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LEXICAL EXPRESSION OF EMOTION
IN CORTICAL STROKE PATIENTS:
INTRA- AND INTERHEMISPHERIC EFFECTS

by

LAWRENCE H. PICK

A dissertation submitted to the Graduate Faculty in Psychology in partial
fulfillment of the requirements for the degree of Doctor of Philosophy, The
City University of New York

2002

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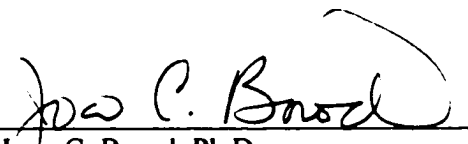
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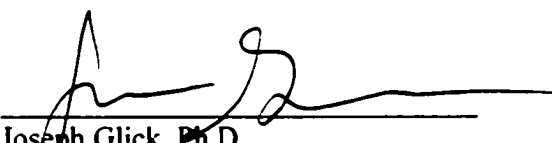
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This Manuscript has been read and accepted for the Graduate Faculty in Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy

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Abstract

LEXICAL EXPRESSION OF EMOTION
IN CORTICAL STROKE PATIENTS:
INTER- AND INTRAHEMISPHERIC EFFECTS

by

LAWRENCE H. PICK

Adviser: Dr. Joan C. Borod

This investigation examined neural mechanisms underlying the expression of lexical (i.e., verbal) emotion. Participants included individuals with left-hemisphere (N = 13) and right-hemisphere (N = 13) cortical cerebrovascular lesions, whose lesions were either in anterior or posterior quadrants. Thirteen healthy controls were also included. Participants were asked to produce narratives based on autobiographical memories, which included emotional or nonemotional topics. The narratives were transcribed so that nonverbal factors (i.e., face and prosody) were excluded and raters could focus solely on the lexical emotional content. The dependent variables of emotional content and intensity, positive emotional content and intensity, and negative emotional content and intensity were analyzed in accordance with the right hemisphere and valence hypotheses.

A rating of thematic accuracy was included to assess how accurately the content

of the narrative reflected the stimulus cue. The confidence of the raters in making the accuracy decision was also examined. Lastly, the effects of gender on emotion were assessed, as women have been shown to express better language and emotion compared to men.

The data revealed that right-hemisphere lesions did not produce global emotional deficits. Unexpectedly, the left brain-damaged group showed increased difficulties processing emotional and positive emotional content/intensity compared to the right brain-damaged and control groups. This effect was not observed for the negative emotional ratings. The LBD's selective difficulties for positive emotional content and intensity provide some partial support for the valence hypothesis.

These group differences seemed to stem from residual language deficits in the left-hemisphere group. For example, individuals with mild residual aphasic symptoms generally performed more poorly on the experimental tasks than those without language deficits. These findings are discussed in terms of lateralization theory, recovery of emotional function, facilitation effects, and methodological issues.

Other findings included: 1) Anterior compared to posterior damage resulted in reduced emotional output. 2) Negative emotions were rated with more content and higher intensity than positive emotions. 3) Women produced more negative emotional content than men did.

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Lastly I dedicate this project to my family, especially my parents. Through their lives I have learned how to persevere, overcome seemingly endless obstacles, maintain self-worth, and love.

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Introduction

Purpose of the Study

The underlying neural mechanisms of emotional processes are often debated, but appear contingent on how specific aspects of emotional experiences (e.g., perception, subjective experience, and arousal) are conceptualized and examined. Within the field of neuropsychology considerable evidence has been produced indicating that the right hemisphere is involved in the cortical mediation of a unitary emotional phenomenon (i.e., right-hemisphere hypothesis). In contrast, other investigators propose that there is an asymmetric anterior cortical lateralization that regulates positive versus negative emotions (i.e., the valence hypothesis).

The two hypotheses have frequently been investigated using emotion paradigms focusing on perception, expression, or experience as assessed through facial and/or prosodic communication channels. In contrast, there has been little neuropsychological research on emotion as processed through language. Irrespective of the channel used in examining the process, a majority of the lexical emotion studies support the right-hemisphere hypothesis, as compared with the valence hypothesis. The inconsistent findings for the valence hypothesis appear to depend somewhat on the methodology employed.

In comparison, the underlying neural mechanisms for language have been extensively documented. In most humans, left-hemisphere dominance is observed when the structural elements (e.g., syntax and phonology) of language are examined at the

sentence level. More recently, the right hemisphere cortices are shown to play a role in the processing of structural, global, and/or inferential components of language.

The primary goal of the current investigation was to examine whether current neuropsychological perspectives on emotion were upheld when the phenomenon was examined using complex language (i.e., spontaneous discourse productions) as the modality of expression. Individuals with neural lesions (i.e., cerebrovascular incidents), as well as healthy participants, recalled and reexperienced emotional episodes that stemmed from autobiographical affective memories. They were then asked to produce narratives based on these recollections. To examine the potential contributions of the two emotion hypotheses more specifically, language samples were rated on various components of emotion (e.g., emotional content and emotional intensity). In light of the macrostructural deficits (e.g., discourse production, inference) often observed with right-hemisphere damage, the thematic accuracy of each narrative was assessed to help ensure that any potential differences in emotional functioning did not result from poorly structured content. Lastly, the study examined whether various subject (e.g., gender, age, and education), cognitive (e.g., memory and attention), and/or mood (e.g., depression) variables impacted the lexical expression of emotion.

Psychological Perspectives on Emotion

The ontology and epistemology of human emotions have been posited by the earliest of philosophers. Yet, only within the past century has the field of psychology begun to explore these philosophically based inquiries and observations using more objective experimental approaches. As psychology has grown and diversified, so has the construct of emotion. The various approaches have examined emotion using a diverse range of operational definitions and experimental paradigms, which have resulted in concordant as well as conflicting findings.

Current psychological and neuropsychological perspectives generally acknowledge at least one or more of the following three components (i.e., physiological, behavioral, and subjective) as the building block/s of an emotional episode (Borod, 1993; Lang, 1988; Plutchik, 1984; Scherer, 1984; Silberman & Weingarten, 1986). Other researchers have conceptualized emotion somewhat differently and included aspects of motivation (Lang, Bradley, & Cuthbert, 1992; Leeper & Madison, 1959; Tompkins, 1981), cognitive appraisal (Lazarus, Averill, & Opton, 1970; Ortony, Clore, & Collins, 1988; Schachter & Singer, 1962), and temperament (Davidson, 1992; Larsen & Ketelaar, 1991). Emotions have also been defined based on dimensions of arousal (Russell, 1980; Watson & Tellegen, 1985), as well as by prototypical/discrete categories (e.g., sadness, happiness) (Ekman, 1992; Izard, 1971; Tompkins, 1984). Experimental paradigms examining these issues have traditionally focused on one specific component (e.g., facial movements, autonomic arousal, and subjective feelings), and efforts to thoroughly

integrate the findings into established or developing theories have been infrequent.

Few psychological models have been formulated which attempt to clearly define the components of emotion when language processes are involved. Two psychological frameworks (Leventhal, 1984; Leventhal & Scherer, 1987; Scherer 1984, 1994) have been developed which address such issues.

Scherer's component process model divides an emotional episode into five parts: physiological regulation, motor expression, motivation, cognition, and monitoring feelings (Scherer, 1984; Scherer, 1994). He agrees, in part, with models of discrete emotions (Ekman 1992; Ekman & Friesen, 1975) and underlying neurobiological circuitry (Panksepp, 1993), which state that there are a limited set of prototypical or primary, evolutionary based emotions (e.g., happiness, sadness). For Scherer, each primary emotion reflects a unique sequencing of the five components inherent to most humans. A less common human emotion (e.g., bliss), diverging from a prototypical emotion (e.g., happiness), results when variability occurs within the pattern sequence for that emotion. In this model, changes in one component may affect the resulting relationships among the other components and ultimately contribute to the variability with which an individual experiences any emotion.

This constant interplay between biology, cognition, and the external world helps to shape how humans experience and structure their emotional world, as well as how they express it through language. In Scherer's model, the emotion lexicon of a specific language emerges when a culture or society determines that particular words should be

mapped onto the various pattern sequences. These words are generally assigned based on the society's common emotional experiences, as well as their values and morals.

Individual emotional lexicons and underlying pattern sequences are then further modified and elaborated subsequent to personal experiences and how the individual appraises situational determinants.

The psychomotor theory of emotion (Leventhal, 1984; Leventhal & Scherer, 1987) is another approach that examines how emotions are constructed via language. Three hypothesized levels, sensory-motor, schematic, and conceptual, characterize this model. The first level deals with how sensory information and motor expressions are integrated into emotional episodes. The schematic level refers to an individual's memories of previous emotional experiences. Leventhal describes this level as consisting of cognitions, which are comprised of internal representations of past emotional experiences. At the conceptual level, symbolic representations are constructed to then help delineate between different kinds of emotional episodes, integrate aspects of rationality, and relate experiences. A reciprocal relationship between these three levels helps to fashion a system that benefits an organism during a new experience by accessing previously stored emotional memories and related sensory-motor reactions.

Akin to Scherer's model, Leventhal's conceptual level provides the foundation for the development and expression of cognitive constructions (e.g., language) related to emotional experiences. Leventhal notes that more complex cognitive processes do not necessarily occur during the actual episode, but often emerge after the individual has had

time to reflect on the event.

The present study attempted to assess two aspects of lexical emotion: underlying emotional representations (i.e., content) and general emotional tone/arousal (i.e., intensity). Before reviewing specific investigations examining lexical emotion, neuropsychological perspectives on emotion will be discussed. The following perspectives were instrumental in the development of the dependent measures used in the current study.

Neuropsychological Perspectives on Emotion

The early investigations in the field of emotion developed neurological models of anatomical structures and connecting pathways via animal experimentation. The role each neural structure played in an emotional episode was less often clarified, and much of the work focused on subcortical processes with some acknowledgment of cortical contributions. However, this research provided the basis for later human studies.

Classic Neuropsychological Models of Emotion

Papez (1937) introduced one of the first neural circuits of emotion. He proposed a neural loop following the initial transfer and propagation of sensory information via the hippocampus to the hypothalamus (mammillary bodies), and then continued transmission to the anterior thalamic nuclei and the cingulate gyrus. The expression of an emotion was considered contingent on the hypothalamic structure. After processing of the external event was completed via this medial circuit and an emotional state was determined, signals were sent to the cortex for preparation of motor and cognitive responses.

Emotional information was transmitted between the two levels (i.e., hypothalamus to cortex), in part, via the fornix. Although accounted for within the circuit, cortical contributions were not considered primary in the processing of emotion.

MacLean (1969) later developed a “triune” model of the neural axis, which anchored relationships between limbic and neocortical systems more solidly. The lowest level of this axis, the reptilian brain or core brain (i.e., R-complex), included the brain stem, basal ganglia, and reticular activating system. This last set of fibers was considered important for the mediation of arousal, a component often considered integral to the development of an emotional experience. The second level, the paleomammalian brain or the visceral/limbic system, was posited to coordinate information between the R-complex, which regulated autonomic functioning, and the outermost aspect of the neomammalian brain (i.e., neocortex), which mediated higher order processes. Within the limbic system, the prefrontal cortex, the septum, and the amygdala were considered essential to the physiological survival and affective functioning of an organism.

Nauta (1971, 1986) provided more specific descriptions of this “limbic area” and how the reciprocal connections with the frontal cortices were pertinent to emotional functioning. In this tripartite system, the first tier included the hypothalamus and the numerous connections to anterior and posterior cortical areas. The second level, the rhinencephalon, was comprised of the olfactory bulb and its projections to pyriform cortex and associated olfactory fibers, as well as to the hippocampal formation, the amygdoloid complex, and the septo-diagonal areas. The last tier included the cingulate

and parahippocampal gyri and their respective connections to the hypothalamus, rhinencephalon, and neocortex.

This model, unlike others, emphasized the importance of reciprocal relationships between fibers of the frontal, temporal and parietal cortical regions, as well as the limbic system, hypothalamus, and meso-diencephalic structures associated with the hypothalamus. Nauta (1986) noted that the numerous fibers of rostral pathways were more likely involved in the integration of information received from areas throughout the brain. Integration of such varied information would be integral to emotional experiences, as well as planning, sequencing, and decision-making processes (Nauta, 1971, 1986).

Recently, some of these proposed connections have been more firmly linked to emotion. A cortical-subcortical set of fibers that has been implicated in the processing, regulation, and response of an emotional episode is a basoventral pathway. This set of fibers stem from inferior temporal and ventral occipital regions, and appears to be involved in the processing of visually perceived environmental stimuli (Barbas, 1995; LeDoux, 1992, 1996; Macchi, 1989). This pathway also appears to be involved in developing memory engrams of an experience by mapping affective tone onto perceptual experiences. (Adolphs & Damasio, 2000; Halgren, 1992; LeDoux, 1987, 1992). One structure within this pathway, the amygdala, is considered primary in the process, because of the numerous afferent/efferent connections with the cortex, especially the anterior regions. This area has also been implicated in the regulation of autonomic, visceral, and endocrine functions, and has been shown to play a role in aggressive, defensive, and flight

behaviors (Halgren, 1992; LeDoux, 1992).

Akin to the psychological models of emotion that follow, the above animal research identifies various "levels" of emotional processing related to a range of neural mechanisms.

Current Neuropsychological Models of Human Emotion

The primary intent of the current study was to further clarify the inter- and intrahemispheric loci involved in the processing of emotional content/representations and emotional intensity/arousal. Supported by animal research, the data, from studies involving human participants, are being used to develop current neuropsychological theories of emotion. This is markedly apparent in light of the sudden surge of fMRI, PET, and EEG/ERP studies.

Componential models have attempted to elucidate the different neural mechanisms underlying the structure of emotions in humans (Borod, 1993; Bowers, Bauer, & Heilman, 1993; Davidson, 1992; Gainotti, Caltagirone, & Zoccolotti, 1993; Tucker, 1986). Many of the researchers in the field agree that emotional processes are mediated within both the vertical (i.e., cortical/subcortical) and horizontal planes (i.e., rostral/caudal) of the neural axis, but much of the work with brain-damaged (BD) participants has been limited by methodological constraints (i.e., size, location, and etiology of lesions).

Borod (1993) has posited a model of emotion which encompasses four components, including processing modes (e.g., perception, arousal, experience),

communication channel (e.g., facial, verbal), emotional dimension (e.g., pleasant-unpleasant), and discrete emotions (e.g., anger, surprise). Her review of the literature has focused specifically on how various aspects of the model relate to the right-hemisphere and valence hypotheses, respectively, as well as subcortical-cortical connections (see below). Further studies are awaited that will provide a comprehensive explanation of the components, their involvement in an emotional episode, and the related neural correlates.

Gainotti et al. (1993) proposed an association between the two planes of the neural axis and the levels of emotion proposed in Leventhal's (1984) perceptual-motor model (see above). Gainotti et al., however, address Leventhal's model somewhat differently, dividing it into two emotional memory systems: one used primarily for conditioned emotional responses (i.e., Leventhal's schematic level) and one used for conceptually-based memories (i.e., Leventhal's conceptual level). The schematic level, mediated by the subcortices, reflects spontaneous and automatic emotional experiences and appears to parallel, in part, the basoventral pathway contributions in attributing emotional tone to a stimulus. In contrast, the conceptual level pertains to controlled and volitional emotional responses, which are regulated by cortical functions. In terms of a horizontal perspective, Gainotti et al. (1993) purport that the right hemisphere is more involved in the unconscious access and utilization of emotional representations, while the left hemisphere functions in a more controlled and analytical fashion.

A somewhat different perspective is based on several studies of discrete emotion functioning and the categorization of emotional terms. When such data have been

examined via factor analytic and multidimensional scaling models, two dimensions have consistently emerged. One dimension consists of arousal (e.g., arousal-calm) and the other relates to valence (e.g., unpleasant-pleasant). In some studies however, two valence dimensions (i.e., positive and negative affect) emerge in lieu of arousal (Ekman, Levenson, & Friesen 1983; Heller, 1993; Mayer & Gaschke, 1988; Tompkins 1984; Watson & Tellegen 1985). A few investigators (e.g., Heller, 1993; Mayer & Gaschke, 1988; Watson & Tellegen, 1985) have suggested that the right hemisphere, especially the posterior cortex, mediates the dimension of arousal (see below), whereas the second dimension of pleasant-unpleasantness or valence is linked to rostral brain areas.

Heller (1990, 1993), suggests that these two dimensions form a “dynamic phenomenon”. She proposes that this system is subserved by interconnections between the right parietal-temporal areas (i.e., arousal) and the bilateral anterior forebrain areas (i.e., valence and/or expressive/experiential emotion). Davidson (1992, 1993a) also considers the frontal cortices to be a “convergence zone” that assimilates the various components of emotion that occur during an episode. He focuses specifically on the connections between the amygdoloid complex and the prefrontal areas, as well as the reciprocal pathways from the prefrontal cortex to the medial parietal cortex (Davidson & Irwin, 1999).

Clearly these models are complex and suggest that there are many aspects of emotion that are mediated by different areas of the brain. Yet, many studies choose to examine only one aspect of emotion, and often in attempts to validate either the right-

hemisphere (i.e., right-hemisphere dominance for all emotion) or the valence hypothesis (asymmetrical dominance for different types of emotions). The current study will attempt to examine whether either of these hypotheses are substantiated when two different measures (i.e., content and intensity) of lexical emotional expression are considered. A review of the literature concerning these two hypotheses will be presented.

Right-hemisphere hypothesis. According to the right-hemisphere hypothesis, the entire right-hemisphere or selected portions are involved in emotional processing (Borod 1992, 1993; Borod et al., 1998; Borod, Haywood, & Koff, 1997; Bowers et al. 1993; Bryden & Ley, 1983; Heilman, Bowers, & Valenstein 1993; Ross, 1997). Some of these investigators have proposed the existence of a global emotional processor. The notion of such a processor is based on perception/identification tasks, which assessed affectively-laden materials across a variety of methodologies and modalities in healthy participants (Borod et al., 2000; Campbell, 1978; Heilman et al., 1993; Ley & Bryden, 1979), and brain-damaged individuals (Borod et al., 1998; Cicero et al., 1999; Gorelick & Ross, 1987; Ross, 1997; Tucker, Watson, & Heilman, 1977). The hypothesis has less often been supported in studies of experienced and expressed emotion within the facial and prosodic modalities (Borod et al., 1997; Campbell, 1986; Gorelick & Ross, 1987; Ross & Mesulam, 1979; Skinner & Mullen, 1991). Recent work on lexical emotion indicates that the right-hemisphere effect occurs less often in the perceptual modality, but it is markedly apparent in paradigms utilizing expression and experience (see review in Borod, Bloom, & Santschi-Haywood, 1998, Cicero et al., 1999; Grunwald et al., 1999).

For those researchers who entertain this hypothesis, there remains a great deal of disparity concerning how the concept of emotion is defined; loose terminology such as "global emotional tone", "perception of emotion", and "emotional semantics" are often used. Stemming from these ambiguous definitions are some uncertainties about whether right-hemisphere findings represent an overarching emotional process or a specific aspect of the emotional experience. Some researchers suggest that irrespective of the component examined, there is a unitary and separate set of neural mechanisms specifically identified for emotion. Others believe that there are more one-to-one correspondences between specific emotional states and underlying neural circuitry (e.g., fear and the amygdala).

Bowers et al. (1993) have attempted to define right-hemisphere dominance as reflecting a nonverbal affect lexicon (i.e., knowledge concerning the emotion meaning of species-typical nonverbal communicative signals). This lexicon is directly related to the expression and perception of prosodic, facial, and gestural emotion. This contrasts with what is referred to as emotional semantics (i.e., conceptual knowledge about the meaning of situational determinants of emotion) or the nonemotional aspects of situations and their related propositions.

This latter knowledge is not necessarily housed within a single hemisphere, but most likely involves bihemispheric processes. Bowers et al. (1993) describe both types of representations as "cold cognitions", which affect judgments and knowledge concerning emotion, but are detached from the actual experiential aspects of an emotional episode. This perspective might provide potential neuroanatomical support for the level

of cognition emphasized in Scherer's theory, as well as the schematic and conceptual levels in Leventhal's theory.

As previously stated, the right-hemisphere effect has also been linked to specific aspects of autonomic and behavioral arousal (Heller, 1993; Russell, 1980). Emotional states and traits have been discussed as representing a dimension of arousal and a dimension of pleasantness/valence. In these studies, right-hemisphere mechanisms are more often associated with the arousal component. Investigations reveal that lesions to the right hemisphere result in disruption of autonomic arousal, as well as subjective interpretations concerning how states of arousal contribute to an individual's emotional functioning (Heilman, Schwartz, & Watson, 1978; Heilman & Van den Abell, 1979; Heller, 1990; Morrow, Vrtunski, Kim, & Boller, 1981; Russell, Tucker, & Williamson, 1984; Valenstein & Heilman 1984). As previously stated, the right parietal-temporal area has been ascribed a primary role in this process (Heller, 1990; Wittling, 1990). Work with individuals who suffer depression (e.g., Flor-Henry, 1979; Jaeger, Borod, & Peselow, 1987; Monakhov, Perris, Botskarev, von Knorring, & Nikiforvet, 1979) has also provided supporting evidence for this supposition. Reduced blood flow and brain activity have been observed in such patients and may result from decrements in arousal levels which manifest as disinterest, sadness, or prevalence of negative mood states.

