The Effect of Contextual Bias on the Processing of Negative Emotions in Patients with Right Hemisphere Damage

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Previous research has shown that damage to the right cerebral hemisphere (RHD) often manifests as higher-level cognitive-linguistic problems in domains such as emotion processing. However, these studies often employ metalinguistic tasks that obscure the nature of processing strengths and weaknesses, with one potential reason for this being the relatively-high cognitive processing demand required to complete the experimental tasks. Individuals with RHD often do not appear to have substantial deficits, and in fact facilitative effects have been observed, when they are assessed in a manner that reduces this demand, via methods such as priming or contextual bias.

This study aimed to investigate the processing of negative emotional input in adults with RHD after affect inducement by an emotionally-biased context. As expected, negative affect word use was higher in a bias condition than in a no-bias condition. Non-brain-damaged control participants (NBD) used more negative affect words than participants with RHD in both conditions, though this between-group difference was not statistically significant. It was originally hypothesized that differences between groups would occur and that these differences would be reduced in a bias condition, but because the groups did not differ in negative affect word use, this hypothesis became moot. Overall, previously-reported "deficits" in processing negative emotions appear to be task- and task-demand-specific, and adults with RHD perform cognitive-linguistic tasks better when primed. Currently, few diagnostic and treatment measures are available for individuals with cognitive-communicative disorders. Findings from this study

will add to the corpus of data to aid in the development of clinical approaches for emotional processing.

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PREFACE

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1.0 INTRODUCTION

Cerebrovascular accidents, more commonly known as strokes, are the leading cause of adult disability in the United States (National Stroke Association; *Stroke 101 Fact Sheet*, n.d.). Nearly 800,000 people suffer a stroke yearly, and two-thirds of these individuals will have some sort of disability resulting from the brain damage (National Stroke Association; *What is Stroke?*, n.d.). The location of the lesion determines the behavioral and/or physical symptoms experienced by the individual.

Strokes confined to the right cerebral hemisphere can cause deficits in both non-linguistic and linguistic domains. Non-linguistically, individuals with right cerebral hemisphere damage (RHD) may have problems with neglect of the left side of space and with the awareness of the presence or impact of their impairments, which is known as anosognosia. These individuals may also have visuo-perceptual and visual-spatial processing difficulties, such as problems with visual memory, attention, integration, and spatial orientation. Other cognitive processes, such as attention and memory, have also been observed to be impaired in some individuals with RHD (Brookshire, 2003; Myers 1999). These behavioral changes can cause difficulty completing activities of daily living that were once quite simple, such as reading the newspaper or washing the dishes.

Many sources provide excellent overviews of the nature of cognitive and communicative difficulties associated with RHD (e.g., Blake, in press; Tompkins, Lei, & Zezinka, in press). At first glance, individuals with RHD may not appear to have issues with linguistic content. It is for this reason that many are not referred for necessary speech-language pathology services. However, more than three-fourths of adults with RHD admitted to rehabilitation units demonstrate some sort of cognitive-communicative deficit (Blake, Duffy, Myers, & Tompkins, 2002; Côté, Payer, Giroux, & Joanette, 2007). For example, discourse processing and pragmatics, or the rules and social use of language, have been observed to be disadvantaged after RHD (Cutica, Bucciarelli, & Bara, 2006; Marini, Carlomangno, Caltagirone, & Nocentini, 2005; Marini, 2012; Sherratt & Bryan, 2012; Tompkins, Lei, & Zezinka, in press). Possible discourse and pragmatic issues include poor topic-maintenance, which may result in the inclusion of tangential utterances and in errors of cohesion. In addition, some adults with RHD may have difficulty with the processing of emotions (Borod, Andelman, Obler, Tweedy, & Welkowitz, 1992; Borod, Cicero, Obler, Welkowitz, Erhan, Santschi, Grunwald, Agosti, & Whalen, 1998; Heberlein, Adolphs, Pennebaker, & Tranel, 2003; Lorch, Borod, & Koff, 1998; Rinaldi, Marangolo, & Baldassarri, 2004; Sherratt, 2007). Various studies investigating both receptive and expressive language abilities report that individuals with RHD may have dulled or inappropriate emotional responses.

Though there are many different behavioral manifestations of RHD, it is important to note that not all individuals will present impairments in every domain or in the same manner. Many other individual differences and concomitant issues (i.e., working memory, attention) impact post-stroke language- and communication-related behaviors, which account for the great variability in the RHD population. Now that a foundation of information on RHD has been established and continues to be refined, future needs include understanding the basis for the observed variation in RHD language and communication deficits.

1.1 NEGATIVE EMOTIONAL PROCESSING

The neural pathways involved in the processing of negative emotions have long been a subject of interest. Because individuals with RHD can display problems with negative emotion processing, it is reasonable to infer that part of this processing occurs within the right cerebral hemisphere.

1.1.1 Negative Emotional Processing and Right Hemisphere Damage

Although findings have been mixed, emotional processing, and perhaps particularly negative affect processing, appears to be disadvantaged after RHD. For instance, Heberlein, Adolphs, Pennebaker, and Tranel (2003) reported that adults with RHD used fewer negative affect words in their descriptions of a video of moving shapes designed by Heider and Simmel (1944). In another vein, Sherratt (2007) found that adults with RHD included fewer elements of evaluating and negotiating emotional judgment while re-telling negative life events. Her participants more frequently talked about the events *per se* and less often expressed an emotional experience pertaining to them. Overall, when negative events were involved, participants with RHD were found to be more objective in their responses and to employ weaker emotion words compared to non-brain-damaged (NBD) controls. Strength of emotion words was evaluated based on the percentage of appraisal categories (i.e., affect, judgment, appreciation, amplification, enrichment, augmentation, and mitigation) used in subjects' discourses (see Sherratt, 2007). On the other hand, adults with RHD did not vary significantly from NBD controls in their life event retellings regarding positive emotions in the Sherratt study.

Other studies have shown that emotional processing in RHD subjects is impaired, regardless of valence. For example, Borod, Andelman, Obler, Tweedy, and Welkowitz (1992) found that individuals with RHD were significantly less accurate on emotional lexical tasks involving word-cluster identification, sentence identification, and word discrimination compared to adults with left hemisphere damage (LHD) and NBD controls. In another study, individuals with RHD were significantly more impaired at identifying and discriminating emotions through facial, prosodic, and lexical inputs compared to participants with LHD and normal controls (e.g., Borod, Cicero, Obler, Welkowitz, Erhan, Santschi, Grunwald, Agosti, & Whalen, 1998). Lorch, Borod, and Koff (1998) found that participants with RHD had less intense responses to pictures of negative or positive emotionally-laden scenes, used the fewest facial expressions, used a smaller quantity of nonpropositional speech, and were overall less responsive compared to subjects with LHD and those in a NBD group. Regardless of whether positive emotion processing is impaired, the cumulative findings suggest that the processing of negative emotional content appears to be disadvantaged following focal RHD.

1.1.2 Emotional Processing Hypotheses

A variety of theories and hypotheses have been proposed in an attempt to explain the hemispheric contributions to emotional processing, as outlined by meta-analyses by Abbott, Cumming, Fidler, & Lindell (2013), Demaree, Everhart, Youngstrom, & Harrison (2005), and Gainotti (2012). The four major emotional processing hypotheses are the Right Hemisphere Hypothesis, the Valence Hypothesis, the Emotional Type Hypothesis, and the Behavioral Activation-Inhibition Hypothesis.

According to the Right Hemisphere Hypothesis, the right cerebral hemisphere is dominant in emotional processing, regardless of the type of affect (Abbott et al., 2013; Demaree et al., 2005; Gainotti, 1972; Gainotti, 2012). The Valence Hypothesis states that positive emotions are processed within the left hemisphere and negative emotions in the right hemisphere (see Abbott et al., 2013; see Demaree et al., 2005; see Gainotti, 2012; Perria, Rosadini, & Rossi, 1961). The Emotional Type Hypothesis proposes that the right hemisphere is responsible for the initial, automatic processing of negative affect while the left hemisphere's role is in processing the social component of emotion interpretation (Ross, Homan & Buck, 1994; see Gainotti, 2012). The Behavioral Activation-Inhibition System is another theory that accords with the proposal that the right hemisphere is active during the processing of negative emotions (see Demaree et al. 2005). According to this view, negative emotions are classified as inhibiting behaviors and associated with a change in right frontal lobe activity. The current study does not test any of these hypotheses directly; rather, these descriptions are included simply to provide context.

1.1.3 Evidence from Brain-Imaging and Priming Studies

In order to gain a basic understanding of the neural contributions and correlates of the processing of emotions, researchers have investigated NBD populations using techniques such as priming and brain imaging. Findings from these studies have yielded mixed results. Using functional magnetic resonance imaging, Pichon, Rieger, and Vuilleumier (2012) found that prior exposure to negative affect semantic information activated the right basal amygdala and right posterior fusiform gyrus when participants viewed both fearful and neutral faces. On the other hand, findings in other studies suggest bilateral activation by negative affect stimuli (Kuchinke, Jacobs, Grubich, Conrad, & Herrmann, 2005; Suslow, Kugel, Ohrmann, Stuhrmann, Grotegerd, Redlich, Bauer, & Dannlowski, 2013). In a study by Shibata, Tereasawa, and Umeda (2011), subjects were presented a three-sentence scenario containing two characters. The third sentence was either a direct or indirect negative statement made by one character to the other. Subjects were asked to rate how the character felt about the statement directed to him. Inferred negative emotions activated the bilateral precentral and postcentral gyrus, insula, left lingual gyrus, and putamen more than inferred positive emotions did, and direct negative utterances in literal sentences were associated with greater activation in right postcentral gyrus, insula, and medial temporal gyrus (Shibata, Terasawa, & Umeda, 2011). Still other brain imaging studies have reported findings in line with the Behavioral Activation-Inhibition Hypothesis. For example, Sass, Habel, Sachs, Huber, Gauggel, & Kircher (2012) found that with the presentation of a negative prime, a suppression of brain activity occurred in the right hemisphere.

Overall, a consensus on the neural bases of emotion processing has not been reached partly because of the varying administrations of test protocol and procedures. For example, some studies focus on the effect of emotional interpretation with faces while others focus on the semantic-lexical evaluation of emotion words. Because emotions and their evaluations are subjective and differ among individuals, uniform classification and quantification have not yet been achieved. It appears that the right hemisphere is recruited during negative emotion processing tasks, but a comprehensive view on what the right hemisphere contributes is still unavailable.

1.2 COGNITIVE RESOURCES AND TASK DEMANDS

Previous research has shown that RHD often manifests as higher-level cognitive-linguistic problems, affecting domains such as emotion, discourse, and/or metaphor processing (Borod et al., 1998; Cutica, Bucciarelli, & Bara, 2006; Heberlein et al., 2003; Marini, 2012; Rinaldi, Marangolo, & Baldassarri, 2004; Sherratt, 2007; Sherratt & Bryan, 2012). However, many of these studies investigating cognitive-communicative deficits following RHD employ metalinguistic tasks that obscure the nature of processing strengths and weaknesses, likely due in part to the relatively-higher cognitive processing demand (Tompkins & Baumgaertner, 1998). Individuals with RHD often do not appear to have substantial deficits, and in fact facilitative effects have been observed, when they are assessed in a manner that reduces this demand, via methods such as priming or contextual bias (Blake, 2009; Tompkins, 1991a & b; Tompkins & Flowers, 1987; Tompkins, Spencer, & Boada, 1994).

