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The Effect of Language Emotionality on Recall: A Preliminary Study

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The Effect of Language Emotionality on Recall: A Preliminary Study

by

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Thesis

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Dedication

This thesis is dedicated to my wonderful parents, sister, and husband who all helped me plan my wedding, and keep my sanity while working on this project.

Mom and Dad, thanks for teaching me how to learn.

Jenna, you'll never have to paint 270 wine glasses ever again, promise.

Justin, thank you for keeping our place clean, keeping food on the table, and doing the laundry while I was typing away. I love you.

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Abstract

The Effect of Language Emotionality on Recall: A Preliminary Study

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Ten male and 10 female participants were presented with six narrative paragraphs and six 10 word lists. Three of the paragraphs were emotional and three were neutral. Each of the paragraphs contained 20 information units and each word list included five neutral and five emotional words. Immediately following paragraph or word list presentation, the participants were asked to recall the stimuli. The mean percent of emotional units (i.e. units of information recalled from emotional paragraphs) recalled was significantly greater than the mean percent of neutral units recalled. Similarly, the mean percent emotional words recalled from word lists was significantly greater than the mean percent neutral words recalled from word lists. Percent recall was significantly greater for words than for paragraphs for both emotional and neutral stimuli. Results supported the hypothesis that emotional saliency increases verbal recall.

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INTRODUCTION

Communication is the building block of human relationships. Effective communication and the maintenance of interpersonal relationships is not only dependent on linguistic coherence, but also on cognitive and behavioral skills such as the pragmatic ability to extract, interpret, and make inferences about emotional content from communication exchanges, whether implicit or explicit. Humans rely on recognition of emotion to formulate interpretations of moods, attitudes, and character. Emotion or "affect" can be conveyed through nonverbal actions and facial expressions as well as language. The ability to process linguistic components expressing or containing emotion as "emotionally salient" to the communicative exchange is a vital component in the perception of emotion and thus effective communication. In the event that an individual is unable to detect emotion being conveyed visually or perceive emotional content within language, the individual is compromised in the area of relational communication.

Both hemispheres of the brain are involved in processing communication, including messages that are emotionally salient. The left hemisphere of the brain is primarily involved in the linguistic processing of messages, while the right hemisphere is described as a holistic interpreter of prosody (melodic tone of speech), visual-facial cues, and other inferred aspects of communication (Myers, 1999). Due to the joint effort

of the hemispheres in effectively interpreting communicative exchanges, damage to either side of the brain can impair effective communication.

Neurogenic disorders can cause linguistic, cognitive, and/or behavioral deficits that impair effective communication. Affective processing deficits can occur as a result of stroke, traumatic brain injury (TBI), degenerative brain disease, and other neural disorders. Although individuals with left hemisphere strokes may be left with reduced capacity for communication based on their speaking and language comprehension abilities, their capacity for extracting emotive content is not necessarily impacted. By comparison, individuals with right hemisphere brain damage or individuals with TBI are observed to have more severe difficulties with emotionally salient language and emotional forms of communication, such as interpreting prosody, humor, sarcasm, facial expressions, and other forms of language which contribute to expression of emotion (Croker & McDonald, 2005; McDonald & Flanagan, 2004; Myers, 1999; Watts & Douglas, 2006).

Deficits in affective processing may be less obvious than those in linguistic processing and thus less frequently reported and treated (Myers, 1999). However, if left without rehabilitation, individuals with affective processing deficits may experience a decline in the quality of their personal relationships because of their inability to perceive and exchange affective information.

The purpose of this study was twofold. The first purpose was to develop a methodology to assess effects of emotional saliency on verbal recall in non-brain

damaged (NBD) individuals. The second purpose was to assess the effect of emotional saliency on recall in NBD individuals.

Right Hemisphere and Emotional Processing

Emotional meaning is expressed through both linguistic and non-linguistic components of communication. The right hemisphere of the brain processes primarily non-linguistic components contributing to emotion including the perception and expression of emotion through physical cues and suprasegmental cues (Myers, 1999). Right hemisphere participation in emotional processing is supported by evidence that individuals with RHD experience difficulty with comprehension of emotion (Myers, 1999). Right hemisphere specificity for emotional processing is further supported by dichotic listening studies in NBD individuals indicating a left ear (right hemisphere) advantage for emotional words (Sim & Martinez, 2005). Sim and Martinez had 62 right-handed participants complete the following four conditions: a) emotional words to the right ear, b) emotional words to the left ear, c) non-emotional words to the right ear, and d) non-emotional words to the left ear. Individuals recalled significantly more emotional words than non-emotional words when presented in the left ear, but there was no statistical difference in recall of emotional as compared to non-emotional words presented in the right ear. This indicates that the right hemisphere (left ear) is more effective at recall of emotionally salient words.

Emotion and mood states are incorporated within the limbic system, which regulates hormone levels and signals the cortex regarding sensory input within the body, but cortical structures contribute to the comprehension and expression of emotional states and behaviors (Myers, 1999). The extent and location of cortical involvement in processing and expressing emotion is largely debated. There are two theories regarding emotional processing in the cortical structures of the brain: the "Valence Theory" and the "Right Hemisphere Dominance Theory" (Myers, 1999).

Research suggests that the left hemisphere has a modality specific role in emotional processing to the extent that it supplements right hemisphere analysis (Kucharska-Pietura, Phillips, Gernand & David, 2003; Myers, 1999). The Valence Theory asserts that the left and right hemispheres are differentially involved in emotional processing depending on the positive or negative connotation of the material. The left hemisphere is considered to be involved in positively connoted material, and the right hemisphere involved in negatively connoted material (Kucharska-Pietura et al., 2003; Myers, 1999). Damage to the right hemisphere would be expected to interfere with sensitivity to negative emotion; damage to the left hemisphere would impair sensitivity to positive emotion.

