage; NBD = No Brain Damage
anterior = anterior to Rolandic fissure; posterior = posterior to Rolandic fissure

Table 2. Clinical characteristics for subject groups.

Characteristics	RHD (N=8)	NBD (N=5)
**Mini Inventory of Right Brain Injury[1]		
Mean (S.D.)	34.1 (5.1)	41.4 (2.1)
Range	26-41	38-43
*Peabody Picture Vocabulary Test[2]		
Mean (S.D.)	184.6 (10.0)	194.2 (3.8)
Range	162-197	188-197
**Behavioural Inattention Test[3]		
Mean (S.D.)	135.9 (17.9)	146.0 (0.0)
Range	92-145	146-146
Auditory Working Memory[4]		
Word Recall Accuracy		
Mean (S.D.)	30.3 (7.5)	36.0 (5.1)
Range	21-39	29-40
True/false Accuracy		
Mean (S.D.)	41.9 (0.4)	41.8 (0.4)
Range	41-42	41-42
*Judgment of Line Orientation[5]		
Mean (S.D.)	19.3 (5.2)	24.6 (3.3)
Range	10.-24	21-30
*Discourse Comprehension Test[6]		
Implied Questions		
Mean (S.D.)	15.6 (1.8)	18.2 (1.1)
Range	14-18	17-19
Stated Questions		
Mean (S.D.)	18.3 (1.3)	18.2 (1.5)
Range	15.-20	16-20
Visual Form Discrimination Test[7]		
Mean (S.D.)	13.8 (2.1)	15.0 (1.0)
Range	12.-16	14-16
Arizona Battery for Communication Disorders of Dementia[8]		
Immediate Story Recall	Not Administered	
Mean (S.D.)		14.2 (1.5)
Range		12.-16
Delayed Story Recall	Not Administered	
Mean (S.D.)		14.4 (1.1)
Range		13-16

RHD = Right Hemisphere Damage; NBD = No Brain Damage

[1] Pimental & Kingsbury (1989).
[2] Dunn & Dunn (1997) (maximum accuracy = 204).
[3] Wilson, Cockburn, & Halligan (1987) (maximum accuracy = 146; neglect cutoff = 129)
[4] Tompkins et al. (1994) (maximum accuracy = 42).
[5] Benton, Hamsher, Varney & Spreen (1983a) (maximum accuracy = 30)
[6] Brookshire & Nicholas (1993) (maximum accuracy per subset= 20)
[7] Benton, Hamsher, Varney & Spreen (1983b) (maximum accuracy = 16)
[8] Bayles & Tomoeda (1993) (maximum accuracy = 17)
* Significant difference by Mann-Whitney U Test, p<0.05
** Significant difference by Mann-Whitney U Test, p<0.01

During the initial testing session with each subject, a hearing screening was conducted to ensure that participants could complete the auditory experimental tasks. Participants were tested in the right, then left, ears with a warble tone at 500, 1000, 2000, and 4000 Hz. To pass the screening, they needed to be able to identify the 35 dB HL tone at 500, 1000 and 2000 Hz. If a participant failed the hearing screening in one ear, he or she was required to repeat 12 fricative-laden words spoken by the tester with a concealed mouth to prevent the participant from lip-reading. To remain eligible, a minimum of 11 out of the 12 words had to be properly repeated by these participants.

2.2 STIMULI DEVELOPMENT

2.2.1 Basis of Stimuli

Dr. David Rapp graciously provided the original 24 stimuli from his 2001 study. These stories are two paragraphs in length, with approximately five or six sentences per paragraph. (See Appendix A for an example of each story, in several versions). At the end of the first paragraph of each story, a trait sentence or neutral control sentence is introduced. The trait sentence implies a positive or negative trait, such as courteousness or rudeness, for the story's central character, while the control sentence does not imply a trait. At the end of the second paragraph of each narrative, two trait-consistent or trait-inconsistent sentences occur. In Rapp et al.'s (2001) study, these stories were presented to undergraduate students, whose online reading times were measured.

2.2.2 Stimuli Modifications

Out of the original 24 stories, five of Rapp et al.'s (2001) stories were selected to be adapted into the present experiment's stimuli sets. These five stories were chosen based on the strength and explicitness of the traits they portrayed, as judged independently by the author and her thesis adviser. For the stories with positive traits, it proved difficult to identify the specific attribute being portrayed. Thus, all stories used in this study implied negative traits.

Table 3 provides one of Rapp et al.'s (2001) stories, with its four final sentence versions. Table 4 features Rapp et al.'s story as modified for the current study. Most importantly, the two critical sentences in each modified story (trait-inducing sentence versus control sentence; additional trait-consistent sentence versus trait-inconsistent sentence) were edited to control extraneous factors that could affect processing time. It was critical that these sentences be as similar as possible to prevent non-manipulated variables from altering the participants' processing times. First, the length of the sentences in syllables was determined and adjustments were made so that the paired trait and control sentences, and trait-inconsistent and trait-consistent sentences, had equivalent syllable counts. To prevent differences in syntax from presenting additional reading time confounds, these critical sentences were revised to achieve roughly parallel sentence structure.

Table 3. Rapp et al.'s original story conveying "rudeness"

Paragraph 1	Nancy was a receptionist at a very prestigious law firm. She was always very busy, handling paperwork and answering phones. Today she was especially looking forward to lunch. She was going to get a pastrami sandwich from her favorite deli.
Trait Sentence	**During lunch the line was very long, so Nancy cut in front of another customer.**
Control Sentence	**One time the law firm bought everyone lunch from the deli after a big settlement.**
Paragraph 2	When she returned from lunch Nancy had a message from her boyfriend. He wanted to go out for Chinese food that night. Nancy and her boyfriend went to a new Chinese restaurant where the food was very good. Nancy offered to pay for dinner and they left the restaurant. A block away from the restaurant Nancy realized she forgot to leave a tip for the waiter.
Trait- Consistent	**Nancy didn't end up going back to pay the waiter. She just wanted to enjoy the rest of her night out.**
Trait- Inconsistent	**Nancy went back and apologized to the waiter for forgetting. Then she gave some money to the waiter and thanked him.**

Table 4. Current study's revised story conveying "rudeness"

Paragraph 1	Nancy was a receptionist at a prestigious law firm. She was always very busy, handling paperwork and answering phones. Today she was especially looking forward to lunch. She was going to get a pastrami sandwich from her favorite deli.
Trait Sentence	**During her break, Nancy didn't want to wait in line and instead cut in front of some customers.**
Control Sentence	**During her break, Nancy didn't want to eat indoors and instead sat in front of the firm's entrance.**
Paragraph 2	Nancy and her boyfriend went to a restaurant that night, and Nancy offered to pay. After dinner, Nancy realized she forgot to leave a tip.
Trait-Consistent	**Nancy counted up her money and walked to the exit.**
Trait-Inconsistent	**Nancy smiled at the waiter and left a generous tip.**

The five selected stories also were modified based on criteria specific to the populations involved in the study. Because participants with RHD often struggle with more abstract concepts, and may have deficits in processing ‘theory of mind’ information (Brownell, 2004; Tompkins & Fassbinder, 2004), mental verbs such as “feel” or “think” were replaced with concrete action verbs. The use of negations, such as “not,” also adds to processing time, and these were edited from the stimuli sentences (Just & Carpenter, 1971). The stimuli were modified to maintain societal expectations concerning gender roles, because an unanticipated twist in the story concerning a character could result in a delay in responses for the participants. To appeal to multiple life circumstances, the stories were edited to feature characters of varying sex, age, and background participating in common daily activities.