It is reasonable to propose that these problems with higher-linguistic interpretation are at least in part a result of broader task- and task-demand processing issues. A complex amalgamation of personal, social, linguistic, semantic, autonomic, and contextual information is required for emotional processing to occur. Evaluation of emotion requires synthesizing a large amount of input extremely quickly, involving a series of processes that may be slowed or non-functioning when cognitive resources are diminished due to brain damage.

Studies utilizing the divided visual field paradigm or brain imaging methods have found that tasks commonly thought of as executed by the right hemisphere only, i.e., processing of metaphor, discourse, inferences, and jokes, indeed involve both hemispheres. Which hemisphere is activated more or has the greater processing advantage is task- and demand-specific (Coulson & Williams, 2005; Marinkovic, Baldwin, Courtney, Witzel, Dale, & Halgren, 2011; Prat, Long, & Baynes, 2007; Shears, Hawkins, Varner, Lewis, Heatley, & Twachtmann, 2008; Yang, Edens, Simpson, & Krawczyk, 2009). Cognitive tasks that require fewer resources may appear unimpaired in populations with brain damage. However, as tasks become more cognitivelydemanding and more resources are required, and fewer resources are available due to damage to the cortex, these neural impairments may manifest as behavioral deficits. In order to facilitate effortful negative emotional processing in adults who have deficits, the neural pathways necessary for processing may need to be pre-activated so subsequent interpretations can be made more quickly and easily. It is likely that inducing an emotionally-toned context prior to processing an affective stimulus will activate these pathways, facilitating the evaluation of emotional material.

1.2.1 Priming

Early findings by Tompkins (1991a) suggest that adults with RHD may struggle with affective semantic incongruence due to increased processing demand and, potentially, decreased mental resources available for computation. However, the same individuals' performance in less-demanding conditions can be improved by a preceding emotionally-toned "prime" stimulus that "readies" the system to make a particular interpretation. Implicit priming methods similarly improve the accuracy of linguistic and prosodic judgments of affect (Tompkins, 1991b), presumably through automatic and effortful processing pathways. In the automatic system, incoming semantic information causes a spreading activation through networks representing linguistic, autonomic, and emotional knowledge. These networks are strengthened with redundant semantic input, facilitating retrieval. In the effortful processing system, expectations develop as the input becomes increasingly predictive or more time is given for computation. Effortful processing builds on the automatic system, allowing for flexibility in thinking with novel and inconsistent scenarios. With these networks already activated, fewer cognitive resources are needed to process similar incoming semantic information (Tompkins 1991a, b).

In a study examining how the perception of emotionally-ambiguous target phrases was influenced by prior linguistic content (Tompkins, 1991b), reaction times (RTs) of participants with RHD in a condition of semantic and prosodic congruence did not quantitatively differ from RTs of participants with LHD and NBD. However, RTs for the group with RHD in incongruent situations were significantly longer compared to RTs of participants in the LHD and NBD groups. These results demonstrate that interpretation of paralinguistic information (prosody) is influenced by the prior mood presented. Automatic processing appears to remain relatively intact in individuals with RHD in this type of contextually-dependent language processing and resolution. In fact, for ambiguous prosodic stimuli, individuals with RHDs' interpretation of mood can be swayed depending on the mood primed before the stimulus itself (Tompkins, Spencer, & Boada, 1994). The increased processing demand of evaluating incongruent semantic information in a given context could be a possible explanation for longer RTs in the group with RHD in the 1991(b) study.

1.2.2 Contextual Bias

Many studies have found that other forms of contextual bias also aid processing in different domains in individuals with RHD. For example, Tompkins and Flowers (1987) found that subjects with RHD performed on par with subjects with LHD and normal controls when provided with congruent biasing paragraphs and prosodically-expressed mood stimuli. In one task, subjects judged the prosodic stimulus phrases in isolation. In the following task, short paragraphs, either emotionally congruent or incongruent, were presented before the stimulus phrases to suggest a particular mood. A similar study revealed that prior linguistic context influenced the perception of emotionally-ambiguous target phrases (Tompkins et al., 1994). Even when prosody was neutral, the congruence of preceding paragraphs and lexical-semantic target phrases facilitated processing in individuals with RHD.

Blake (2009) studied reading times as a way to examine how subjects with RHD used contextual clues. Subjects read stories constructed with either high or low predictability of a particular outcome, but this outcome was disconfirmed near the end of the stories. Individuals with RHD had significantly slower reading times during the disconfirming sentence in stories with high predictability and appeared nearly unaffected by the sentence in the stories constructed with low predictability. Blake and Lesniewicz (2005) also found that subjects with RHD were able to use context to generate elaborative inferences. Some participants generated more inferences in a high context condition compared to a low context condition but generated more inferences in the low context condition compared to a control condition, a pattern mimicking the NBD group's performance. Other participants with RHD generated the same number of elaborative inferences in the high and low context conditions, but these conditions generated significantly more inferences compared to the control condition. Results like these demonstrate that individuals with RHD do use contextual cues during interpretation and processing.

1.3 STUDY AIMS AND OBJECTIVES

This study returned to Heberlein and colleagues' (2003) report of lower negative affect word usage by adults with RHD. The current study aimed to investigate if negative affective information, induced in a biased context created implicitly by prior exposure to semantic-lexical cues, would increase the percentage of negative affect words used in descriptions of moving shapes. Subjects were shown half of a video (Heider & Simmel, 1944), and asked to describe what they had seen. A negatively-toned bias was then induced, with the second half of the video and participants' narrated descriptions following.

It was hypothesized that prior to the inducement of the negative affect bias, the narrated descriptions of subjects with RHD would contain a smaller percentage of negative affect words than those of age-, sex-, and education-matched, control participants. It was also expected that the percentage of negative affect words used would be higher in a bias than in a no-bias condition. Control subjects were expected to use a larger percentage of negative affect words compared to subjects with RHD overall, but after the contextual bias, the between-group difference was expected to decrease or disappear. No differences were expected between conditions on a control measure, the percentage of motion words, since the negative affect contextual bias was not intended to influence and increase their usage.

2.0 METHODS

2.1 STUDY DESIGN

The current study used a two-by-two mixed design. Participant group (RHD, NBD) was the between-subject factor, and video condition (No-Bias, Bias) served as the within-group factor.

2.2 PARTICIPANT RECRUITMENT AND CHARACTERISTICS

Eleven individuals with RHD and ten NBD participants completed the experiment. All subjects who participated in the current study provided voluntary written consent prior to testing. Subjects were between the ages of 40 and 85, right-handed, learned only English when developing language as a child, and self-reported no history of or current substance abuse.

Subjects with RHD contacted for this study were part of the Tompkins Language Laboratory Research Registry. These individuals previously provided voluntary consent to be a part of the registry for participation in studies conducted by the Tompkins Language Lab. All participants with RHD had experienced a cerebrovascular accident confined to the right hemisphere region as determined by examination notes of CT or MRI scans. Control subjects contacted for this study were either a part of the Tompkins Language Laboratory Research Registry or from the community.

After an initial telephone screening, informed consent was obtained for the current study. Hearing, vision, and dementia screenings were conducted at the beginning of experimental testing sessions. To pass the hearing screening, subjects needed to achieve a pure-tone average of less than 35 dB HL at 500 Hz, 1000 Hz, and 2000 Hz. If screening requirements were failed at any of these thresholds, a behavioral speech-recognition and repetition hearing screening was conducted. For this screening, participants were asked to repeat ten one- and two-syllable words read by the primary investigator (PI). A folder was held in front of the PI's mouth to prevent subjects from having a lip-reading advantage. To pass, 100% accuracy needed to be achieved. This procedure was used with only one participant from the NBD group.

The vision screening consisted of a shape similarity task and a word identification task. For the shape similarity task, subjects were shown two items that represented one of six possible size and shape categories from the experimental stimulus video, either large or small circles, squares, or triangles, and were asked if items were similar or different. A response of similar required the two shapes to match in shape category and size (i.e., two large triangles, two small circles, etc.); all other conditions required a response of different. This task had ten trials, five each with identical stimuli or different stimuli. The word identification task comprised three words, each bolded and centered on a 3" x 5" note card, which participants read aloud. During the screening, these cards were aligned vertically on the testing surface at the participant's midline. Appendix A contains further detail on these tasks.

Dementia was ruled out for both groups via the difference between immediate and delayed story retell on the Arizona Battery for Communication Disorders of Dementia (ABCD; Bayles & Tomoeda, 1993). Participants in the NBD group also were assessed with the Mini Mental State Examination (MMSE, Folstein, Folstein, & McHugh, 1975) and had to achieve a minimum score of 27. Subjects' demographic information and clinical characteristics are listed in Table 1.

Table 1. Subject demographic information and clinical characteristics

Characteristics	RHD, n=11	Control, n=10
Sex	5 Females, 6 Males	4 Females, 6 Males
Age		
Mean (Std. Dev.)	67.8 (12.3)	63.3 (10.6)
Range	51-85	49-78
Education		
Mean (Std. Dev.)	14.6 (2.7)	15.3 (2.6)
Range	10-20	12.0-18.9
Months post-onset		
Mean (Std. Dev.)	93.7 (39.7)	N/A
Range	20-155	N/A
Peabody Picture Vocabulary Test-Revised[a], Peabody Picture Vocabulary Test-III[b]		
Mean (Std. Dev.)	158.8 (15.1), 173.3 (24.5)	164.0 (5.3)
Range	122-168, 145-188	154-172
Behavioural Inattention Test[c]		
Mean (Std. Dev.)	131.5 (20.7)	143.7 (5.0)
Range	77-146	130-146
Judgment of Line Orientation[d]		
Mean (Std. Dev.)	22.9 (5.6)	27.8 (3.1)
Range	12-32	23-32
Visual Form Discrimination[e]		
Mean (Std. Dev.)	24.9 (4.7)	31.0 (1.4)
Range	15-32	28-32
Discourse Comprehension Test[f], Total % Correct		
Mean (Std. Dev.)	80.9 (11.6)	88.9 (4.7)
Range	65.0-97.5	80.0-95.0
Discourse Comprehension Test[f], Implied % Correct		
Mean (Std. Dev.)	75.9 (14.5)	85.9 (4.9)
Range	60.0-95.0	80.0-93.8
Auditory Working Memory[g]		
Word recall errors		
Mean (Std. Dev.)	10.8 (5.1)	6.1 (4.0)
Range	4-21	1-12
True/False Errors		
Mean (Std. Dev.)	1.2 (1.2)	0.7 (1.3)
Range	0-3	0-4

[a]Dunn, L. M. & Dunn, L. M. (1981). Peabody Picture Vocabulary Test: Revised Edition. Circle Pines, MN: American Guidance Service.
[b]Dunn, L. M. & Dunn, L. M. (1997). Peabody Picture Vocabulary Test: 3rd edition. Circle Pines, MN: American Guidance Service.
[c]Wilson, B., Cockburn, J., & Halligan P. W. (1987). Behavioural Inattention Test. Tichfield, England: Thames Valley Test Company.
[d]Benton, A. L. Hamsher, K. D., Varney, N. R., & Spreen, O. (1983). Judgment of Line Orientation. In *Contributions to neuropsychological assessment*. (pp. 44-54). New York: Oxford University Press.
[e]Benton, A. L., Sivan, A. B., Hamsher, K. D., Varney, N. R. & Spreen, O. (1983). Visual Form Discrimination. In *Contributions to neuropsychological assessment* (2nd ed.), (pp. 65-72). New York: Oxford University Press.
[f]Brookshire, R. H. & Nicholas, L. E. (1993). The Discourse Comprehension Test. Tuscon, AZ: Communication Skill Builders, a Division of the Psychological Corporation.
[g]Tompkins, C. A., Bloise, C. G. R., Timko, M. L. & Baumgaertner, A. (1994). Working memory and inference revision in brain-damaged and normally aging adults. *Journal of Speech and Hearing Research, 37,* 896-912.