One potential explanation concerning why the right hemisphere has become lateralized for these functions is based on evolutionary predispositions concerning how the brain processes specific types of information (Derryberry & Tucker, 1992; Tucker,

1981, 1986). Tucker proposes that right-hemisphere functions are primed to process emotion, as well as other types of cognitive functions, as a result of specific neurochemical and structural features of the hemisphere. He suggests that the development of the right hemisphere in humans has been primed, both morphologically and physiologically, to orient towards, register, and mediate sensory information, which is then encoded as analog representations. This type of information processing system may have developed as part of a phasic arousal system involved with the habituation of attention and information that is subserved primarily by noradrenergic pathways (Goldberg & Costa, 1981).

Neuromorphological evidence for the above explanation may be found in the increased cellular density within the right hemisphere (Gur et al., 1980). Using Xest inhalation procedures, Gur et al. demonstrated that the relation of gray to white matter was found to be increased in the left compared to the right hemisphere and that these left-right differences were found primarily in frontal and precentral regions. Lateralized disparities were further identified in all neural areas except for certain central-parietal temporal areas.

The greater cellular density, in addition to greater interregional connectivity (Tucker, Roth, & Blair, 1986; Semmes, 1968) and cortical pathways (Semmes, 1968), would prime this hemisphere to be more adept at processing complex, multimodal, associative stimuli. It would also provide the right hemisphere the capacity to manage various representations during a single task (Gur et al., 1980; Semmes, 1968). A

hemisphere primed to assimilate and integrate information from numerous channels would seem more likely involved in the mediation of complex and integrative functions such as emotion, visual-spatial information, and complex language productions.

In comparison, Tucker (1981, 1986) considers the left hemisphere to be specialized for the processing of analytic information, which is subserved by a tonic, motor activation system (redundancy bias control system) involving primarily dopaminergic pathways (Goldberg & Costa, 1981; Tucker 1981, 1986). This hemisphere seems to have developed cellular networks that are more adept at processing and transferring discrete and homogenous information across smaller cortical regions (Semmes 1968). These neural characteristics would seem less likely to support emotional processes, but would be better predisposed for the mediation of phenomena such as language, which relies on the detailed analysis of information that is processed in parallel modalities.

In summary, the right-hemisphere effect has been demonstrated using several different operational definitions (e.g., general emotional processor, emotional knowledge related to nonverbal processing systems, and different types of arousal) and methodologies (e.g., perception of facial emotion, expression of prosody, and autonomic arousal). For lexical emotion, the dominance is observed more often with expression than perception. This asymmetry has been explained via a number of differences in information processing systems, as well as in neuroanatomical, neurochemical, and physiological functioning.

Valence hypothesis. Another goal of the current study was to examine whether the valence of emotional processes was mediated by asymmetrical neural mechanisms.

The valence hypothesis has been posited as an alternative explanation to the right-hemisphere hypothesis, stating that the right hemisphere processes negatively valenced emotional stimuli, whereas positive emotions are associated with the left hemisphere. Similar to the preceding hypothesis, studies supporting valence findings have examined emotional functions in normal and brain-damaged participants (Davidson, 1984, 2000; Ehrlichman, 1987; Sackeim et al., 1982; Silberman & Weingartner, 1986). As the right-hemisphere hypothesis has been linked to global emotional processing, perception of emotion, emotional semantics, and/or emotional arousal, the valence hypothesis has been observed in studies evaluating the experience and expression of emotion through nonverbal channels (Bryden & Ley 1983; Davidson, 1984, 1993b; Tucker, Luu, & Pribram, 1995). Data from studies that include individuals with atypical mood and personality traits (Davidson, 2000; Ekman, Saron, Senulis, & Friesen, 1990; Davidson & Tomarken, 1989; Tucker et al., 1981) have also resulted in support for the valence effect. Regarding lexical emotion, several perceptual studies have shown either full, partial, or no support for the effect. Valence has only been examined using expressive or experiential lexical emotion in a handful of studies and the findings were similarly inconsistent (Borod et al., 1998).

Interestingly, much of the initial evidence for the valence hypothesis stemmed from a separate line of research based on incidental findings observed in epileptic

individuals who underwent the intracarotid amobarbital or Wada procedure (i.e., a test to determine hemispheric lateralization of language functions) (see review Snyder & Harris, 1997).

During the procedure, various emotional reactions have been exhibited depending on which hemisphere was inactivated. Left hemisphere inactivation resulted in depressive, catastrophic reactions, whereas right hemisphere inactivation revealed euphoric, maniacal behavior (Bear & Fedio, 1977; Rossi & Rosadini, 1967; Sackeim et al., 1982). Similar behaviors have been observed in individuals with strokes incurred on the right side of the brain (Gainotti 1972; Rossi & Rosadini 1967). In one study, crying was observed more often with left-hemisphere injections, and laughter with right-hemisphere injections (Lee, Loring, Meadern, & Brooks, 1990). Interestingly, in this latter study only part of their sample exhibited these reactions. Lee et al. argued that their findings may have resulted from individual differences in underlying mood or personality characteristics. These differences may have facilitated or suppressed the emotional behavior of one group compared with the other.

Another line of data suggests that valence effects are not mediated by an entire hemisphere, but housed primarily within the anterior cortices (Borod, 1993; Bryden, 1982; Davidson 1984; Heller 1993; Tucker, Luu, & Pribram, 1995). It has been posited that the anterior localization of emotional expression and experience developed in light of evolutionary based survival mechanisms and related motor actions (Davidson, 1993b, Davidson et al., 1990; Davidson & Irwin, 1999; Fox, 1991; Kinsbourne, 1989). As the

frontal cortices are involved in the initiation, planning, and maintenance of motor functions, as well as the integration of subcortical and posterior cortical input, the anterior pathways could be expected to play a vital role in behavioral reactions required during an on-line emotional episode. This suggestion, similar to the right-hemisphere hypothesis, can also be considered in terms of evolutionary development and hemispheric dominance for certain types of information processing. The more analytic and representational left hemisphere may be better suited to mediate positive emotions that are commonly linked to the initiation of interaction within a species. These approach scenarios often require the integration of cognitive processes, as well as the expression and comprehension of speech/language, which are also linked to the anterior cortices.

The right hemisphere, in comparison, would be activated during withdrawal experiences, which often stem from negative affective episodes, during which the organism must quickly assess the environment and determine whether to remain or flee. As the right hemisphere has increased reticular inputs and noradrenergic afferent, it would appear that this hemisphere may have been biased early on to react to negative emotions (e.g., avoidance or flight behavior) based on instinctual patterns of arousal/survival. Faster response times would, therefore, not depend on the more detailed, propositional components of the left hemisphere, but be linked to pathways subserving autonomic arousal, as well as visual-perceptual and visual-spatial processes (Davidson, 1993a; Davidson et al., 1990; Fox, 1991; Kinsbourne, 1989).

Of late, a number of imaging studies (e.g., fMRI, PET) are attempting to localize

emotion in the brain, but not necessarily using these hypotheses. Electrophysiological studies, however, have examined the valence hypothesis using EEG. Findings support potential hemispheric differences based on emotional states and traits (e.g., mood and personality). A number of studies have suggested that individuals, who respond with more fear and disgust when viewing film materials or are more anxious regarding social interactions, demonstrate tonic EEG right frontal activation. In contrast, diminished levels of left anterior EEG activation have been observed in individuals who are depressed (for reviews, see Davidson, 1993a, 2000; Davidson & Tomarken, 1989). Not surprisingly, these EEG findings appear somewhat contingent upon an individual's baseline level of emotional functioning, neural predispositions to specific valenced materials, and individual responses to specific stimuli (Davidson & Tomarken 1989; Robinson, Kubos, Starr, Rao, & Price, 1984).

The variability of results from the behavioral studies previously mentioned may stem, in part, from variability in mood and personality characteristics. Since the present study attempted to examine experiential and expressive aspects of emotion as related to asymmetrical anterior cortical localization, it was important to control for mood and personality disorders. In order to ensure that pathological affective states did not potentially interfere with the paradigm, all participants were screened for several DSM-IV diagnoses within the mood and anxiety spectrums.

Neurolinguistics: Lateralized Differences

The next section briefly explores the neural substrates underlying the expression

of language. As the current study examined emotional expression through language, it is also important to have an understanding of these relationships to help assess potential facilitation or suppression effects occurring between the two functions.

Linguistic functioning has historically been linked to left cortical mechanisms in most humans (Kurthen et al., 1994; Rasmussen & Milner, 1977; Zangwill, 1966). Much of this determination results from investigations examining the microstructural elements of language (i.e., phonology, morphology, and syntax [see reviews in Gazzaniga, 1983; Millar & Whitaker, 1983]).

Historically, contributions of the right or “nondominant” hemispheric were considered nonexistent or minimal. As early as the 1800s, however, Hughlings-Jackson (1880) observed individuals with left-hemisphere lesions and significant aphasia expressing expletives and automatic speech, suggesting that all language was not completely localized within the left hemisphere. Studies of commissurotomies (Gazzaniga, 1983; Zaidel, 1983, 1990) and hemispherectomies (Krashen, 1973; Zaidel, 1990) further supported the right-hemisphere's role in language functions.

Within the past few decades, similar to the field of emotion, an increasing amount of research has been conducted on right-hemisphere language functions. Data strongly suggest that a role of this hemisphere relates to the macrostructure or global elements of language (e.g., discourse production and the ability to use inferences). Studies of microstructure indicate that non-aphasic individuals with right-hemisphere lesions appear to generate equal amounts of linguistic output (i.e., number of words, syntax, and

morphology) compared with left-hemisphere lesioned persons (Joanette, Goulet, & Hannequin, 1990; Nicholas, & Brookshire, 1995). Right-hemisphere damage in these patients, however, results in comprehension and organizational deficits as related to inferential abilities (Foldi, Cicone, & Gardner, 1983; Tompkins, Lehman-Blake, Baumgaertner, & Fassbinder, 2001), complex linguistic materials (i.e., jokes and stories; Lojek-Osiejuk, 1996; Ostrove, Simpson, & Gardner, 1990; Rehak et al., 1992; Schneiderman, Marasugi, & Saddy, 1992; Wapner, Hamby, & Gardner, 1981), abstract concepts (Searleman, 1977), and humor (Wapner et al., 1981). Damage to the right hemisphere has also been shown to impede the development and/or maintenance of a topic during conversation or narrative production (Bloom, Obler, DeSanti, & Ehrlich, 1994; Davis, O'Neil-Pirozzi, & Coon, 1997; Lojek-Osiejuk, 1996), as well as disrupt pragmatic skills (Bloom, Obler, DeSanti, & Ehrlich, 1994; Bryan & Hale, 2001; Foldi et al., 1983; Kaplan, Brownell, Jacobs, & Gardner, 1990). These right-hemisphere language deficits are especially apparent when attempts are made to formulate and comprehend discourse, as compared with single sentences or words (Kertesz, 1982; Meyers, 1979; Meyers & Brookshire, 1995; Van Lancker & Kempler, 1987).

Some individuals with right-hemisphere damage also seem to produce reduced or anomalous content, as well as experience difficulties using common repair strategies to bridge these deficits (Foldi et al., 1983; Joanette et al., 1990). Such individuals have been noted to inappropriately embellish and/or confabulate their language, perhaps due to their inability to maintain a coherent story structure and/or theme content. These verbal

deficits appear to occur mostly in anterior right brain-damaged groups (Hough, 1990).

Left brain-damaged groups, in contrast, seem able to fairly easily maintain and repair their discourse, even if their language is impaired at the level of microstructure.

Akin to emotional processes, it is not entirely clear whether right-hemisphere based linguistic deficits reflect specific difficulties with language and/or disturbances in general cognitive processes. Unfortunately, it has been difficult to tease these issues apart, as many of the studies failed to compare right-hemisphere groups to normal control and/or nonaphasic left hemisphere damaged individuals (Joanette et al., 1990).

Since this study centered on distinguishing the participant's ability to produce emotion through language, it was important to observe whether right-sided brain damage, especially in the anterior regions, impaired the ability to develop and maintain thematic structures.

Emotion and Language

The next section examines studies that focus specifically on the expression and/or experience of lexical emotion as related to the right-hemisphere and valence hypotheses, respectively.

There are fairly extensive literatures within other psychological domains that have examined emotion as comprehended and produced via language (e.g., clinical and developmental psychology). In comparison, there have been few neuropsychological studies focusing on how emotion is processed through linguistic functions. As previously discussed, most of these investigations have assessed the phenomena via perception, and

only a handful have concentrated specifically on the expression and experience of emotion. Many of the studies center on the processing of affective materials using single words or sentences, but some have manipulated emotion through richer, more complex, and spontaneous language. Much of the evidence from these investigations supports right-hemisphere lateralization, with inconsistent findings emerging for the more infrequently examined valence hypothesis. Methodologies requiring the elicitation of limited verbal output will be discussed first followed by studies using complex and spontaneous discourse productions.

Borod, Koff, Lorch, and Nicholas (1985) assessed the emotional content of brief spontaneously produced verbal responses to positive and negative slides of real life events. Their findings showed that an anterior LBD group, compared with RBD and NC groups, used comparably less language. The responses of the RBD group, however, were rated as less emotionally appropriate than those of the other groups, suggesting a right hemisphere involvement in this type of emotional processing.

Further support (Bloom, Borod, Obler, & Koff, 1990) for a right-hemisphere effect was demonstrated in a study examining the accuracy (i.e., ability to convey emotion through language), pleasantness, and emotional intensity of the verbal responses produced in the Borod et al. (1985) study. The RBD and LBD groups were comprised of six subjects (3 per group) with mixed cortical lesions. Three normal controls were also included. A group of separate neurologically intact raters judged the emotional intensity and pleasantness of the utterances' emotional content. The RBD group was rated as

conveying less accuracy and less positive emotion than the other two groups. In an analysis of the actual content, the RBD group conveyed less emotional intensity and less pleasant emotion compared to the other two groups. Bloom et al. suggested that this finding might reflect the RBD group's difficulty in using words to convey emotion.

In a somewhat different vein, Cicone, Wapner, and Gardner (1980) examined groups of RBDs ($n = 21$), LBDs ($n = 18$), bifrontal leucotomized schizophrenics ($n = 13$), and NCs ($n = 10$) on a variety of emotional tasks, of which two are relevant here. On one task, subjects were asked to match an emotionally toned situation (i.e., happiness, love, fear, anger, and sadness) with one of four target items: a) an item imbuing a similar emotional tone, b) an item with similar visual features, but the opposite valence of the target emotion, c) an item with similar visual features, but a neutral tone, or d) an item with unrelated visual features and a neutral tone. No emotional expressions were drawn on the character faces, leaving subjects to make their decisions based on visual cues (i.e., objects or body movements) and situational inferences occurring within the picture. The other task focused on the production of verbal descriptions for the previously presented situations.

In the Cicone et al. study (1980), RBDs performed significantly worse than the LBD and NC groups on the visual matching task, but better than the LBD group and worse than the NC group on the verbal description task. The comparison between the two BD groups was not significant on the latter task. Interestingly, the frontal leucotomy group performed the poorest on both tasks. The authors concluded that the overall

comprehension of emotional tone was impaired in the RBD group as they tended to be unaware or unable to discern the dimension of valence, erroneously grouping emotions of different valences together more than the other groups. On the phrase task, the RBD and frontal leucotomy groups were found to produce many irrelevant/confabulatory and bizarre remarks about the drawings. Impairments of the LBD group seemed to result from disturbances in language formulation, not emotional processing.

Bloom, Borod, Obler, and Gerstman, (1992) examined the emotional content of more complex and structured spontaneous expressions (i.e., discourse). Three groups were asked to produce stories based on three sets of picture sequences varying in thematic content (i.e., neutral/procedural, visual-spatial, negative emotion). Each sequence had the same number of predetermined story elements, which differed thematically. Overall, NCs produced more story elements than both BD groups. For the visual and neutral conditions, the RBD group produced more elements than the LBD group, but no differences were seen in the emotional condition between the two BD groups. When analyzing differences between thematic content within each group, the RBD group produced fewer elements on the emotional story compared with the other two stories. The LBD and NC groups performed similarly on each story sequence.

The next set of studies incorporated more extensive language, which was spontaneously elicited, but not necessarily based on a predetermined set of stimuli. Some of the studies relied on the use of language to represent emotional experiences, as recalled from short-term semantic and/or long-term autobiographical memory.

In one investigation, groups of individuals with left, right, or bilateral brain-damage were asked to read two short stories (one neutral story and one emotionally toned story regarding illness) and then immediately recall the information (Wechsler, 1973). Overall, the three brain-damaged groups recalled fewer items than controls on both stories, but retained less information on the emotionally imbued story as compared with the neutral story. The RBD group recalled more items for both stories compared with either the LBD or bilateral group. This latter finding may suggest better recall in the RBD group or less language impairment than in the LBD group. When examining errors of distorted content or inclusion of self-references, the brain-damaged groups fared significantly worse on the emotional story compared with controls; the RBD group made more errors than the LBD group. The anterior RBDs were also more likely to embellish and confabulate information in both stories, especially for the emotional story.

As all three groups experienced difficulties recalling the emotionally laden materials, it is somewhat difficult to attribute group differences solely to a right hemisphere advantage for emotion versus other cognitive deficits, especially as this was more of a memory paradigm and the groups were not well matched on demographic characteristics, lesion site, or lesion size. It should also be noted that the etiology of the lesions was due to a variety of disease processes beyond vascular incidents (i.e., tumors, dementia, and trauma). This heterogeneity also may have confounded the clarity of the findings.

Cimino, Verfaelli, Bowers, and Heilman (1991) asked RBD and NC groups to

recall autobiographical memories of emotional experiences in hopes that the emotional output would be more salient compared with remote emotional stimuli (i.e., less personally relevant stimuli). These personal experiences, which occurred prior to their strokes, were elicited based on 8 object word cues (i.e., book, river, hand, car, milk, dog, tree, and game) and 8 emotion word cues (i.e., angry, lonely, surprised, happy, brave, hurt, strong, and tense). These emotional terms were a mixture of prototypical emotions and less commonly identified emotions (e.g., tense and brave). Four independent raters evaluated the stories for emotionality using a 1-10 scale.

For both subject groups, the emotionally cued narratives resulted in higher emotionality ratings than those for the neutral cues. In addition, the RBD group was rated as less emotional compared to the NC group in both conditions. Cimino et al. concluded that autobiographical memories, being self-referential may have imbued some emotional content irrespective of the cues provided and that this perhaps explained why the RBD group performed more poorly in both conditions.

Similar to Cimino et al., Borod et al. (1996) asked NC and BD groups to recall and re-experience a number of personal experiences (i.e., happiness, pleasant surprise, interest, anger, disgust, and sadness) for one minute. Nonemotional categories (i.e., beauty, strength, intelligence, fatness, weakness, stupidity, and hair color) were also included and used to control for potential language and memory confounds. All the narratives were transcribed into written formats, and then independent raters assessed the level of emotional intensity (i.e., on a 6-point Likert scale). The most (i.e., happiness and

intelligence) and least (i.e., sadness and weakness) non/emotionally intense categories were then selected. Hair color was also retained as a nonemotional category. Using the same emotional intensity scale, the subset of narratives was then rerated by a separate group of individuals.

In terms of the emotional stimuli, the RBD group produced narratives with less emotional intensity than did the other two groups, providing support for the right-hemisphere hypothesis. In post-hoc analyses, LBDs were shown to produce narratives with less emotional content than the NC group. No group differences were elicited in the nonemotional conditions. In exploring the valence hypothesis, more emotionality was elicited for negative than positive emotions across all groups. When examining group performance for each valence, no differences were observed for positive emotions. However, for negative emotions, LBDs and NC exhibited more emotional intensity than the RBD group, providing some support for the valence hypothesis.

Studies have also attempted to examine how measures of language functioning directly relate to emotion. Bloom, Borod, Obler, and Gerstman (1993), using the same materials and subjects from the Bloom et al. (1992) study, examined the pragmatic performance of their participants and found that both BD groups had difficulties related to specific features within the emotional condition. Summing across several individual pragmatic features, the RBD group's content was found to be significantly less pragmatically appropriate in the emotional condition than in the nonemotional conditions compared to the other groups. The opposite pattern was observed for the LBD group.

The RBD group experienced deficits in specific features including revision strategy and conciseness, which reflect “successful spontaneous repair of a topic if and when ambiguities occur” and “utterances that are informative without conveying excessive detail”, respectively. These patterns seem to support RBDs' experienced difficulties with emotion and complex language processes, and suggest that there may exist some overlap in the neural mechanisms mediating both sets of processes. It further implies that emotion potentially interferes with these individuals' ability to adhere to a topic, be parsimonious, and exclude erroneous details and inferences, which possibly result in bizarre, tangential, and circumlocutory remarks.

To examine the relationships between emotion and discourse production, Borod et al. (2000) applied Bloom et al.'s (1993) set of pragmatic ratings to the narratives produced in the Borod et al. (1996) study and compared their findings to the scales of emotional intensity used in the Borod et al., (1996) study. Only nine of 108 correlations were significant, suggesting that there was little relationship between ratings of emotional intensity and pragmatic performance.