The Right Hemisphere Dominance Theory, also called the Right Hemisphere Hypothesis, argues that the right hemisphere is specialized for processing emotional stimuli (Kensinger & Choi, 2009; Myers, 1999; Nagae & Moscovitch, 2002). This theory is supported by dichotic listening study that shows that more emotional words than neutral words are recalled when presented to the left ear, indicating a right

hemisphere advantage for emotionally charged auditory stimuli (Sim & Martinez, 2005). Additional support is garnered via split visual field tests that demonstrate cerebral differences in processing of emotional and non-emotional words in NBD individuals. Visual field studies found a right hemisphere advantage in processing memory for words with emotional connotations (Myers, 1999; Nagae & Moscovitch, 2002). In effect, the right hemisphere hypothesis asserts that this hemisphere is the primary source of emotional processing at the cortical level. The theories differ regarding hemispheric laterality of some emotional processing tasks, but both theories support right hemisphere dominance in processing emotion.

Right Hemisphere Brain Damage

The most common cause of RHD is a cerebrovascular accident or injury specifically to the brain's right hemisphere (Myers, 1999; Tompkins, 1995). Individuals with RHD have reduced capacity for expressing and perceiving emotion effectively, which is considered to confirm the role of the right hemisphere in emotive processing (Myers, 1999). Right hemisphere brain damage results in impairment of cognitive and communicative functions (Myers, 1999; Tompkins, 1995). Individuals with RHD present with deficits in perception, communication and cognition (Sherratt, 2007). These deficits may include, but are not limited to: inattention, hemi-neglect of the left-side, visual memory, organization, spatial orientation, problem solving, reasoning, and social communication. Other deficits may include comprehension and

expression of emotion and prosody, the rhythm, stress, and intonation of speech which reflects the emotions of the speaker as well as whether the sentence is declarative, inquisitive, or otherwise (Myers, 1999; Sherratt, 2007; Tompkins, 1995).

Individuals with RHD typically are unaware of the seriousness of their disorder and are relatively insensitive to emotion that impacts communication with relatives, friends, coworkers, and employers (Bowers et al., 1986; Mizuno, 1991). Research on the emotional stimuli recall abilities of individuals with RHD would provide a basis for determining the potential of intervention for individuals with RHD, particularly in the area of emotional language processing. Emotional language processing is unique because it incorporates emotional perception via the right hemisphere of the brain and language processing via the left hemisphere. Individuals with RHD may benefit from explicit training in emotional processing utilizing left hemisphere processes of language that may facilitate easier interpretation and expression of emotion.

The deficits that arise from RHD provide further evidence that the processing and representation of emotionally salient material are primarily located in the right hemisphere of the brain. The present study will address linguistically encoded emotion in verbal recall tasks. Results from this study may give rise to interventions in emotional processing through utilization of the left hemisphere and the semantic value of language as the primary source for interpreting emotional content.

Left Hemisphere and Emotional Processing

The left hemisphere is dominant for linguistic processing, including processing of affective language. The left hemisphere houses the traditional neural areas associated with language in addition to the semantic network located in the temporal lobe (Hickok & Poeppel, 2007). Broca's area is located in the left inferior frontal gyrus and is involved in articulatory planning and execution of word forms. Wernicke's area is located in the superior temporal gyrus and is involved in the comprehension of spoken language. The semantic network area is located in the temporal lobe, adjacent to Wernicke's area. Interruption to these specific areas can cause difficulty with expressing and comprehending linguistically coded emotion. An individual with damage to Broca's area may experience difficulty expressing emotion because of an impaired ability to articulate word forms. Damage to Wernicke's area would result in difficulty comprehending auditorially presented linguistic information, and the intrinsic semantic and emotional value of the information would be lost.

In addition to responsibility for extracting the semantic value encoded in words conveying emotion, the Valence Theory asserts that the left hemisphere is also involved in processing positively charged emotional material (Kucharska-Pietura et al., 2003; Myers, 1999). Thus, damage to the left hemisphere would be expected to impact linguistic functions as well as functions related to perception of positive emotion.

Traumatic Brain Injury

Traumatic brain injury can affect emotional processing. TBI is caused by brain injury from motor vehicle collisions, sports injuries, missile wounds, industrial accidents, and other incidents causing head trauma (McDonald, Togher, & Code, 1999). These injuries are described as either "open" or "closed." Open head injuries have pierced the skull and penetrated the brain, such as gunshot wounds; closed head injuries include contusions and shearing, tearing, and stretching effects of rapid acceleration and deceleration of brain tissue. Cerebrovascular accidents cause a frank lesion to a limited area, TBIs, in contrast, are "multi-focal" due to the movement of the brain within the skull. The broad spectrum of brain damage impacts multiple areas critical to communication including linguistic, cognitive, and behavioral deficits (McDonald et al., 1999).

Individuals with TBI often exhibit disorders in attention, executive functions, and memory. Poor recovery of social functions is often reported (McDonald et al., 1999), and arguably may be the most permeating difficulty in communication (Watts & Douglas, 2006). Though social functions cover a broad area, research has largely focused on the interpretation of visual emotional cues through faces and emotional cues through prosodic tone (Croker & McDonald, 2005; McDonald & Flanagan, 2004; Watts & Douglas, 2006). Individuals with TBI typically exhibit difficulty with correctly matching emotion in facial expressions (Watts & Douglas, 2006), interpreting prosody of speech, and determining the perspectives of other individuals using theory of mind (McDonald & Flanagan, 2004). However, little research has focused on the extraction

of emotional content in semantics. The ability to perceive emotional content in word form and content is often equally imperative to the interpretation of emotion. Difficulties in perceiving emotion may arise not only from failure to interpret facial and prosodic cues, but also from failed interpretation of semantic content. A word may be linguistically processed without the attachment of the underlying emotional saliency, leading to inadequate communication.