2.3 VIDEO NARRATION TASK

A copy of the original video stimulus from Heider and Simmel (1944) was downloaded from YouTube. Seventeen pilot trials were conducted to validate the subdivision of the video stimulus so that half could be played in each of two conditions, an experimental (Bias) condition and a control (No-Bias) condition.

Pilot participants narrated what they saw in the video, and their responses were recorded via microphone with Audacity audio recording software. Six trials had participants watch the complete video while providing on-line interpretations, six trials had participants watch the complete video in reverse while providing on-line interpretations, and five trials had participants watch the video in two parts without on-line interpretations. Instead, the video was divided in half at the 48-second mark, and participants provided their interpretations of what they saw after viewing each half. Responses were orthographically transcribed by the PI. The PI cross-checked each transcription for accuracy.

No differences in percentage of negative affect words or motion words were observed among the different presentations of the video. Thus for the experimental task, the video was divided in half at the midway point. The first half of the video would serve as the No-Bias Condition, and the second half of the video, after a negative affect contextual bias task, would serve as the Bias Condition.

2.4 CONTEXTUAL BIAS TASK

In the Contextual Bias task, participants listened to short sentences designed to elicit a negative interpretation and selected a word label to identify that interpretation. The negative affect sentences were taken from a previous study, where their emotional categorization was validated by five adult males in pre-experimental rating sessions (Tompkins, 1984). The phrases and their intended negative interpretations are listed below in Table 2. These stimuli were presented live voice by the PI, in the order listed below. Three affect word labels (*fear*, *anger*, and *neither*) were created with Times New Roman font, size 70, Bold, and in all capital letters. The words were each placed in the center of a 3” x 5” white plain index card. During the experimental testing session, these cards were aligned vertically on the testing surface at the participant’s midline. Participants indicated their response to each sentence by pointing to the card of their choice.

Table 2. Contextual bias task: Negative affect phrases and answers

Negative Affect Sentences	Correct Answer
A waiter spilled coffee on you.	Anger
A snarling dog chases you.	Fear
You are lost in the forest at night.	Fear
A friend tells lies about you.	Anger
Your brakes don't work on the freeway.	Fear
Someone claimed your idea.	Anger
A passing car splashes you.	Anger
Your house catches on fire.	Fear

2.5 DATA ANALYSES

The primary dependent measure for this study was the percentage of negative affect words in each video narration condition. A control measure, percentage of motion words, was also evaluated and was not expected to differ between conditions.

Subjects' responses were recorded with Audacity audio recording software. The responses were orthographically transcribed verbatim by the PI and included fillers, errors, re-phrasings, and additional extraneous utterances. The percentages of negative affect and motion words in transcribed responses were determined via the Linguistic Inquiry and Word Count Lite (LIWClite) word analysis software (Pennebaker, Booth, & Francis, 2007), following procedures in the Heberlein and colleagues study (2003).

The Mann-Whitney U Test for Independent Samples was chosen to analyze the between-subject comparison of negative affect word use by the two subject groups. The Related-Samples Wilcoxon Signed Rank Test was employed to analyze the within-subject comparison, across video bias conditions, for percentages of negative affect and motion words. These nonparametric tests were used because of small sample sizes, the heterogeneity of the data, and the non-normality of the data, which were positively skewed. *T*-tests were used to analyze differences between and within groups on the evaluation of the negative affect sentences of the contextual bias task. Spearman's Rho correlation coefficient was generated to investigate the possible effect of time post-onset, which was vast in range, on individuals with RHD's performance across task conditions.

Qualitative analysis also was conducted through comparison of subjects' responses between and within groups. Features of interest in responses included length, comparisons, emotional content, and personification.

3.0 RESULTS

3.1 PRELIMINARY ANALYSIS

The control group achieved 93.8% accuracy for the affect contextual bias task (raw score M = 7.50 of 8 total; SD = 0.71). Subjects with RHD achieved an accuracy of 90.9% (raw score M = 7.27 of 8 total; SD = 0.79). Evaluation of the sentences was scored as "correct" if subjects chose either negative affect response (i.e., *fear* or *anger*), because the intention of the sentences was to induce a negative emotional context. Therefore, only an answer of n*either* was marked as incorrect. Thus, both groups were accurate at evaluating the negative affect sentences that were designed to induce the contextual bias. The slightly higher accuracy for the NBD group was not statistically significant ($t(19) = -0.39$, $p > 0.05$). Two other between-group *t*-tests indicated that male and female participants within each participant group did not differ significantly on the contextual bias task (RHD $t(9) = 2.02$, $p > 0.05$; NBD $t(8) = 0.53$, $p > 0.05$).

3.2 PRIMARY ANALYSIS

Results for percentage of negative affect and motion words used in the video narration task are illustrated in Tables 3, 4, and 5 and Figures 1 and 2. Appendix B provides individual subjects' percentages of negative affect and motion word use in each condition.

The percentage of negative affect words used by each subject group in the No-Bias and the Bias Conditions did not differ significantly (No-Bias Condition, $p = 0.76$; Bias Condition $p = 1.00$). The percentage of negative affect words in subjects' narrated descriptions did vary significantly between the No-Bias and Bias Conditions (NBD, $p = 0.01$; RHD, $p = 0.04$). Negative affect word use in Bias Condition descriptions was significantly influenced by the preceding negative affect priming task. Within-group analysis conducted with independent sample *t*-tests revealed that male and female performance in each group did not differ significantly in either the No-Bias or Bias condition (RHD No-Bias: $t(9) = 0.14$, $p > 0.05$; RHD Bias: $t(9) = 0.23$, $p > 0.05$; NBD No-Bias: $t(8) = 1.32$, $p > 0.05$; Bias: $t(8) = 1.11$, $p > 0.05$).

The percentage of motion words in subjects' narrated descriptions did not vary significantly between the No-Bias and Bias Conditions (NBD, $p = 0.33$; RHD, $p = 0.74$). Therefore, the negative affect contextual bias did not influence motion word use in Bias Condition descriptions. This further verifies the division of the video in half; subjects viewed and described relatively equal amounts of action events, as evident from their responses across conditions.

Table 3. Means (standard deviations) for percentage of negative affect and motion word use across conditions

	RHD	**NBD**
No-Bias Condition		
Negative Affect	0.41 (0.60)	0.68 (1.08)
Range	0.00-2.04	0.00-2.94
Motion	2.42 (3.59)	4.00 (2.96)
Range	0.00-10.20	0.00-8.77
Bias Condition		
Negative Affect	2.01 (1.82)	2.30 (2.40)
Range	0.00-5.71	0.00-8.16
Motion	2.32 (2.75)	3.08 (2.26)
Range	0.00-8.70	1.09-6.67

Table 4. Means (standard deviations) for percentage of negative affect use for between- and within-subject analyses

Between-Subject Findings (Mann-Whitney U for Independent Samples)	Within-Subject Findings (Related-Samples Wilcoxon Signed Rank Test)
No-Bias Condition: (U = 49; $p = 0.76$)	RHD ($p = 0.04$)
RHD: 0.41 (0.60)	No-Bias Condition : 0.41 (0.60)
NBD: 0.68 (1.08)	Bias Condition : 2.01 (1.82)
Bias Condition: (U = 47; $p = 1.00$)	NBD ($p = 0.01$)
RHD: 2.01 (1.82)	No-Bias Condition : 0.68 (1.08)
NBD: 2.30 (2.40)	Bias Condition : 2.30 (2.40)

Note: $a = 0.05$

Table 5. Means (standard deviations) for percentage of motion word use in within-subject analysis*

RHD	NBD
No-Bias Condition: 2.42 (3.59)	No-Bias Condition: 4.00 (2.96)
Bias Condition: 2.32 (2.75)	Bias Condition: 3.08 (2.26)
$p = 0.74$	$p = 0.33$