Lastly, the trait-inconsistent and trait-consistent sentences were manipulated so that the word conveying the consistency occurred at the end of the final sentence in each story. Beyond balancing the point at which trait consistency could be determined, this manipulation helped to make the participants’ responses as close to online as possible.

2.3 STIMULI

The five stories, selected from Rapp et al.’s (2001) study based on their trait strength and coherence, provided the basis for the experimental stimuli. For these five stories, four versions of each were created: Trait, Trait-Consistent (TTC); Trait, Trait-Inconsistent (TTI); Control, Trait-Consistent (CTC); and Control, Trait-Inconsistent (CTI). These four versions thus involved combining a trait-inducing or control sentence in the first paragraph with a trait-consistent or trait-inconsistent sentence in the second paragraph.

2.3.1 Task Construction

A female speaker audio recorded the five stories, reading the narrative just as illustrated in Table 4, with one critical sentence immediately preceding its paired alternate sentence. The speaker maintained a consistent, neutral voice throughout and attempted comparable prosody in the paired trait-inducing and control sentences, and in the trait-inconsistent and trait-consistent sentences. Both the author and her thesis adviser assisted in judging the parallel suprasegmentals of the critical sentences in each paragraph. All recordings were made in a double-walled, sound-treated booth with an Audio-Technica ATR20 vocal/instrument microphone, where a constant distance of approximately eight centimeters was maintained between microphone and mouth. A Dell Optiplex SX280 recorded the audio stimuli into the program Audacity Beta 1.3 Unicode.

The Audacity program was then used to edit the stimuli. Because the stories were recorded with both possible final sentences for each paragraph, the alternate sentences were extracted and pasted to create the four versions of each story. Between most sentences in a story, 1000 ms of silence were maintained. Approximately 1500 ms of silence occurred between the end of the first paragraph and the beginning of the second.

Because participants were to be trained to make a specific judgment, rapidly, at the end of the story, two additional sound files were created. The first, a 75 ms 1000 Hz pure tone signal, was used to indicate to participants that the final sentence was about to play. This tone was inserted into the stimuli using the Audacity program. At the end of the penultimate sentence, 1000 ms of silence were inserted prior to the beginning of the final sentence. The tone was added at 450 ms into that silence.

The second inserted file was a standard Windows bell signal, to remind participants to respond quickly. The bell signal occurred at different intervals after the final sentence for the two groups. Considering precedents from prior work on discourse comprehension in the Tompkins lab, a base time of 750 ms was extended by 269 ms for the group with RHD (average simple reaction time to the auditory word “no” for 18 pilot subjects), and by half that amount for the NBD group (whose simple reaction times consistently approximate half those of participants with RHD in Tompkins’ work). If participants responded after the bell, their accuracy and response time were still recorded by the E-prime program.

2.3.2 Stimuli Organization

The presentation of the stimuli was pseudorandomized using a blocking system. There were twenty stimuli in total, consisting of the five stories in their four versions. Four blocks of trials were established, each containing one version of each of the five stories. Every participant heard all stories in all conditions, across two sessions. The tester pseudorandomly assigned the four blocks to the subjects, presenting the first two blocks in the first session and the remaining two in the final session. Story versions within each block were pseudorandomly varied to ensure that the same types of stories did not occur next to each other or in the same position in each block. This also was intended to ensure that the responses to the stimuli were varied to avoid recurring “yes” or “no” responses from the participants. Table 5 provides the details of which stories were contained in each block of trials.

Table 5. Content of four stimuli blocks.

BLOCKING	Story	First Paragraph Final Sentence	Second Paragraph Final Sentence	Correct Answer
Block A	1	Control	Trait-Inconsistent	y/n
	5	Trait	Trait-Inconsistent	n
	4	Trait	Trait-Inconsistent	n
	2	Control	Trait-Inconsistent	y/n
	3	Trait	Trait-Consistent	y
Block B	5	Control	Trait-Consistent	y/n
	3	Control	Trait-Inconsistent	y/n
	2	Trait	Trait-Consistent	y
	1	Trait	Trait-Consistent	y
	4	Control	Trait-Inconsistent	y/n
Block C	2	Control	Trait-Consistent	y/n
	1	Trait	Trait-Inconsistent	n
	3	Control	Trait-Consistent	y/n
	4	Trait	Trait-Consistent	y
	5	Trait	Trait-Consistent	y
Block D	3	Trait	Trait-Inconsistent	n
	4	Control	Trait-Consistent	y/n
	2	Trait	Trait-Inconsistent	n
	5	Control	Trait-Inconsistent	y/n
	1	Control	Trait-Consistent	y/n

y = yes; n = no; y/n = either yes or no

2.4 EXPERIMENTAL APPARATUS AND PROCEDURES

Testing was conducted in two 60-minute sessions approximately one week apart. The author tested all subjects. Testing took place in a quiet room, either at the subjects' homes or in the Tompkins Language Laboratory, depending upon the subjects' preferences. A Dell Inspiron 5150 notebook computer delivered the auditory stimuli using Windows Media Player and the software E-Prime. A Serial Response Box model 200A recorded the time (in ms) and accuracy of the subjects' responses. Supraaural earphones were worn by the participants, and loudness level was adjusted based on the subjects' comfort level using Quick Mixer v1.7.2.

2.4.1 Experimental Task

Prior to the first block of the experimental task, participants were instructed that they would be hearing a series of short stories and making a judgment about them. They were then told that at the end of the story they were to decide whether the last sentence fit with the character's personality, and they were to respond by pressing the "yes" or "no" button on the response box. With a selected response finger placed on a "home base" button equidistant from the "yes" and "no" response buttons, each subject was instructed to respond as quickly and accurately as possible before returning their finger to the "home base."

To ensure that the subjects understood the task, two live voice examples were first presented. The correct responses to these stories were explained if necessary. After the live voice practice, a computerized practice comparable to the experimental task was run. This included six trials based on stories revised from Rapp et al.'s (2001) study that were not used as the experimental stimuli. The six practice stimuli featured examples of all four versions of the stories. If the participant was inaccurate or slow to respond to these trials, the tester reviewed the instructions with the participant and presented the practice trials a second time.