Emotional Stimuli and Recall

Recall tasks typically require subjects to recall as many items as possible after being exposed to stimuli over a period of time. These tasks are considered to be highly indicative of an individual's short term memory function and processing ability (Glanzer, 1982; Murphy & Puff, 1982). A word-list free recall task and a narrative retell free recall task incorporating both emotional and neutral (non-emotional) material may be used to effectively assess whether memory functions and processing ability for emotional material is impacted in individuals with RHD, left hemisphere brain damage, and TBI. Word-list recall tasks present no context to encode information while narrative tasks, such as the paragraph recall, provide context for the recall of the emotional and neutral information. Paragraphs, because they are longer, may be easier to recall through the use of context-dependent memory (Besken & Mulligan, 2010).

Altarriba and Bauer (2004) demonstrated that individuals recall emotionally salient words more easily than both concrete and abstract words. Given the evidence for right hemisphere lateralization for emotion, these results suggest that individuals with neurogenic disorders, particularly those with RHD and TBI, would not recall emotional items as readily as NBD individuals. Individuals with left hemisphere damage may not recall as many items as NBD but might be expected to show similar trends as NBD individuals favoring emotionally charged content in recall.

Cimino et al. (1991) investigated the ability to recall autobiographical information based on emotional cues in individuals with RHD and found that these patients typically recalled less specific and less emotional information than their NBD counterparts. Studies of word list recall abilities of individuals with RHD in conjunction with use of the *California Verbal Learning Test* (CLVT) (Delis, Kramer, Kaplan, & Ober, 2000) showed that RHD patients do not respond and recall as well as NBD individuals (Halper & Cherney, 2004). A study on recall of spoken discourse indicated that RHD patients recalled fewer content units than their NBD counterparts and were slower overall in recalling content (Titone et al., 2001). These varied studies did not specifically investigate the effect of emotionality on stimuli recall.

The initial study which addressed the issue of emotional saliency of language and its effect on recall in RHD patients was conducted by Wechsler (1973). The participants in Wechsler's study were NBD individuals as well as RHD, left brain damaged, and bilaterally brain damaged (BBD) individuals. Participants read two passages, one with emotional content and one without, both of which were reported by

Wechsler to have had "morals." Results from each participant were measured both quantitatively and qualitatively although measurement parameters and procedures were not specified.

Wechsler found that both left hemisphere damaged (LHD) and individuals with RHD showed deficits in memory compared with NBD individuals. Left brain damaged individuals accurately remembered more items from the emotional passage than RHD individuals. Some of the questions the study raised were "What constitutes 'emotional stimuli'?", "What impact did the narrative presentation have?", "Did contextual language have an effect?", "Is it the lexical items of emotional words, or their comprehension in context?"

Objective of the Current Study

Research regarding right hemisphere function post cerebrovascular accident or brain injury has focused primarily on comprehension and expression of emotion and prosody (Bowers et al., 1986; Mizuno, 1991; Myers, 1999; Tompkins, 1995). Limited research has examined word recall or narrative retelling abilities of individuals with neurogenic disorders, and only one study has been conducted regarding recall of emotional language stimuli in individuals with neurogenic disorders (Wechsler, 1973). Research regarding emotional recall in NBD individuals rarely addresses paragraph recall. In word list recall, assessments of individuals with hemispheric deficits

frequently lack statistical basis for typical recall of the stimuli and lack of assessment of emotional content of the stimuli.

Previous research on neurogenic disorders and emotion has addressed emotional perception (via prosodic and facial expressions) or recall abilities, but to date, to this author's knowledge, no studies have investigated the potential interaction between emotion and recall. The primary aims of this study were to develop stimulus sets utilizing emotional and neutral content in the form of both paragraphs and word lists and to utilize the stimulus sets to establish a baseline of typical performance by NBD individuals. The participants, all NBD individuals, were expected to recall more units of emotional stimuli than neutral stimuli.

Results may lend support to similar future investigations of the influence of emotion on verbal recall in individuals with RHD, traumatic brain injury, and left hemisphere stroke. The information regarding lateralization and recall difference in the neurogenic populations as compared with NBD individuals may also lead to more effective intervention targeting teaching of emotional words and language using intact left hemisphere language processes to increase comprehension and thus expression of basic communication in daily life. Reorganizing comprehension of emotionally loaded language such that dependence is shifted from the right to the left hemisphere may be an option for intervention in individuals with emotional processing deficits due to RHD.

METHOD

Participants

The participants were 10 male and 10 female (N = 20; age range = 20 – 55yrs; M = 29.2) monolingual, native English speaking individuals who were recruited through local contacts and The University of Texas Speech and Hearing Clinic. The University of Texas granted IRB approval, and the investigator obtained informed consent from all participants. The participants had no history of brain or hearing impairment. Participants also followed the instructions for the recall experiments without any apparent auditory processing difficulty.

Stimuli

The initial list of stimulus words and paragraphs was contructed based on previous studies addressing language and emotion (Altarriba & Bauer, 2004; Borod et al., 1992; Davidson et al., 2001; Halper & Cherney, 2004; Wechsler, 1973). Ten paragraphs were created: five emotional, and five non-emotional. The label of emotional or non-emotional was based on the literal interpretation of the words and phrases. Three of the paragraphs were selected from the Wechsler study (1973), but were slightly altered to fit the parameters of this study. Paragraphs were limited to five sentences each and divided into 20 content units. Each content unit was a small section

of information ranging from 2-5 words (see Appendix A). Factors within these paragraphs such as word length, phonotactic probability, and parts of speech were free to vary as they do not appear to have an impact on recall (Glanzer, 1982; Murphy & Puff, 1982). The word list was comprised of 100 words that were four syllables or less in length. Half of the word list was considered "emotionally salient"; the other half was neutral.

Thirty female students without a history of cognitive and/or communication disorders were recruited from the University of Texas Speech and Hearing Center and the local contacts to rate the emotionality of each of the 10 paragraphs and 100 words on a 100 mm. analog scale. The rating anchors were l mm for neutral emotional content and 100 mm. for highly emotional content (see Appendix A). The paragraphs were rated for emotionality as a whole while each word was rated individually.