*Related-Samples Wilcoxon Signed Rank Test, $\alpha = 0.05$

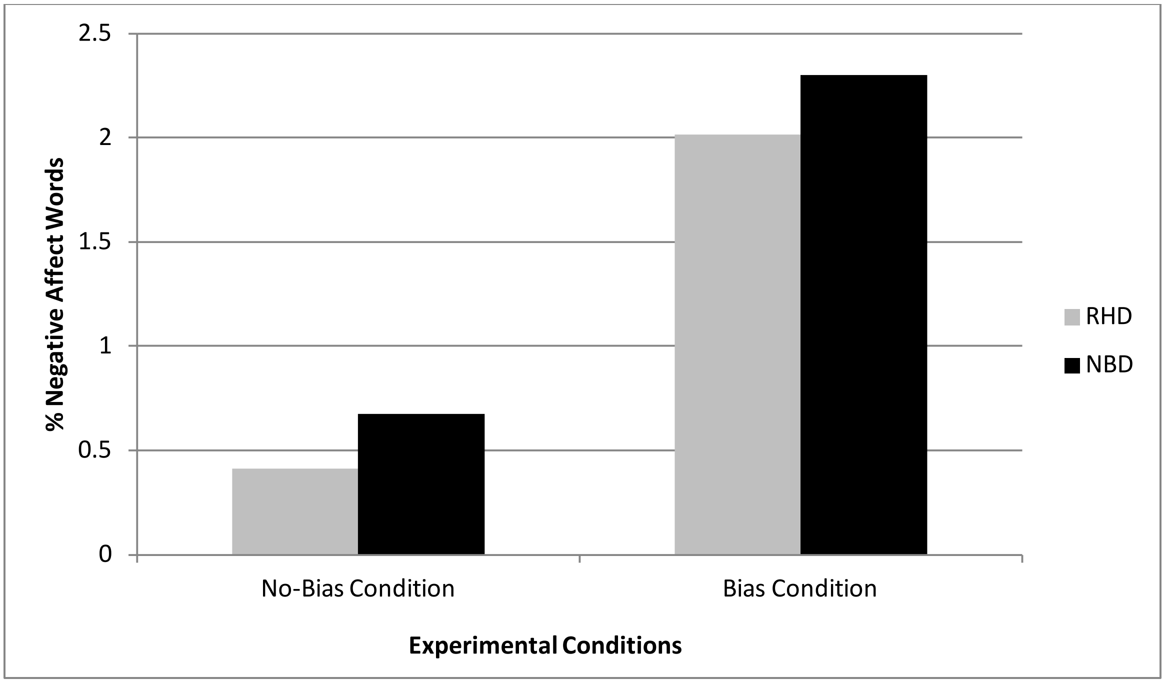


Figure 1. Percent negative affect words in subjects' narrated descriptions

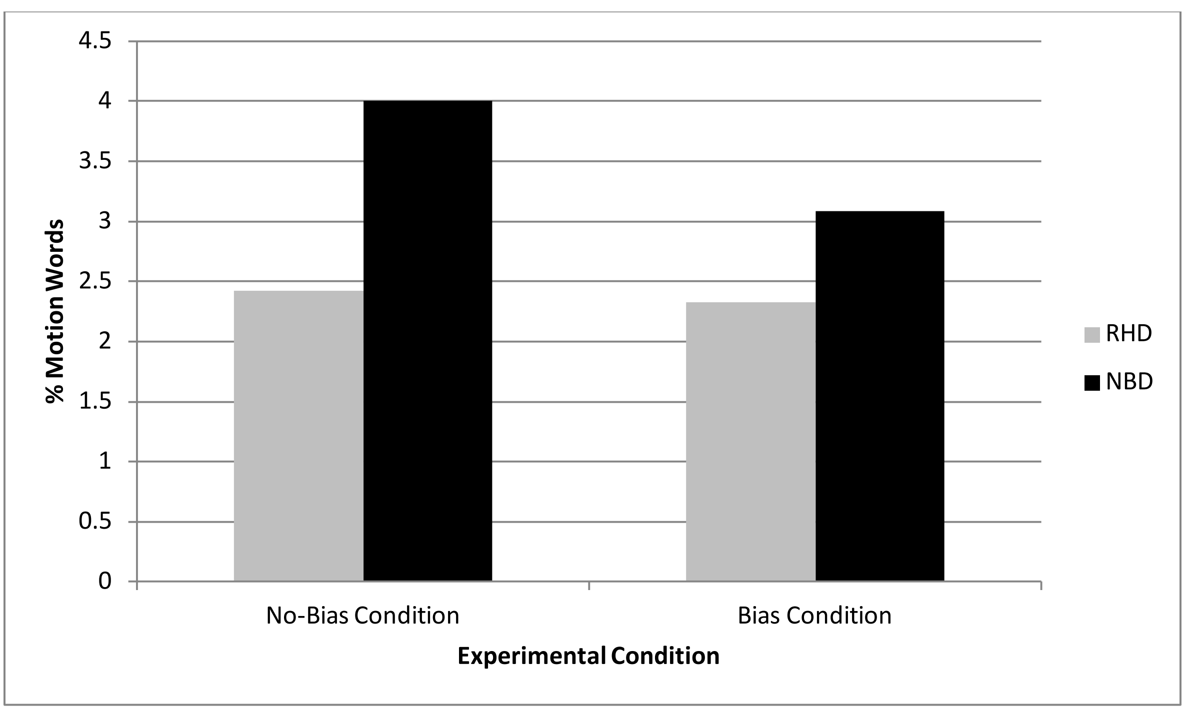


Figure 2. Percent motion words in subjects' narrated descriptions

3.3 *POST HOC* ANALYSIS

3.3.1 Narrated Description Length

Although there was great variation, on average, subjects' narrated descriptions contained more words in the Bias Condition compared to the No-Bias Condition. Control subjects' responses contained more words than the responses of subjects with RHD. These findings are presented in Table 6. Appendix C provides data on the length of each individual subject's descriptions in each condition.

Table 6. Mean (M) and Standard Deviation (SD) of number of words used in subjects' descriptions

RHD	NBD
No-Bias Condition:	**No-Bias Condition:**
M= 67.64	M= 89.10
SD = 47.70	SD = 78.68
Range = 9.00-170.00	Range = 29.00-293.00
Bias Condition:	**Bias Condition:**
M= 92.36	M= 107.30
SD = 64.17	SD = 86.95
Range = 28.00-255.00	Range = 15.00-276.00

3.3.2 Qualitative Findings

Between-group observations of narrative quality revealed that both groups provided descriptions with varying detail, ranging from a simple listing of the actions that occurred to developing a creative story by assigning roles and motives to the shapes.

One stylistic difference observed was in the control subjects' use of hedges. Subjects in the NBD group often started descriptions with "appeared to be" or "seemed to be" prior to describing a personified action or detail of the shape. The NBD group also used more adjectives to describe the different shapes, especially the two triangles, compared to subjects in the RHD group. Five of the eleven subjects in the RHD group did not use adjectives to distinguish the two triangles from one another. Rather, the two triangles were differentiated by the context in which one of them was mentioned based on its actions.

Table 7 summarizes the frequency of use of three other types of qualitative parameters in each subject groups' descriptions. These are comparisons, personifications (with three subcategories: personified actions, states of being, and social processes), and emotions.

For the purposes of this study, *Comparisons* were identified when objects and events were described in terms of another thing or event. Comparisons to a person were not included in this category, but instead were classified as social processes.

Personified actions were defined as when the origin and execution of an action (verb) originated from an object and was goal-directed or intentional. Verbs were not considered personified actions if participants used them only in a "play-by-play" manner (i.e., simply commenting on the action occurring and not providing a verb that's meaning or use added an animate quality within the context). Psycholinguistic literature indicates that the following continuum is utilized to describe animacy (see de Swart, Lamers, & Lestrade, 2008 & Vogels, Krahmer, & Maes, 2013):

Human > Animal (Animate) > Inanimate

In the current study, actions considered to be personified fell within the human category of the continuum.

States of being were defined as words or phrases that did not describe an emotional condition but that depicted another condition of the object that added an animate quality. A word could be classified as both a state of being and an emotion.

Social processes were originally described and analyzed by Heberlein and colleagues (2003). This category of words consisted of "social pronouns (first-person plural, second-person, and third person pronouns), communication verbs ("talk", "share"), and references to family, friends, and other humans." (p. 715). In the current study, social processes consisted only of social pronouns and references to family, friends, and other humans. Communication verbs were already accounted for in the personified actions subcategory of personifications. The pronoun *they* was considered a social process term when it had an animate noun referent.

Emotion terms were defined as words or phrases that rendered or described a positive or negative emotional state of the shapes within the context of the video. This category included terms originally identified as "negative affect words" by the LIWClite analysis of narrated descriptions, but it also captured terms that were not so categorized by the analysis software. For example, terms described as comparisons or personifications could be co-labeled as emotions if prior context suggested an emotional interpretation. To illustrate, the verb *chase* would be classified only as a personified action unless, earlier in the context, another word lent it emotional significance, such as *escape* or *angry*. In that case, *chase* would be counted as an emotionally-laden personified action.

Table 7. Group mean frequency of qualitative parameters in narrated descriptions

Descriptive Parameters	RHD, N=11	NBD, N=10
Comparisons	1.00	1.00
Personifications		
Social Processes	0.55	2.30
Personified Actions	3.36	6.50
States of Being	0.64	1.20
Emotions	2.00	4.00

Two measures of each of these parameters are considered below. The first is the proportion of each type of qualitative term, relative to the total number of words in a narrated sample. Each and every use of a term was included in the calculation of this measure. The second measure is the unique variability of terms in each parameter category, for each group. This measure identifies the proportion of specific terms used by participants in one group that were not used by those in the other group. For example, if the group with RHD used 10 Comparison terms, 6 of which were used by the NBD group as well, the unique variability would be 4 unique terms/10 = 0.40. For this measure, only the initial use of a term by a subject was included in the calculations.

Tables 8 and 9 provide the data for the proportions of qualitative terms in the No-Bias and Bias Conditions, respectively. Tables 10 and 11 present the data on unique variability for each condition. Appendix D provides the qualitative findings for individual subjects.

Table 8. Group proportion data for qualitative terms relative to total words in No-Bias Condition

No-Bias Condition	RHD	NBD
Comparison		
M	0.030	0.033
SD	0.023	0.026
Range	0-0.065	0-0.069
Personification (Total)		
M	0.067	0.116
SD	0.054	0.075
Range	0-0.184	0.061-0.304
Social Processes		
M	0.001	0.034
SD	0.003	0.059
Range	0-0.011	0-0.179
Personified Actions		
M	0.060	0.074
SD	0.049	0.018
Range	0-0.163	0.051-0.105
States of Being		
M	0.002	0.009
SD	0.006	0.013
Range	0-0.02	0-0.036
Emotions		
M	0.013	0.032
SD	0.021	0.028
Range	0-0.06	0-0.088

Table 9. Group proportion data for qualitative terms relative to total words in Bias Condition

Bias Condition	RHD	NBD
Comparison		
M	0.020	0.038
SD	0.019	0.032
Range	0-0.06	0-0.102
Personification (Total)		
M	0.103	0.129
SD	0.059	0.098
Range	0.027-0.229	0.025-0.377
Social Processes		
M	0.019	0.047
SD	0.040	0.086
Range	0-0.114	0-0.26
Personified Actions		
M	0.075	0.098
SD	0.027	0.037
Range	0.027-0.13	0.037-0.155
States of Being		
M	0.008	0.006
SD	0.013	0.009
Range	0-0.036	0-0.022
Emotions		
M	0.034	0.053
SD	0.041	0.033
Range	0-0.114	0-0.104

Table 10. Group data for unique variability in No-Bias Condition

No-Bias Condition	RHD	NBD
Comparison		
M	0.288	0.183
SD	0.422	0.337
Range	0-1	0-1
Personification (Total)		
M	0.257	0.589
SD	0.342	0.262
Range	0-1	0-1
Social Processes		
M	0.000	0.233
SD	0.000	0.344
Range	0-0	0-1
Personified Actions		
M	0.258	0.557
SD	0.345	0.308
Range	0-1	0-1
States of Being		
M	0.091	0.500
SD	0.302	0.527
Range	0-1	0-1
Emotions		
M	0.273	0.505
SD	0.467	0.460
Range	0-1	0-1

Table 11. Group data for unique variability in Bias Condition

Bias Condition	RHD	NBD
Comparison		
M	0.121	0.200
SD	0.308	0.358
Range	0-1	0-1
Personification (Total)		
M	0.330	0.455
SD	0.311	0.292
Range	0-1	0-1
Social Processes		
M	0.000	0.180
SD	0.000	0.309
Range	0-0	0-0.857
Personified Actions		
M	0.319	0.435
SD	0.316	0.269
Range	0-1	0-1
States of Being		
M	0.364	0.300
SD	0.505	0.483
Range	0-1	0-1
Emotions		
M	0.252	0.429
SD	0.369	0.392
Range	0-1	0-1

Both subject groups used *Comparisons* in their responses. In the Bias Condition, the NBD group used about one and a half times more comparisons per total words than the RHD group. However, there was no group difference in the No-Bias Condition. The results for unique variability in comparison terms varied by condition. Unique variability of comparisons was higher for the RHD group than the NBD group in the No-Bias Condition, but higher for the NBD group in the Bias Condition. Table 12 lists the comparison terms used by each group.

Table 12. Comparisons used by subjects in narrated descriptions*

RHD	NBD
door (2), ball (6), house, box, building, *dot, card, entrance way, gate, two little birds one bigger bird running after the smaller one, demolition*	***door (5), ball (3), house (3), box (4), building***, *room (2), wall (2), game of cat and mouse, game, domestic altercation*

Note: For words used by multiple participants, the number who used the term is in parenthesis. For instance, *ball* (6) was found in six RHD participants' narrated descriptions.

*Bolded words indicate terms shared across groups

Table 13 lists the three subsets of the *Personification* category and the specific personification terms used by both subject groups. Overall, in the No-Bias Condition, the NBD groups' narrated descriptions contained about twice the proportion of personifications compared to descriptions by individuals in the RHD group, with less difference for personified actions than for the other subcategories. In the Bias Condition, however, there was very little difference between groups overall, and what there is is driven by the social processes subcategory. The unique variability of personification terms in descriptions of the NBD group was nearly two times higher than that of the RHD group in the No-Bias Condition. The between group difference was smaller in the Bias condition, reflecting a smaller difference in the variability of personified action terms and approximately equal group variability in state-of-being terms. The adults with RHD used no unique social processes terms in either condition.