Once the subject displayed an understanding of the task (i.e., was accurate on at least three of the six practice items, four of which involved trait instantiation), the actual experimental stimuli were introduced. Two stimuli blocks were played in each session, with several ancillary tasks between blocks. Before the second, third, and fourth blocks of trials, participants were reminded to judge whether the final sentence fit with the character's personality and to respond as quickly and accurately as possible. Because the third and fourth blocks occurred in the second test session, which was a week after the initial task instructions and block of six practice stimuli were presented, a review of the instructions and completion of the same block of computerized practice trials occurred at the beginning of session two.

All responses were recorded for time (in ms) and accuracy by the E-prime software. Additionally, the tester manually recorded the responses on a response form.

2.4.2 Ancillary Tasks

A variety of ancillary tasks were incorporated into the testing sessions. These tasks provided clinical information about the participants, to determine whether the group with RHD was different from the NBD group in expected ways, to assess predictors of performance in the experimental task, and to assist with generalization of the results. The following tasks were inserted between the experimental block in the two testing sessions:

1. *Peabody Picture Vocabulary Test-III* (Dunn & Dunn, 1997), to gain information about each participant's receptive vocabulary. Four pictures were presented to the participants while the tester read a word aloud. Participants were instructed to choose the picture that matched the presented word.
2. *Behavioural Inattention Test* (Wilson, Cockburn & Halligan, 1987), to test for visual neglect. Tasks include cancellation, line bisection, shape recognition, figure copying, and drawing.
3. *Arizona Battery for Communication Disorders of Dementia* (Bayles & Tomoeda, 1993) immediate and delayed recall tasks, for NBD participants only. A brief story is played and subjects are asked to retell the story, including everything they can

remember. They are scored for all content units of the story that they recall after immediately hearing the story, and then after some time (about fifteen minutes in this study) has passed. This task was given to rule out a latent dementia in the NBD group.

4. *Mini Inventory of Right Brain Injury* (Pimental & Kingsbury, 1989), to assess the presence and severity of deficits common in adults with right brain injury. This test incorporates visual, verbal, and motor tasks to gain a comprehensive perspective on the participants' processing abilities. It is, however, insensitive to mild impairment (Tompkins, 1995).

5. *Discourse Comprehension Test* (Brookshire & Nichols, 1993), to determine general understanding of stories presented verbally. This test is in some ways similar to the experimental task, requiring participants to listen to stories and questions, and to make judgments by selecting "yes" or "no" on a response box concerning stated and implied details and main ideas of a story. After familiarizing participants with a live voice and a computerized narrative practice item, Set A stories (N=5) were presented and followed by eight questions each.

6. *Visual Form Discrimination* (Benton, Hamsher, Varney & Spreen 1983b), to test visual perceptual skills with the presentation of black and white line drawings of four shapes, one of which is duplicated on an adjoining page. Participants must choose which of the four shapes matches the single image. This test breaks down scores based on errors in peripheral location, rotation, or distortion.

7. *Judgment of Line Orientation* (Benton, Hamsher, Varney & Spreen 1983a), to appraise visual spatial skills. Eleven numbered lines are presented, radiating in a half

circle from 0 to 180 degrees from the center. Participants must identify the numbers of the two lines which have been duplicated on an adjoining page.

8. *Working Memory Capacity for Language* (Tompkins, Bloise, Timko, & Baumgaertner 1994), to assess recall ability as well as accuracy in responding to sets of true or false statements, with the sets increasing in size from two to five statements each. Participants heard short sentences and determined if they were true or false, pressing the respective button on a response box. They were instructed to simultaneously remember the final word of each sentence until the tester indicated that the participants had completed the set and were to recall these words. There were four sets of sentences with three trials in each set.

The order of tasks in each testing session is presented in Table 6, below.

Table 6. Order of experimental and ancillary tasks

Session 1	Session 2
EXPERIMENTAL TASK BLOCK 1	**BLOCK 3**
Peabody Picture Vocabulary Test-III	Mini Inventory of Right Brain Injury
Behavioural Inattention Test	Discourse Comprehension Test
Arizona Battery for Communication Disorders of Dementia – Immediate Story Retell*	Judgment of Line Orientation
BLOCK 2	Visual Form Discrimination
Arizona Battery for Communication Disorders of Dementia – Delayed Story Retell*	**BLOCK 4**
*for NBD participants only	Working Memory Capacity for Language

3.0 RESULTS

This study assessed the hypothesis that adults with RHD would have more difficulty processing information about a story protagonist that was inconsistent with the implied trait (TTI stories), than information that was consistent with the implied trait (TTC stories). The NBD group was expected to perform similarly to the group with RHD in this regard. Inherent in the hypothesized difference is the expectation that both groups would be sensitive to trait information. No difference was expected between the two versions of control stories, which did not imply trait information.

One group difference was predicted. Specifically, adults with RHD have particular difficulty processing material that is internally inconsistent and requires a revision of initial interpretations. As such, the group with RHD was expected to do less well than the NBD group on the trait-inducing stories that ended with trait-inconsistent information (TTI narratives). Because individuals with RHD do well when language input is consistent throughout, the group with RHD was expected to perform similarly to the NBD group on the trait-inducing stories that ended with a consistent sentence (TTC stories).

Both accuracy and RT data were collected and analyzed.

3.1 PRELIMINARY ANALYSES

Prior to the primary data analyses, the distributions of all variables in this study were inspected by calculating ratios of skewness and kurtosis to their respective standard errors. The absolute values of these ratios did not exceed two, indicating that the data resembled a normal distribution (Dixon, Brown, Engelman, & Jennrich, 1990). Gender differences were assessed by inspecting scores on all variables for males versus females, within each participant group. Data for the few females in each group were well within the distribution of the male participant data. Finally, the data distributions in each group were inspected for outlying values (values > /2/ S.D. from the group mean). None were detected.

3.2 PRIMARY ANALYSES

3.2.1 Analytic Approach

Nonparametric statistics were performed, due to the small sample sizes in each group. A significance criterion of $p \leq .05$ was adopted for all analyses.

3.2.2 Accuracy Data

Accuracy data were totaled across the five stories in each story type, and averaged within each group. Descriptive data for both groups are provided in Table 7. For control stories, no character trait was implied. Thus, there was no correct answer to whether the final sentence fit with the character's personality. Accordingly, an "accurate" response was assigned to any control story when the response given was the same as the response expected for its paired trait story. For example, for trait-inducing stories with trait-consistent endings (TTC), the answer should be "yes" because the trait fits with the character's personality. Performance on control stories with the same trait-consistent sentences at the end (CTC) was scored as accurate whenever the participant responded "yes."

Table 7. Accuracy data for four story types

	TTC	TTI	CTC	CTI
RHD				
Mean (S.D.)	3.0 (1.5)	2.4 (1.3)	2.1 (1.5)	2.3 (1.1)
Median	3	2.5	2	2
NBD				
Mean (S.D.)	3.6 (1.1)	3.8 (1.1)	1.8 (1.3)	1.2 (0.8)
Median	4	3	2	1

RHD = Right Hemisphere Damage; NBD = No Brain Damage
TTC = trait story, trait-consistent sentence
TTI = trait story, trait-inconsistent sentence
CTC = control story, trait-consistent sentence
CTI = control story, trait-inconsistent sentence
Maximum possible accuracy score in each cell = 5.0

3.2.3 Response Time Data

Response times (RTs) were calculated only for accurate items; for inaccurate items, RTs were designated as invalid. Because there was no "accurate" response for control stories, only the trait stories (TTC, TTI) were considered in the RT analyses.