Overall, these studies of lexical emotion tend to support the right-hemisphere hypothesis. Valence has been assessed less often and those studies examining it did not find consistent results. Although the dependent variables in many of the studies appear to assess a general level of emotional tone (e.g., "emotional intensity" and "pleasantness"), the conceptualization of emotion is not necessarily clarified for the reader. This lack of clarity is also sometimes reflected in how the methodologies were constructed (e.g., level

of training on rating scales).

It should also be noted that some form of deficit was identified in the LBDs and/or anterior groups related to language functioning. These deficits included poorer quality and/or limited verbal output. Interestingly, the RBDs, at times, produced extraneous remarks or confabulations. Yet, how the left- and right-sided language deficits potentially interfered with emotional processes or the ability to measure emotional output received little attention.

Although similar to the methodologies of these studies, the current investigation differed in a number of ways. First, an attempt was made to examine more than one measure of emotional functioning (i.e., content and intensity), and not just a single emotional process. A set of positive and negative emotional ratings was also included, in addition to the overall emotional ratings, to better assess the valence hypothesis. The inclusion of the two additional sets of ratings allowed us to examine the possibility that both valences may be operating simultaneously within a narrative.

Secondly, word cues representing prototypical emotions (e.g., "happiness" and "sadness") were chosen instead of more imprecise emotional terms, such as "brave" or "melancholy", as it was believed that the participants would be able to talk about the former categories more easily. The nonemotional word cues were carefully selected so that the narratives would include a minimal amount of emotional content or intensity. Additionally, lengthier discourse productions were elicited in hopes that the participants would fully reexperience the emotional event and then produce comprehensive narratives.

The narratives in this investigation were also assessed for thematic accuracy. This rating was employed to help determine whether certain participant groups differed in their ability to maintain the topic of a narrative and whether differences in this measure would affect how emotional content and intensity were rated.

This study also tried to equally match participant groups on demographic, cognitive, mood, and neurological factors. Only individuals with cortical lesions stemming from cerebrovascular incidents were included, to limit potential disruptions in the underlying subcortical mediation of emotion.

Gender

Gender differences have also been noted in both the emotion and language literatures. Regarding emotional processes, stimuli have been better perceived by women compared to men (Brody & Hall, 1993; Grunwald et al., 1999; Hall, 1978; Otta, Abrosia, & Hoshino, 1996), and women have demonstrated better ability to produce facial expressions (Buck, Savin, Miller, & Caul, 1972). Interestingly, when levels of arousal were examined in response to emotional stimuli, women showed diminished autonomic response compared with men (Buck et al., 1972; Craig & Lowrey, 1969). Studies of language functions have also often reflected that women perform better than men (Baxter & Seidenberg, 1997; Kimura & Hampson, 1993; Maccoby & Jacklin, 1978), however, few investigations have explored the effects of gender on emotion and language. Grunwald et al. (1999) did find that on a lexical emotion perception task, women perceived lexical emotional stimuli more accurately and rated stimuli more intensely than

did men.

When examining the neural mechanisms related to these functions, women appear to have increased lateralization for emotional processing compared with men (Strauss & Moscovitch, 1981). Linguistic functions in women, however, seem to be represented more often in bilateral than unilateral neural locations (Lake & Bryden, 1976; McGlone, 1980).

In light of these lateralized findings, it was of interest to the current study what results would occur when gender was included as a variable. Therefore, it was added to the following analyses for exploratory purposes.

Purpose of Current Study

The purpose of the current study was to elucidate whether neuropsychological hypotheses of emotion (i.e., the right-hemisphere hypothesis versus the valence hypothesis) were supported when emotional processes were examined through complex expressive language (i.e., narratives). The investigation addressed whether potential differences in neural functioning were manifested when emotion was operationalized at the levels of emotional content and emotional intensity. Positive and negative versions of each variable were constructed to further examine the valence hypothesis (see below).

Participants included individuals with right-hemisphere and left-hemisphere lesions in anterior or posterior quadrants, as well as healthy controls. Each individual was screened on general cognitive and mood functioning using a number of measures. This was carried out to help ensure that potential differences in emotional functioning

were not masked or biased by variability in information-processing systems or atypical personality characteristics. The participants were asked to produce discourse regarding autobiographical recollections of emotional and nonemotional experiences based on preselected topics (e.g., happiness or preparing a meal).

As previously mentioned, scales of content and intensity were used to independently assess general emotion, positive emotion, and negative emotion. The content rating was devised to measure the amount of emotion content included in a narrative. Content reflected the amount of emotional tone or representations. The intensity measure assessed the degree/magnitude of emotion in the previously selected content and was believed to reflect the level of arousal experienced by the individual.

Prior to assessing the emotional variables, it was worthwhile to assess whether the language produced accurately reflected the emotional or nonemotional stimulus cue. Thus, ratings of thematic accuracy were obtained to help validate the general integrity of the content/intensity measures and assess how well the narratives adhered to the topic. A second variable was devised to assess the rater's confidence. This rating helped to evaluate the raters' sureness of their accuracy decisions. This measure also assisted in determining potential inaccuracies made by the participants. For example, low thematic accuracy scores could result for at least two basic reasons: the participants produced well-formed narratives for the wrong target emotion or they produced vague, difficult-to-judge narratives. In the first scenario, low accuracy would be rated with high confidence. In the latter case, both low accuracy and low confidence ratings would occur.

Lastly, for exploratory purposes, the variable of gender was added to the study.

Statement of Hypotheses

Primary Hypotheses

If the right-hemisphere hypothesis were operative, the RBD group would produce less emotional content and intensity compared with the LBD and HC groups. This difference would be evidenced for the emotional, but not the nonemotional condition. If the right-hemisphere hypothesis held true only for a specific component of emotion (i.e., content versus intensity), then the above predictions would manifest for only that rating.

Alternatively, if valence effects mediated emotional processes, then the RBD group would exhibit less negative emotion compared to the HC and LBD groups. In comparison, the LBD group would exhibit less positive emotion compared with the HC and RBD groups. This hypothesis was examined by dividing the BD groups into anterior and posterior subgroups. The posited differences were expected to occur only for the anterior subgroups. If the measures of content and intensity represented different aspects of emotional processes, the results for each dependent variable would be dissimilar.

Secondary Hypotheses.

General thematic accuracy was assessed in order to examine whether any content (i.e., macrostructural) deficits were observed in the RBD group and whether emotion impacted this type of process. Based on the literature reviewed, it was predicted that the RBDs would produce less accurate discourse compared with LBDs and HCs for both the emotional and nonemotional conditions. Of all the subgroups, the anterior RBD group

would produce the least accurate discourse.

Tertiary Hypotheses

In order to assess whether other cognitive and/or affective variables contributed to the findings for the first two hypotheses, individual subject characteristics (e.g., age, education, and mood) and screening criteria/cognitive factors (e.g., verbal fluency and memory) were examined. Group comparisons for each variable were considered separately. No differences would be expected. However, if any significant findings emerged, then the primary analyses would be rerun, controlling for the relevant variables.

An additional variable of Gender was added to the main analyses. Based on the previous literature, women would be expected to perform more accurately and with greater content and intensity than men.

Methods

Participants

Participants included 13 right-brain-damaged (RBD), 13 left-brain-damaged (LBD), and 13 healthy control (HC) adults. Participants were recruited as part of a larger study examining the neurological processes underlying several components of emotion. Individuals comprising the two BD groups were recruited from inpatient and outpatient neurology departments at the Mount Sinai Medical Center and the Bronx Veteran's Administration Medical Center, as well as local stroke clubs in the New York metropolitan area. The control group included employees solicited from the above mentioned hospitals, as well as local volunteers. All participants were provided a brief description of the investigation, and reviewed and signed informed consent prior to participation. All participants received monetary compensation for their time and travel expenses.

In order to best equate the participants on individual characteristics which have been shown to impact upon neuropsychological tasks (Lezak, 1983), the three groups were matched as closely as possible on the following demographic variables: age, level of education (number of years in school), and level of occupation (as assessed by the Hollingshead rating scale; Hollingshead, 1977). See Tables 1-3 for complete demographic information. The HC and LBD groups each included eight men and five women; the RBD group included nine men and four women. In terms of ethnicity, the HC group included seven Caucasians and six African-Americans, the LBD group nine

Demographic characteristics of the healthy participants

ID No.	Gender	Age	Ethnicity*	Years of Education	Occupational Scale**	Language Background***
1.	M	76	1	20	9	1
2.	M	71	1	18	7	1
3.	M	75	1	16	8	1
4.	F	78	1	12	5	0
5.	M	73	1	16	7	1
6.	M	66	1	12	5	0
7.	F	48	2	13	6	1
8.	F	50	2	15	5	0
9.	M	60	2	13	6	0
10.	M	63	2	12	5	0
11.	F	57	1	12	6	0
12.	M	63	2	12	6	0
13.	F	52	2	14	6	0

* 1 = Caucasian, 2 = African-American

** Occupational Scale = Nine point scale, used by Hollingshead (1977) (9 = Higher executives and major professionals, 5 = clerical and sales workers, or small business owners, 1 = farm laborers and menial service workers)

*** 0 = Native English speaker, 1 = English acquired before age 7

Demographic characteristics of the right-brain damaged participants

ID No.	Gender	Age	Ethnicity*	Years of Education	Occupational Scale**	Language Background***
14.	F	50	1	16	7	1
15.	M	77	1	12	5	0
<u>16.</u> ⁺	M	72	1	20	9	1
<u>17.</u> ⁺	M	65	1	18	9	0
18.	M	75	2	14	5	0
19.	F	50	2	12	3	0
20.	M	48	2	13	4	0
21.	M	78	2	11	7	0
22.	F	66	1	14	7	1
<u>23.</u> ⁺	F	76	2	5	1	1
24.	M	52	1	12	4	1
25.	M	69	1	12	6	0
26.	M	89	2	14	8	0
27.	M	70	1	9	4	0
28.	F	63	2	15	5	0
29.	M	56	1	16	7	0

* # Three additional participants with frontal ("anterior") pathology

* 1 = Caucasian, 2 = African-American

** Occupational Scale = Nine point scale, used by Hollingshead (1977) (9 = Higher executives and major professionals, 5 = clerical and sales workers, or small business owners, 1 = farm laborers and menial service workers)

*** 0 = Native English speaker, 1 = English acquired before age 7

Demographic characteristics of the left-brain damaged participants

ID No.	Gender	Age	Ethnicity*	Years of Education	Occupational Scale**	Language Background***
30.	M	72	1	13	7	0
31.	M	71	1	18	7	0
32.	M	64	1	8	4	1
33.	F	73	2	13	6	0
34.	F	81	1	20	9	1
35.	M	70	2	12	1	1
36.	F	52	1	13	5	0
37.	M	48	1	13	4	1
38.	M	48	2	14	5	1
39.	M	79	1	16	8	1
40.	M	75	1	11	4	1
41.	F	74	1	18	7	0
42.	F	62	2	14	4	0

* 1 = Caucasian, 2 = African-American

** Occupational Scale = Nine point scale, used by Hollingshead (1977) (9 = Higher executives and major professionals, 5 = clerical and sales workers, or small business owners, 1 = farm laborers and menial service workers)

*** 0 = Native English Speaker, 1 = English Acquired Before Age 7

Caucasians and four African-Americans, and the LBD group seven Caucasians and six African-Americans.

To determine whether there were significant differences in the demographic information for the three groups, between-subjects, one-way ANOVAs were computed for each measure. No significant differences were evidenced for any one variable: age, $F(2,36) = 0.21, p = 0.81$, education, $F(2,36) = 0.72, p = 0.50$, or occupational status, $F(2,36) = 0.82, p = 0.45$. Furthermore, no groups differences were found as a function of gender, $\chi^2(1) = .31, p = 0.78$ or ethnicity, $\chi^2(1) = 1.26, p = .26$. For a list of means and standard deviations for each group see Tables 4 and 5.

Inclusion Criteria

Prior to entering the study, potential participants were assessed on a number of variables via the telephone and in person. Any individual who did not meet these requirements was excluded from the investigation. The inclusion criteria were composed of the following:

a. Participants were native speakers of English or achieved fluency in the English language before age 7.

This criterion was assessed based upon a brief interview conducted by the researcher. This component of the interview considered each participant's language background in depth.

b. Participants were right-handed.

As previously discussed, the lateralization of language to the left hemisphere, in

Table 4

Means and standard deviations for participant characteristics: Lesion side

Variable	<u>HC</u>		<u>RBD</u>		<u>LBD</u>	
	<u>M</u>	<u>S.D.</u>	<u>M</u>	<u>S.D.</u>	<u>M</u>	<u>S.D.</u>
Age	64.00	10.24	63.92	12.47	66.85	11.25
Education	14.23	2.62	13.54	2.40	14.08	3.23
Occupational Scale	6.23	1.24	5.85	1.82	5.46	2.15
Gender	8M	5F	9M	4F	8M	5F
Ethnicity	7C	6AA	7C	6AA	9C	4AA

Note. Education = number of years of formal schooling; Occupation = Hollingshead Scale (1-9); Gender: M = Male, F = Female; Race: C = Caucasian, AA = African American

Table 5

Means and standard deviations for participant characteristics: Lesion side and lesion site

<u>Variable</u>	<u>RBD</u>				<u>LBD</u>			
	<u>Anterior</u>		<u>Posterior</u>		<u>Anterior</u>		<u>Posterior</u>	
	<u>M</u>	<u>S.D.</u>	<u>M</u>	<u>S.D.</u>	<u>M</u>	<u>S.D.</u>	<u>M</u>	<u>S.D.</u>
Age	65.89	10.74	66.14	14.46	66.33	12.99	67.29	10.59
Education	13.33	4.39	13.29	2.29	14.00	2.53	14.14	3.93
Occupational Scale	5.67	2.69	5.71	1.60	5.67	1.63	5.29	2.63
Gender	7 M	2 F	4 M	3 F	4 M	2 F	4 M	3 F
Ethnicity	5 C	4 AA	4 C	3 AA	5 C	1 AA	4 C	3 AA
<u>Note.</u> Education = number of years of formal schooling; Occupation = Hollingshead Scale (1-9); Gender: M = Male, F = Female; Race: C = Caucasian, AA = African American								

right-handed individuals has been consistently demonstrated. Although left-handed individuals are usually lateralized for language in the left hemisphere, right or bilateral representation could have occurred, potentially confounding the assessment of emotion in this study. Handedness was therefore assessed using self-report items from an inventory developed by Coran, Porac and Duncan (1979).

c. Participants did not have a previous or current history of psychiatric disorder (e.g. depression or anxiety), neurological disease (e.g. dementia, epilepsy, head trauma, or additional neurological disorders for stroke patients), mental retardation, learning disability, severe cognitive deficits, substance abuse, or psychotropic drug treatment.

Psychiatric diagnoses and substance abuse history were assessed using a structured interview, the Lifetime Schedule for Affective Disorders and Schizophrenia (SADS-L; Endicott & Spitzer, 1978), and a self-report questionnaire, the Beck Depression Inventory (Beck, 1967). Neurological disorders, learning disabilities, and/or medication use were assessed via self-report during the brief interview, as well as from a review of any available neurological and medical records.

d. Participants did not have moderate to severe aphasia.

As the experimental tasks required the comprehension and production of complex language, participants in the LBD group were also screened for aphasia or language pathology using selected subtests (i.e., Commands, Complex Ideational Material, and Reading Sentences and Paragraphs) of the Boston Diagnostic Aphasia Examination

(BDAE; Goodglass & Kaplan, 1983) and the 15-item Boston Naming Task (Mack, Freed, Williams, & Henderson, 1992). Those individuals found to evidence any form of moderate or severe aphasia on these tasks were excused from the study, as they would most likely be unable to produce fluent or coherent language samples and/or comprehend instructions. Participants with mild residual aphasic symptoms were included (see Tables 6 and 7).

Description of Lesion Sites

Those individuals with brain damage incurred their lesions via a single unilateral cerebrovascular accident (CVA) and were at least two weeks post-onset of the CVA. The etiology of the CVAs occurred as a result of a hemorrhage or cerebral infarction. Based on computerized tomography (CT) and/or magnetic resonance imaging (MRI) scans, as well as clinical neurological findings and medical records, two neurologists determined the inter- and intra-hemispheric lesion site/s. If a disagreement occurred during the reading of the scans, a third neurologist was introduced to help make a final determination. All participants were scanned soon after their incident and these scans were used to determine lesion location.

In order to examine hypotheses regarding lesion site (i.e., caudality, intrahemispheric lesion), attempts were made to equate the number of individuals with anterior and posterior neocortical involvement, as well as their respective lesion site/s. The anterior group was defined as those individuals with damage to the frontal cortex (anterior to the central rolandic sulcus and superior to the lateral sulcus). Individuals with

Follow-up assessment of aphasia severity in the LBD participants

ID No.	Aphasia Code	History of Aphasia	Test Data (BDAE*/BNT**/Other)
30.	0	No Hx***	All subtests within normal limits
31.	1	Hx	All subtests within normal limits
32.	0	No Hx	All subtests within normal limits
33.	1	Hx	Chart review & informal observation
34.	1	Hx	Chart review & informal observation
35.	2	Hx	BDAE: 1 subtest 2 S.D. below mean, 1 subtest 1 S.D. below mean; BNT: 13/15 correct
36.	2	Hx	BDAE: 3 subtests 2 S.D. below mean, 1 subtest 1 S.D. below mean; BNT: 13/15 correct
37.	2	Hx	BDAE: 5 subtests 2 S.D. below mean, 1 subtest 1 S.D. below mean, BNT: 11/15 correct
38.	2	Hx	BDAE: 3 subtests 2 S.D. below mean, 2 subtests 1 S.D. below mean, BNT: 15/15 correct
39.	2	Hx	BDAE: 2 subtests 2 S.D. below mean, 4 subtests 1 S.D. below mean; BNT: 13/15 correct
40.	2	Hx	BDAE: 1 subtest 2 S.D. below mean, 2 subtests 1 S.D. below mean; BNT: 15/15 correct
41.	2	Hx	Chart review & informal observation
42.	0	No Hx	All subtests within normal limits

* BDAE = Boston Diagnostic Aphasia Examination (norms based on Borod, Goodglass, and Kaplan, 1980)

** BNT = Boston Naming Test

*** Hx = History

Classification system for aphasia severity based on history of symptoms and administration of the BDAE and BNT

-
- 0 No aphasia:** no aphasia or language deficit
- 1 Aphasia history, but no current deficit:** history of aphasia but no language deficits at the time of testing
- A history of mild deficit at the time of insult. No evidence of aphasia in spontaneous speech. BDAE results within normal limits with up to 1 subtest having a score equaling more than 2 S.D. below the mean and no more than 2 subtest scores equaling 1 - 2 S.D. below the mean.
- 2 Mild residual aphasia:** History of aphasia with mild residual aphasia at the time of testing.
- A history of aphasia. May have had speech/language therapy. No evidence of frank aphasia in spontaneous speech. BDAE results show more than 2 subtest scores falling below the means, but no more than 5 subtests each having scores more than 2 S.D. below the mean.
- 3 Frank aphasia:** History of aphasia and frank aphasia at the time of testing.
- A history of aphasia and speech/language therapy, evidence of deficit in spontaneous speech/ BDAE results show various (usually more than 5) subtests with scores falling equal to or below 2 S.D. of the mean.
- 4 Language deficit, but no history of aphasia:** No history of aphasia, but some language deficits evident at time of testing.
- No history of aphasia, but BDAE results show language deficit (could be associated with low education, primary progressive aphasia, dementia, and other causes)
-

cortical parietal, temporal, and/or occipital lesions comprised the posterior group (posterior to the central rolandic fissure and inferior to the lateral sulcus). To isolate cortical involvement, only those individuals with damage primarily in the gray matter were included. Due to the often expansive nature of this type of damage, resulting cellular changes (e.g., axonal degeneration), and difficulty obtaining pure cortical lesions, some individuals with additional white matter tract involvement were included.

Although attempts were made to equate groups based on specific lesion locations (see Tables 8 and 9), it was difficult to obtain a large sample of participants with pure anterior cortical lesions who did not also demonstrate significant cognitive deficits. This occurred due to the fact that anterior damage in the LH group often led to severe cognitive deficits and/or a significant aphasia, which precluded such individuals from meeting the screening criteria or completing the experimental tasks. Therefore, when making anterior versus posterior comparisons, the anterior group was composed of individuals with anterior lesions, as well as those with anterior plus posterior pathology. The posterior group included only those individuals with posterior lesions. Combining the groups in such a fashion was also necessary in order to increase the sample size of the anterior group.