Table 13. Personifications used by subjects in narrated descriptions*

	RHD	NBD
Personified Actions	***come in/out/up (5), get in/out (8), break (4), chase (5), bully, go after (2), leave (3), join, play, look, go away, try (6), destroy, escape (3), open (2), sneak out, run, close****, duke it out, skitter, swallow, eat, let out, hit, dislodge, compete, able, pull, figure out, tear down, locked up, fight, win, get away, start (3), locked in, release*	***come in/out/up (6), get in/out (8), break (3), chase (5), bully, go after (2), leave (2), join, play, look, go away, try (8), destroy (3), escape (4), open (3), sneak out (2), run (3), close (2)****, pursue, lend aid, team up against, run away (2), maneuver, enter (2), attack (2), scare, exit, allow, not let in/out (2), let in, kiss, come (2), tear up, attempt, hide, manage (2), meet, follow, after, burst, push (2), get in a fight, break it off, break up [the fight], break in, confront, challenge, smash, poke, approach, drive, sneak up, stay away, distract, dance (2), come after, retreat, interact, see, migrate, proceed, use, take advantage, worked his way, notice*
States of Being	*come-uppance, gone, free, trouble, disappear, bad, poor*	*want (2), not know, prefer, not like, decide (2), ready, no rhyme or reason, curious, interested, alone, not understand, wildly*
Social Processes	***bully, his, friend, he (3), guy, him***	***bully, his (3), friend, he (4), guy, him (5)****, wife, girlfriend, other party, related party, husband, boyfriend, they (2), she (2), them (2), person, people, kids, opposite sex, her, each other, reunited company, himself*

Note: For words used by multiple participants, the number who used the term is in parenthesis. For instance, *chase* (5) was found in five NBD participants' narrated descriptions.

Note: For personified action terms, only the present first person singular form of the verb is provided, but all forms of the verb are accounted for in this single form.

*Bolded words indicate terms shared across groups

Regarding the *Emotion* parameter, overall, the NBD group used proportionately more emotion terms in both conditions and had one and a half to nearly two times the unique variation in emotion words compared to participants with RHD. Table 14 lists the different emotion terms used by both groups.

Table 14. Emotion words used by subjects in narrated descriptions*

RHD	NBD
***go after, bully (2), chase (4), break (2), escape (3), friend, angry (2), destroy**, **play,** afraid, upset, not happy, locked in, release, duke it out, trouble, locked up, win, fight, bad, poor, get away, tear down*	***go after, bully (2), chase (4), break (2), escape (4), friend, angry/anger (5), destroy (3)**, **play,** not let in/out (2), sneak out (2), get in a fight, break it off, domestic altercation, break in, confront, distraught, challenge, rage, smash, mean, prefer, team up against, attack (2), scare, not like, kiss, push (2), poke, drive, stay away, run away, happiness/happy (2), come after, retreat, aggressive, take advantage, enjoy, violently, tear up*

Note: For words used by multiple participants, the number who used the term is in parenthesis. For instance, *bully* (2) was found in two RHD participants' narrated descriptions.
*Bolded words indicate terms shared across groups

Inter-rater reliability for these qualitative parameters was established by comparing independent categorizations made by the PI and the PI's mentor for 20% of the narrated samples. Across parameters, point-to-point scoring agreement ranged from acceptable to perfect (78-100%). Disagreements were settled during comparison of the ratings by the PI and the PI's mentor.

4.0 DISCUSSION

This study aimed to investigate the effect of contextual bias on the production of negative emotion words by individuals with RHD. It was adapted from the Heberlein and colleagues study (2003), which reported that subjects with RHD used fewer negative affect words compared to subjects with LHD and to normal controls in descriptions of a video. In the current study, subjects provided narrated descriptions of that same video in both a No-Bias and Bias Condition. The negatively-toned bias was induced by having participants evaluate the emotion of negative affect sentences in the contextual bias task. The results comported with expectations in some regards, and not in others.

4.1 NEGATIVE AFFECT WORD USE

Following focal RHD, the production of negatively-toned material has been reported to be impaired (e.g., Borod et al., 1992; Borod et al., 1998; Heberlein et al., 2003; Lorch et al., 1998; Sherratt, 2007). However, as predicted, inducement of a contextual bias prior to presentation of the experimental video stimulus facilitated processing and description of negative emotions by a group with RHD. Both RHD and NBD subject groups significantly increased the percentage of negative affect words in their narrated descriptions following the contextual bias. Based on the findings it is hypothesized that the evaluation of these sentences in the contextual bias task pre-activated pathways involved in negative emotional processing. While subjects viewed the second half of the stimulus, the negative emotion processing pathways remained activated, reducing the cognitive demand of the task and/or facilitating a more negative interpretation in the narrated descriptions. NBD participants produced a higher percentage of negative affect words than subjects with RHD overall, but this difference was not statistically significant. Not surprisingly, then, while the between-group difference in percentage of negative affect word use did decrease in the Bias Condition, this difference was not significant either. Motion word use did not differ across conditions, supporting the contention that the bias inducement influenced the intended factor, negative affect word use.

There were two participants in the RHD group who did not produce any negative affect words in either condition. These individuals also scored below the cut-off for neglect on the Behavioural Inattention Test (Wilson, Cockburn, & Halligan, 1987). However, they were highly accurate at evaluating the negative affect contextual bias sentences (scores of 7 or 8 of 8 possible). This finding could suggest that individuals with RHD who have neglect do not benefit from contextual bias, but more analyses would be needed to determine any other ways in which these individuals may have differed from the rest of the participants in the RHD group. In addition, there were two individuals in the NBD group who did not produce any negative affect terms in either condition, suggesting that the lack of negative affect production simply could be due simply to general individual variability.

Facilitation of negative affect processing can be analyzed by examining the nature of impairments resulting from RHD. Processing deficits have been observed in different cognitive domains in this population (e.g., Myers, 1999). When these same domains are investigated after reducing the cognitive demand of the tasks, however, individuals with RHD often do not appear to have substantial deficits (Blake & Lesniewicz, 2005; Blake, 2009; Tompkins, 1991a&b; Tompkins & Flowers, 1987; Tompkins, Spencer, & Boada, 1994). Studies that examine processing following focal RHD often use metalinguistic tasks that obscure the nature of processing strengths and weaknesses perhaps because of the relatively-high cognitive demand required (Tompkins & Baumgaertner, 1998). The results of the current study, along with these past reports, suggest that one way to facilitate effortful processing for adults with RHD is to make it less 'effortful,' by activating the necessary pathways prior to engaging in what otherwise might be a high-demand task.

4.2 CONTEXTUAL BIAS EVALUATION

Both groups were accurate at evaluating the negative affect sentences in the contextual bias task. Despite some range of performance within each group, a *post hoc* analysis determined that the accuracy of the negative affect sentence evaluations did not correlate with or predict the percentage of negative affect words used in Bias Condition narrated descriptions (RHD r_s (10) = 0.22; NBD r_s (9) = 0.37).

4.3 QUALITATIVE FINDINGS

In a *post hoc* analysis of subjects' narrated descriptions, both qualitative similarities and differences were observed. These findings are descriptive in nature.

4.3.1 Narrated Description Length

Because the task included a subjective interpretation of events, responses from both subject groups were expected to be highly variable, ranging from non- to highly-elaborative in regards to descriptions. Both groups, on average, provided longer descriptions in the Bias Condition compared to the No-Bias Condition. However, this pattern cannot be extended to individual subject tendencies; three RHD and five NBD participants used fewer words in their Bias than their No-Bias Condition narrated descriptions. This observed group difference can be explained by individual cognitive and linguistic variability.

4.3.2 Hedges

One narrative difference that was observed between groups was the use of “hedges” by NBD controls. The use of hedges conveyed a sense doubt or uncertainty in the NBD group’s responses (Allott, 2010; Lakoff, 1973). This linguistic tool may have been employed as a way to avoid complete attribution of human characteristics to nonhuman objects, and thus avoid the chance of providing an incorrect description of the video, especially if participants were not comfortable that their interpretation of the video was the correct one.

4.3.3 Other Qualitative Parameters

4.3.3.1 Proportional Use of Parameters

There was no group difference in object-to-object comparisons in the No-Bias Condition. In that condition, though, the NBD group’s narrated descriptions had larger proportions of personifications and emotion words than the RHD group's narrations. This is consistent with some work that reports that RHD leads to difficulties in attributing and inferring mental states of others, which is one facet of Theory of Mind (ToM) (Champagne-Lavau & Joanette, 2009; Happé, Brownell, & Winner, 1999). Similarly, some work documents difficulty with anthropomorphization to adults with RHD. For example, a study by Weed, McGregor, Nielsen, Roepstorff, and Frith (2010) investigated ToM differences in RHD and NBD groups using the stimulus from the current study. Weed and colleagues tested subjects' ability to anthropomorphize mental states onto the geometric shapes as a potentially better-than-typical indicator of ToM abilities. Clips of the large and small triangle either "interacting" or moving with random self-propelled motion were shown to subjects. The "interacting" clips were intended to cause subjects to anthropomorphize the movements of the two triangles. After viewing the clips, subjects were asked if the video reflected a story or not and then were asked to describe what they had seen. The researchers found that participants with RHD were less accurate in discriminating between the two types of video clips, i.e., interacting or random movement of triangles, and had a reduced quantity of anthropomorphisms in their recorded descriptions.

Interestingly, introducing the contextual bias in the current study decreased the proportion of object-to-object comparisons used by the RHD group and increased their proportional use of personification and emotion terms. This is consistent with the RHD group beginning to treat the shapes in the video as animate entities with motives and emotions, and for whom actions beget consequences. Despite the apparent facilitation of animacy-oriented descriptions for the RHD group, an inspection of the specific emotion and personification terms used by this group, especially terms that identified states of being, suggests that the RHD group may have focused more on consequences and the NBD group more on ToM concepts.

When no comparisons were used and the name of the shape itself was instead mentioned in descriptions, the participant groups seemed to vary rather widely in the manner in which they differentiated the shapes from one another. Subjects in the NBD group were more likely to use adjectives to ascribe qualities or characteristics to specific shapes, especially when speaking about the two triangles in order to distinguish one from the other. Almost half of participants with RHD did not use any adjectives to differentiate between the two triangles. Rather, it was only apparent from contextual information which shape these participants were describing. Because the PI was familiar with the test stimulus, she understood which shapes subjects were describing in their narrations. This understanding cannot be soundly extended to a blind evaluator with no knowledge of the video stimulus, if one were to work only from transcriptions of participants' descriptions.

This finding could reflect a tendency for some adults with RHD to over-assume common ground between communication partners (e.g., Brownell, Carroll, Rehak, & Wingfield, 1992). Some individuals with RHD have been observed to use unclear references or provide too little information to facilitate understanding for a listener. They may also inaccurately or inadequately evaluate common ground, or shared knowledge (Blake, 2006; Myers, 1999). The consistency between the patterns often observed in other studies of adults with RHD (Brownell et al., 1992; Marini, 2012; Marini, Carlomangno, Caltagirone, & Nocentini, 2005; Uryase, Duffy, & Liles, 1991) and the results for this study's RHD group suggests that a representative sample was included in this investigation.

4.3.3.2 Unique Variability of Qualitative Parameters

The unique variability of comparison terms for the RHD group also decreased after the introduction of the contextual bias. This could reflect both the fact that they were using proportionally fewer comparisons in the Bias Condition and that the Bias Condition corresponded to the second half of the video, when it was less likely that any novel comparisons would be made. Additionally, this result again could reflect a problem with assumptions of common ground by adults with RHD (e.g., Brownell, Carroll, Rehak, & Wingfield, 1992). This possibility is consistent with the fact that there was no decrease in unique variability of comparisons for the NBD group after the contextual bias.

Unique variability of personification terms simultaneously increased for the RHD group and decreased for the NBD group after introduction of the contextual bias. The reduction for the NBD group may reflect the second-half effect, wherein there are fewer new things to say about the ongoing action as the video continues. For the RHD group, this result again may reflect the success of the bias in inducing them to personify and ascribe human qualities, motivations, and consequences to the shapes in the video.

Despite this potential facilitation from the contextual bias, the RHD group appeared to use a smaller range of emotion terms, represented in the unique variability measure, than the NBD group, in both conditions. This is consistent with previously-described, well-documented difficulties with emotion processing for adults with RHD (e.g., Borod et al., 1992, Heberlein et al., 2003, Lorch et al., 1998, Sherratt, 2007) and raises questions of whether and when pre-stimulation or priming can completely compensate for any such difficulties.