Each participant's RT data were averaged within the five TTC and five TTI stories. RTs for Stories 2 and 4 ultimately were excluded from the primary RT analyses because few individuals in either group had valid RTs; that is, there were many errors in these stories. Thus, the average RT data for each story type was based on a maximum of three data points (from Stories 1, 3, and 5).

Ten of the thirteen participants in this study made at least one error on these six possible data points. The decision was made to exclude data for participants who had fewer than two valid RTs per story type. No one from the NBD group was excluded, though two individuals from this group (1, 2) had only two valid RTs in one story type. This criterion did affect six of the eight individuals in the RHD group, however. Specifically, two adults with RHD (Participants 3, 6) were excluded because they had no valid RTs in one story condition, and four in the RHD group (Participants 1, 2, 4, and 7) had only one valid RT in one story condition. RT data, accordingly, are presented with the utmost caution.

Descriptive RT data are provided in Table 8.

Table 8. Response time data for two story types

	TTC	**TTI**
RHD		
Mean	1327	1889
S.D.	388	704
Median	1455	1886
NBD		
Mean	1021	1684
S.D.	451	1056
Median	1185	1482

RHD = Right Hemisphere Damage
NBD = No Brain Damage
TTC = trait story, trait-consistent sentence
TTI = trait story, trait-inconsistent sentence
RT = response time; all RT data in ms

3.3 PREDICTED PERFORMANCE

3.3.1 Predicted Within-Group Differences

To examine the predicted within-group differences across story types, an *a priori* comparison was first performed within each group, contrasting accuracy on TTC vs. TTI stories. Wilcoxon's signed rank tests indicated that this difference was not significant for either group. Because of this, the contrast between control conditions (CTC vs. CTI) was deemed unnecessary and was not performed.

The same analyses were performed on average RTs for the participants who contributed valid data. For the three individuals with RHD, TTC judgments were significantly faster than those for TTI stories (Z = 1.60; p = 05, 1-tailed). The same was true for the NBD group (Z (5) = 2.02; p = .02, 1-tailed). There were no tied ranks for either group.

To examine the source of the unexpected accuracy result, a *post hoc* analysis assessed performance on the TTC vs. CTC stories within each group, to determine whether participants appreciated the trait-inducing information. Results of this analysis just missed significance for both groups (RHD Z = -1.63; p = .051 (1-tailed); NBD Z = -1,63; p = .052 (1-tailed)).

3.3.2 Predicted Between Group Differences

Mann-Whitney U tests were performed to analyze the predicted group patterns on trait-inducing stories. As expected, the NBD group was more accurate than the RHD group in the TTI condition (U = 9.0; N1 = 8, N2 = 5; p = .047, 1-tailed). The RHD group did not differ statistically from the NBD group in the TTC condition, also as predicted.

3.3.3 Additional Post Hoc Analysis

It was expected that responses to the control stories would be random, because there was no character trait against which to judge whether the character's final action fit with his or her personality. The accuracy data in Table 7 suggest that this may not be the case for the NBD group. Accordingly, exploratory Wilcoxon tests were conducted to examine whether this group displayed any particular response tendency for control stories. Results indicated a significantly higher number of "no" responses for TTI narratives than for CTI narratives ($Z = -2.03$; $p = .021$, 1-tailed). Thus, in the absence of a trait-inducing sentence, the NBD group was more likely to say "yes," indicating that a trait-inconsistent (i.e. positive) action fit with a character's personality.

3.4 PREDICTORS OF PERFORMANCE

To explore variables associated with accuracy and RT performances, Kendall's tau-b was used to index associations among accuracy and RT data and of accuracy and RTH data with demographic and clinical variables. This statistic was chosen over the Spearman correlation because the tau-b corrects for tied ranks. Analyses were performed separately for each group. Correlations are reported below only if they reached statistical significance.

3.4.1 Accuracy Data

There was only one significant correlate of accuracy performance, for both groups. For the participants with RHD, TTI accuracy was perfectly negatively associated with average RT for TTC stories (T (4) = -1.00), for the small subset of participants with valid RT data. For the NBD group, TTC accuracy was strongly negatively associated with average RTs for TTC stories (T (5) = -0.95; p = .023).

3.4.2 Response Time Data

For adults with RHD, RT correlates are presented with extreme caution, due to the limited sizes of the participant and item samples. Average RTs for TTC and TTI stories were perfectly associated for the three participants who contributed data. As already presented above, average TTC RT were perfectly negatively associated with TTI accuracy for the four participants with valid RTs.

There were no demographic correlates of average RTs for participants with RHD, but performance on the MIRBI was moderately negatively associated with average RTs for TTI stories (T (6) = -0.60; p = .045).

For the NBD group, WM accuracy was moderately negatively associated with average RT for TTC stories (T (5) = -0.738; p =.038).

4.0 DISCUSSION

This study assessed the hypothesis that adults with RHD would be poorer at comprehending information about the main character in a narrative that was inconsistent with an implied character trait (TTI stories), than information that was consistent with the established trait (TTC stories). This difference was not expected for control stories, which did not contain trait information. Comparable, though perhaps not significantly different, effects were hypothesized for the NBD group. Additionally, because adults with RHD do well when they process internally-consistent stimuli (e.g., Brownell et al., 1986; Tompkins & Mateer, 1985), the group with RHD was expected to perform similarly to the NBD group on stories that were coherent throughout, i.e., that included a trait-consistent sentence (TTC stories). Conversely, participants with RHD were expected to perform more poorly than NBD individuals on narratives with trait-inconsistent information (TTI stories). Both accuracy and RT data were collected and analyzed.

4.1 WITHIN-GROUP PERFORMANCE ON TTC VS. TTI STIMULI

The accuracy data were not consistent with the prediction that TTI narratives would be more poorly processed than TTC narratives. This is not particularly surprising for the NBD group, whose processing differences may be more likely to be observed in RTs rather than accuracy.

Indeed, RTs were faster for TTC stimuli than for TTI narratives for the NBD group. This aligns with Rapp et al.'s (2001) findings that trait information improves the processing of additional information that coheres with the instantiated trait.

For the RHD group, accuracy on TTI stories was at chance and the performance difference between TTC and TTI stories was in the right direction, with higher accuracy in the TTC condition. However, this difference was not statistically significant. It is possible that this difference would be significant with a larger number of participants and/or narrative stimuli, or with a more homogenous group of adults with RHD. Individual differences in performance are addressed in the section on predictors of performance. It is also possible that this difference would have been significant if trait-(in)consistency at the end of the story had been established more strongly or redundantly. In Rapp et al.'s (2001) original stimuli, the consistent or inconsistent trait was established in two sentences, whereas in this study only one sentence was used. This manipulation was intentional, as part of an effort to better control syntax and the point in each narrative when the trait-(in)consistency could be determined. However, this manipulation may have diluted the effects obtained.