Participants were consecutively placed into their respective groups based on the location of their lesions (i.e., side and site). Each participant was provided an identification number to ensure confidentiality, and this number was used throughout the study. This coding system was made known only to the investigators directly running the

Neurological information for the right-brain damaged participants

ID No.	Location Of Lesion	MPO*
14.	Temporal	31
15.	Occipital	21
16.*	Frontal	27
17.*	Frontal	41
18.	Frontal, (SCWM)	3
19.	Frontal, Parietal, (Corona Radiata)	3
20.	Parietal, (Corona Radiata)	8
21.	Frontal, Temporal, (Corona Radiata)	65
22.	Temporal, Parietal, Occipital, (Optic Radiation)	17
23.*	Frontal	11
24.	Frontal, Parietal (Corona Radiata; Internal, External, & Extreme Capsule; Claustrum; Putamen)	9
25.	Frontal, Parietal, Occipital	60
26.	Temporal, Parietal (SCWM)	12
27.	Parietal	27
28.	Temporal	144
29.	Frontal, Parietal	82

* MPO = Months Post Onset

+ # = additional three anterior participants

Neurological information for the left-brain damaged participants

ID No.	Location Of Lesion	MPO*
30.	Occipital	18
31.	Frontal, Parietal, Occipital, Temporal	10
32.	Temporal, Occipital, (Internal Capsule)	2
33.	Frontal, Parietal	6
34.	Parietal, (Non-specific SCWM)	24
35.	Temporal	39
36.	Frontal, Temporal, (Internal, External, & Extreme Capsule; Claustrum)	49
37.	Frontal, Temporal, Parietal, (Insula)	22
38.	Temporal	6
39.	Frontal, (Corona Radiata)	12
40.	Frontal, (Corona Radiata)	9
41.	Temporal, (Insula)	3
42.	Parietal	9

*MPO = Months Post Onset

study.

Three additional right anterior participants were obtained during the course of the study (see Table 8). However, it was extremely difficult to obtain additional matched LBD participants with similar damage who were able to pass all the screening criteria. Due to this problem no additional anterior LBD patients could be identified during the course of the study. Therefore, the three additional individuals with right hemisphere lesions were only included in specific analyses using inter- and intrahemispheric lesion sites as between-subject variables. These analyses are indicated whenever they occurred¹.

No differences were observed between the number of individuals comprising each intrahemispheric group, $X^2(1) = 0.08$, $p = 0.78$ for both comparisons: RBD (anterior, anterior/posterior = 7; posterior = 6) and LBD (anterior, anterior/posterior = 6; posterior = 7) groups. When a chi-square analysis was rerun including the additional three RBDs, again, no significant findings emerged. See Table 10 for a list comparing lesion sites across the two brain-damaged groups.

The number of months post-onset of the vascular incident was compared for the two BD groups using an independent t-test. A trend was evidenced, $t(24) = 2.013$, $p =$

1. Since the three additional participants were included in selected data analyses for the experimental variables, the one-way ANOVAs were rerun (RBD = 16) for each demographic variable. No significant statistical differences were evidenced. The subsequent analyses in the manuscript reflect a sample size of 13 unless otherwise specified.

Table 10

Neurological information divided by lesion side and lesion site

	<u>RBD</u>	<u>LBD</u>
Lesion Location	N	N
<u>One Lesion</u>		
Frontal	4 ⁺	2
Temporal	2	3
Parietal	2	2
Occipital	1	1
<u>Two Lesions</u>		
Frontal, Temporal	1	1
Frontal, Parietal	3	1
Temporal, Parietal	1	-
Temporal, Occipital	-	1
<u>Three Lesions</u>		
Frontal, Parietal, Occipital	1	-
Frontal, Temporal, Parietal	-	1
Temporal, Parietal, Occipital	1	-
<u>Four Lesions</u>		
Frontal, Temporal, Parietal, Occipital	-	1

⁺ Includes the 3 additional frontal ("anterior") participants

.063. This trend appeared to result from the inclusion of two RBD participants with more than 100 months post-onset of their stroke. This was supported by a nonsignificant finding when the comparison was recomputed after removing the two RBDs with extreme scores, $t(24) = 1.10$, $p = 0.28$. A 2 (Lesion Side) x 2 (Lesion Site) between-subjects ANOVA, including the additional three RBD participants was computed using this dependent variable. No significant main or interaction effects were found: Lesion Side, $F(1,24) = 3.017$, $p = .095$; Lesion Site, $F(1,24) = .043$, $p = .837$; Lesion Side x Site, $F(1,24) = .006$, $p = .939$.

Screening Measures

In order to assess the participants' cognitive abilities, a number of standardized neuropsychological tasks were administered before the participants completed the experimental tasks. These cognitive abilities (e.g., general intellectual functioning, attention, memory, and language) were considered important factors in order for the participants to perform the experimental tasks. Furthermore, as the study's purpose was to examine emotional processes, intact global cognitive abilities were necessary so as not to contribute to and/or mask any potential differences in emotional functioning. Any participant whose performances exceeded the cutoff scores for these screening measures was compensated for their contributions to that point in time and excused from the study. Cutoff scores for the following tasks were determined using findings from previous pilot studies, as well as standardized normative data developed for each task. These scores generally fell 1 to 2 standard deviations below the mean of the respective task and are

specified below.

a. Wechsler Adult Intelligence Scale - Revised Version (WAIS-R: Wechsler, 1981):

Information and Block Design subtests

The Information and/or Block Design subtest was administered as an index of general cognitive function. These subtests are often used as indices of cognitive functioning in lieu of Full Scale IQ scores (Lezak, 1983). Participants with age-corrected scaled scores equivalent to or below 6 on either task were excluded due to possible borderline or deficient intelligence.

The Information subtest was administered to HCs and RBDs to gauge verbal intelligence. LBDs were not administered this subtest due to the possibility that they may appear to have limited intelligence, which was actually secondary to language deficits. This task consists of 29 questions concerning general fund of knowledge. Raw scores are derived by computing one point for each correct response.

The Block Design subtest was given to the HCs and LBDs to assess non-verbal or performance intelligence. RBDs were not given this subtest due to the increased probability that they would obtain lower scores resulting from visuospatial and/or visuoconstructional deficits. This subtest requires participants to arrange colored blocks into geometric designs according to pictured models. There are 9 possible designs. Scoring for the first two designs equals 2 points for a correct response on the first trial, and 1 point for a correct response on the second trial. Designs 3 - 9 are scored for the correct completion of each design and bonus points are added for timeliness. No credit is

given for designs that are partially correct or fully correct, but have exceeded the established time limit.

Raw scores on both subtests were computed and transformed into age-corrected scaled scores.

b. Dementia Rating Scale (DRS; Mattis, 1988): Memory and Attention subtests

Participants' global attention and short-term memory abilities were assessed using the respective subsections of this scale.

The attention section includes items assessing digit span (forward and backward), following commands, focused visual attention, visual matching, and verbal recognition. A raw score equaling 34 or above was required on this section.

The memory section includes assessment of general orientation, sentence recall, verbal recognition of word lists, and visual recognition of designs. For these items, a raw score criterion of 22 or above was established.

c. Wechsler Memory Scale - Revised (WMS-R; Wechsler, 1987): Logical Memory subtest

Since the experimental tasks required the generation of internal representations at the level of discourse, the use of a standardized task (Logical Memory Subtest) to assess the encoding, storage, and recall of structured and complex verbal materials was included. Cutoff scores on this task did not exceed 2 S.D. below the age group means for both short- and long-term recall.

d. Boston Diagnostic Aphasia Examinations (BDAE; Goodglass and Kaplan,

1983): Animal Naming, Commands, Complex Ideational Material, and Reading Sentences and Paragraphs subtests

The experimental tasks also required the participants to produce reasonably fluent speech, which was semantically intact. A brief assessment of this function was conducted for all participants using the Animal Naming, Commands, Complex Ideation Material, and Reading Sentences and Paragraphs subtests. The latter three subtests assess the ability to comprehend simple and complex language. The Animal Naming subtest evaluates general semantic category production. On this task, participants must name as many animals as possible within a 90-second period. Counting the number of items within the most productive consecutive 60 seconds results in the score. Those participants whose scores fell 2 S.D. below their age group mean were excluded.

e. Verbal Fluency (FAS)

Word retrieval and fluency were also assessed at the phonetic level by having participants produce words beginning with the letters, “F”, “A,” and “S”, respectively. Sixty seconds were allowed each participant for each letter. Scores for this task were calculated based on the number of retrieved items for each letter. The overall mean for the three letters was also computed. Participants whose scores fell below 2 S.D. of their mean age group were excluded.

f. Beck Depression Inventory (BDI; Beck, 1967)

This scale, which is composed of self-report items, was administered to all the participants to assess their perception of common depressive symptoms. Since the

SADS-L was used to screen for clinically significant depression, the Beck was employed as a control task. Therefore, a cutoff score was not needed for the BDI.

Group Performance on Screening Measures

Table 11 lists the means and standard deviations for the LBD, RBD, and HC groups and their performances on the cognitive and mood variables. Table 12 depicts similar information, but with the BD groups divided into four subgroups based on inter- and intrahemispheric lesion site (i.e., right anterior plus posterior lesions, left anterior plus posterior lesions, right posterior lesions, and left posterior lesions). For those scores derived from standardized tests, percentiles are provided. All other scores reflect the sum across the items (i.e., raw score), because normative data were not available.

Two sets of ANOVAs were completed for each screening measure. First, ANOVAs were computed using a single between-subjects factor (Group: LBD, RBD, and HC). The second set of analyses examined Lesion Side (i.e., left-sided lesions and right-sided lesions) x Lesion Site (i.e., anterior lesions and posterior lesions) for each factor. Significant F-values were followed by multiple pairwise comparisons using the Bonferonni procedure.

One-way between-subjects ANOVAs: Lesion side. Significant one-way ANOVA effects were observed for the MDRS: attention subscale, $F(2,36) = 6.35$, $p = .004$, the FAS fluency measure, $F(2,36) = 10.92$, $p = .0001$, and the BDAE animal naming task, $F(2,36) = 3.52$, $p = .041$. For the attention subscale, the LBD group ($M = 90.00$, $SD =$

Table 11

Means and standard deviations for the screening measures: healthy control, right-brain damaged, and left-brain damaged participants

Variable	Score	HC (N = 13)		RBD (N = 13)		LBD (N = 13)		ANOVA	
		<u>M</u>	<u>S.D.</u>	<u>M</u>	<u>SD.</u>	<u>M</u>	<u>S.D.</u>	<u>F</u>	<u>p</u>
WAIS INFO	Scaled	12.92	2.81	10.85	1.99	-	-	2.17 [*]	*
WAIS BD	Scaled	9.23	1.48	-	-	10.67	2.64	1.70 [*]	ns
BDAE COM	Percentile	71.23	15.16	67.23	17.88	67.54	19.83	.21	ns
BDAE CIM	Percentile	57.00	33.89	55.54	32.10	59.38	31.06	.05	ns
BDAE SP	Percentile	62.08	32.63	62.46	26.14	51.77	32.54	.51	ns
Mattis: Attention	Percentile	66.38	28.62	54.38	30.89	90.00	15.62	6.35	**
Mattis: Memory	Percentile	77.23	33.46	72.15	33.12	77.15	34.35	.10	ns
Wechsler Memory I	Percentile	60.46	18.58	51.23	20.94	47.62	22.99	1.30	ns
Wechsler Memory II	Percentile	64.15	21.38	51.46	22.85	48.85	22.97	1.74	ns
Beck Depression	1-15	2.23	1.74	3.00	2.77	3.00	3.08	.38	ns
FAS	Percentile	77.17	27.17	55.00	29.49	26.92	23.99	10.92	***
BDAE AN	Percentile	46.83	30.01	23.77	19.54	23.92	24.34	3.52	ns

^{*}.05 ^{**}.01 ^{***}.001 [†]t-test results

WAIS INFO - WAIS Information Subtest; WAIS BD - WAIS Block Design Subtest; BDAE COM - Boston Diagnostic Aphasia Examination - BDAE Commands; BDAE CIM - Complex Ideational Material; BDAE SP - Reading Sentences and Paragraphs; FAS - Controlled Word Association Test; BDAE AN - BDAE Animal Naming

Table 12

Means and standard deviations for the screening measures: right-brain damaged and left-brain damaged participants; anterior/posterior lesions

Variable	Score	RBD				LBD				ANOVA	
		Anterior (N=7)		Posterior (N=6)		Anterior (N=6)		Posterior (N=7)		F	p
		<u>M</u>	<u>S.D.</u>	<u>M</u>	<u>S.D.</u>	<u>M</u>	<u>S.D.</u>	<u>M</u>	<u>S.D.</u>		
WAIS INFO	Scaled	10.57	1.62	11.33	3.81	-	-	-	-	.49'	ns
WAIS BD	Scaled	-	-	-	-	10.20	3.19	11.00	2.38	.47'	ns
BDAE COMP	Percentile	64.44	28.08	54.14	26.93	73.50	5.86	62.43	26.30	.68	ns
BDAE IMP	Percentile	57.33	32.20	51.29	32.97	61.00	31.34	58.00	33.26	.11	ns
BDAE SIP	Percentile	64.22	31.48	57.00	27.63	43.17	39.36	59.14	26.26	.56	ns
Mattis: Attention	Percentile	38.78	27.05	66.43	28.62	94.50	13.47	86.14	17.30	8.79	***
Mattis: Memory	Percentile	79.67	33.99	70.00	28.69	78.83	38.70	75.71	33.26	.12	NS
Wechsler Memory I	Percentile	52.56	24.62	42.57	22.69	49.00	27.11	46.43	21.01	.24	ns
Wechsler Memory II	Percentile	57.56	23.23	41.29	24.92	48.33	33.05	49.29	12.02	.62	ns
Beck Depression	1-15	4.56	4.10	1.86	1.46	2.67	1.86	3.29	3.99	.99	NS
FAS	Percentile	40.78	26.75	65.71	28.39	22.00	20.68	31.14	27.39	3.45	*
BDAE AN	Percentile	23.33	20.45	23.29	16.89	27.67	31.41	20.71	18.35	.11	ns

.05 .01 .001 *t-test results

WAIS INFO - WAIS Information Subtest; WAIS BD - WAIS Block Design Subtest; BDAE COM - Boston Diagnostic Aphasia Examination - BDAE Commands; BDAE CIM - Complex Ideational Material; BDAE SP - Reading Sentences and Paragraphs; FAS - Controlled Word Association Test; BDAE AN - BDAE Animal Naming

15.62) demonstrated significantly better attentional abilities than the RBD group ($M = 54.38$, $SD = 30.89$), $t(24) = 3.71$, $p = .001$. A significant effect in the same direction was noted for the LBD's performance compared with that of the HC group, [$M = 66.38$, $SD = 28.62$; $t(24) = 2.612$, $p = .015$], but no differences were observed between the RBD and HC groups, $t(24) = 1.03$, $p = .31$. On the FAS task, the LBD group ($M = 26.92$, $SD = 23.99$) produced significantly fewer lexical items than the RBD group [$M = 55.00$, $SD = 29.49$; $t(24) = 2.66$, $p = .014$] or the HC group [$M = 77.17$, $SD = 27.17$; $t(23) = 4.91$, $p = .0001$]. A trend was observed comparing the HC and the RBD groups, $t(23) = 1.95$, $p = .064$. On the animal naming subtest, both the LBD ($M = 23.92$, $SD = 24.34$) and RBD ($M = 23.77$, $SD = 19.54$) groups produced fewer semantically related words than the HCs ($M = 46.83$, $SD = 30.01$) [$t(23) = 2.10$, $p = .047$, $t(24) = 2.30$, $p = .031$, respectively]. In fact, the two BD groups produced almost the same number of words, $t(24) = .011$, $p = .98$, suggesting that although the LBD group experienced difficulties with fluency as related to phonetic cues, semantic naming was impaired due to damage occurring in either hemisphere.

2 x 2 between-subjects ANOVAs: Lesion Side x Lesion Site. When performing the 2 x 2 between-subjects ANOVAs, a similar pattern of findings resulted as demonstrated for the one-way analyses. Table 12 shows that for the MDRS: attention subtest, a significant main effect of both Lesion Side and Lesion Site was evidenced. The direction of the main effect for Lesion Side again showed the RBDs as performing more poorly than the LBD group. For the main effect of Lesion Site, the anterior group ($M =$

61.07, $\underline{SD} = 35.80$) demonstrated poorer attention skills than the posterior group ($\underline{M} = 76.29$, $\underline{SD} = 24.91$), $\underline{F}(1,25) = 18.74$, $p = .000$. A significant main effect of Lesion Side was also obtained for the FAS verbal fluency task, $\underline{F}(1,25) = 7.34$, $p = .01$, with a trend observed for the main effect of Lesion Site, $\underline{F}(1,25) = 2.99$, $p = .096$. Again, the effect of Lesion Side recapitulated the above findings with the LBD group performing significantly more poorly than the RBD group. For Lesion Site, the anterior group ($\underline{M} = 33.27$, $\underline{SD} = 25.54$) tended to produce fewer words than the posterior group ($\underline{M} = 48.43$, $\underline{SD} = 32.35$). No other findings approached significance.

Experimental Measures

All testing was conducted at the Mount Sinai Medical Center and Queens College - City University of New York. These procedures were obtained from the New York Emotion Battery: NYEB (Borod, Welkowitz, & Obler, 1992; Borod, Cicero, et al., 1998). During the experimental procedure, participants were read the instructions and provided example narratives (see Appendix A). Any questions about the procedures were answered at that time. Participants were then provided with an emotional or nonemotional cue words and asked to recollect and reexperience the event, and then relate the event for a minimum of two minutes or until they had completed the narrative. This minimal time period was selected in order to obtain enough linguistic content for analyses. After relating each monologue, participants were provided a short break and then presented with the next cue word. This process was continued until a block of 8 monologues had been completed. Two separate sessions were completed to reduce

potential fatigue. Four block-randomized orders of the cue words were created and randomly assigned to the participants.

During their productions, participants were audio- and videotaped in order to capture all verbal content, as well as to assess paralinguistic cues for use in future studies. The examiners produced no comments unless the participants were having difficulty recalling, initiating, or eliciting information. If participants were experiencing such difficulties prior to the beginning of the narrative, they were provided with a structured example, which was available to all individuals. However, once they had begun producing their narrative, only nonleading cues were used (e.g., “can you tell me more?”) to help focus the participant.

Emotion Tasks

Experimental materials included eight emotional cue words, presented orally, as well as on an 8.5 x 11 white piece of paper. Participants produced eight separate narratives discussing the last or most recent time they experienced three positive (i.e., happiness, interest, and pleasant surprise) and five negative (i.e., anger, disgust, fear, sadness, and unpleasant surprise) emotions. These emotions were selected based on previous research (Borod, 1993; Ekman, 1992; Ekman & Friesen, 1975) suggesting that the set of topics comprises prototypical/universal emotions. Participants were asked to remember, reexperience, and retell a most recent personal experience, which best represented the stimulus cue. In attempts to recreate original aspects of their emotional experiences (e.g., physiological and cognitive), participants were instructed to take their

time in thinking about and recapturing the situation, feelings, etc., before they began producing the narrative

Nonemotion Tasks

An analogous nonemotional task was also constructed. Participants were asked to recall and produce their eight most recent nonemotional personal experiences (i.e., going for a walk, going to a restaurant, buying something for the house, making a meal, shopping at the supermarket, watching TV, visiting someone, and taking a form of transportation). These cues were presented in the same oral and written formats as the emotional condition. This analogous nonemotional task was developed to elicit narratives, which presumably paralleled the narrative structure (e.g., number of words, length of utterance, and complexity of syntax) produced during the emotional task, but included minimal emotional content, if any. Although the recall of any memory would most likely result in the inclusion of some emotional content, it was believed that such contributions would be very small when they were not the primary focus of the task. The use of this parallel task was also devised to help control for any variability in language, attention, and memory skills that might have occurred during the production of narratives in both conditions.

Procedures Conducted Prior to the Final Ratings of the Experimental Data

Transcription

Attempts to elicit all 624 narratives (3 groups x 13 subjects x 16 monologues) were made. Due to subject difficulties recalling or recounting certain events, however, 17

narratives were not produced across the three groups. For the healthy control group, one narrative (i.e., Bought Something for the House) was not produced. Among the RBD group, 10 narratives (i.e., Going out to Eat, Preparing a Meal, Watching TV, Visiting Someone, Anger, Disgust (x2), Happiness, Pleasant Surprise, and Unpleasant Surprise) were not produced. Six narratives (i.e., Going Out to Eat, Preparing a Meal (x2), Going to the Supermarket, Disgust, and Fear) from the LBD group were not elicited. Due, in part, to the missing narratives across the three groups, composite mean scores were computed using the available narrative ratings (see below), and these scores were used in all analyses.

In order for the raters to focus solely on language and not the facial or prosodic information, verbatim written transcripts for each narrative were produced from the audiotapes by one of two research assistants. One rater made several passes of the audiotapes to ensure transcription accuracy. Videotapes were used for further clarification when needed. A second transcriber then reviewed each transcript by checking the final draft against the audiotape. Ten percent of the transcripts were then randomly selected and recoded by a third assistant to ensure that the exactness of the manuscript was high, which it was. Although reliability values were not calculated, very few meaningful errors were identified in the last editing pass.

All transcribers used the same transcription format, which basically followed a word-for-word transcription. Each participant's speech was transcribed as closely as possible, including vernacular, fillers (e.g., um), incomplete statements, repetitions,

articulation errors, and paraphasic errors. Although transcriptions were not completed phonetically, efforts were made to represent the speech output as closely as possible using English orthography (e.g., "cuz" for "because", "gonna" for "going", and "dunno" for "I don't know"). All of the original information was included in the transcription, except for materials that may have identified a specific individual (e.g., names and addresses). Such materials were replaced with "..." to inform the reader that certain information had been deleted. All examiner cues were included and marked accordingly.