The ratings were used to develop dichotomous emotional and neutral stimuli for the experimental task. Each word and paragraph rating by the 30 raters on the visual analogue scale was measured using a metric ruler. An emotional numeric value was assigned based on the length of the line in millimeters (e.g., 77 mm line = emotionality rating of 77). Each paragraph and word was assigned a total emotional rating based on the average of the 30 individual ratings (see Appendix B for all word and paragraph ratings).

The three most emotional (highest numeric ratings) and three least emotional or neutral (lowest numeric ratings) paragraphs were selected for the study. The mean rating of the emotional paragraphs was 91.44; the mean rating of the neutral paragraphs

was 14.64. A t-test revealed that the ratings of emotion for the paragraphs were significantly different (t= 4.56, df= 19 p= <.0001). The mean ratings for emotional saliency of the three highest rated and lowest rated paragraphs are shown in Table 1.

Table 1: Emotionality Rating Means and Standard Deviations for Paragraphs

Neutral Paragraph	Mean Rating	Standard Deviation	**Emotional Paragraph**	Mean Rating	Standard Deviation
Justin	10.00	16.48	Michelle	87.57	11.78
Maria	14.73	19.17	Sarah	91.73	15.32
Mr. Jones	19.20	18.95	Sister	95.03	10.49
Neutral Mean	**14.64**	**18.20**	**Emotional Mean**	**91.44**	**12.53**

The 30 most emotional (highest numeric ratings) and 30 least emotional or neutral (lowest numeric ratings) words were selected for the study. The mean rating of the emotional words was 81.35; the mean rating of the neutral words was 12.09 (see Table 2). A t- test revealed a significant difference in the ratings for emotional compared to the neutral words (t= 3.55, df= 19, p= <.0001). The words were used to create six word lists of 10 words each (5 emotional, 5 non-emotional). Words were randomly assigned to each list and to their position within the list with the restriction that half the words on each list were emotionally salient. Other factors such as phonotactic probability, part of speech, and frequency were free to vary because they were not expected to impact recall (Glanzer, 1982; Murphy & Puff, 1982).

Table 2: Emotionality Rating Means and Standard Deviations for Words

Neutral Word	Mean Rating	Standard Deviation	Emotional Word	Mean Rating	Standard Deviation
Straw	2.97	9.95	Noose	71.87	25.73
Hibernate	3.87	5.66	Enslave	72.27	25.85
Stick	3.97	11.91	Failure	73.30	28.91
Pen	4.80	12.86	Home	74.10	20.39
Capsule	5.13	11.81	Accident	74.20	17.55
Cleaners	5.50	14.91	Peace	74.40	19.99
Spoon	5.87	17.93	Maimed	74.53	29.07
Here	6.63	14.68	Kiss	75.23	19.69
Baker	6.77	13.92	Disease	76.13	19.42
Switched	8.27	13.13	Addict	76.40	21.90
Meeting	8.50	14.82	Freedom	76.50	20.18
Medium	8.60	16.57	Cured	76.60	18.73
Tossed	11.07	17.25	Strangle	78.60	25.48
Coworker	11.80	17.87	Happy	78.80	20.06
Professional	12.50	21.85	Sob	78.80	16.50
Drive	13.27	21.26	Sex	80.60	20.53
Coffee	13.33	22.13	Alcoholic	82.20	17.33
Swing	13.73	23.35	Suffocate	82.40	18.68
Bump	13.87	17.27	Drown	82.73	20.35
Allow	14.33	23.38	Wedding	83.67	17.68
Water	15.83	28.15	Family	85.27	15.34
Acquaintance	16.27	19.59	Affair	86.07	14.31
Alright	16.67	19.04	Euthanasia	87.03	15.53
Assist	17.87	24.01	War	87.43	14.13
Watched	18.97	24.95	Love	89.23	14.08
Cookie	19.13	26.53	Abused	89.70	18.56
Delivery	20.20	24.74	Death	92.33	11.87
Procedure	20.87	27.01	Abortion	92.43	13.21
Dented	20.90	21.33	Rape	92.90	16.42
Cool	21.30	25.21	Suicide	94.80	8.41
Neutral Mean	**12.09**	**18.77**	**Emotional Mean**	**81.35**	**18.86**

Procedures

Testing was completed during a single visit to the University of Texas Speech and Hearing Clinic or at a separate location of the participant's choosing. Each paragraph and word lists were rehearsed prior to the administration sessions for

maintenance of rate, intensity, and neutral prosody, and was presented verbally. The participant was asked to verbally recall as much information as possible. Prior to administration of the paragraph portion of the study the administrator gave the following instructions:

> I am going to read you a short paragraph. After the paragraph, I will ask you to tell it back to me. I want you to tell me the paragraph as precisely as you remember hearing it. If you can remember parts of it word for word, please recite it word for word. If you need to paraphrase, this will also be accepted. Are you ready?

After each of the six paragraphs was presented in random order with regard to emotionality, the participant was prompted, "Now, you tell me the paragraph." All responses from participants were verbal and recorded via digital voice recorder (Olympus VN-4100PC) for future analysis.

Next, each word list was presented in random order. The participants were asked to recall the stimuli verbally. Prior to administration of the word list portion of the study the administrator presented the following instructions:

> I am going read you a list of words. After I am done, I want you to repeat the words you remember from the list back to me. You may recall the words in any order.

After each of the six lists, the administrator prompted participants with, "Tell me the words you remember." All responses from participants were verbal, and were recorded via digital voice recorder for future analysis.

Coding and Reliability

A score was computed for the six paragraphs based on the number of content units recalled with 20 as the highest possible score for each paragraph. The number of recalled emotional words from the word lists was then tallied (30 possible), as well as the number of recalled neutral words (30 possible). Responses with incorrect tense were marked as correct.