The RT data must be interpreted with extreme caution for the group with RHD due to the small numbers of data points and participants contributing to these data. However, consistent with this study's prediction, these data tentatively hint at an RT advantage for TTC over TTI narratives for the individuals with RHD who contributed valid data to the analysis. This result is in line with numerous findings that adults with RHD perform especially poorly when they encounter inconsistencies in to-be-comprehended material (e.g., Blake, 2008; Brownell et al., 1986; Silverman & Tompkins, 2009; Tompkins, 1991a; Tompkins et al., 2004).

4.1.1 Are Adults With RHD Sensitive to Character Bias?

The hypothesis that adults with RHD would perform better on TTC than TTI stories was based on the expectation that these individuals' judgments of a character's actions would be influenced by the biasing information in the trait-inducing stories. The RT advantage for TTC stories suggests that some of the participants with RHD could and did use this information. However, the nonsignificant accuracy results raise the question of whether the group with RHD as a whole was sensitive to the character biases.

The answer to this question is a qualified "yes." The group with RHD was more accurate on trait-inducing stories with trait-consistent endings (TTC stimuli) than on control stories with the same endings (CTC stimuli), although this difference just missed the significance criterion ($p = .051$). Again, it is possible that this difference would be significant with more stimuli, more or more homogenous participants, and/or more strongly established trait-(in)consistency. If so, this result would reinforce a variety of evidence showing that adults with RHD are indeed sensitive to contextual biasing information in making various sorts of judgments, including the outcomes experienced by narrative protagonists (Blake, 2008), as well as the emotions conveyed by prosody (Tompkins, 1991a) and narrative information (Tompkins, 1991b).

4.2 BETWEEN-GROUP PERFORMANCE ON TTC VS. TTI STIMULI

As predicted, there were no group differences in the TTC condition, but the participants with RHD were less accurate in the TTI condition than the group with NBD. Again, this finding aligns with a variety of evidence that adults with RHD have difficulty revising interpretations (e.g., Brownell et al., 1986; Tompkins et al., 2004) or mental models (Stemmer & Joanette, 1998) when they process stimuli that contain incongruities.

There are several possible interpretations of this result. In general terms, it is consistent with numerous observations that discontinuity in discourse creates processing difficulty (e.g., Gernsbacher, 1997; Zwaan et al., 1995). More specifically, the suppression deficit hypothesis of RHD comprehension (Tompkins et al., 2000, 2001, 2004) would trace this difficulty to ineffective suppression of initial interpretations of character traits that became less appropriate to the given stimulus context. Suppression deficits in the RHD population have been identified in various situations, ranging from the processing of lexical ambiguities (Klepousniotou & Baum, 2005; Tompkins et al., 2000) to the application of conversational conventions (Kennedy, 2000).

4.2.1 Other Performance Observations

Two additional performance observations deserve comment. First, Stories 2 and 4 were more difficult for both groups than were Stories 1, 3, and 5. Upon inspection, it appears that the traits in Stories 1, 3, and 5 (rudeness, cheating, belligerence) are more strongly negative and strongly implied, while the traits in Stories 2 and 4 (forgetfulness, bullying) are more subtle and less strongly implied. For example, forgetfulness is a condition that affects us all and is not deemed particularly negative, in contrast with characteristics such as rudeness, cheating, or overt anger which are disapproved of by society. Bullying is also frowned upon, of course, but in reviewing Story 4 it is not clear that this is the trait being implied. In terms of the strength with which the traits are implied, forgetfulness is suggested by the information that the character “looked for her car for more than ten minutes” in a parking lot, while cheating is implied when a character “decided to copy the answers of a nearby student” in a course he absolutely had to pass.

Belligerence is even more strongly implied: the character kicks a wall, tears down a sheet of paper, and rips it up.

Thus, it appears that in order for older adults and adults with RHD to be influenced by trait information, the traits themselves must be highly emotional (i.e., highly negative in this study) and/or strongly biased. This is consistent with evidence that adults with RHD benefit from contextual information primarily when it is strongly biased (Lehman-Blake & Tompkins, 2001; Blake & Lesniewicz, 2005). In retrospect, it would have been important to ensure that the narrative stimuli were more homogenous in the perceived negativity of the character traits and the strength with which these traits were conveyed.

The second observation worthy of comment is that the NBD group was significantly less “accurate” in the CTI condition than in the TTI condition. “Accurate” is in quotes here because, as noted previously, there is no correct response to a control story; when no character trait is implied, there is no accurate answer to the question whether the final sentence of a narrative fits with the character’s personality. As such, for statistical comparisons, a control story response was deemed accurate when it matched the response expected for its paired trait story.

To interpret this result, it must be remembered that all trait-inconsistent sentences conveyed positive actions and that “it does not fit with the character’s personality” is the correct response to a TTI (and its paired CTI) story. Thus, this result indicates that when there was no initial character bias (CTI stories) the NBD group was more likely to respond that the final, positive sentence of a narrative did fit with the character’s personality than they were in trait-inducing stories. This suggests a tendency to view story characters positively in the absence of other trait information.

This same tendency might be predicted for the group with RHD in light of the view that the intact right hemisphere is dominant for processing negative emotions (e.g., Davidson, 1995; Sato & Aoki, 2006; Tucker, 1981). However, the group with RHD did not tend to view the world positively, possibly because they were less optimistic than the NBD group, or were subtly depressed. It would be interesting to have measures of optimism and depression risk to assess these possibilities. The adults with RHD did not have medically documented depression when they entered the Tompkins Research Registry, but depression could have developed at a later time.

4.3 PREDICTORS OF PERFORMANCE

The significant associations for the group with RHD all involve RT data, so any interpretation must be extremely cautious. These associations hint that individuals who are faster in judging consistent trait information are also able to respond more accurately and more quickly when faced with incongruent character information. In addition, those who are faster in their accurate judgments to inconsistent character information are less severely impaired on a general screening of cognition and communication (the MIRBI; Pimental & Kingsbury, 1989). One tentative story about these findings is that adults with RHD who are better able to build and maintain congruent mental structures that include trait information are also more skilled in suppressing trait interpretations that need to be revised, a skill that varies with general severity of RHD. In Gernsbacher's (1990, 1997) structure building framework of comprehension, individual differences in suppression processes predict discourse comprehension; the same is true of comprehension in adults with RHD (Tompkins et al., 2000, 2001, 2004). It has also been suggested more generally that adults with RHD who comprehend better are better able to build and maintain mental models of discourse (e.g., Molloy & Brownell, 1998; Stemmer & Joanette, 1998).