Analyses of Word Count

Each narrative underwent a total word count to assess whether the three groups produced similar numbers of lexical items. The word counts were carried out using a computer program and were double-checked. Following the primary hypotheses, the word counts were divided by the presence of emotion (Emotional Condition: emotion versus nonemotional narratives), as well as by valence (Valence Condition: positive versus negative narratives). See the results section for more specific information regarding how these composite scores were created. Two separate one-way (Group: NC, RBD, LBD) repeated-measures ANOVAs were completed using the Emotion and Valence Conditions, respectively. No significant main effects or interactions were obtained. (Tables 13a and 13b lists means and standard deviations for each group.)

The same dependent variables were then reanalyzed including only the four brain-damaged groups. No significant effects were observed, except for a Lesion Side x Lesion Site interaction for the Valence Condition, $F(1,25) = 4.19$, $p = .051$. A similar interaction

for the Emotion Condition was obtained, $F(1,25) = 3.77$, $p = .063$ (Table 14a and 14b lists means and standard deviations for each group). However, when post-hoc analyses were applied to these interactions, no comparison resulted in a significant finding.

Lastly, the between-subjects variable of Gender was included in a similar ANOVA analysis, as this measure would be included in the analyses of the experimental data (see below). All findings were nonsignificant.

Based on this data, each group was found to produce similar quantities of words.

Rating Scales

Eight rating scales were developed to evaluate the hypotheses of the study (see Appendix B). Six point Likert scales (i.e., 0 - 5) were used to provide a null point (i.e., "0"), leaving a 5-point scale with a clearly defined midpoint. Attempts were made to create labels for each level that would be consistent across all eight scales. Analogous training materials (see below) were also developed to expose the raters to the scales and instruct them in their use.

To assess the accuracy with which the subjects related narratives about specific emotional and nonemotional topics, a 6-point accuracy scale was developed to measure how well the overall content of the narrative reflected the stimulus cues (e.g., happiness and going to the supermarket.). A 6-point confidence scale was also developed to determine the sureness of the raters' accuracy judgements. The confidence scale was also implemented to help determine potential inaccuracies in the participants' productions. For example, poor accuracy ratings may reflect either a) that the participant produced a

a. Descriptive statistics for the total number of words for healthy controls, right-brain damaged, and left-brain damaged participants: Emotional condition

Condition	<u>HC</u>		<u>RBD</u>		<u>LBD</u>	
	<u>M</u>	<u>S.D.</u>	<u>M</u>	<u>S.D.</u>	<u>M</u>	<u>S.D.</u>
Emotion	313.00	98.13	280.72	93.58	275.80	113.08
Nonemotion	286.07	89.13	260.00	112.48	282.28	130.57

b. Descriptive statistics for the total number of words for healthy controls, right-brain damaged, and left-brain damaged participants: Valence condition

Condition	<u>HC</u>		<u>RBD</u>		<u>LBD</u>	
	<u>M</u>	<u>S.D.</u>	<u>M</u>	<u>S.D.</u>	<u>M</u>	<u>S.D.</u>
Positive	307.12	91.20	275.41	110.91	275.66	137.37
Negative	316.52	104.46	284.13	89.72	276.91	102.53

Table 14

a. Descriptive statistics for the total number of words for right-brain damaged and left-brain damaged participants divided by anterior and posterior lesions: Emotional condition

Condition	<u>RBD</u> <u>Anterior</u>				<u>LBD</u> <u>Posterior</u>			
	<u>M</u>	<u>S.D.</u>	<u>M</u>	<u>S.D.</u>	<u>M</u>	<u>S.D.</u>	<u>M</u>	<u>S.D.</u>
Emotion	328.43	152.14	259.94	41.83	221.48	68.87	322.56	127.05
Nonemotion	283.72	134.66	252.25	74.91	219.80	94.62	335.84	139.25

b. Descriptive statistics for the total number of words for right-brain damaged and left-brain damaged participants divided by anterior and posterior lesions: Valence condition

Condition	<u>RBD</u> <u>Anterior</u>				<u>LBD</u> <u>Posterior</u>			
	<u>M</u>	<u>S.D.</u>	<u>M</u>	<u>S.D.</u>	<u>M</u>	<u>S.D.</u>	<u>M</u>	<u>S.D.</u>
Positive	323.93	167.36	246.00	57.50	210.67	77.07	331.38	157.94
Negative	331.80	148.30	276.87	36.64	227.97	65.03	318.86	114.24

narrative, which did not adhere to the topic at hand or b) that the participant's narrative followed the topic, but was vague/confusing. If the first scenario were true then accuracy ratings would be low and confidence ratings would be high. In the second case, both ratings would be low.

Three 6-point scales were also developed to assess the overall amount of emotional content, positive emotional content, and negative emotional content, respectively. Each of the three emotional content scales was paired with a separate 6-point intensity scale, which evaluated the corresponding degree of emotional intensity, positive emotional intensity, and negative emotional intensity. The positive and negative scales were developed to better assess the valence hypothesis, instead of relying solely on measures of global emotion.

Initial Development of the Rating Procedures and Selection of the Training Stimuli

Training materials were constructed and based, in part, on previously developed materials used to assess emotional functioning (see Appendix C) (e.g., Canino, Borod, Madigan, Tabert, & Schmidt, 1999). To ascertain whether the training materials were comprehensible and whether the materials could be reliably implemented, two volunteer undergraduate students from Queens College were recruited to help evaluate the clarity and applicability of the ratings. The students were informed of the overall goal of the study, but no other details were provided to them concerning the study's hypotheses or its participants (e.g. age, health, gender, or identity). One 21 year-old woman, who had 16 years of education, and one 26 year-old man, who had 14 years of education, were

selected based on the following criteria: a) right-handed, b) native speaker of English or fluent in English by the age of 7, c) no history of drug or alcohol abuse, e) no past or present history of psychiatric disorder, f) no past or current history of neurological disease, g) no past or present head injury, h) no mental retardation, i) no learning disabilities, j) no current use of psychotropic medication, and k) aged 19-35. This information was obtained during a phone interview screening.

To ensure that these students, as well as the final raters, had average or higher intellectual and verbal abilities, they were administered a modified version of the WAIS-R Vocabulary subtest (Evans, 1985; Satz-Mogel, 1962) and the Complex Ideational Material subtest of the BDAE (Goodglass & Kaplan, 1983).

The two students independently read the training materials, which were to be used during the actual rating sessions. The scales were discussed and any questions answered. Both individuals were able to comprehend the materials as assessed via self-report. They then rated a large set of randomly selected narratives that had been produced by individuals with both subcortical and cortical lesions. These individuals could not be used in the present experiment due to the subcortical damage. A small set of narratives was also obtained by healthy controls who were not used in this study. Through visual inspection, these narratives appeared to parallel those used for the final study in terms of story content and length. The individuals who produced these sample narratives represented a cross-section of the actual participants across age, gender, education, and narrative type.

For each narrative, the two raters applied the eight ratings sequentially in the following order: accuracy and confidence scales, valence scales (positive emotional content, positive emotional intensity, negative emotional content, and negative emotional intensity), and emotion scales (emotional content and emotional intensity). For the latter two sets of scales, one rater completed the positive ratings prior to the negative ratings. The other rater completed the two sets of ratings in the opposite order. Based on visual inspection of these ratings, it was confirmed that the two students used all the available points on each scale.

The experimenter and a research assistant independently completed these ratings at the same time as the two students. This was done to examine if there would be differences between individual ratings based on exposure and knowledge of the ratings scales, which did not occur. Based on the four raters, narratives, which received the same rating or were disparate by one point, were selected to form the sets of examples used during the formal training session. Narratives for each training phase were selected so that each level of the Likert scale was represented. Each set included narratives from both emotional and nonemotional conditions, as well as each discrete topic. Attempts were also made to ensure that all training materials included narratives of varied length and similar linguistic structure; however, no formal data analyses were conducted examining these factors.

Experimental Rating Procedures

The raters were undergraduate and graduate students who were recruited from

Queens College and compensated monetarily for their time. Sixteen students were initially recruited from Queens College and met all of the inclusion criteria (see above). Each rater was informed of the general intent of the study, but not provided with any other information. Raters were screened over the phone for the above criteria, as well as administered the measures of general intellectual functioning and language comprehension. On these latter two measures, all raters earned average or above average scaled scores (i.e., 8 or above). The four groups of raters who evaluated accuracy/confidence, emotion, positive emotion, and negative emotion, respectively, were compared on age, years of education, modified WAIS-R scores, and the BDAE subtest scores, using one-way between-subject ANOVAs. No significant differences resulted for any of these variables (see Table 15 for demographic information).

After it was determined that each individual had met the screening criteria, they were randomly placed into one of the four rating groups, until each group had four raters. Each rater was then provided an identification number to ensure confidentiality. During training, one individual dropped out of the accuracy group and was replaced by a 17th individual. After the final rating procedures had begun, one rater from each of the accuracy, emotion, and positive emotion groups terminated their participation. The four individuals left the project due to either family emergencies or sickness and were not replaced, as the final Intraclass Correlation Coefficients were adequate to proceed. Analyses were then rerun on screening measures for the final groups of raters and no significant findings emerged.

Demographic information for the four groups of raters

ID No.	Rating	Gender	Age Group	Ethnicity	Years of Education
1.	A	M	20	1	14
2.	A	F	24	1	18
3.	A	F	23	2	17
Mean Data		66.6% F	22.3	66.6% 1	16.3
4.	E	F	21	1	16
5.	E	F	19	1	15
6.	E	F	19	1	14
Mean Data		100% F	19.6	100%	15
7.	P	M	23	2	16
8.	P	F	24	2	15
9.	P	F	23	1	17
Mean Data		66.6% F	22.3	66.6% 2	16
10.	N	F	24	1	18
11.	N	F	20	1	15
12.	N	F	27	2	15
13.	N	M	30	1	16
Mean Data		75% F	25.3	75% 1	16

Note. A = Accuracy, E = Emotion, P = Positive Emotion, N = Negative Emotion; F = Female, M= Male; 1 = Caucasian, 2 = African-American

Each group was trained on only one of the four sets of rating scales (i.e., accuracy/confidence, emotional content/intensity, positive emotional content/intensity, and negative emotional content/intensity). The rating sessions were conducted in three phases: a training phase, a conferencing phase, and a final rating phase, adapted from Canino et al., 1999.

The final rating phase was also evaluated statistically to determine whether the raters would be able to reliably carry out the procedures.

Training Phase

The "training phase" was used to describe the general purpose of the study and to define the parameters of the respective set of scales. After general definitions of the first scale were established, the raters were provided narratives, which were considered to be prototypical examples of each point on the scale (i.e., accuracy or one of the content measures). The raters read the narratives with the experimenter and then discussed reasons why these narratives best represented each point. Two narratives were presented for each interval of the scale. If raters disagreed or were confused, further discussion occurred. After reviewing the scale and each example, the raters were then introduced to the second respective scale (i.e., confidence or one of the emotional intensity measures) and provided definitions and examples for this aspect of the training.

For the emotion scales, raters judged intensity only for the emotional content that had been previously selected during the first rating, not necessarily the entire narrative. By focusing only on the previously selected emotional content, any neutral or opposing

valenced materials were not accounted for in the subsequent intensity ratings. It was believed that a purer measure of intensity would result if nonessential information was excluded when the raters considered emotional content. Furthermore, this paradigm would less likely result in the raters confusing the two ratings or using similar criteria to make their decisions. In light of potential confounds however, differences between the two ratings were emphasized during this part of the training. The raters returned to the previously discussed set of narratives presented for accuracy or content, reviewed each content rating, and then discussed how the intensity scale scores were derived. Note that at this level of the training, examples of confidence ratings were not presented to the raters.

Conferencing Phase

During the second phase of the training, "conferencing phase", raters were presented with a separate set of 16 randomly ordered emotional and nonemotional narratives. Two narratives (i.e., one emotional and one nonemotional) representing each point on the scale were provided. In order for each narrative topic to be represented at least once, four additional narratives, falling at random points on the scales, were included. Each narrative was presented on a separate 8.5 x 11-inch page of white paper and then compiled into a booklet. An accompanying scoring sheet was also provided so that the raters could record their answers. A set of enlarged scales and definitions of each point were provided for reference. These materials were formatted and presented to each rater on a separate 8.5 x 11-inch piece of white paper.

Raters were asked to individually read and score the first narrative in their booklet using their respective parameters; first content and then intensity, which was based only on the previously selected content. After completing each item, all ratings were orally presented to the examiner. If a discrepancy of more than two points arose and/or questions concerning the process occurred, the specific item was conferenced as a group. In sharing their ratings and strategies, the group become more aware of other existing approaches to determine ratings, as well as idiosyncratic approaches they should avoid. After discussing each item, if any rater felt that they would like to rescore the item, they did so, and the examiner recorded the new score. This process was repeated for each individual item. After rating all the stimuli, Intraclass Correlation Coefficients (ICC) were calculated and determined to be sufficient (.75 or above) to proceed with the final stages of training (see Table 16). The ICC for the confidence rating was .47. This value was most likely lower than the other values because it measured the subjective feelings of the raters as they evaluated accuracy. Furthermore, no specific training or guidelines were given to the raters concerning how to evaluate this measure..

Final Rating Phase - Piloting Stage

The last phase of the training session had the raters individually rate a third set of narratives using their respective scales. Raters were provided with 40 narratives, which were produced by the same subjects as in the previous two training phases. Narratives represented each level of the scale across the 16 topics and across three similar participant groups. Each narrative was presented on an 8.5 x 11-inch page of white paper, and raters

Intraclass correlation coefficients for the conferencing stage of the rater training

Rating Scale	N	Intraclass Correlation (1 st Ratings)	Intraclass Correlation (2 nd Ratings)
<u>Accuracy</u>			
Content	16	.88	.91
Confidence	16	.50	.47
<u>Emotion</u>			
Content	16	.80	.89
Intensity	16	.83	.89
<u>Positive Emotion</u>			
Content	16	.88	.90
Intensity	16	.81	.84
<u>Negative Emotion</u>			
Content	16	.90	.96
Intensity	16	.93	.97

Note: 1st Rating = Intraclass correlations computed prior to conferencing the ratings.

2nd Rating = Intraclass correlations computed following the conferencing of the ratings.

completed their ratings by circling the appropriate interval on the accompanying scales, which were also printed on an 8.5 x 11-inch piece of white paper. Enlarged copies of the two scales and definitions of each level were also made available. Raters were allowed to take as much time as needed for each rating. However, once a narrative had been rated, they were asked not to return to the previous item/s and/or change their scoring.

Upon completion of this phase of the training, ICC was again calculated and was sufficient to proceed to the experimental ratings. For the three emotional sets of ratings, every ICC fell above .80. For the accuracy rating, the ICC fell at .76, but this was considered high enough to proceed. A coefficient of .55 was obtained for the confidence rating. See Table 17 for a complete list of ICCs computed for each group. ICCs for each group were also computed sequentially, excluding one rater at a time to examine whether a single rater significantly influenced the level of ICC. This did not hold true.

Experimental Ratings

During the final rating sessions, raters individually completed the 607 ratings across several sessions to reduce fatigue. Each rater received a set of narratives that had been completely randomized across participant group, emotional/valence condition, and topic. They were provided with their respective scales, answer sheets, and definitions of each scale interval. These were presented on enlarged 8.5x11-inch pieces of white paper.

Intraclass correlation coefficients for the final stage of the rater training

Rating Scale	Intraclass Correlation Coefficient	Rating Scale	Intraclass Correlation Coefficient
<u>Accuracy</u>		<u>Positive Emotion</u>	
Content		Content	
All	.76	All	.87
-5	.70	-1	.82
-6	.63	-2	.90
-7	.77	-3	.82
-8	.72	-4	.76
Confidence		Intensity	
All	.55	All	.85
-5	.38	-1	.81
-6	.44	-2	.85
-7	.41	-3	.81
-8	.63	-4	.74
<u>Emotion</u>		<u>Negative Emotion</u>	
Content		Content	
All	.81	All	.90
-9	.75	-13	.86
-10	.75	-14	.85
-11	.84	-15	.90
-17	.69	-17	.87
Intensity		Intensity	
All	.82	All	.90
-9	.82	-#13	.90
-10	.72	-#14	.85
-11	.79	-#15	.88
-12	.77	-#16	.86

Note. (All) = ICC calculations based on all raters in that group; (- #) = ICC calculations based on all raters in that group minus the specified rater

Results

Data Analyses

Data analyses were constructed following the major premises of the study. The primary objective of the study was to compare the right-hemisphere and valence hypotheses using two types of emotional measures (i.e., content and intensity), as produced through language, in participants with neural lesions. This was examined by having brain-damaged and neurally intact individuals produce narratives, which spanned several emotional and nonemotional topics. Both content and intensity were assessed for general emotion, positive emotion, and negative emotion. This resulted in three separate sets of dependent variables. For exploratory purposes, the potential effects of Gender (i.e., men versus women) on emotional processes were investigated by recomputing the statistical procedures with Gender as an additional between-subjects factor.

A secondary goal of the research was to discern whether specific neural damage led to differences in the ability to adhere to the topic of a narrative, and whether emotional processes affected this aspect of discourse. The hypothesis was initially analyzed by examining group differences on the mean accuracy score across all 16 topics. The latter aspect of the hypothesis was assessed by comparing the accuracy ratings for emotional versus nonemotional narratives. Another related dependent variable, confidence, was similarly examined.

Lastly, the study assessed whether there were relationships between specific demographic, cognitive, and/or mood variables and the experimental measures. This was

conducted to establish whether any of the nonexperimental measures would need to be controlled for in the primary analyses.

Data Inspection

Data accuracy. The experimental data were grouped according to the four sets of scales used (accuracy/confidence, emotion, positive emotion, and negative emotion). Each data set was entered into a computerized database and double-checked for data entry mistakes. This inspection also helped to ensure that each rater had utilized all potential points on the scale.

Creation of mean scores. To compare group performances on the accuracy and confidence measure, six mean scores were created. Two mean scores were created by averaging across the 8 emotional categories for accuracy and confidence, respectively. Averaging across the 8 nonemotional categories for each scale created another two mean scores. The last two mean scores collapsed across all 16 topics.

To evaluate the right-hemisphere hypothesis, emotional and nonemotional means were calculated across each of the eight categories. Thus, four separate mean scores were averaged for each set of ratings (e.g., emotional content, nonemotional content, emotional intensity, and nonemotional intensity).

To examine the valence hypothesis, positive and negative mean scores were calculated for each set of ratings (e.g., a mean score across the positive emotional topics for the negative intensity ratings and a mean score across the negative emotional topics for the negative intensity ratings). The positive mean scores were obtained by computing

across the three positive emotions (i.e., happy, interest, and pleasant surprise) for each participant. The negative mean scores represented the five negative categories (i.e., sad, fear, anger, disgust, and unpleasant surprise).

Intraclass Correlation Coefficients for the Experimental Data

For each of the eight scales, separate Intraclass Correlation Coefficients (ICC) were computed across the respective group of raters and across all 16 narrative topics. As previously stated, the reliability coefficients needed to fall above 0.70 to proceed with further analyses.

Table 18 depicts the ICCs for the experimental data. ICCs were calculated for each rating using the entire group of raters. Additional ICCs were then successively recalculated excluding each member of a rater group. This was done to evaluate whether the contributions of any single rater skewed the data. This, however, was never the case. For the six emotion-based ratings, ICCs ranged from .79 to .90. As these coefficients were high, the plan for data analyses could continue. The ICC for accuracy fell at .69, which was sufficient to continue with the formal analyses. Interestingly, the ICC for the accuracy confidence rating (.22) was lower than the ICCs obtained during the training sessions.

Correlational Analyses

Experimental Ratings versus Screening Measures

Pearson product-moment and Spearman rank-order correlations were computed between each of the experimental (i.e., emotion, nonemotion, positive, and negative mean

Intraclass correlation coefficients for the experimental data

Rating Scale	Intraclass Correlation Coefficient	Rating Scale	Intraclass Correlation Coefficient
<u>Accuracy</u>		<u>Positive Emotion</u>	
Content		Content	
All	.69	All	.84
-6	.54	-1	.79
-8	.59	-2	.77
-17	.63	-3	.76
Confidence		Intensity	
All	.22	All	.81
-6	.19	-1	.69
-8	.15	-2	.72
-17	.14	-3	.81
<u>Emotion</u>		<u>Negative Emotion</u>	
Content		Content	
All	.79	All	.88
-10	.75	-13	.81
-11	.74	-14	.85
-12	.67	-15	.88
Intensity		-16	.81
All	.88	Intensity	
-10	.84	All	.90
-11	.83	-13	.87
-12	.83	-14	.87
		-15	.90
		-16	.85

Note. (All) = ICC calculations based on all raters in that group; (- #) = ICC calculations based on all raters in that group minus the specified rater

scores) *and* demographic (i.e., age, years of education, and socioeconomic status) and cognitive variables (Dementia Rating Scale - Attention and Memory Subsections; Wechsler Memory Scale - Logical Memory Subtests 1 and 2; Animal Naming; FAS). Correlations were carried out separately for each participant group, as well as for all participants combined. This was conducted on an exploratory basis to determine the level of association between the stated measures, as well as identify whether certain screening variables should be included as control measures in the final analyses.