4.4 CURRENT AND PREVIOUS STUDY FINDINGS

The results of this study do not accord with the conclusions of the original study by Heberlein and colleagues (2003), in that the current study found no significant difference between RHD and NBD participants in percentage of negative affect word use in either the No-Bias and Bias Conditions. Possible explanations for the differences between study outcomes include varying sampling, data collection and data analysis methods. Participants with RHD in the previous study had damage confined to a single cerebral location, the right somatosensory area, whereas lesion location was variable amongst individuals with RHD in the current study. Perhaps the right somatosensory area is particularly involved in simulation of negative emotions.

Another difference is that the previous study averaged the data from two narrative description conditions of the entire video into one, because similar patterns of effect were observed. However, the second narration followed a set of questions that were designed to induce personifications and evaluations of the shapes (e.g., “Which one would you like to spend time with? Which one would be a better friend? Why?”). With results averaged across narrations, the two studies cannot be compared directly. In particular, it is not possible to tell whether the intervening questionnaire may have primed adults with RHD to use more affective words in the second narration. The current study also, however, analyzed the data in each condition separately, which could have led to the difference between studies.

A final parameter to note is that the current study employed nonparametric analyses due to high variability of the data and small sample size. Heberlein and colleagues (2003) used parametric methods despite their own small samples.

4.5 LIMITATIONS

Though the results of the current study were consistent with the hypothesis that contextual bias can facilitate emotional processing for adults with RHD, there are some limitations to consider.

In regards to subject participation, the sample size was small (N = 21 total), introducing the possibility that the RHD cohort was not a complete representational cross-section of this population. With larger cohorts that are representative of the population as a whole, the facilitative properties of contextual bias can be further investigated.

Another potential limitation is that time post onset of stroke differed widely among participants with RHD (see Table 1). While this difference could have affected the results, the correlations between time post onset and performance for participants with RHD were small and non-significant (Spearman's r_s (10) = -0.33 (No-Bias), -0.34 (Bias)).

In addition, the relationship between task performance and lesion location was not investigated. This kind of assessment would be necessary to ascertain whether different parts of the right hemisphere are more or less involved in the processes of interest, and to test some of the differences between the hypotheses of emotional processing listed earlier.

Another potential issue is that the extent and nature of rehabilitation that participants with RHD received was not known and therefore not collected by nor controlled by the PI. Different cognitive strategies could have given those with certain types or intensities of rehabilitation an edge over others who did not receive the same type, quality, or quantity of treatment.

The directions given to subjects before they reported their narrated descriptions (i.e. *Tell me in your own words what you saw*) were somewhat vague. This was intended; however, this ambiguity may have also worked against the researchers. It is possible that subjects may have believed that their interpretations would have been incorrect or "bizarre" if they attributed human characteristics to mere shapes moving, causing them to "second-guess" their initial interpretations. In the future, the directions could be modified to inform participants that there is no correct answer to the stimulus about to be viewed, and that the investigator is interested in only the personal interpretation of the events that occur.

4.6 FUTURE DIRECTIONS

There are many individual differences as well as concomitant problems that account for the vast variability in cognitive and communicative performance in the RHD population. However, many investigative factors also influence performance of adults with RHD. Previous and current inclusion criteria for RHD studies have been lesions confined to the right hemisphere only (Brookshire, 2003; Myers, 1999). This requirement is much broader compared to inclusion criteria for other studies that focus on specific types of Aphasia, for example. However, the broadly-defined RHD criterion may have been necessary in conducting early studies of the nature and generality of behavioral changes associated with RHD (Tompkins, Lei, & Zezinka, in press). Future studies could work on attempting to link observed behaviors in adults with RHD and lesion location.

Processing and task demands have been found to influence performance variability and processing among individuals with RHD (e.g., Blake, 2009; Coulson & Williams, 2005; Prat, Long, & Baynes, 2007; Shears, Hawkins, Varner, Lewis, Heatley, & Twachtmann, 2008; Tompkins, 1991 a & b; Yang, Edens, Simpson, & Krawczyk, 2009). More work is needed to investigate the relationship between processing task and demand and the effect of contextual bias among other types of cognitive and language functions. Findings from these avenues will provide insight into the processing role of the right hemisphere as well as aid in the development of clinical approaches for individuals with RHD.

5.0 CONCLUSION

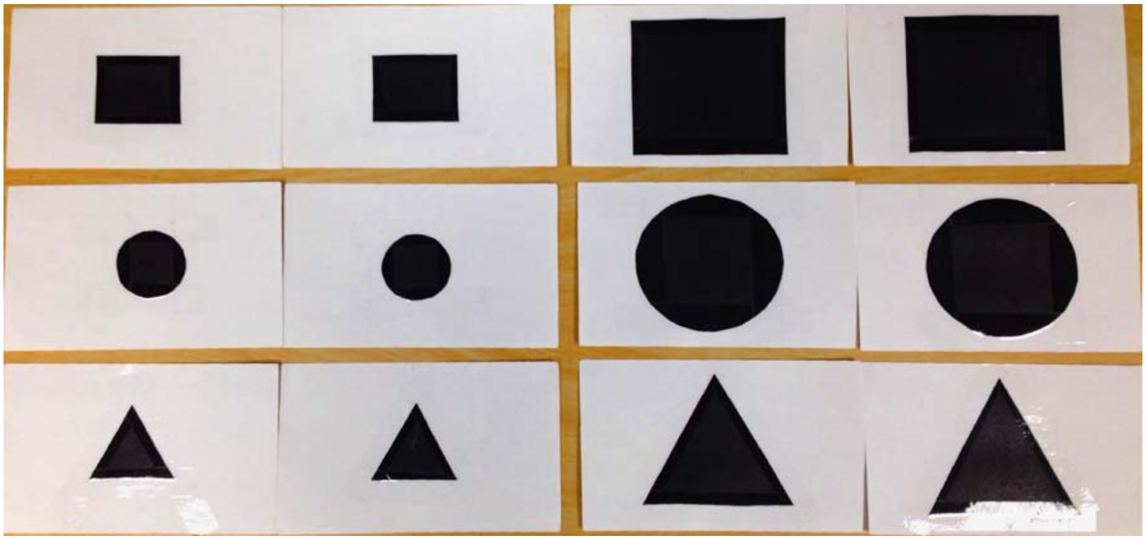
Findings from the current study are consistent with a task- and task-demand modulation of negative affect processing after RHD. Results indicated that contextual bias facilitated the processing of negative emotions in adults with RHD, and perhaps increased their tendency to ascribe humanlike qualities, motivations, and consequences to moving shapes. Findings add to the corpus of data on emotional processing in this clinical population and further document the supportive effect of contextual bias, which may be exploited in treatments for these individuals (Tompkins, Blake, Meigh, & Wambaugh, 2011; Tompkins, Scharp, Meigh, Blake, & Wambaugh, 2013). The use of strategies to reduce cognitive demands can highlight not only problem areas but also processing strengths. These are important concepts for both clinical assessment and management of cognitive-linguistic deficits in adults with RHD.

Few diagnostic and treatment measures are available for individuals with cognitive-communicative disorders, yet it is estimated that well more than half of individuals with RHD admitted to rehabilitation facilities have some kind of cognitive-communicative deficit (Côté, Payer, Giroux, & Joanette, 2007 ; Blake, Duffy, Myers, & Tompkins, 2002). Future directions in right hemisphere disorder research include investigating other effects and uses of contextual bias in RHD populations, exploring other domains that may reveal a task and task-demand interplay in processing, connecting lesion location to observed behavioral and linguistic deficits, and developing evaluations and treatments that take advantage of the facilitative effects of contextual bias.

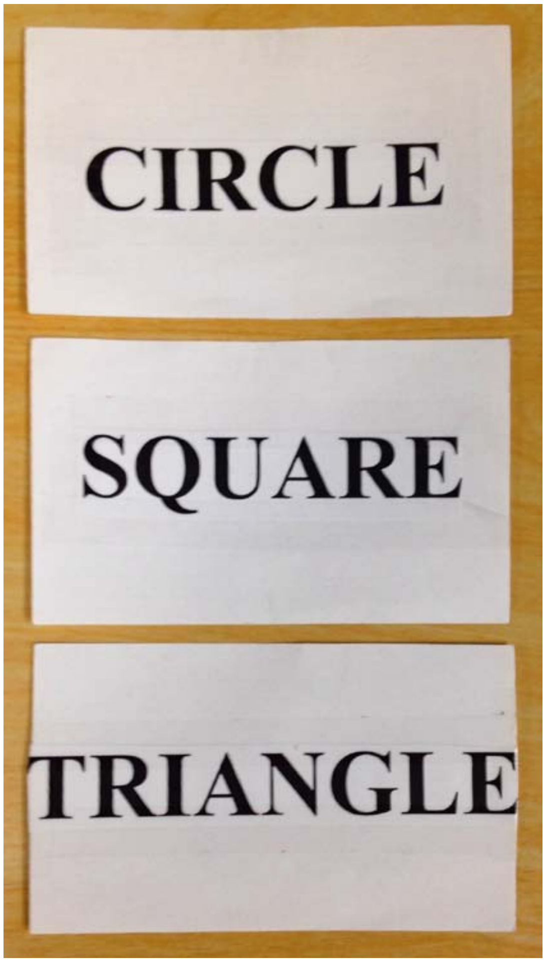
APPENDIX A

SCREENING MATERIALS

Shapes for the shape similarity task in the vision screening were created with the Clipart Application on Microsoft Word 2010 software. All shapes were solid black in color. The large triangles, circles, and squares had dimensions of 2.67” x 2.33”, 2.67” x 2.49”, and 2.8” x 2.51”, respectively. The small triangles, circles, and squares had dimensions of 1.5” x 1.34”, 1.26” x 1.22”, and 1.57” x 1.27”, respectively. All shapes were placed in the center of a 3” x 5” white plain index card.



Words for the word discrimination task in the vision screening were created with Times New Roman font, size 70, Bold, and in all capital letters. The words were placed in the center of a 3” x 5” white plain index card.



APPENDIX B

PERCENT NEGATIVE AFFECT AND MOTION WORD USE BY PARTICIPANTS ACROSS CONDITIONS

RHD Subjects	100	101	102	103	104	105	106	107	108	109	110
No-Bias Condition											
Negative Affect	0	0	0	0	0	0.59	0	0	2.04	0.76	1.15
Motion	1.89	0	8	0	0	3.53	0	0	10.2	3.03	0
Bias Condition											
Negative Affect	0	3.57	2.9	2.22	5.71	0.78	0	1.9	1.54	0	3.57
Motion	2.72	0	8.7	0	0	1.57	0	0.95	4.62	4.63	2.38

NBD Subjects	200	201	202	203	204	205	206	207	208	209
No-Bias Condition										
Negative Affect	0	2.94	0	0	0.88	0.68	0	0	0	2.27
Motion	6.59	3.92	0	1.79	8.77	2.39	5.1	6.9	0	4.55
Bias Condition										
Negative Affect	1.37	3.26	0	2.6	1.72	1.09	1.11	0	3.7	8.16
Motion	1.37	6.52	3.7	1.3	5.17	1.09	1.11	6.67	1.85	2.04

APPENDIX C

LENGTH (IN WORDS) OF INDIVIDUAL PARTICIPANTS' NARRATED DESCRIPTIONS

RHD	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**
Condition											
No-Bias	53	29	50	9	25	170	62	78	49	132	87
Bias	147	28	69	45	35	255	75	105	65	108	84

NBD	**200**	**201**	**202**	**203**	**204**	**205**	**206**	**207**	**208**	**209**
Condition										
No-Bias	91	102	34	56	114	293	98	29	30	44
Bias	219	92	27	77	174	276	90	15	54	49

APPENDIX D

QUALITATIVE PARAMETER FINDINGS FOR` INDIVIDUAL SUBJECTS

Note: For words used multiple times in a single narrated description, the number of times the term was used is in parenthesis. For instance, *box* (2) was found twice in Participant 102's No-Bias Condition narrated description.