The three neutral paragraph scores were added to form each participant's neutral paragraph recall score, and the three emotional paragraph scores were added to form each participant's emotional paragraph recall score. The number of emotional words and the number of neutral words recalled by each participant was computed. The scores for each section (emotion paragraph, neutral paragraph, emotion words, and neutral words) were divided by the total units possible for that section to compute a percent recall score.

The investigator and one assistant (Bachelor of Science degree, trained in coding and analysis for the present study) scored paragraph and word recall results. A second assistant (also Bachelor of Science degree and trained in the coding system) aided in reliability measurements. To determine interscorer reliability, the assistant aiding in reliability scored five of the 20 participants who also were scored by the investigator. Interscorer reliability was determined by comparing each answer for a participant between the two scorers. The mean percent of responses coded the same for the five participants was 95.30% in paragraph responses. In word lists, 100% of responses were coded the same.

RESULTS

The mean percent and standard deviation for neutral and emotional words and paragraphs are shown in Table 3. The mean percent of emotional units recalled (57.78%) was significantly greater than the mean percent of neutral units recalled (46.61%). There was a significant effect of emotional saliency on recall for both words and paragraphs. The mean percent of units recalled in the emotional paragraphs was 54.42%; the mean percent recall in the neutral paragraphs was 44.33%. Similarly, the mean percent emotional words recalled from word lists was 64.42%; the mean percent neutral words recalled from word lists was 51.17%. Statistical analyses were performed using the computer software program StatCrunch (Integrated Analytics, 2010).

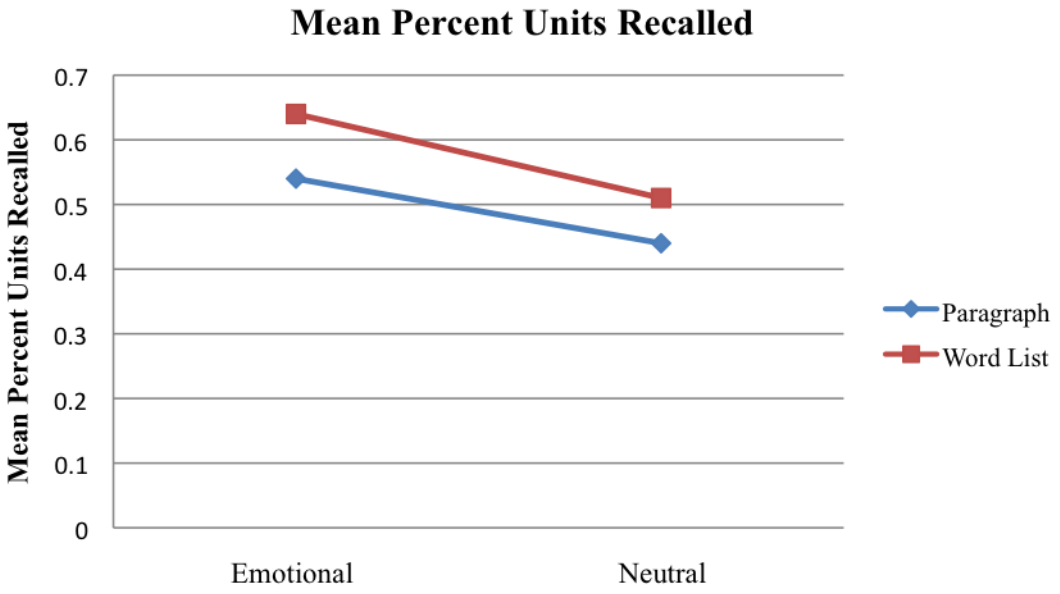
A two way repeated measures analysis of variance revealed a significant effect for stimulus type (i.e. paragraphs or words) ($F= 10.51$; $df= 1$; $p= <0.01$), and for emotional saliency ($F= 19.53$; $df= 1$; $p= <0.0001$), but not the interaction between emotionality and length ($F= 0.35$; $df= 1$; $p= 0.551$). Post-hoc t-tests yielded significant differences in the number of emotional units recalled for both words ($p= <.01$) and paragraphs ($p= <.001$). There also was significantly greater recall for word lists than paragraphs for both emotional ($p= <.05$) and neutral ($p= <.05$) stimuli.

Table 3: Percent Recall for Emotional (Emo) and Neutral (Neu) Words and Paragraphs for the 20 Participants in the Study

	Paragraph Recall		Word List Recall		Combined Recall	
Participant	Emo	Neu	Emo	Neu	**Mean Emo**	**Mean Neu**
1	48.33	41.67	70.00	46.67	**55.56**	**43.33**
2	68.33	43.33	31.67	60.00	**56.67**	**48.89**
3	68.33	51.67	53.33	63.33	**63.33**	**55.56**
4	50.00	43.33	60.00	66.67	**53.33**	**51.11**
5	80.00	53.33	86.67	50.00	**82.22**	**52.22**
6	53.33	48.33	60.00	40.00	**55.56**	**45.56**
7	58.33	46.67	56.67	63.33	**57.78**	**52.22**
8	68.33	55.00	73.33	56.67	**70.00**	**55.56**
9	36.67	33.33	60.00	40.00	**44.44**	**35.56**
10	50.00	45.00	70.00	53.33	**56.67**	**47.78**
11	50.00	48.33	60.00	53.33	**53.33**	**50.00**
12	46.67	28.33	70.00	46.67	**54.44**	**34.44**
13	40.00	28.33	70.00	53.33	**50.00**	**36.67**
14	50.00	36.67	73.33	46.67	**57.78**	**40.00**
15	30.00	38.33	66.67	46.67	**42.22**	**41.11**
16	70.00	60.00	76.67	36.67	**72.22**	**52.22**
17	30.00	40.00	43.33	46.67	**34.44**	**42.22**
18	70.00	56.67	80.00	66.67	**73.33**	**60.00**
19	51.67	46.67	76.67	56.67	**60.00**	**50.00**
20	68.33	41.67	50.00	30.00	**62.22**	**37.78**
Mean % Units Recalled	**54.42**	**44.33**	**64.42**	**51.17**	**57.78**	**46.61**
Standard Deviation	*14.20*	*8.74*	*13.20*	*10.10*	*11.10*	*7.38*

In summary, the participants recalled significantly more emotional units than neutral units from word lists and paragraphs. Participants also recalled a higher percentage of units from word lists than from paragraphs as shown in Figure 1.