For the NBD group, better average RTs in the TTC condition were associated with higher accuracy in both the TTC condition and an estimated auditory working memory task that requires the simultaneous processing and storage of language (Tompkins et al., 1994). The first association is not surprising: individuals with better-established mental models of trait information ought to be able to determine more quickly when later information is consistent with that trait. In addition, people with higher estimated working memory capacity for language may be able to build and maintain those mental models more quickly or with less effort than people with lower working memory capacity for language.

4.4 LIMITATIONS OF THE CURRENT STUDY

There are a number of limitations of this study. One is the fact that all of the implied character traits were negative, making generalization to positive trait situations impossible.

Other important limitations are the small numbers of participants and stimuli. With more participants and more stimuli, it would have been possible to use parametric statistics rather than the less powerful nonparametric analyses. With parametric analyses, a number of the predicted findings that just missed statistical significance would more likely be significant. Small samples plagued the RT analyses in particular, with so many participants and narratives excluded due to low accuracy. Thus, the interpretation of all RT results remains tentative and external validity of RT findings is extremely low, particularly for the group with RHD.

It has been noted that more homogenous stimuli, better controlled for the strength of the character trait and the strength with which the trait is implied, should have been used as well. Another limitation is that the final sentences in TTI stories may not have been equally inconsistent with the established trait. For example, in Story 3, the inconsistent behavior ("Chris couldn't resist picking up a cookie") could be interpreted as somewhat sneaky, and as such consistent with the instantiated trait of "cheater." This may have led some participants to say "yes," agreeing that the behavior fit the character's personality, when the intended response was "no." If so, these participants' accuracy and RT data would be artificially lower/slower on TTI stories. Because this result is consistent with the study hypotheses, the interpretation of results that conform to these predictions is ambiguous. This may be the case for the RT results, which conformed to the study hypotheses for the control group and for the three participants with RHD.

There would be value in investigating more homogenous participants, too. However, participant heterogeneity allows an evaluation of factors that affect performance, so there is a trade-off to consider. A larger sample of somewhat heterogeneous participants may be the best compromise.

An additional potential limitation of the current stimuli is that the trait-consistency or inconsistency of the story ending was minimally established, in only one sentence, whereas Rapp et al. (2001) used two sentences for this purpose. Therefore, this study's manipulation of trait-(in)consistency is likely weaker than that in the original stimuli. Although this manipulation was purposeful, it is possible that it diluted the predicted effects.

In terms of interpreting the results, the nature of the significant RT differences between TTC and TTI stories cannot be determined. No conclusions can be made on whether character trait information speeded accurate judgments of trait-consistent information, slowed them for trait-inconsistent information, or some combination of the two. Also, the potential interpretation of suppression deficit for adults with RHD in the TTI condition cannot be established without some measurement of lingering activation for the trait that needed to be suppressed. The suppression deficit would be based on between-group accuracy data; for example, RHD accuracy for the TTI condition was less than NBD accuracy for the TTI condition.

Measures of optimism and depression may have helped to interpret the potential difference between groups in the tendency to attribute positive actions to characters when no trait is implied (CTI stories). This is a smaller limitation of this study, because the observation was *post hoc* and the study was not designed to test it.

Finally, the methods in this study were not designed to address whether the observed effects reflect the involuntary or intentional mechanisms of comprehension that were described by Rapp et al. (2001). The results likely implicate primarily intentional cognitive processes, because the judgment task is metalinguistic and response times were slow. However some more implicit measure would be necessary to evaluate the contribution of involuntary cognitive processes.

4.5 FUTURE PROJECTS AND FOLLOW-UP EXPERIMENTS

To address the limitations of the current study, future research can be strengthened by expanding and building upon the concepts introduced in this experiment. As one modification, the testing of more subjects could provide a substantially larger sample size that could meet assumptions for parametric analyses, and as such have greater experimental power. A larger sample would also potentially provide the opportunity to evaluate differences in the RHD group based on site of lesion in order to note any possible trends in lesion location and performance. This modification should improve generalizability to other samples, as well.

Secondly, the TTI and TTC stories may not have instantiated the trait as strongly as Rapp et al.'s (2001) study. The stimuli could be revised to incorporate a stronger or more redundant portrayal of a trait in the trait-inducing versions. If future studies addressed this in the development of stimuli, it is likely that the hypothesized difference between the TTI and TTC stories would be apparent for the RHD group. At the same time, the degree of trait-inconsistency of the final sentences in TTI stories needs to be better controlled.

Third, the measure used to appraise RT and accuracy for this study's task was explicit. Instead of using such an explicit metalinguistic task, implicit measures such as ERPs or fMRIs could be used. Also, future studies could incorporate tasks allowing other types of implicit measures. For example, the probe task could divert participants' attention from the character trait itself, unlike the task in the present study that asked subjects to make a judgment about each character's personality. In Rapp et al.'s (2001) study, the undergraduate subjects were asked to respond to a true or false task pertaining to the content of the story they had just read. Another way to divert attention from the trait itself would be to ask participants to generate a title after being presented with each story.

Fourth, the order or timing of stimulus block presentation could be modified to avoid what could be labeled as "multiple inconsistencies" in each testing session. In this study, two versions of the same story were presented in each session, and these versions differed only in the presence of a trait or the trait-consistency of the final sentence. In each session, then, a single character could have appeared in a trait story and a control story, and with the trait-consistent or inconsistent final sentence. In addition, in trait stories, the character manifested the trait in two different contexts (e.g., being rude by cutting in line; being rude by consciously choosing not to leave a tip). The participants in this study thus may have had to process multiple inconsistencies in each stimulus. It would be interesting to test how adults with RHD perform when there are fewer inconsistencies in the experiment. It may be that they could do better if, for example, the trait information in the final sentence of a story was implied in the same context that implied the trait initially (e.g., cutting in line), or if the established trait for each character was retained across sessions and applied it to all versions of the story. On the other hand, increasing the consistency between and within story versions may augment a potential suppression deficit in participants with RHD.

Finally, a future study could test for a suppression deficit in the group with RHD, rather than assuming it. This could be achieved by probing for lingering activation from an initial trait inference after that inference has been contradicted in TTI stories.

4.6 CONCLUSIONS AND POTENTIAL IMPLICATIONS

Overall, the results of this study suggest that when character biases are strongly negative and/or strongly implied, adults with RHD appear to represent these character biases in their narrative processing, though these biases do not improve their accuracy at judging the trait-(in)consistency of subsequent information. Tentatively, it appears that these biases speed the processing of minimally-established trait-consistent information for mildly-impaired adults with RHD and/or disrupt the processing of trait-inconsistent information. As has been observed with various kinds of stimuli, adults with RHD are as able as control participants with no brain damage to accurately judge trait-consistent information, but are at a particular disadvantage when dealing with incongruity.

Clinically, the results of this study suggest that strength of character bias could be manipulated in assessment and treatment when working to improve the narrative processing of adults with RHD. Character plays a crucial role in stories, and addressing this aspect of comprehension may be critical in improving individuals' ability to understand narratives.