RHD	100	101	102	103	104	105	106	107	108	109	110
No-Bias Condition											
Comparisons		*ball*	*dot, box (2)*		*ball*	*ball (4)*	*card, entrance way (2), building*	*gate (4)*	*ball*	*two little birds one bigger bird running after the smaller one*	*ball (2)*
Personifications											
Social Processes											*he*
Personified Actions		*get in*	*come out, chase, bully, go after*	*chase*	*try, duke it out, get in and out*	*swallow, let out, eat, hit (2), dislodge*	*try, get in or out*	*compete, get in/through (4), able (2)*	*try (2), get in (2), pull, come in, run, figure out*	*try, get out/in (3), come out/in (2), go after*	*get out/in (5), fight, try, win*
States of Being									*trouble*		
Emotions			*go after, bully, chase*		*duke it out*				*trouble*		*win, fight*

RHD	100	101	102	103	104	105	106	107	108	109	110
<u>Bias Condition</u>											
Comparisons	*door (3)*	*ball*	*box (2)*		*house*	*ball*	*building, ball*	*gate (2)*			*ball (3), door, demolition*
Personification											
Social Processes					*bully, his, friend, he*				*he*		*guy (2), he (4), him*
Personified Actions	*start (2), come in/out (2)*	*get in, break*	*go after, leave, join, play, come out, look, go away, start, break*	*locked in (2), release*	*skitter, leave, destroy*	*try (3), get out/in (6), hit (2), open (3), start (3), break*	*try (2), chase, escape (2)*	*compete (2), get out/in (3), able (4), sneak out, open*	*get in, tear down, locked up*	*try (2), get in/out (2), go after, escape, come out, chase, leave*	*chase, come up, escape, close, get away, break*
States of Being					*come-uppance*	*gone, free (2)*			*disappear*		*bad (2), poor*
Emotions			*go after, afraid, upset, break, not [too] happy, play*	*locked in (2), release*	*bully, friend, angry, destroy*		*chase, escape (2)*		*angry, tear down, locked up*	*escape, chase*	*bad (2), chase, poor, escape, break, get away*

NBD	200	201	202	203	204	205	206	207	208	209
No-Bias Condition										
Comparisons		*domestic altercation, house (3), building*	*box*	*house (2), door*	*room, door (4)*	*box*	*box (4), ball (2)*	*room (2)*		*box*
Personifications										
Social Processes		*wife, girlfriend, other party, related party, they*	*she, he, him*	*person (2), bully (2), people, kids, guy, he (3)*		*him, her, each other (2), his (2)*				
Personified Actions	*come out/up(2), chase (2), attempt, hide, come*	*come out (3), get in a fight (2), break it off, try, break up [the fight]*	*not let in, let in*	*come up, allow, get in, close, open*	*sneak out, poke (3), get out, approach, attack, push, look, drive, come in, go after*	*try, get out, come in/out (2), retreat (3), interact, push (3), escape, see, migrate, join*	*come out, maneuver, enter (3)*	*get out, bully*	*pursue (2)*	*chase, try, enter, attack*
States of Being			*prefer*	*not like, decide*	*ready*	*decide, curious*	*no rhyme or reason*			
Emotions		*get in a fight (2), break it off, domestic altercation*	*mean, prefer, not let in*	*bully (2), not like*	*attack, poke (2), push, drive, go after*	*retreat (3), push (3), escape, aggressive (2)*		*bully*		*attack*

NBD	200	201	202	203	204	205	206	207	208	209
<u>Bias Condition</u>										
Comparisons	*ball (3), door*	*house (2)*	*game of cat and mouse, game*	*house (4)*	*room (4), door (3), walls*	*box (5), wall, door*	*box (3), ball*			*house (3), ball, door*
Personifications										
Social Processes	*he (4), him (2)*	*husband (4), wife (2), boyfriend (2), him, she (2), them, they*		*bully (2), person (2), his (4), friend, him, they (3), opposite sex, he (4), them (2)*		*his (2), reunited company, himself, he*				*his*
Personified Actions	*try (2), escape, not let in/out (2), manage, sneak out, meet, come out (2), chase, get in (2), follow, after, burst (3), destroy (2)*	*try (2), get in, break in, confront, challenge, run, smash*	*run*	*come, get out/in (3), kiss, chase, try, escape, tear up*	*sneak up (2), try (5), get in/out (2), attack, run, stay away, open, come in/out (2), distract, manage, sneak out, run away, chase (2), dance, come after, go away, close, break (2)*	*proceed (3), migrate (2), use, open, play, take advantage, work his way, escape, enjoy, dance (2), leave (2), notice, break*	*go after, try (2), get in/out (2), leave (2), exit, destroy*	*team up against, run away*	*try, pursue, lend aid, get out, escape (2), destroy*	*scare, chase, break*
States of Being		*want, not know*				*interested, wildly, alone, not understand*			*want*	
Emotions	*escape, not let out/in (2), sneak out, chase, after, angry, destroy (2)*	*break in, confront, distraught, challenge, rage, smash*		*bully (2), chase, escape, anger, tear up, friend, kiss*	*attack, stay away, sneak out, run away, chase (2), happiness, come after, break (2)*	*play, take advantage, escape, enjoy, happy, violently, anger*	*destroy*	*team up against*	*escape (2), angry, destroy*	*scare, angry, chase, break*

PROPORTIONS OF QUALITATIVE TERMS COMPARED TO TOTAL WORDS IN EACH CONDITION FOR INDIVIDUAL SUBJECTS

RHD	100	101	102	103	104	105	106	107	108	109	110
No-Bias Condition											
Comparisons	0.000	0.034	0.060	0.000	0.040	0.024	0.065	0.051	0.020	0.008	0.023
Personifications (Total)	0.000	0.034	0.080	0.111	0.012	0.035	0.032	0.090	0.184	0.053	0.103
Social Processes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.011
Personified Actions	0.000	0.034	0.040	0.111	0.012	0.035	0.032	0.090	0.163	0.053	0.092
States of Being	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.000	0.000
Emotions	0.000	0.000	0.060	0.000	0.040	0.000	0.000	0.000	0.020	0.000	0.023

RHD	100	101	102	103	104	105	106	107	108	109	110
Bias Condition											
Comparisons	0.020	0.036	0.029	0.000	0.029	0.004	0.027	0.019	0.000	0.000	0.060
Personifications (Total)	0.027	0.071	0.130	0.067	0.229	0.082	0.067	0.105	0.077	0.083	0.190
Social Processes	0.000	0.000	0.000	0.000	0.114	0.000	0.000	0.000	0.015	0.000	0.083
Personified Actions	0.027	0.071	0.130	0.067	0.086	0.071	0.067	0.105	0.046	0.083	0.071
States of Being	0.000	0.000	0.000	0.000	0.029	0.012	0.000	0.000	0.015	0.000	0.036
Emotions	0.000	0.000	0.072	0.067	0.114	0.000	0.040	0.000	0.046	0.019	0.083

NBD	200	201	202	203	204	205	206	207	208	209
No-Bias Condition										
Comparisons	0.000	0.049	0.029	0.054	0.044	0.003	0.061	0.069	0.000	0.023
Personifications (Total)	0.077	0.127	0.176	0.304	0.114	0.078	0.061	0.069	0.067	0.091
Social Processes	0.000	0.049	0.088	0.179	0.000	0.020	0.000	0.000	0.000	0.000
Personified Actions	0.077	0.078	0.059	0.089	0.105	0.051	0.051	0.069	0.067	0.091
States of Being	0.000	0.000	0.029	0.036	0.009	0.007	0.010	0.000	0.000	0.000
Emotions	0.000	0.039	0.088	0.054	0.053	0.031	0.000	0.034	0.000	0.023

NBD	200	201	202	203	204	205	206	207	208	209
Bias Condition										
Comparisons	0.018	0.022	0.074	0.052	0.046	0.025	0.044	0.000	0.000	0.102
Personifications (Total)	0.132	0.025	0.037	0.377	0.155	0.098	0.100	0.133	0.148	0.082
Social Processes	0.027	0.141	0.000	0.260	0.000	0.018	0.000	0.000	0.000	0.020
Personified Actions	0.091	0.087	0.037	0.117	0.155	0.065	0.100	0.133	0.130	0.061
States of Being	0.000	0.022	0.000	0.000	0.000	0.014	0.000	0.000	0.019	0.000
Emotions	0.041	0.065	0.000	0.104	0.057	0.025	0.011	0.067	0.074	0.082

UNIQUE VARIABILITY OF QUALITATIVE TERMS IN EACH CONDITION FOR EACH SUBJECT

RHD	100	101	102	103	104	105	106	107	108	109	110
No-Bias Condition											
Comparisons	0.000	0.000	0.500	0.000	0.000	0.000	0.667	1.000	0.000	1.000	0.000
Personifications (Total)	0.000	0.000	0.000	0.000	0.333	1.000	0.000	0.667	0.429	0.000	0.400
Social Processes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Personified Actions	0.000	0.000	0.000	0.000	0.333	1.000	0.000	0.667	0.333	0.000	0.500
States of Being	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000
Emotions	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	1.000	0.000	1.000

RHD	100	101	102	103	104	105	106	107	108	109	110
Bias Condition											
Comparisons	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.333
Personifications (Total)	0.500	0.000	0.111	1.000	0.250	0.500	0.000	0.400	0.600	0.000	0.273
Social Processes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Personified Actions	0.500	0.000	0.111	1.000	0.333	0.333	0.000	0.400	0.667	0.000	0.167
States of Being	0.000	0.000	0.000	0.000	1.000	1.000	0.000	0.000	1.000	0.000	1.000
Emotions	0.000	0.000	0.600	1.000	0.000	0.000	0.000	0.000	0.667	0.000	0.500

NBD	200	201	202	203	204	205	206	207	208	209
No-Bias Condition										
Comparisons	0.000	0.333	0.000	0.000	0.500	0.000	0.000	1.000	0.000	0.000
Personifications (Total)	0.600	0.800	0.667	0.462	0.545	0.563	0.750	0.000	1.000	0.500
Social Processes	0.000	1.000	0.333	0.500	0.000	0.500	0.000	0.000	0.000	0.000
Personified Actions	0.600	0.600	1.000	0.200	0.500	0.500	0.667	0.000	1.000	0.500
States of Being	0.000	0.000	1.000	1.000	1.000	1.000	1.000	0.000	0.000	0.000
Emotions	0.000	1.000	1.000	0.500	0.800	0.750	0.000	0.000	0.000	1.000

NBD	200	201	202	203	204	205	206	207	208	209
Bias Condition										
Comparisons	0.000	0.000	1.000	0.000	0.667	0.333	0.000	0.000	0.000	0.000
Personifications (Total)	0.400	0.750	0.000	0.438	0.444	0.667	0.167	1.000	0.429	0.250
Social Processes	0.000	0.857	0.000	0.444	0.000	0.500	0.000	0.000	0.000	0.000
Personified Actions	0.462	0.571	0.000	0.429	0.444	0.615	0.167	1.000	0.333	0.333
States of Being	0.000	1.000	0.000	0.000	0.000	1.000	0.000	0.000	1.000	0.000
Emotions	0.429	1.000	0.000	0.286	0.750	0.571	0.000	1.000	0.000	0.250

BIBLIOGRAPHY

Abbott, J. D., Cumming, G., Fidler, F., & Lindell, A. K. (2013). The perception of positive and negative facial expressions in unilateral brain-damaged patients: A meta-analysis. *Laterality: Asymmetries of Body, Brain, and Cognition*, 18(4), 437-459.