Figure 1: Mean Percent Units Recalled for Paragraphs and for Words



These results support previous research indicating that NBD individuals recall significantly more emotional words and language units than non-emotional words and language units (Altarriba & Bauer, 2004). As expected, the NBD participants recalled more emotionally salient units than neutral units. NBD individuals showed increased recall with emotionally salient units in both paragraph and word list form.

DISCUSSION

This study investigated the effects of emotional saliency on word and paragraph recall. The stimuli created were rated as emotional and neutral, and showed differences in recall of both word lists and paragraphs as related to emotionality. The stimuli were valid indicators of emotional saliency as evidenced by the ratings prior to the testing of the stimuli and also the differences in recall of the stimuli.

Although the recall percentages were greater in the word-list than the paragraph, the proportion of words recalled was similar to the proportion of units recalled. Participants recalled an average of 32.65 out of 60 possible units from the three emotional paragraphs, and 26.60 out of 60 possible units from the neutral paragraphs. In word-list recall, participants recalled an average of 19 emotional words out of 30 possible and 15.4 neutral words out of 30 possible. The word lists (10 words in length) were much shorter than the paragraphs (20 units in length, 2-5 words per unit). Longer list length, or a shorter paragraph length, may have produced results favoring the recall of paragraphs as opposed to word lists based on the influence of context (Besken & Mulligan, 2010). As an alternative explanation, there is also a possibility that the words in some word lists were unintentionally related semantically which could have facilitated greater recall than the paragraphs.

Both forms of stimuli elicited similar patterns of recall from participants. More emotional words than neutral words were recalled from word-lists and more units were recalled from emotional paragraphs than from neutral paragraphs. The effect of stimulus saliency for emotional units in recall indicates that emotional saliency allowed for easier recall, confirming the findings of Altaribba and Bauer (2004).

One limitation of the study was the presentation of the stimuli. Because the stimuli were presented verbally by the investigator, there may have been variance of rate, intensity, and prosody that could have affected recall. However, the benefit of having the physical representation of a person presenting the material, as opposed to material presented over binaural headphones, was more important to the recall than the possible variance in presentation.

The idea that emotionally salient material is processed more effectively by the right hemisphere is supported by dichotic listening tasks indicating a right hemisphere advantage for emotional word recall (Altaribba & Bauer, 2004; Sim & Martinez, 2005) and split visual field tests and other visual assessments indicating a right hemisphere advantage for emotional material (Kucharska-Pietura, 2003; Mizuno, 1991; Myers, 1999; Nagae & Moscovitch, 2002; Sherratt, 2007). The effect of emotional saliency on verbal recall may indicate that emotional material is processed simultaneously by both hemispheres; linguistically in the left hemisphere, and emotionally in the right hemisphere thus lending the material to be processed more efficiently or completely.

Future studies should target populations with specific neurogenic disorders to observe their performance on this task. Analyzing the recall of emotionally distinctive

stimuli in individuals with RHD, TBI, and left hemisphere stroke may reveal more about the processing of emotionally salient material as related to this task. More support may be garnered for the idea that linguistically encoded emotional material allows for a recall advantage based on possible simultaneous processing.

Based on the results of this study and previous studies in emotional processing, if this study were executed with individuals with RHD, these individuals may recall neutral and emotional material equally as emotional material has essentially lost its saliency. Individuals with TBI may recall fewer items as both hemispheres are damaged and show less advantage for recall of emotional material. Individuals with left hemisphere damage may recall fewer items due to linguistic deficits in processing but may show an advantage for recall of emotional material as the right hemisphere is intact.

In summary, this study revealed a distinct advantage for recall of emotional words in recall of mixed emotional and neutral word lists as well as an advantage in recall of emotionally loaded paragraphs as opposed to neutral paragraphs. In addition, word-lists revealed a higher percentage of recall overall as compared to paragraphs in both emotional and neutral recall suggesting that word lists were more successfully recalled than paragraphs.

APPENDICES

Appendix A: Sample of Paragraph and Word Emotionality Rating Forms

Instructions:
Read the following paragraphs. After reading the paragraph, rate the paragraph on the scale from Neutral (not emotional) to Emotional (containing or evoking emotion, whether positive or negative in connotation). Place a vertical line on the scale to mark where the paragraph rates in terms of emotional content.

EX:
The starving family won the lottery after finding a ticket on the street.

Non-Emo _____ High Emo

The cat ate its food.

Non-Emo _____ High Emo

Human tissue and blood spattered the wall from the murder.

Non-Emo _____ High Emo

Sarah watched / as her son was arrested / and put in / the police car. / He screamed obscenities / at Sarah / as she looked away. / He cursed at / the policeman / and fought against them. / Sarah's son / was arrested on account / of illegal drug dealing. / Sarah had known / her son was troubled / and had tried to help him, / but when she found / drugs in her home, / she had called the police.

Non-Emo _____ High Emo

A cowboy / went to San Francisco / with his dog, / which he left / at a friend's / while he bought / a new suit of clothes. / He came back / to the dog / dressed in his new suit / but the dog didn't recognize him / and gave a mournful / howl. / So the cowboy / put on his old suit / and the dog / immediately / showed its joy / on seeing its master / as it thought he should look.