Regarding the combined group of participants, 128 coefficients were calculated for each set of ratings: accuracy/confidence, emotional content/intensity, positive emotional content/intensity, and negative emotional content/intensity, respectively. Of the overall 512 correlations calculated, no coefficient exceeded a magnitude of .50, suggesting that minimal or no associations occurred between the variables (see Appendix D).

Accuracy/Confidence. When examining the correlations between the accuracy/confidence ratings and the screening measures, only seven of the 128 coefficients were significant at the .05 level; four at the .01 level. These correlation coefficients ranged from .28 to .46. It is interesting to note that five of these coefficients included verbal fluency measures and three others, paragraph recall. These findings, however, were not felt to be highly meaningful, as there appeared to be no consistent pattern among the variables, and the number of significant associations was no more than would be expected to occur by chance.

Emotional Content/Intensity. Turning to the ratings of emotional content and intensity, nine of the 128 correlations were significant at the .05 level, ranging in magnitudes from .31 to .36. Again, four of these correlations were related to the verbal fluency measures, while the others resulted from associations with five separate variables.

Positive Emotional Content/Intensity. When the positive emotional ratings were examined, only three significant correlations occurred for the positive emotional content/intensity measures (i.e., two with the FAS measure and one with the BDI). Interestingly, for the association with the BDI, the data revealed that those individuals with higher levels of depressive symptoms produced significantly less positive emotional content, but this only occurred for the nonemotional narratives. A negative correlation was observed between the BDI and the positive emotional intensity measure for the nonemotional narratives, but this was not significant. All other correlations with the BDI variable did not exceed a coefficient of .05.

Negative Emotional Content/Intensity. Appendix D shows the correlations for the negative emotional content and intensity variables. Fourteen correlation coefficients were significant ranging in magnitudes from .34 to .43. In contrast to the other scales, eight of the experimental scales were significantly correlated with the BDAE subtests. Four of the scales were associated with the demographic variables and two with FAS.

Ultimately, these screening variables were not used as covariates in the following analyses, because 33 of the 512 correlations were significant. This was not higher than the number that would be expected to occur by chance (i.e., 26). Covariates were also not

included in primary analyses, because the 33 significant associations were nominal in magnitude.

Group Performance on the Accuracy/Confidence Ratings

Analyses of Accuracy and Confidence

Group Differences. To examine secondary hypotheses examining potential right-hemisphere language deficits as related to the thematic integrity of the narratives, several ANOVAs were carried out on the accuracy and confidence scales. Based on the preceding literature, it was hypothesized that the RBD group, specifically the right anterior group, would produce less accurate narratives than any other participant group.

Lesion Side: One-Way Between-Subjects ANOVAs. First, to examine whether interhemispheric lateralization was evidenced for the production of narratives, two one-way between-subjects ANOVAs were run on the overall accuracy and confidence means, respectively, comparing the performance of the three participant groups.

The group analysis for accuracy resulted in a significant main effect, $F(2,36) = 5.07$, $p = .011$. In contrast to the above assumptions however, post-hoc comparisons revealed that the LBD group performed with significantly less accuracy ($M = 4.27$, $SD = .42$) than both the RBD group ($M = 4.63$, $SD = .33$; $p = .026$) and the HC group ($M = 4.62$, $SD = .19$; $p = .029$). No differences were evidenced when comparing the RBD and HC groups. To examine whether this effect was potentially mediated by a rater's confidence with which they made their decisions, a Pearson product-moment correlation was computed between the total scores for accuracy and confidence. This was not

significant and therefore it was not used as a covariate.

Group differences were also examined on the confidence rating. A one-way between-subjects ANOVA was computed, but no significant variability was found between the groups, $F(2,36) = .94$, $p = .40$. Mean scores varied by less than .10 between each group: NC, $M = 4.92$, $SD = .15$; RBD, $M = 4.87$, $SD = .14$; LBD, $M = 4.84$, $SD = .16$.

Lesion Side x Lesion Site: 2 x 2 Between-Subjects ANOVAs. These two dependent variables were also considered when lesion location was divided across intra- and interhemispheric dimensions. Accuracy and confidence ratings were subjected to two 2 (Lesion Side) x 2 (Lesion Site) between-subjects ANOVAs using data from only the four brain-damaged groups. The three additional right anterior lesioned participants were included in this analysis, but the HC group was not so as to increase statistical power and more directly address the hypotheses. Follow-up ANOVA and post-hoc analyses were completed when necessary.

For the accuracy measure, the main effect of Lesion Side (i.e., Group) was again found to be significant, $F(1,25) = 5.04$, $p = .034$ with the LBDs ($M = 4.27$, $SD = .42$) performing worse than the RBDs ($M = 4.59$, $SD = .32$). No main effect of Lesion Site or interaction with Lesion Side was obtained. Nonsignificant findings were produced for the confidence rating.

Interhemispheric Effects

Right-Hemisphere Hypothesis

Next, analyses were completed which assessed the primary hypotheses relating to a right-hemisphere dominance for emotional processing. If the right-hemisphere hypothesis was operative for both emotional processes, then the RBD group would perform more poorly than the LBD and HC groups on the emotional narratives compared to the nonemotional narratives, irrespective of whether content or intensity was being examined.

To examine the right-hemisphere hypothesis, the Emotional Condition (i.e., emotional and nonemotional narratives) for each pair of ratings (i.e., accuracy, emotion, positive emotion, and negative emotion) underwent separate 3 x 2 (Group x Emotion Condition) multivariate analyses of variance (MANOVA: Wilks' lambda procedure) comparing the brain-damaged and healthy control groups. Significant multivariate F-tests were followed by univariate ANOVA and/or Bonferroni procedures when necessary. The pairwise comparisons were conducted in this fashion to help control for Type 1 errors due to the increased number of calculations. P-values of 0.05 were selected for each analysis.

Accuracy and Confidence Ratings. To examine whether emotion influenced the ability to produce thematically intact narratives and the confidence with which raters judged such accuracy, a two-way mixed-factorial MANOVA was performed on the two dependent variables (accuracy and confidence): one between-subjects factor (Group: RBD, LBD, and HC) and one within-subjects factor (Emotion Condition: emotional and nonemotional narratives). Using the Wilks' criterion, the combined DVs were found to be significantly affected by the Emotion Condition, multivariate $F(2,35) = 5.23, p = .01$.

The Group factor for the two DVs was also significant, multivariate $F(4,70) = 2.48$, $p = .052$, but the interaction between the two variables was not.

Two (Group) x two (Emotion Condition) mixed-factorial, univariate F-tests were performed to examine the contributions of the main effects on each dependent variable. For the confidence ratings, a significant main effect of Emotion Condition was obtained, univariate $F(1,36) = 4.59$, $p = .039$, with raters feeling more sure of their decisions on the nonemotional narratives ($M = 4.93$, $SD = .21$) than on the emotional narratives ($M = 4.83$, $SD = .20$). No effects were revealed for the accuracy ratings at this level of analysis.

When further assessing the multivariate effect of Group, a significant main effect was obtained for the accuracy ratings, univariate $F(2,36) = 4.97$, $p = .012$, but not for the confidence ratings, univariate $F(2,36) = .89$, $p = .419$. For the former variable the HC ($M = 4.62$, $SD = .29$; $p = .036$) and the RBD ($M = 4.64$, $SD = .39$; $p = .024$) groups were significantly more accurate than the LBD group ($M = 4.28$, $SD = .52$). The HC and RBD groups did not differ significantly.

No significant univariate interactions occurred.

Emotional Content and Emotional Intensity Ratings. A two-way mixed-design MANOVA (Group x Emotion Condition) was applied to the two dependent variables of emotional content and emotional intensity. Similar to the accuracy rating, the Emotion Condition appeared to significantly influence the combined dependent variable, $F(2,35) = 123.42$, $p = .000$, with a trend emerging for the main effect of Group, $F(4,70) = 2.26$, $p =$

.071.

Univariate analyses resulted in a significant main effect of Emotion Condition for the emotional content measure, $F(1,36) = 219.70$, $p = .000$. The examination of mean scores revealed that the emotional narratives had greater emotional content ($M = 4.16$, $SD = .65$) than the nonemotional stories ($M = 2.70$, $SD = .64$). It should be noted however, that the nonemotional topics were rated with some degree of emotionality. Follow-up evaluation of the main effect of Group revealed a trend for the emotional content rating, $F(2,36) = 2.68$, $p = .082$. Although the HC group ($M = 3.57$, $SD = .74$) demonstrated higher ratings than the LBD group ($M = 3.15$, $SD = .61$; $p = .154$), this comparison was not significant. Similarly, no significant discrepancies were observed when comparing the HCs versus the RBDs ($M = 3.57$, $SD = .47$; $p = .146$) or the LBD versus the RBD groups ($p = .162$).

Turning to the emotional intensity variable, a significant main effect of Emotion Condition was obtained, univariate $F(1,36) = 194.99$, $p = .000$, such that emotional narratives were rated as being more intense ($M = 4.45$, $SD = .54$) than the nonemotional narratives ($M = 3.05$, $SD = .83$). Similar to the content ratings, a significant main effect of Group occurred, $F(2,36) = 3.44$, $p = .043$. The HC group ($M = 4.02$ LBD, $SD = .52$) produced significantly more intense narratives than the LBDs ($M = 3.43$, $SD = .77$; $p = .042$), but were not significantly different compared with the RBDs ($M = 3.81$, $SD = .63$); the LBDs did not differ significantly from the RBDs.

No significant interactions emerged for emotional content or intensity.

Positive Emotional Content and Positive Emotional Intensity. In order to explore whether the right-hemisphere effect was operative when narratives were rated on positive emotion, a two-way (Group x Emotion Condition) mixed-design, MANOVA was applied to the ratings for positive emotional content and positive emotional intensity. Results from the MANOVA revealed a main effect of Group, which approached significance, $F(4,70) = 2.26$, $p = .070$. However, the main effect of Emotion Condition ($p = .90$) and the interaction ($p = .20$) were not significant.

When 2 x 2 mixed-factorial ANOVA designs were applied to each dependent variable separately, a significant main effect for Group on the positive content ratings emerged, $F(2,36) = 3.77$, $p = .033$. Post-hoc comparisons showed that the HC ($M = 2.13$, $SD = .34$; $p = .048$) produced significantly more positive content compared to the LBD ($M = 1.83$, $SD = .33$) group. When comparing the LBDs and RBDs ($M = 2.09$, $SD = .45$; $p = .106$), the LBD group performed more poorly. No differences between the HC and RBD groups were noted.

For the positive emotional intensity measure, there was a significant main effect for Group, $F(2,36) = 3.87$, $p = .03$. Again, the HCs ($M = 2.66$, $SD = .44$) expressed more positive emotional intensity than the LBD group ($M = 2.20$, $SD = .49$; $p = .030$). No significant differences were observed between the other groups (RBD mean performance; $M = 2.50$, $SD = .57$).

Negative Emotional Content and Negative Emotional Intensity. A two-way (Group x Emotion Condition) mixed-factorial MANOVA was also performed using the

negative emotional content and intensity ratings as dependent variables, with one between-subjects factor, Group, and one within-subjects factor, Emotion Condition. In contrast to the analyses of the positive emotion ratings, the combined negative emotion ratings were significantly affected by the Emotion Condition factor, multivariate $F(2,35) = 168.90$, $p = .000$, but not by the Group factor, multivariate $F(4,70) = 1.22$, $p = .310$. No interaction effect occurred, multivariate $F(4,70) = .58$, $p = .681$.

Further examination of the Emotion Condition via one-way ANOVAs revealed a significant main effect of Condition on the negative emotional content ratings, univariate $F(1,36) = 236.75$, $p = .000$. Overall, emotional narratives were rated as having significantly larger amounts of negative emotional content ($M = 3.13$, $SD = .38$) compared to the nonemotional narratives (content, $M = 1.91$, $SD = .42$)

The main effect of Condition for the negative emotional intensity measure was significant, univariate $F(1,36) = 342.82$, $p = .000$, revealing more intense productions for the emotional ($M = 3.05$, $SD = .37$) compared with the nonemotional narratives ($M = 1.86$, $SD = .41$).

Valence Hypothesis

Interhemispheric effects for the valence hypothesis were considered next. If the valence hypothesis were operative, then the LBDs would be expected to do more poorly on the positive narratives and the RBDs worse on the negative narratives, irrespective of whether content or intensity were being examined. The accuracy and confidence ratings were again examined using this approach to determine whether valence impacted upon

these measures. Similar multivariate and univariate analyses, as used for the right-hemisphere hypothesis, were applied to the ratings, but substituting the within-subjects variable of Valence Condition (i.e., positive narratives versus negative narratives) for Emotional Condition. Although the data set used in each analysis was the same, the new within-subjects variable resulted in a different configuration of the data. The nonemotional means were not included in this set of analyses for two reasons. First, as the previous set of multivariate analyses demonstrated, the nonemotional narratives were always rated with lower content and intensity than the emotional narratives. Second, more degrees of freedom would be maintained if this level of the factor was excluded; resulting in more powerful MANOVA and ANOVA analyses.

Accuracy and Confidence. A 2 x 2 (Group x Valence Condition) MANOVA was conducted on the dependent variables of accuracy and confidence. The independent variable was Group (HC, RBD, and LBD) and the repeated-measures variable, Valence Condition (positive and negative narratives). Although no differences were noted on the combined variable for the main effect of Valence Condition, multivariate $F(2,35) = .14$, $p = .86$, or the Valence Condition x Group interaction, multivariate $F(4,70) = .46$, $p = .76$, a significant main effect of Group was obtained, multivariate $F(4,70) = 2.66$, $p = .040$.

Further investigation of group performance on each dependent variable revealed significant differences for accuracy, univariate $F(2,36) = 4.57$, $p = .02$, but not confidence, univariate $F(2,36) = 2.19$, $p = .13$. This was reflected in significantly diminished accuracy for the LBD group ($M = 4.28$, $SD = .59$) compared to the RBD ($M =$

4.69, $SD = .54$; $p = .045$) and HC ($M = 4.71$, $SD = .44$; $p = .033$) groups. No significant difference was observed for the pairwise comparison between the RBD and HC groups.

Emotional Content and Emotional Intensity. The effects of the Valence Condition on the emotion ratings were computed using the same MANOVA procedures described above for accuracy/confidence. Significant main effects were obtained for Group, $F(4,70) = 2.56$, $p = .046$ and Valence Condition, $F(2,35) = 6.29$, $p = .005$, but not for their interaction, $F(4,70) = .69$, $p = .603$.

When examining each dependent variable separately, the Group factor resulted in a trend for the emotional content ratings, univariate $F(2,36) = 2.78$, $p = .076$. Exploratory post-hoc analyses applied to this rating revealed that the RBD group ($M = 4.41$, $SD = .83$) produced more content than the LBD group ($M = 3.81$, $SD = .65$; $p = .073$). This finding approached significance. There were no significant findings when comparing the LBD and HC ($M = 4.15$, $SD = .63$) groups, and the RBD and HC groups. Turning to the multivariate effect of Valence Condition, the significant univariate effect of content, $F(1,36) = 12.90$, $p = .001$, showed that negative narratives ($M = 4.30$, $SD = .65$) were rated as having larger amounts of emotion than were positive narratives ($M = 3.94$, $SD = .82$).

For the intensity ratings, the significant univariate main effect of Group, $F(2,36) = 4.34$, $p = .02$, showed that the LBD group ($M = 4.08$, $SD = .68$) produced significantly less intense narratives compared with the RBD ($M = 4.60$, $SD = .56$; $p = .046$) and HC ($M = 4.60$, $SD = .55$; $p = .044$) groups, but that there was no significant difference

between the latter two groups. When the main effect of Valence Condition was assessed, a significant finding emerged, $F(1,26) = 7.09$, $p = .012$, such that negative narratives ($M = 4.56$, $SD = .54$) were again rated as more intense than positive narratives ($M = 4.30$, $SD = .73$).

Positive Emotional Content and Positive Emotional Intensity. The application of the 2 x 2 (Group x Valence Condition) mixed-design MANOVA to the combined dependent variables of positive emotional content and positive emotional intensity resulted in significant main effects for Group, multivariate $F(4,70) = 2.50$, $p = .05$, and Valence Condition, multivariate $F(2,35) = 219.28$, $p = .000$, as well as their interaction, multivariate $F(4,70) = 4.31$, $p = .004$.

For the univariate main effect of Group, $F(2,36) = 5.07$, $p = .01$, significant differences were obtained on the content rating with the LBDs ($M = 1.95$, $SD = .41$) performing significantly worse than the RBDs ($M = 2.45$, $SD = .51$; $p = .015$), but not the HCs ($M = 2.36$, $SD = .54$; $p = .058$). No difference occurred between the HC and RBD groups.

The univariate F-test was significant for the main effect of Valence Condition, $F(1,36) = 321.39$, $p = .000$. The set of positive narratives was rated as having more positive emotional content ($M = 3.10$, $SD = .79$) as compared to the negative narratives ($M = 1.40$, $SD = .30$). This would be expected given the nature of the rating scale.

Further analyses of the multivariate Group x Valence Condition interaction resulted in a significant univariate interaction for positive emotional content, $F(2,36) =$

9.77, $p = .000$ (see Figure 1). Post-hoc comparisons of the content ratings first examined group differences within each valence category. The LBD group ($M = 2.51$, $SD = .49$) produced significantly less content on the positive narratives compared to the RBDs ($M = 3.50$, $SD = .72$; $p = .000$) and the HCs ($M = 3.30$, $SD = .79$; $p = .005$), but there were no differences between the RBD and HC groups (see Figure 1). Within the negative narrative condition, no significant participant group differences emerged (HC: $M = 1.42$, $SD = .28$; RBD: $M = 1.40$, $SD = .30$; LBD: $M = 1.38$, $SD = .34$). When comparing the valence conditions within each participant group, all pairwise analyses were significant at the .000 level. As might be expected with this type of rating, each group produced more positive emotional content for the positive narratives than the negative narratives.

The main effect of Valence Condition for the positive emotional intensity rating was also significant, univariate $F(1,36) = 440.28$, $p = .000$, such that positive narratives ($M = 3.85$, $SD = .83$) had more positive intensity than the negative narratives ($M = 1.65$, $SD = .42$). When examining the main effect of Group, univariate $F(2,36) = 3.34$, $p = .047$, none of the three groups differed significantly from each other (HC: $M = 2.90$, $SD = .63$; RBD: $M = 2.90$, $SD = .53$; LBD: $M = 2.45$, $SD = .59$). However, trends emerged when comparing the HC and LBD groups ($p = .094$) and the RBD and LBD groups ($p = .095$), with the LBDs always performing more poorly.

The interaction of Group x Valence Condition for intensity was also significant, univariate $F(2,36) = 5.16$, $p = .011$ (see Figure 2). Post-hoc analyses paralleled that of the content measure such that on the positive narratives, the HCs ($M = 4.09$, $SD = .86$; $p =$

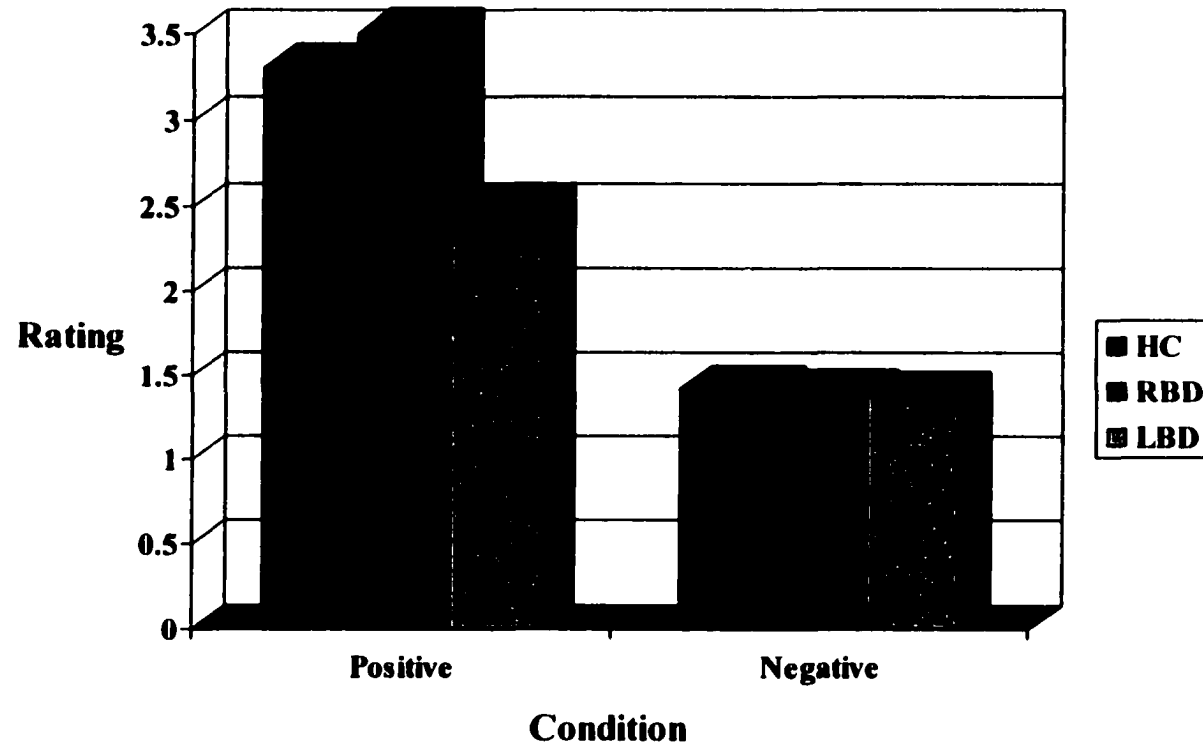


Figure 1. 3 x 2 (Group x Valence Condition) interaction for positive emotional content.