Allott, N. (2010). *Key terms in pragmatics*. New York, NY: Continuum International Publishing Group.

Bayles, K. A. & Tomoeda, C. K. (1993). *Arizona Battery for Communication Disorders of Dementia*. Tucson, Arizona: Canyonlands Publishing, Inc.

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

Blake, M. L. (2009). Inferencing processes after right hemisphere brain damage: Effects of contextual bias. *Journal of Speech, Language, and Hearing Research*, 52(2), 373-384.

Blake, M. L. (in press). Cognitive-communication deficits associated with right hemisphere brain damage. In M. L. Kimbarow (Ed.), *Cognitive communication disorders* (2nd ed.). San Diego: Plural Publishing.

Blake, M. L., Duffy, J. R., Myers, P. S., & Tompkins, C. A. (2002). Prevalence and patterns of right hemisphere cognitive/communicative deficits: Retrospective data from an inpatient rehabilitation unit. *Aphasiology*, 16(4-6), 537-547.

Blake, M. L. & Lesniewicz, K. S. (2005). Contextual bias and predictive inferencing in adults with and without right hemisphere brain damage. *Aphasiology*, 19(3/4/5), 423-434.

Borod, J. C., Andelman, F., Obler, L. K., Tweedy, J. R., & Wilkowitz, J. (1992). Right hemisphere specialization for the identification of emotional words and sentences: Evidence from stroke patients. *Neuropsychologia*, 30(9), 827-844.

Borod, J. C., Cicero, B. A., Welkowitz, J., Erhan, H. M., Santschi, C., Grunwald, I. S., Agosti, R. M., & Whalen, J. R. (1998). Right hemisphere emotional perception: Evidence across multiple channels. *Neuropsychology*, 12(3), 446-458.

Brookshire, R. H. (2003). *An introduction to neurogenic communication disorders* (6th ed.). St. Louis, MO: Mosby-Year Book, Inc.

Brownell, H. H., Carroll, J. J., Rehak, A., & Wingfield, A. (1992). The use of pronoun anaphora and speaker mood in the interpretation of conversational utterances by right hemisphere brain-damaged patients. *Brain and Language*, 43(1), 121-147.

Champagne-Lavau, M. & Joanette, Y. (2009). Pragmatics, theory of mind and executive functions after a right-hemisphere lesion: Different patterns of deficits. *Journal of Neurolinguistics*, 22, 413-426.

Côté, H., Payer, M., Giroux, F., & Joanette, Y. (2007). Towards a description of clinical communication impairment profiles following right-hemisphere damage. *Aphasiology*, 21(6-8), 739-749.

Coulson, S. & Williams, R. F. (2005). Hemispheric asymmetries and joke comprehension. *Neuropsychologia*, 43, 128-141.

Cutica, I., Bucciarelli, M., & Bara, B. G. (2006). Neuropragmatics: Extralinguistic pragmatic ability is better preserved in left-hemisphere-damaged patients than in right-hemisphere-damaged patients. *Brain and Language*, 98, 12-25.

Demaree, H. A., Everhart, D. E., Youngstrom, E. A., & Harrison, D. W. (2005). Brain lateralization of emotional processing: Historical roots and a future incorporating “dominance”. *Behavioral and Cognitive Neuroscience Reviews*, 4(1), 3-20.

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). “Mini-mental state”: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, 12(3), 189-198.

Gainotti, G. (1972). Emotional behavioral and hemispheric side of the lesion. *Cortex*, 8(1), 41-55.

Gainotti, G. (2012). Unconscious processing of emotions and the right hemisphere. *Neuropsychologia*, 50(2), 205-218.

Happé, F., Brownell, H., & Winner, E. (1999) Acquired 'theory of mind' impairments following stroke. *Cognition*, 70, 211-240.

Heberlein, A. S., Adolphs, R., Pennebaker, J. W., & Tranel, D. (2003). Effects of damage to right-hemisphere brain structres on spontaneous emotional and social judgments. *Political Psychology*, 24(4), 705-726.

Heider, F. & Simmel, M. (1944). An experimental study of apparent behavior. *The American Journal of Psychology*, 57(2), 2430259.

Kuchinke, L., Jacobs, A. M., Grubich, C., Võ, M. L., Conrad, M., & Herrmann, M. (2005). Incidental effects of emotional valence in single word processing: An fMRI study. *NeuroImage*, 28(4), 1022-1032.

Lakoff, G. (1973). Hedges: A study in meaning criteria and the logic of fuzzy concepts. *Journal of Philosophical Logic*, 2(4), 458-508.

Lorch, M. P., Borod, J. C., & Koff, E. (1998). The role of emotion in the linguistic and pragmatic aspects of aphasic performance. *Journal of Neurolinguistics*, 11(1-2), 103-118.

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

Marini, A., Carlomangno, S., Caltagirone, C., & Nocentini, U. (2005). The role played by the right hemisphere in the organization of complex textual structures. *Brain and Language*, 93(1), 46-54.

Marinkovic, K., Baldwin, S., Courtney, M. G., Witzel, T., Dale, A. M., & Halgren, E. (2011). Right hemisphere has the last laugh: Neural dynamics of joke appreciation. *Cognitive, Affective, and Behavioral Neuroscience*, 11, 113-130.

Myers, P. S. (1999). *Right hemisphere damage: Disorders of communication and cognition*. San Diego, CA: Singular Publishing Group, Inc.

National Stroke Association. (n.d.) *Stroke 101 Fact Sheet.* Retrieved from http://www.stroke.org/site/DocServer/Stroke_101_Fact_Sheet.pdf?docID=8343

National Stroke Association. (n.d.). *What is Stroke?* Retrieved from www.stroke.org/site/PageServer?pagename=stroke

Pennebaker, J. W., Booth, R. J., & Francis, M. E. (2007). Linguistic Inquiry and Word Count Lite (Version 2007) [software]. Available from http://www.liwc.net/

Perria, L., Rosadini, G., & Rossi, G. F. (1961). Determination of side of cerebral dominance with amobarital. *Archives of Neurology*, 4(2), 173-181.

Pichon, S., Rieger, S. W., & Vuilleumier, P. (2012). Persistent affective biases in human amygdala response following implicit priming with negative emotion concepts. *NeuroImage*, 62(3), 1610-1621.

Prat, C. S., Long, D. L., & Baynes, K. (2007). The representation of discourse in the two hemispheres: An individual differences investigation. *Brain and Language*, 100, 283-294.

Rinaldi, M. C., Marangolo, P., & Baldassarri, F. (2004). Metaphor comprehension in right brain-damaged patients with visuo-verbal and verbal material: A dissociation (re)considered. *Cortex*, 40, 479-490.

Ross, E. D., Homan, R. W., & Buck, R. (1994). Differential hemispheric lateralization of primary and social emotions: Implications for developing a comprehensive neurology for emotions, repression, and the subconscious. *Neuropsychiatry, Neuropsychology,& Behavioral Neurology*, 7(1), 1-19.

Sass, K., Habel, U., Sachs, O., Huber, W., Gauggel, S., & Kircher, T. (2012). The influence of emotional associations on the neural correlates of semantic priming. *Human Brain Mapping*, 33(3), 676-694.

Shears, C., Hawkins, A., Varner, A., Lewis, L., Heatley, J., & Twachtmann, L. (2008). Knowledge-based inferences across the hemispheres: Domain makes a difference. *Neuropsychologia*, 46, 2563-2568.

Sherratt, S. (2007). Right brain damage and the verbal expression of emotion: A preliminary investigation. *Aphasiology*, 21(3-4), 320-339.

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

Shibata, M., Terasawa, Y., & Umeda, S. (2011). Brain activity underlying emotional valence in negative and positive utterances: An fMRI study. *Neuroscience Research*, 71, e288. doi: 10.1016/j.neures.2011.07.1251

Suslow, T., Kigel, H., Ohrmann, P., Stuhrmann, A., Grotegerd, D., Redlich, R., Bauer, J., & Dannlowski, U. (2013). Neural correlates of affective priming effects based on masked facial emotions: An fMRI study. *Psychiatry Research: Neuroimaging*, 211(3), 239-245.

de Swart, P., Lamers, M., & Lestrade, S. (2008). Animacy, argument structure, and argument encoding. *Lingua*, 118, 131-140.

Tompkins, C. A. (1984). Comprehension of moods in prosodic and linguistic channels by brain-damaged subjects. (Doctoral Dissertation), University of Washington, Washington.

Tompkins, C. A. (1991b). Automatic and effortful processing of emotional intonation after right and left hemisphere brain damage. *Journal of Speech and Hearing Research*, 34(4), 820-830.

Tompkins, C. A. (1991a). Redundancy enhances emotional inferencing by right- and left-hemisphere-damaged adults. *Journal of Speech and Hearing Research*, 34(5), 1142-1149.

Tompkins, C. A. & Baumgaertner, A. (1998). Clinical value of online measures for adults with right hemisphere brain damage. *American Journal of Speech-Language Pathology*, 7(1), 68-74.

Tompkins, C. A., Blake, M. L., Meigh, K. M., & Wambaugh, J. (2011). A novel, implicit treatment for language comprehension processes in right hemisphere brain damage: Phase I data. *Aphasiology*, 25(6-7), 789-799.

Tompkins, C. A. & Flowers, C. R. (1987). Contextual mood priming following left and right hemisphere damage. *Brain and Cognition*, 6, 361-376.

Tompkins, C. A., Lei, C., & Zezinka, A. (in press). The nature and implications of right hemisphere language disorders. In A. Hillis (Ed.), *Handbook of adult language disorders: Integrating cognitive neuropsychology, neurology, and rehabilitation* (2nd ed.). New York, NY: Psychology Press.

Tompkins, C. A., Scharp, V. L., Meigh, K. M., Blake, M. T., & Wambaugh, J. L. (2013). Generalisation of a novel, implicit treatment for coarse coding deficit in right hemisphere brain damage: A single subject experiment. *Aphasiology*, 26(5), 689-708.

Tompkins, C. A., Spencer, K. A., & Boada, R. (1994). Contextual influences on judgments of emotionally ambiguous stimuli by brain-damaged and normally-aging adults. *Clinical Aphasiology*, 22, 325-333.

Uryase, D., Duffy, R. J., & Liles, B. Z. (1991). Analysis and description of narrative discourse in right-hemisphere-damaged adults: A comparison with neurologically normal and left-hemisphere-damaged aphasic adults. *Clinical Aphasiology*, 19, 125-137.

Vogels, J., Krahmer, E., & Maes, A. (2013). When a stone tries to climb up a slope: The interplay between lexical and perceptual animacy in referential choices. *Frontiers in Psychology*. doi: 10.3389/fpsyg.2013.00154

Weed, E., McGregor, W., Nielson, J. F., Roepstorff, A., & Frith, U. (2010). Theory of Mind in adults with right hemisphere damage: What's the story? *Brain & Language*, 113, 65-72.

Wilson, B., Cockburn, J., & Halligan P. W. (1987). Behavioural Inattention Test. Tichfield, England: Thames Valley Test Company.

Yang, F. G., Edens, J., Simpson, C., & Krawczyk, D. C. (2009). Differences in task demands influence the hemispheric lateralization and neural correlates of metaphor. *Brain & Language*, 111, 114-124.