Non-Emo _____ High Emo

There was once / a king / who was very sick / and his doctors / were unable / to cure him. / He sent for his wise men / who told him / he would get well / if he wore / the shirt / of a truly / happy man. / So he sent his messengers / out all over the kingdom / looking for / a truly / happy man / and they finally found one / but he didn't have a shirt.

Non-Emo _____ High Emo

Mr. Jones / brought home / a bag of chocolates / for the office's party. / He put them / in the closet / and went to bed. / His son Joey / heard him / hiding the chocolates / and came down / to investigate. / Joey found the chocolates / and took them / to his desk / to hide them. / After he went to sleep / the dog took them / out to the back yard / and buried them.

Non-Emo _____ High Emo

When Maria's parents / came home from work / they brought home / a new pencil / for Maria, / which she needed. / That night / Maria dropped her pencil, / and it rolled away. / She looked for her pencil / everywhere, / only to find / the one she had lost / the week before. She finished her work / and continued to look / for a short while. / Maria found / her new pencil, / and played until bedtime.

Non-Emo _____ High Emo

A sister / was traumatized / when her parents / picked her up / from school / with bad news. / Her brother / was murdered. / The sister sobbed / as her parents explained / that he was killed / while saving a woman / being assaulted / by a masked man. / His heroic actions / saved the woman, / but cost him / his life. / The sister smiled / at his memory.

Non-Emo _____ High Emo

Ron went / outside / to play / a game / with his brother./ His brother / wasn't interested / in the game, / so Ron decided / to play by himself. / After a while, / Ron decided / to find a game / they could both enjoy. / Ron and his brother / had a snack. / After their snack / they went back outside / to play together.

Non-Emo _____ High Emo

The doctor told / Michelle / that a mass / growing on her brain / would require / invasive brain surgery. / Michelle asked / if she would / dance again. / The doctor said / that she wouldn't. / Three months after / her brain surgery, / Michelle put away / her walker / and started dancing. / She refused / to take "no" / for an answer.

Non-Emo _____ High Emo

A newly married / sailor / left his bride / at home / for his final voyage / before retiring / and returning to the family business. / The boat sank / and the rescue squad / found no survivors. / His wife cried frequently / for many years thereafter / and began to drink / too much brandy. / She finally recovered / and remarried / and was happy / until they found the sailor / on a nearby island / living with a native girl.

Non-Emo _____ High Emo

Justin went / to the video game store / but didn't find anything / he liked. / He decided / to rent a game / rather than spend / his money / on a game / he wasn't sure / he would enjoy. / After renting the game, / Justin decided / he made the right choice / in renting the game. / The game was boring, / and had he bought it / he would have wated / $40.

Non-Emo _____ High Emo

Instructions:
Read the following words. After reading the paragraph, rate the paragraph on the scale from Neutral (not emotional - NonE) to Emotional (containing or evoking emotion, whether positive or negative in connotation - HighE). Place a vertical line on the scale to mark where the paragraph rates in terms of emotionality.

EX:

Tree NonE _____ HighE

Joyous NonE _____ HighE

Scale NonE _____ HighE

Abortion NonE _____ HighE

Abused NonE _____ HighE

Accident	NonE		HighE
Acquaintance	NonE		HighE
Addict	NonE		HighE
Affair	NonE		HighE
Alcoholic	NonE		HighE
Alive	NonE		HighE
Allow	NonE		HighE
Alright	NonE		HighE
Amused	NonE		HighE
Arson	NonE		HighE
Assist	NonE		HighE
Baker	NonE		HighE
Blood	NonE		HighE
Bump	NonE		HighE
Campaign	NonE		HighE
Capsule	NonE		HighE
Champion	NonE		HighE
Cleaners	NonE		HighE
Coffee	NonE		HighE
Cookie	NonE		HighE
Cool	NonE		HighE
Coworker	NonE		HighE
Cured	NonE		HighE
Death	NonE		HighE
Delivery	NonE		HighE
Dented	NonE		HighE
Disease	NonE		HighE
Drive	NonE		HighE
Drown	NonE		HighE
Drugs	NonE		HighE
Embrace	NonE		HighE
Engulf	NonE		HighE
Enough	NonE		HighE
Enslave	NonE		HighE
Euthanasia	NonE		HighE
Failure	NonE		HighE
Family	NonE		HighE

Fan	NonE	_____	HighE
Favor	NonE	_____	HighE
Freedom	NonE	_____	HighE
Friend	NonE	_____	HighE
Game	NonE	_____	HighE
Grotesque	NonE	_____	HighE
Guest	NonE	_____	HighE
Gun	NonE	_____	HighE
Happy	NonE	_____	HighE
Help	NonE	_____	HighE
Here	NonE	_____	HighE
Hibernate	NonE	_____	HighE
Holiday	NonE	_____	HighE
Home	NonE	_____	HighE
Hometown	NonE	_____	HighE
Hospital	NonE	_____	HighE
House	NonE	_____	HighE
Jail	NonE	_____	HighE
Kiss	NonE	_____	HighE
Knife	NonE	_____	HighE
Like	NonE	_____	HighE
Love	NonE	_____	HighE
Maimed	NonE	_____	HighE
Medium	NonE	_____	HighE
Meeting	NonE	_____	HighE
Noose	NonE	_____	HighE
Peace	NonE	_____	HighE
Pen	NonE	_____	HighE
Poison	NonE	_____	HighE
Procedure	NonE	_____	HighE
Professional	NonE	_____	HighE
Rape	NonE	_____	HighE
Recess	NonE	_____	HighE
Safe	NonE	_____	HighE
Saved	NonE	_____	HighE
School	NonE	_____	HighE
Sex	NonE	_____	HighE