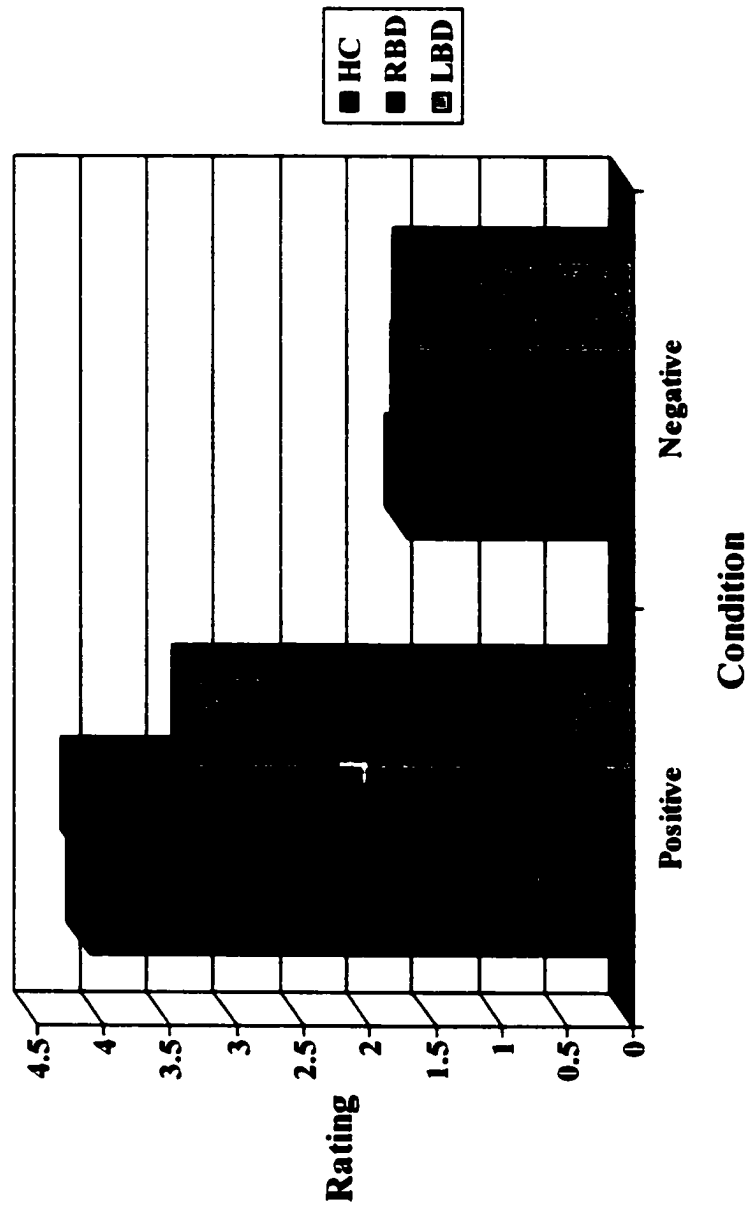


Figure 2. 3 x 2 (Group x Valence Condition) interaction for positive emotional intensity.

.019) and RBDs ($M = 4.15$, $SD = .68$; $p = .006$) produced a significantly greater degree of positive emotional intensity than did the LBDs ($M = 3.31$, $SD = .72$) (see Figure 2). The HC and RBD participants performed similarly on this portion of the task. When producing the negative narratives, no significant differences between any group comparison occurred. Turning to each group's performance when comparing the positive and negative narratives, no significant differences emerged.

Negative Emotional Content and Negative Emotional Intensity. The multivariate effect (Valence Condition) for the combined dependent variables of negative emotional content and negative emotional intensity was significant, $F(2,35) = 402.08$, $p = .000$. Although no significant main effect of Group was obtained, $F(4,72) = .77$, $p = .547$, the interaction between the two factors approached significance, $F(4,72) = 2.08$, $p = .093$

A significant main effect of Valence Condition for negative emotional content was found, univariate $F(1,36) = 799.67$, $p = .000$. As would be expected, negative narratives were always rated as having larger amounts of negative content than that produced for the positive narratives.

Interestingly, when applying ANOVA procedures to each variable separately, the Group x Valence Condition interaction for negative emotional content was significant, univariate $F(2,36) = 3.89$, $p = .029$ (see Figure 3). The pairwise comparison testing on the content measure revealed that the LBD group produced smaller amounts of negative content ($M = 3.74$, $SD = .47$) than the RBD group ($M = 4.22$, $SD = .42$; $p = .012$). Although, no other significant group difference were found, observation of the mean

scores indicated that the HC ($M = 4.04$, $SD = .45$) generated slightly more negative content than the LBDs, but similar amounts compared with the RBDs (see Figure 3).

There were no significant differences when comparing the groups on the positive narratives (HC: $M = 1.58$, $SD = .37$; RBD: $M = 1.71$, $SD = .41$, $M = 1.74$, $SD = .41$). Not surprisingly, these scores approached floor effects. Further comparisons showed that all groups produced more content on the negative versus the positive narratives. Each of these comparisons fell at p-values of .000.

Examination of the univariate effects for Valence Condition on the negative emotional intensity rating, $F(1,36) = 558.84$, $p = .000$, revealed that the negative narratives ($M = 3.86$, $SD = .49$) were rated with more negative emotional intensity than the positive narratives ($M = 1.69$, $SD = .39$). This effect, however, was not modified by a significant Group by Valence Condition interaction, univariate $F(2,36) = 2.08$, $p = .140$.

Intrahemispheric Effects

The right-hemisphere and valence hypotheses were next examined considering how anterior versus posterior cortical lesions contributed to the expression of lexical emotion. This was carried out by subdividing the brain-damaged participants based on two between-subject factors: interhemispheric (i.e., Lesion Side - right versus left) and intrahemispheric (i.e. Lesion Site - anterior versus posterior) lesion location. The same within-subjects variables of Emotion or Valence Condition were used (see above). However, due to the limited number of participants in each cell of the design, the MANOVA procedure could not be considered as an appropriate statistic. Therefore,

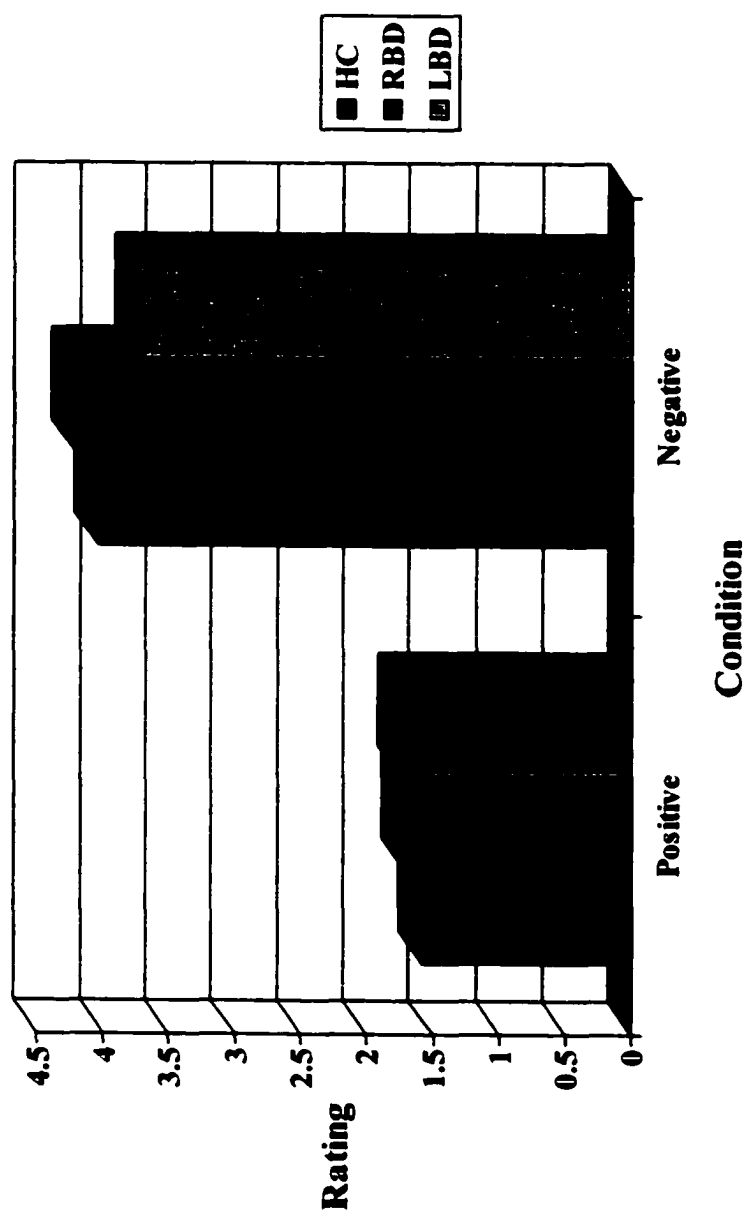


Figure 3. 3 x 2 (Group x Valence Condition) interaction for negative emotional content.

2 x 2 x 2 mixed-factorial ANOVA (Lesion Side x Lesion Site x Emotion or Valence Condition) statistics were performed separately for each rating scale to maintain the power of the analyses. Significant univariate main effects and interactions were again followed by Bonferroni pairwise comparisons when necessary. P-values of 0.05 were selected for each analysis. The inclusion of the Lesion Side variable in these analyses resulted in similar findings as reported above (see Interhemispheric Effects). Therefore, these redundant data were described, but not always presented in detail. All information however, was presented when Lesion Site effects were obtained.

Right-Hemisphere Hypothesis

Accuracy and confidence ratings. When examining accuracy, a significant main effect of Lesion Side resulted, $F(1,25) = 5.07$, $p = .033$, with the right-sided group ($M = 4.60$, $SD = .44$) relating more accurate narratives than the left-sided group ($M = 4.27$, $SD = .52$). The main effect for Lesion Site and the 2-way interaction were not significant.

For the confidence rating, the main effect of Emotion Condition was significant, $F(1,25) = 5.68$, $p = .025$. In this case, raters felt more sure of their decisions on the nonemotional narratives ($M = 4.93$, $SD = .22$) than on the emotional narratives ($M = 4.80$, $SD = .19$). No other interactions approached significance.

Emotional content and emotional intensity ratings. Almost all the main effects for Emotion Condition, Lesion Side, and Lesion Site were significant when the univariate procedures were applied to the emotional content and emotional intensity ratings. However, no significant 2- or 3-way interactions were revealed.

The within-subjects effect of Emotion Condition for the content ratings revealed that participants expressed significantly, $F(1,25) = 157.84$, $p = .000$, more emotional content for the emotion narratives ($M = 4.20$, $SD = .70$) than for the nonemotional narratives ($M = 2.62$, $SD = .69$). Similarly, significant results, $F(1,25) = 132.21$, $p = .000$, were also observed for the emotional intensity ratings: emotional narratives, ($M = 4.42$, $SD = .56$) and nonemotional narratives, ($M = 2.91$, $SD = .84$).

In terms of the between-subjects variable of Lesion Side, the RBD group always performed better than the LBD group for both content, $F(1,25) = 6.46$, $p = .018$, ($M = 3.65$, $SD = .69$; $M = 3.13$, $SD = .61$, respectively) and intensity, $F(1,25) = 4.36$, $p = .047$, ($M = 3.89$, $SD = .58$; $M = 3.42$, $SD = .77$, respectively).

When examining the main effect of Lesion Site for the content ratings, the posterior group ($M = 3.60$, $SD = .69$) generated significantly larger amounts of emotional content than the anterior group ($M = 3.18$, $SD = .67$); $F(1,25) = 4.28$, $p = .049$. For the emotional intensity rating, a trend was observed for the effect of Lesion Site: $F(1,25) = 3.06$, $p = .093$. Again, the posterior group ($M = 3.84$, $SD = .74$) produced more emotional intensity than the anterior group ($M = 3.45$, $SD = .74$).

Positive emotional content and positive emotional intensity ratings. The main effects for Emotion Condition were nonsignificant.

Turning to the positive emotional content ratings, significant main effects were observed for the between-subjects variables of Lesion Side and Lesion Site, $F(1,25) = 8.20$, $p = .008$, $F(1,25) = 4.44$, $p = .045$, respectively. The right-hemisphere group ($M =$

2.14, $\underline{SD} = .42$) produced significantly more content than the left-hemisphere group ($\underline{M} = 1.82$, $\underline{SD} = .33$). For the main effect of Lesion Site, the posterior lesioned group displayed significantly more positive emotional content ($\underline{M} = 2.10$, $\underline{SD} = .39$) than the anterior group ($\underline{M} = 1.87$, $\underline{SD} = .41$).

Significant main effects of Lesion Side for positive emotional intensity, $\underline{F}(1,25) = 5.18$, $p = .032$, and Lesion Site, $\underline{F}(1,25) = 4.92$, $p = .04$ were also obtained. The direction of these findings paralleled those of positive emotional content with the RBDs ($\underline{M} = 2.55$, $\underline{SD} = .54$) producing more intensity than the LBDs ($\underline{M} = 2.19$, $\underline{SD} = .50$), and the posterior group ($\underline{M} = 2.54$, $\underline{SD} = .51$) producing more intensity than the anterior group ($\underline{M} = 2.19$, $\underline{SD} = .54$).

Interestingly, for the intensity measure, a trend was observed for the three-way interaction of Lesion Side x Lesion Site x Emotion Condition, $\underline{F}(1,25) = 3.07$, $p = .092$. Although no significant comparisons emerged, inspection of the means showed that the right posterior group performed similarly on the emotional and nonemotional narratives, but with more intensity than any other group. For the emotional narratives, there was a higher degree of variability among the groups, with the left anteriors performing the worst. However, the performances of the right anterior and left-hemisphere groups on the nonemotional variable were fairly similar (see Figure 4).

Negative emotional content and negative emotional intensity ratings. For the negative emotional content and intensity ratings, the 2 x 2 x 2 mixed-design ANOVAs revealed significant Emotion Condition effects: $\underline{F}(1,25) = 222.06$, $p = .000$, and $\underline{F}(1,25) =$

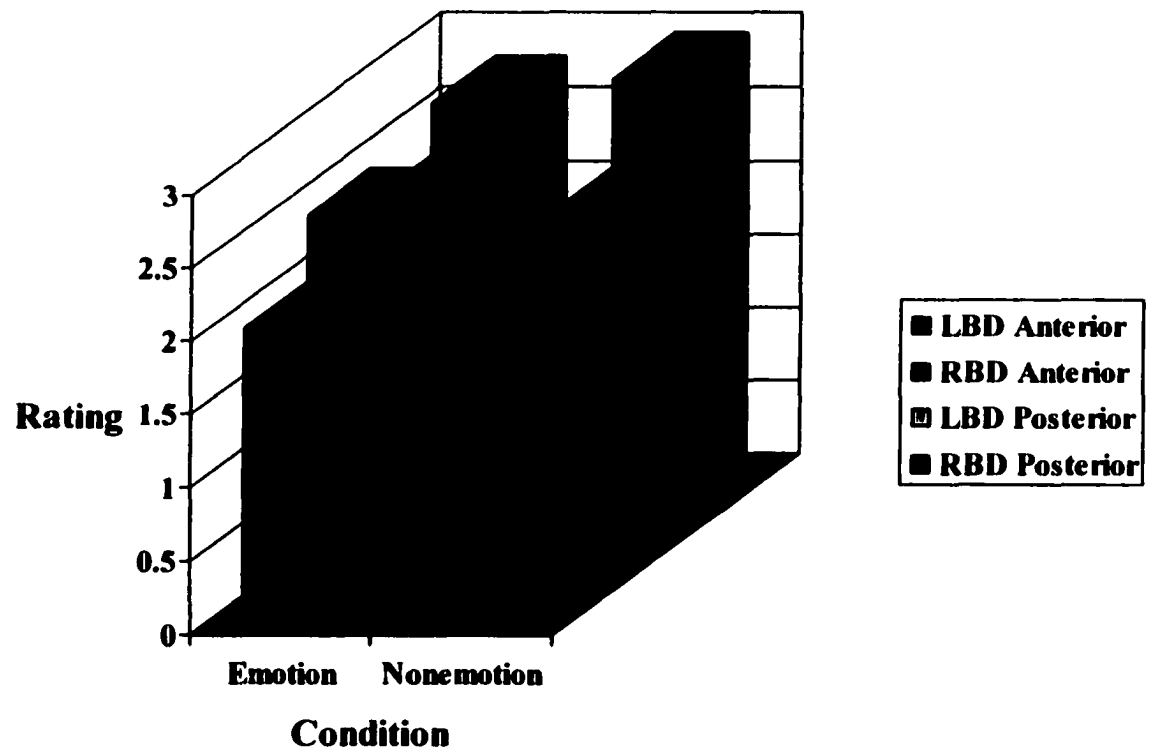


Figure 4. 2 x 2 x 2 (Lesion Side x Lesion Site x Emotion Condition) interaction for positive emotional intensity.

242.89, $p = .000$, respectively. For both ratings, larger amounts of content ($M = 3.14$, $SD = .38$) with elevated intensity ($M = 3.03$, $SD = .36$) were produced for the emotional narratives compared to the nonemotional narratives (content: $M = 1.93$, $SD = .38$; intensity: $M = 1.86$, $SD = .38$).

Nonsignificant main effects of Lesion Site and Lesion Site, as well as the interactions with Emotion Condition were computed.

Valence Effects

The next set of analyses followed a 2 (Lesion Side: left and right hemispheres) x 2 (Lesion Site: anterior and posterior lesion sites) x 2 (Valence Condition: positive and negative narratives) mixed-factorial ANOVA design. Post-hoc analyses were conducted when appropriate using the Bonferroni procedure.

Accuracy and confidence ratings. Application of this ANOVA structure to the accuracy ratings again resulted in a significant main effect of Lesion Side, $F(1,25) = 4.55$, $p = .043$, with the right hemisphere group ($M = 4.65$, $SD = .11$) performing more accurately than the left-hemisphere group ($M = 4.27$, $SD = .13$). No significant effects were observed for other main effects or interactions. No significant findings emerged for the confidence measure.

Emotional content and emotional intensity ratings. Significant main effects were obtained on the emotional content ratings for Valence Condition, $F(1,25) = 9.93$, $p = .004$, and Lesion Side, $F(1,25) = 7.72$, $p = .010$; a trend occurred for the main effect of Lesion Site, $F(1,25) = 3.40$, $p = .077$. No significant interactions were identified. For the

main effect of Valence Condition, more emotional content was produced for the negative ($M = 4.34$, $SD = .67$) compared with the positive narratives ($M = 3.98$, $SD = .89$). Regarding the Lesion Side effect the RBDs ($M = 4.46$, $SD = .78$) produced larger amounts of emotional content than the LBDs ($M = 3.79$, $SD = .65$). For the significant main effect of Lesion Site, the posterior group ($M = 4.35$, $SD = .79$) also expressed more emotional content than the anteriors ($M = 3.90$, $SD = .75$).

When examining the emotional intensity ratings, significant main effects for Valence Condition, $F(1,25) = 5.12$, $p = .033$, and Lesion Side, $F(1,25) = 9.61$, $p = .005$, followed the same pattern as that found for the emotion content ratings. The main effect of Lesion Site again resulted in a trend, $F(1,25) = 3.63$, $p = .068$, with the anterior group ($M = 4.18$, $SD = .70$) performing more poorly than the posterior group ($M = 4.55$, $SD = .60$).

A trend was also observed for the Lesion Side x Valence Condition interaction for emotional intensity, $F(1,25) = 3.21$, $p = .085$, but no other significant interactions were evidenced. Using visual inspection, the weakest performances were observed in the LBD group on the positive narratives. However, this group also demonstrated less intensity on the negative narratives compared with the performance of the RBDs (see Figure 5).