APPENDIX A

ORIGINAL STORIES FROM RAPP ET AL.'S (2001) STUDY

Note: These are the five stories selected from the original 24 stories to form the basis of the present study's experimental stimuli

Story 1 (Originally labeled Story 3):

Trait	**RUDE**
Paragraph 1	Nancy was a receptionist at a very prestigious law firm. She was always very busy, handling paperwork and answering phones. Today she was especially looking forward to lunch. She was going to get a pastrami sandwich from her favorite deli.
Trait	**During lunch the line was very long, so Nancy cut in front of another customer.**
Control	**One time the law firm bought everyone lunch from the deli after a big settlement.**
Paragraph 2	When she returned from lunch Nancy had a message from her boyfriend. He wanted to go out for Chinese food that night. Nancy and her boyfriend went to a new Chinese restaurant where the food was very good. Nancy offered to pay for dinner and they left the restaurant. A block away from the restaurant Nancy realized she forgot to leave a tip for the waiter.
Trait-Consistent	**Nancy didn't end up going back to pay the waiter.** **She just wanted to enjoy the rest of her night out.**
Trait-Inconsistent	**Nancy went back and apologized to the waiter for forgetting.** **Then she gave some money to the waiter and thanked him.**

Story 2 (Originally labeled Story 5):

Trait	**FORGETFUL**
Paragraph 1	Greta had to pay her school bill this morning. She parked her car in the lot and headed over to the registrar's office. She paid her bill, and was now free to register. She headed back to the parking lot.
Trait	**It took her almost fifteen minutes to remember where she parked her car.**
Control	**One section of the parking lot had been blocked off for road repair.**
Paragraph 2	When she got home she decided to bake a cake. Greta mixed the dough and put it into a pan. Then she set the oven temperature for 450 degrees and put the cake mixture in the oven to bake. She decided to turn on the television, and watched an interesting news report on famous mob bosses of New York City. Meanwhile, the cake continued to bake.
Trait-Consistent	**Greta only realized her error when she smelled the cake burning.** **She couldn't find her oven mitt to pull the cake out of the stove.**
Trait-Inconsistent	**Greta remembered when to take the cake out of the oven.** **She had seen the complex recipe on the news last week and memorized it.**

Story 3 (Originally labeled Story 6)

Trait	**CHEATER**
Paragraph 1	On Tuesday Chris was going to have a big economics test. He hadn't prepared enough for it. The topics of economics and number-crunching didn't interest him. Even though he didn't want a job dealing with numbers and figures, he knew he had to at least pass the course.
Trait	**So Chris decided to copy off of the person sitting next to him.**
Control	**It turned out that the professor cancelled the test at the last minute.**
Paragraph 2	A few days later, he went to his friend Kelly's house. It was a very rainy day, so they decided to stay indoors, watch a movie, and share gossip. They decided to play checkers and Chris lost three games in a row.

	During their last game, Kelly was called away by her mother to walk the dog. Chris examined the board in her absence.
Trait-Consistent	**Chris picked up a piece and moved it to a better position on the board.** **Now he had a great chance to win.**
Trait-Inconsistent	**Chris closed his eyes and thought about the best move he could make to win.** **When Kelly returned they continued playing the game.**

Story 4 (Originally labeled Story 8)

Trait	**BULLY**
Paragraph 1	Kevin hated going to school. Every day he'd have to wake up early and take the school bus to junior high. He thought his teachers were very boring. The only class he mildly enjoyed was gym.
Trait	**In school, the only fun he had was picking on other children.**
Control	**In gym class the teacher let the students play volleyball and baseball.**
Paragraph 2	One day Kevin decided to play hooky from school. He went to the local park and sat on a hill eating his lunch. While it was boring spending the day by himself, he thought it was a hundred times better than going to school. A stray cat must have smelled his lunch and walked over to visit. Kevin held out a bit of food for the cat to sniff.
Trait-Consistent	**Kevin waited to shove the cat when it got close.** **He picked up some rocks to throw at the stray.**
Trait-Inconsistent	**Kevin gently patted the cat as it nibbled the food.** **He was happy he had made a new friend today.**

Story 5 (Originally labeled Story 10)

Trait	**BELLIGERENT**
Paragraph 1	Henry went to the bulletin board outside the front of the gym. There was a list of people who had been selected for the intramural basketball squad. He looked for his name on the alphabetical list. His name wasn't there.
Trait	**He kicked the wall ferociously, tore down the list, and ripped up the sheet of paper.**
Control	**Only half the list had been posted so far, the other half would be posted tomorrow.**
Paragraph 2	Later that day he went to the cafeteria to get lunch. He picked up an apple, a sandwich, and a soda. Henry brought the items to the counter and paid for them. On the way to a table, a man bumped him and the sandwich tumbled to the floor. The man didn't seem to notice and started to walk off.
Trait-Consistent	**Henry screamed at the man to get his attention.** **He began giving him a piece of his mind.**
Trait-Inconsistent	**Henry shrugged it off because it was an accident.** **He could get a new sandwich in the cafeteria.**

APPENDIX B

REVISED STORIES USED AS EXPERIMENTAL NARRATIVES

Story 1

Trait	**RUDE**
Paragraph 1	Nancy was a receptionist at a prestigious law firm. She was always very busy, handling paperwork and answering phones. Today she was especially looking forward to lunch. She was going to get a pastrami sandwich from her favorite deli.
Trait	**During her break, Nancy didn't want to wait in line and instead cut in front of some customers.**
Control	**During her break, Nancy didn't want to eat indoors and instead sat in front of the firm's entrance.**
Paragraph 2	Nancy and her boyfriend went to a restaurant that night, and Nancy offered to pay. After dinner, Nancy realized she forgot to leave a tip.
Trait-Consistent	**Nancy counted up her money and walked to the exit.**
Trait-Inconsistent	**Nancy smiled at the waiter and left a generous tip.**

Story 2

Trait	**FORGETFUL**
Paragraph 1	Sarah had to pay her city tax bill. She drove downtown and parked her car in a huge lot. Then she walked several blocks to the city administration building. A clerk took her check. Sarah then headed back toward the parking lot.
Trait	**She looked for her car for more than ten minutes.**
Control	**She turned on the radio for the ride home.**

Paragraph 2	When Sarah got back to her home she decided to make a cake. While it baked, she tuned in to her favorite TV show.
Trait-Consistent	**Sarah jumped off the couch when she smelled her burning cake.**
Trait-Inconsistent	**Sarah took out the cake when she heard her oven timer.**

Story 3

Trait	**CHEATER**
Paragraph 1	On Tuesday Chris was going to have a big economics test. The subject didn't interest him, and he struggled to understand some of the material. Although he did not want a job dealing with numbers and figures, he knew he had to pass the course.
Trait	**Chris decided to copy the answers of a nearby student.**
Control	**Chris decided to study the questions from his old assignments.**
Paragraph 2	A few days later, he went to his friend Michelle's house to play cards and eat some of her famous cookies. In the middle of the card game, Michelle went to the bathroom and left her cards face down on the table.
Trait-Consistent	**Chris couldn't resist picking up her cards.**
Trait-Inconsistent	**Chris couldn't resist picking up a cookie.**