Smile	NonE	_____	HighE
Smirk	NonE	_____	HighE
Sob	NonE	_____	HighE
Spoon	NonE	_____	HighE
Stick	NonE	_____	HighE
Strangle	NonE	_____	HighE
Straw	NonE	_____	HighE
Suffocate	NonE	_____	HighE
Suicide	NonE	_____	HighE
Sunburn	NonE	_____	HighE
Sweat	NonE	_____	HighE
Swing	NonE	_____	HighE
Switched	NonE	_____	HighE
Team	NonE	_____	HighE
Tension	NonE	_____	HighE
Tickle	NonE	_____	HighE
Tossed	NonE	_____	HighE
Trapped	NonE	_____	HighE
Vent	NonE	_____	HighE
War	NonE	_____	HighE
Watched	NonE	_____	HighE
Water	NonE	_____	HighE
Weak	NonE	_____	HighE
Wedding	NonE	_____	HighE

Appendix B: Mean Paragraph and Word Ratings, Standard Deviations, and Assigned Ratings

Paragraph	Mean Rating	Standard Deviation	Assigned Rating
Justin	10.00	16.48	NEUTRAL
Maria	14.73	19.17	NEUTRAL
Mr. Jones	19.20	18.95	NEUTRAL
Ron	19.60	22.88	-
King	39.03	28.89	-
Cowboy	42.93	23.46	-
Sailor	74.30	26.27	-
Michelle	87.57	11.78	EMOTIONAL
Sarah	91.73	15.32	EMOTIONAL
Sister	95.03	10.49	EMOTIONAL
Word	Mean Rating	Standard Deviation	Assigned Rating
Straw	2.97	9.95	NEUTRAL
Hibernate	3.87	5.66	NEUTRAL
Stick	3.97	11.91	NEUTRAL
Pen	4.80	12.86	NEUTRAL
Capsule	5.13	11.81	NEUTRAL
Cleaners	5.50	14.91	NEUTRAL
Spoon	5.87	17.93	NEUTRAL
Here	6.63	14.68	NEUTRAL
Baker	6.77	13.92	NEUTRAL
Switched	8.27	13.13	NEUTRAL
Meeting	8.50	14.82	NEUTRAL
Medium	8.60	16.57	NEUTRAL
Tossed	11.07	17.25	NEUTRAL
Coworker	11.80	17.87	NEUTRAL
Professional	12.50	21.85	NEUTRAL
Drive	13.27	21.26	NEUTRAL
Coffee	13.33	22.13	NEUTRAL
Swing	13.73	23.35	NEUTRAL

Bump	13.87	17.27	NEUTRAL
Allow	14.33	23.38	NEUTRAL
Water	15.83	28.15	NEUTRAL
Acquaintance	16.27	19.59	NEUTRAL
Alright	16.67	19.04	NEUTRAL
Assist	17.87	24.01	NEUTRAL
Watched	18.97	24.95	NEUTRAL
Cookie	19.13	26.53	NEUTRAL
Delivery	20.20	24.74	NEUTRAL
Procedure	20.87	27.01	NEUTRAL
Dented	20.90	21.33	NEUTRAL
Cool	21.30	25.21	NEUTRAL
Vent	21.57	31.39	-
Fan	21.97	27.27	-
Guest	22.30	21.83	-
Favor	24.77	24.10	-
Sweat	24.77	27.86	-
Enough	24.80	26.89	-
Recess	25.23	24.83	-
House	25.37	21.30	-
Sunburn	26.43	24.81	-
Game	28.07	24.78	-
Campaign	28.33	29.72	-
Team	31.30	28.96	-
School	32.63	31.46	-
Weak	33.57	27.13	-
Knife	37.23	28.91	-
Engulf	41.47	32.27	-
Like	44.63	22.67	-
Amused	45.07	30.47	-
Tickle	46.13	26.33	-
Alive	46.97	30.94	-
Smirk	47.83	26.32	-
Safe	50.37	26.25	-
Tension	53.03	30.96	-
Blood	54.27	30.43	-

Saved	57.63	26.18	-
Poison	57.70	26.06	-
Jail	58.20	27.91	-
Help	58.27	29.09	-
Champion	58.77	27.97	-
Grotesque	61.70	25.14	-
Arson	62.30	30.63	-
Trapped	63.93	26.26	-
Holiday	64.10	28.38	-
Hometown	65.67	23.15	-
Hospital	65.93	27.86	-
Smile	67.33	21.24	-
Gun	68.07	19.76	-
Drugs	69.73	25.56	-
Embrace	70.17	26.80	-
Friend	70.57	19.99	-
Noose	71.87	25.73	EMOTIONAL
Enslave	72.27	25.85	EMOTIONAL
Failure	73.30	28.91	EMOTIONAL
Home	74.10	20.39	EMOTIONAL
Accident	74.20	17.55	EMOTIONAL
Peace	74.40	19.99	EMOTIONAL
Maimed	74.53	29.07	EMOTIONAL
Kiss	75.23	19.69	EMOTIONAL
Disease	76.13	19.42	EMOTIONAL
Addict	76.40	21.90	EMOTIONAL
Freedom	76.50	20.18	EMOTIONAL
Cured	76.60	18.73	EMOTIONAL
Strangle	78.60	25.48	EMOTIONAL
Happy	78.80	20.06	EMOTIONAL
Sob	78.80	16.50	EMOTIONAL
Sex	80.60	20.53	EMOTIONAL
Alcoholic	82.20	17.33	EMOTIONAL
Suffocate	82.40	18.68	EMOTIONAL
Drown	82.73	20.35	EMOTIONAL
Wedding	83.67	17.68	EMOTIONAL

Family	85.27	15.34	EMOTIONAL
Affair	86.07	14.31	EMOTIONAL
Euthanasia	87.03	15.53	EMOTIONAL
War	87.43	14.13	EMOTIONAL
Love	89.23	14.08	EMOTIONAL
Abused	89.70	18.56	EMOTIONAL
Death	92.33	11.87	EMOTIONAL
Abortion	92.43	13.21	EMOTIONAL
Rape	92.90	16.42	EMOTIONAL
Suicide	94.80	8.41	EMOTIONAL

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