Story 4

Trait	**BULLY**
Paragraph 1	Kevin hated going to day camp. Every day he had to wake up early and catch the bus to the camp. He thought the activities were very boring. The only activities he mildly enjoyed involved sports.
Trait	**At camp, Kevin always made fun of the other children.**
Control	**At camp, Kevin often played a game of basketball.**
Paragraph 2	One day Kevin decided to skip school and eat lunch at a bench. A stray cat walked over to visit.
Trait-Consistent	**The cat sniffed Kevin and he shoved it.**
Trait-Inconsistent	**The cat sniffed Kevin and he stroked it.**

Story 5

Trait	**BELLIGERENT**
Paragraph 1	Jim went to the bulletin board in the local theater's lobby There was a list of people who had been selected to be in the play. He looked for his name on the alphabetical list, but it wasn't there.
Trait	**Jim kicked the wall hard, tore down the list, and ripped up the sheet of paper.**
Control	**Jim checked the list again, got out his keys, and walked out the door to his car.**
Paragraph 2	Later on, while Jim waited for a movie to start, a man next to him bumped his drink, which then spilled on the floor. The man didn't notice.
Trait-Consistent	**Jim called after the man and began to yell.**
Trait-Inconsistent	**Jim called after the man and began to smile.**

APPENDIX C

EXPERIMENTAL TASK INSTRUCTIONS

Materials Needed:

- E-Prime recording form (to document RT during practice)

Before Initiating Testing:

- Have the practice block ready on the computer and double check the subject group (NBD or RHD) and your order of administration sheet for the appropriate set of test blocks (NBD or RHD) and the appropriate sequence of testing blocks

Scoring**:**
E-Prime scoring: 2= yes (true)
4= no (false)
3= home base

IF THIS IS THE FIRST TIME THE Ss IS COMPLETING THIS TASK:

Say: "For this task, a woman's going to read some short stories. After each story, I'll ask you to decide *whether the last sentence fits with the character's personality*. If the last sentence fits with the character's personality, you'll push "yes" [gesture]. If the last sentence doesn't fit with the character's personality, you'll push "No." You'll need to listen to the entire story to do this task. We'll give you a signal before the last sentence occurs.

While you're listening to the story, please choose one finger to use to make your response. Which one do you want to use? Okay. Keep that finger here, on home base [demonstrate on the response box] until the story ends, and then use it to push the button Yes or No. Any questions so far?

"Then let's do some practice. I'll point here to signal when the last sentence will occur. After the last sentence, please use your finger to respond as quickly and accurately as possible.

LIVE VOICE EXAMPLE #1:

Laurie was going out on a date with her boyfriend, Mark.
They were going to the museum together.
They arrived at the museum, and to their dismay it was very crowded.
They had to wait in a long line to buy their tickets.

A few other women were looking at Mark, which made Laurie very angry.

The following weekend they went to an ice skating competition.
They were both fans of figure skating.
A young woman was skating to some slow music out on the ice.
Laurie noticed that Mark was watching the skater very closely.
POINT
Laurie slapped his arm when she saw him paying attention.

If the subject is incorrect:

1. Say, "Okay, let's try that one again" and read example again.
2. If the Ss is still incorrect, review the story and last sentence with the Ss.

If the subject is correct:

"Nice job – here's another one. This time, I'd like you to respond as *quickly* as you can. So, start your finger here [gesture] on home base. Then, at the end of the story, please press the appropriate button as fast as you can [demo, returning to home base]. I'd like you to return your finger to home base, after you've responded. Remember, I'll point here before the last sentence occurs. Ready?"

LIVE VOICE EXAMPLE #2**:**

Philip was graduating from college.
He had to buy a graduation gown and cap for the event.
Everyone at the ceremony was happy and proud of the graduating class.
Philip was proud of himself, because he always worked hard to do his best.

The next weekend Philip went over to his friend Greg's house.
They planned to play the board game version of Jeopardy.
Philip had never played the game before, and Greg explained the rules to him.
POINT
Philip quit guessing after only two questions.

"Okay, that's it. Before we practice on the computer, I need to tell you a few more things. From now on, you'll *hear* the signal that the last sentence is coming up. It'll be a tone, like this [give example of the tone]. Also, after the last sentence of each story, you'll hear the sound of a bell [give example of the bell, ding.wav]. The bell is just a reminder to keep responding as quickly and accurately as you can -- it doesn't mean that your answer is wrong. Okay?"

"So, start here [gesture] on home base [indicate use of same finger]. Listen to the story, and then for the bell. Then, after the last sentence of the story, you'll indicate whether the last sentence fits with the character's personality [gesture in the area of the Yes and No buttons]. Please press the button as fast as you can [demo, returning to home base], because I'll be measuring your speed."

COMPUTERIZED PRACTICE EXAMPLE #1:

If first story is incorrect, return to Live Voice Practice #1, and re-instruct as above.
"Okay, you've got the idea. Now let's go back to the computer."

If more than one error, repeat practice block.

If correct, say: "Okay, you've got the idea. Let's go through some more practice items. Please respond as quickly and accurately as you can"

[Provide nonverbal reminders as needed, about returning finger to home base between stories, etc.]

ADMINISTER the PRACTICE TRIALS

Say: "nice job on those. Let's go through them one more time, so you can practice your speed." [Give reminders, if needed, at this time – i.e., to start on, and return to, home base; the bell at the end of the story is just a reminder to keep responding quickly]

ADMINISTER EXPERIMENTAL BLOCK

Say: "great. Now let's move on to the real thing. There will be 5 stories. Please listen carefully to each story, and decide as quickly and accurately as you can whether the last sentence fits with the character's personality." [Point toward home base if subject hasn't already put his/her chosen finger there.] "Ready?"

[No comment or feedback during or after the experimental block, unless a nonverbal reminder to return finger to home base]

START HERE if the subject has completed this task in a PREVIOUS SESSION OR if this is the SECOND BLOCK in this session:

Say: "Now we're going to return to the stories where you judge whether the last sentence fits with the character's personality. You'll hear the tone to let you know that the last sentence is coming up. Then after the last sentence, you'll hear the bell to remind you to keep responding quickly. Let's get warmed up again on the computer"

ADMINISTER the PRACTICE TRIALS

[If it's the *same session*, first two practice trials should be enough – unless the subject seems to have lost track of any elements of the task, or his/her RTs have slowed more than would be expected based on prior performance.

[If it's *a second session*, run through at least 4 practice trials, until the Ss is again performing with confidence and RTs are where you'd expect]

Say: "That's it – now we'll move on to the real thing. There will be 5 stories again. Please remember to respond as quickly and accurately as you can, whether the last sentence of each story fits with the character's personality. [Nonverbal reminder to use finger on home base, if needed]. Ready?"

ADMINISTER EXPERIMENTAL BLOCK

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