Positive emotional content and positive emotional intensity ratings. The findings for the positive emotion content ratings, based on a 2 (Lesion Side) x 2 (Lesion Site) x 2 (Valence Condition) ANOVA were somewhat more elaborate. First, a significant main effect of Valence Condition, $F(1,25) = 267.16$, $p = .000$, was obtained with a larger

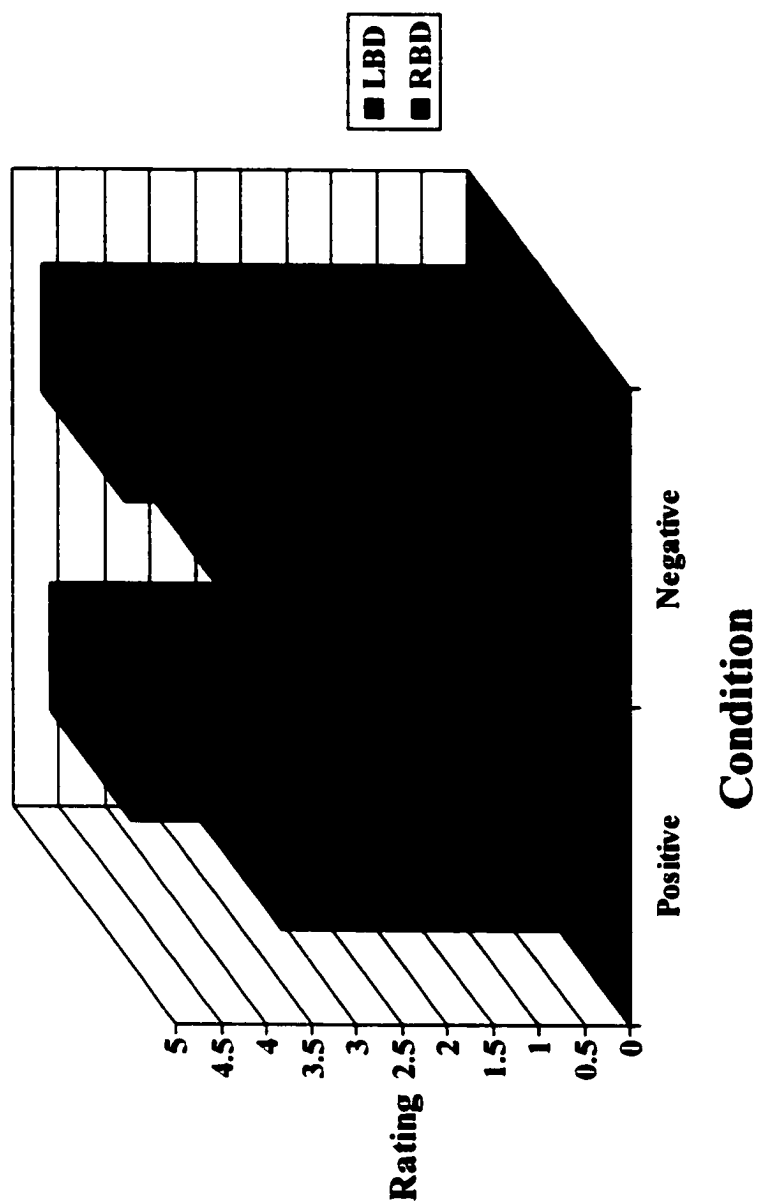


Figure 5. 2 x 2 (Lesion Side x Valence Condition) interaction for emotional intensity.

amount of positive emotional content being expressed for the positive ($\underline{M} = 3.08$, $\underline{SD} = .79$) than for the negative ($\underline{M} = 1.39$, $\underline{SD} = .31$) narratives. This would be expected as the ratings are based on the assessment of positive emotion. A significant main effect of Lesion Side also emerged, $F(1,25) = 16.03$, $p = .000$, with higher ratings occurring for the RBDs ($\underline{M} = 2.49$, $\underline{SD} = .49$) compared with the LBDs ($\underline{M} = 1.94$, $\underline{SD} = .41$). For the Lesion Site trend, $F(1,25) = 3.06$, $p = .093$, the posterior group ($\underline{M} = 2.34$, $\underline{SD} = .57$) expressed more content compared to the anterior group ($\underline{M} = 2.10$, $\underline{SD} = .52$).

Interestingly, two findings were obtained for this dependent variable, which were not previously observed in other analyses. The main effects of Lesion Side and Valence Condition, were modified by a Lesion Side x Valence Condition interaction, $F(1,25) = 28.55$, $p = .000$, as well as a Lesion Site x Valence Condition interaction, $F(1,25) = 7.48$, $p = .011$.

For the Lesion Side x Valence Condition interaction (see Figure 6), pairwise testing, comparing group performances within each level of the condition, revealed that the LBD group ($\underline{M} = 2.51$, $\underline{SD} = .49$) produced significantly less positive emotional content than did the RBD group ($\underline{M} = 3.55$, $p = .69$) for the positive narratives, $t(27) = 4.56$, $p = .000$, but similar amounts for the negative narratives ($\underline{M} = 1.39$, 1.40 , $\underline{SD} = .34$, $.29$, respectively). When examining performance on the positive and negative narratives within each group, as would be expected, more positive emotional content was expressed in the positive than in the negative narratives: RBD group, $t(15) = 13.40$, $p = .000$; LBD group, $t(12) = 7.14$, $p = .000$.

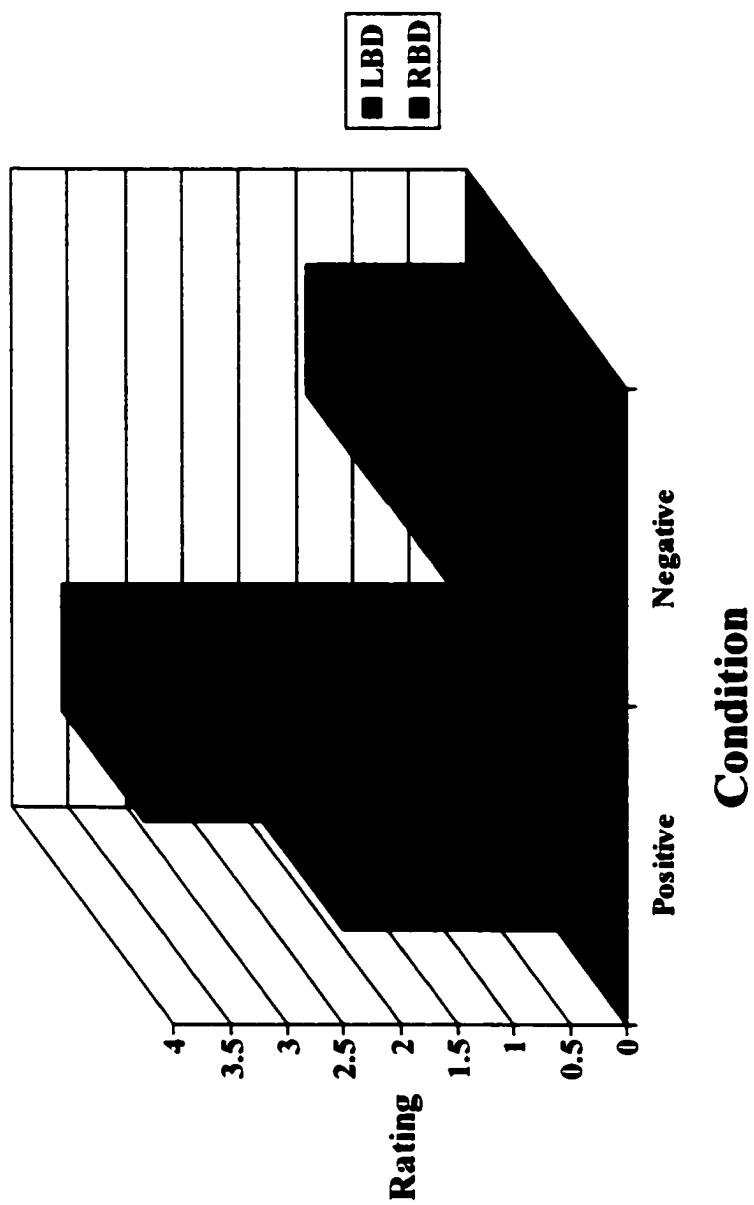


Figure 6. 2 x 2 (Lesion Side x Valence Condition) interaction for positive emotional content.

For the Lesion Site x Valence Condition interaction, no significant differences were obtained when comparing the groups on positive versus negative narratives. However, within a group, both the anteriors, $t(14) = 8.52$, $p = .000$ and posteriors, $t(13) = 8.36$, $p = .000$ expressed more positive emotional content for the positive narratives ($M = 2.88$, 3.30 , $SD = .71$, $.86$, respectively) compared to the negative narratives ($M = 1.42$, 1.37 , $SD = .34$, $.29$, respectively) (see Figure 7).

Turning to the positive emotional intensity rating, a similar configuration of results was obtained: significant main effects of Valence Condition, $F(1,25) = 452.91$, $p = .000$ and Lesion Side, $F(1,25) = 9.34$, $p = .005$, as well as a trend for Lesion Site, $F(1,25) = 2.86$, $p = .103$. Significant interactions for Lesion Side x Valence Condition, $F(1,25) = 18.55$, $p = .000$ and Lesion Site x Valence Condition, $F(1,25) = 14.98$, $p = .001$ were also found. Post-hoc comparisons resulted in the exact same pattern of findings as determined in the analyses of positive emotion content, except for one significant finding. The posterior group ($M = 4.10$, $SD = .83$) elicited a significantly higher degree of positive intensity than the anterior group ($M = 3.52$, $SD = .67$) on the positive narratives, $t(27) = 2.13$, $p = .042$ (see Figure 8).

Negative emotional content and negative emotional intensity ratings. When the negative emotion ratings were subjected to the same three-way ANOVA analyses, a different profile of effects emerged. For the measure of negative emotional content, a significant main effect of Valence Condition occurred, $F(1,25) = 697.74$, $p = .000$. Negative narratives ($M = 3.99$, $SD = .48$) included larger amounts of negative emotional

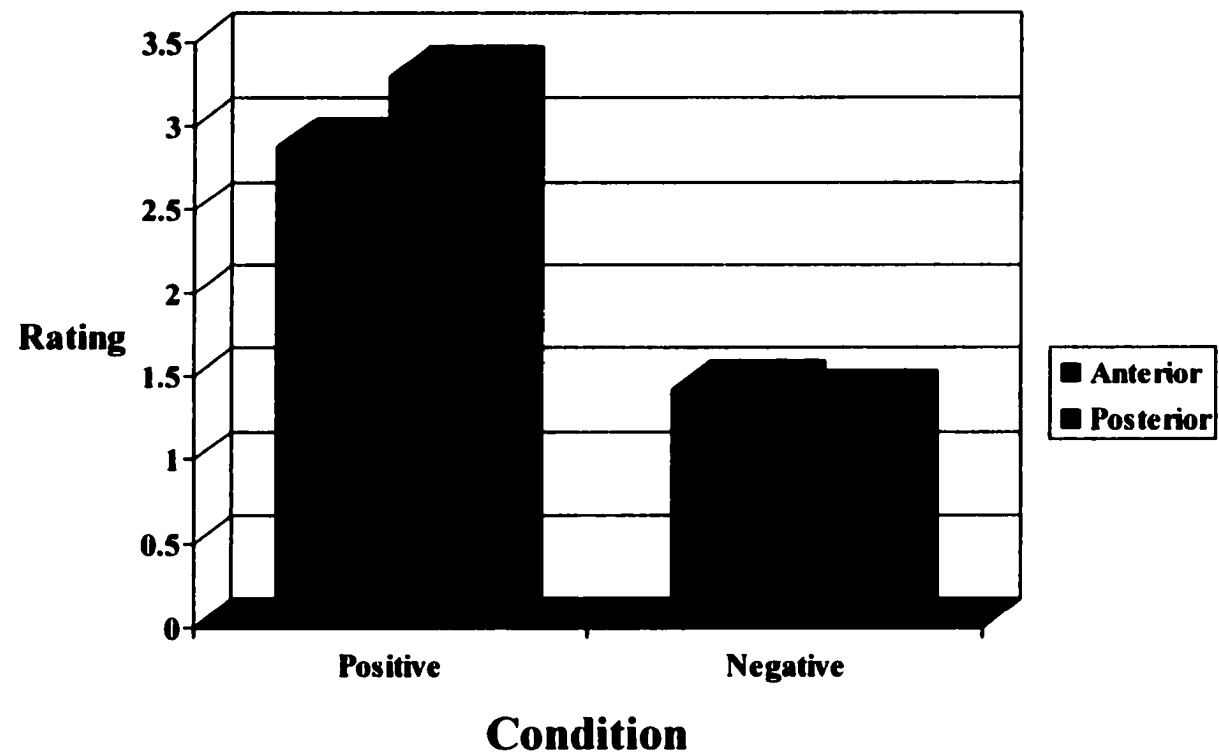


Figure 7. 2 x 2 (Lesion Site x Valence Condition) interaction for positive emotional content.

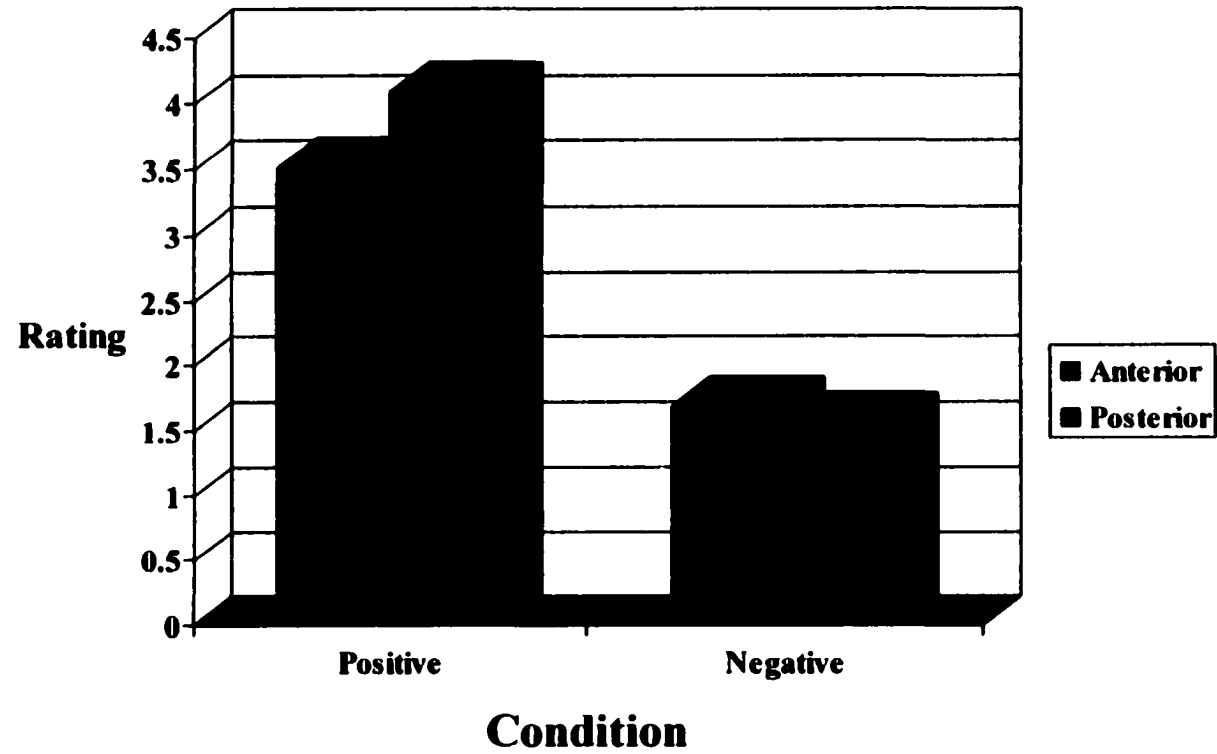


Figure 8. 2 x 2 (Lesion Site x Valence Condition) interaction for positive emotional intensity.

content than positive narratives ($M = 1.73$, $SD = .38$) across all four groups. In contrast to the findings for the positive content ratings, the negative content ratings resulted in a trend for the main effect of Lesion Side, $F(1,25) = 3.28$, $p = .082$, but not for Lesion Site, $F(1,25) = .07$, $p = .799$. The direction for the Lesion Side effect showed that the RBDs ($M = 2.96$, $SD = .38$) expressed more negative emotional content than the LBDs ($M = 2.74$, $SD = .44$).

However, a Lesion Side x Valence Condition interaction, $F(1,25) = 9.18$, $p = .006$, and a Lesion Site x Valence Condition, $F(1,25) = 9.75$, $p = .004$ were significant. Regarding the former interaction, the LBDs produced significantly less negative emotional content on the negative narratives ($M = 3.74$, $SD = .478$) than the RBDs ($M = 4.19$, $SD = .39$). No differences were observed between the groups on the positive narratives. When examining valence comparisons within each group, more content was always produced for the negative narratives compared with the positive narratives: RBD group, $t(15) = 21.49$, $p = .000$ and LBD group, $t(12) = 12.37$, $p = .000$. This is not surprising given the low ratings for the positive narratives.

For the Lesion Site x Valence Condition interaction, no differences occurred when comparing the groups within each level of the Valence Condition. However, within each caudal grouping, negative narratives were always rated as having larger amounts of negative emotional content than the positive narratives (anterior: $M = 3.88$, 1.84 , $SD = .42$, $.43$; posterior: $M = 4.11$, 1.61 , $SD = .52$, $.31$) (see Figure 9).

A similar pattern of effects was noted for the negative emotional intensity

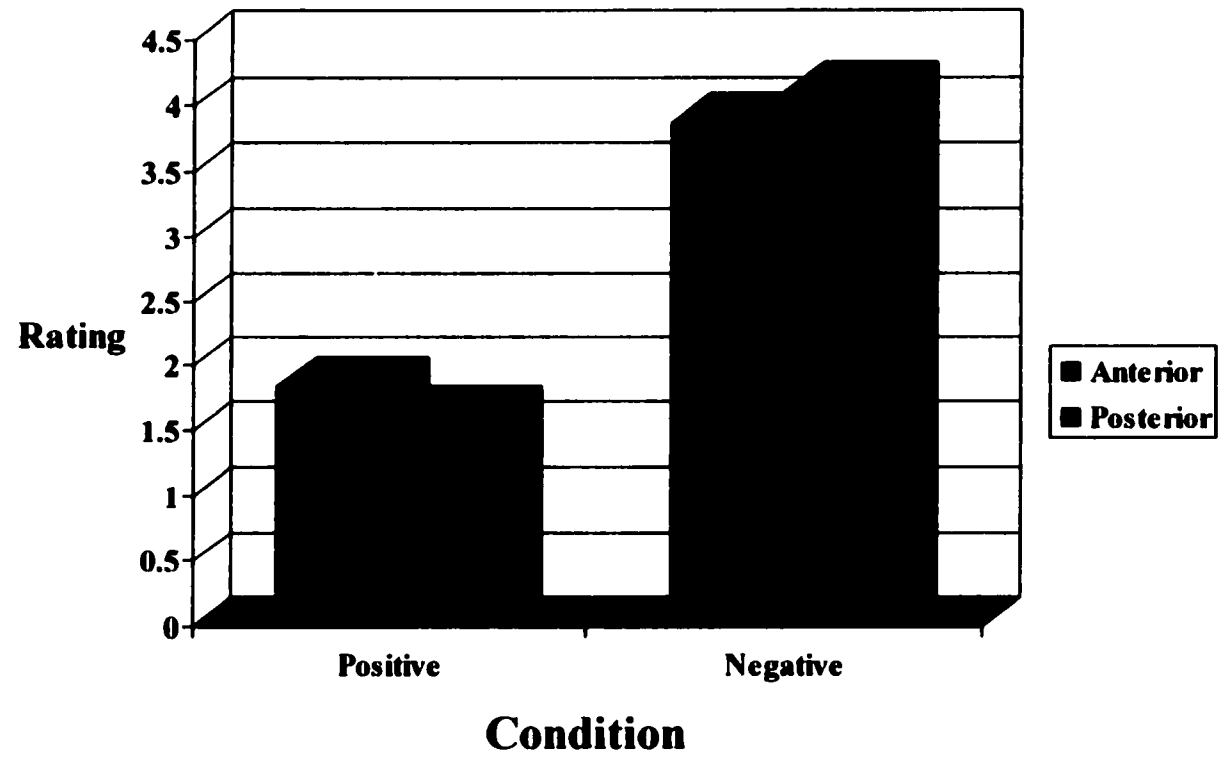


Figure 9. 2 x 2 (Lesion Site x Valence Condition) interaction for negative emotional content.

variable. A significant main effect of Valence Condition was revealed, $F(1,25) = 478.88$, $p = .000$, and the content of the negative narratives ($M = 3.82$, $SD = .47$) was more intense than that of the positive narratives ($M = 1.74$, $SD = .41$). No significant main effects of Lesion Side or Lesion Site were produced. The main effect of Valence Condition was, however, modified by a significant interaction with Lesion Site, $F(1,25) = 10.42$, $p = .003$. A trend occurred for the Lesion Side x Valence Condition interaction, $F(1,25) = 3.44$, $p = .075$.

Follow-up testing of the Lesion Site x Valence Condition interaction revealed that every valence difference within a group was significant at a p -value of .000.

Additionally, when comparing the groups within each level of the valence condition, the posterior group produced significantly, $t(27) = 2.23$, $p = .034$, higher levels of negative emotional intensity than the anterior group for the negative narratives ($M = 4.01$, $SD = .39$ versus $M = 3.65$, $SD = .48$ respectively), but not for the positive narratives ($M = 1.64$, $SD = .39$ versus $M = 1.83$, $SD = .42$ respectively) (see Figure 10).

Gender

To explore the impact of gender on the previously assessed dependent variables, the original 2 (Group: LBD, RBD, HC) x 2 (Emotion or Valence Condition) MANOVA analyses were recomputed including this new between-subjects variable (Gender: men and women). Gender was not introduced into the Lesion Side x Lesion Site x Condition ANOVA analyses, as it would have further subdivided the number of participants in each cell, substantially reducing the sample size and subsequent power. As many of the results

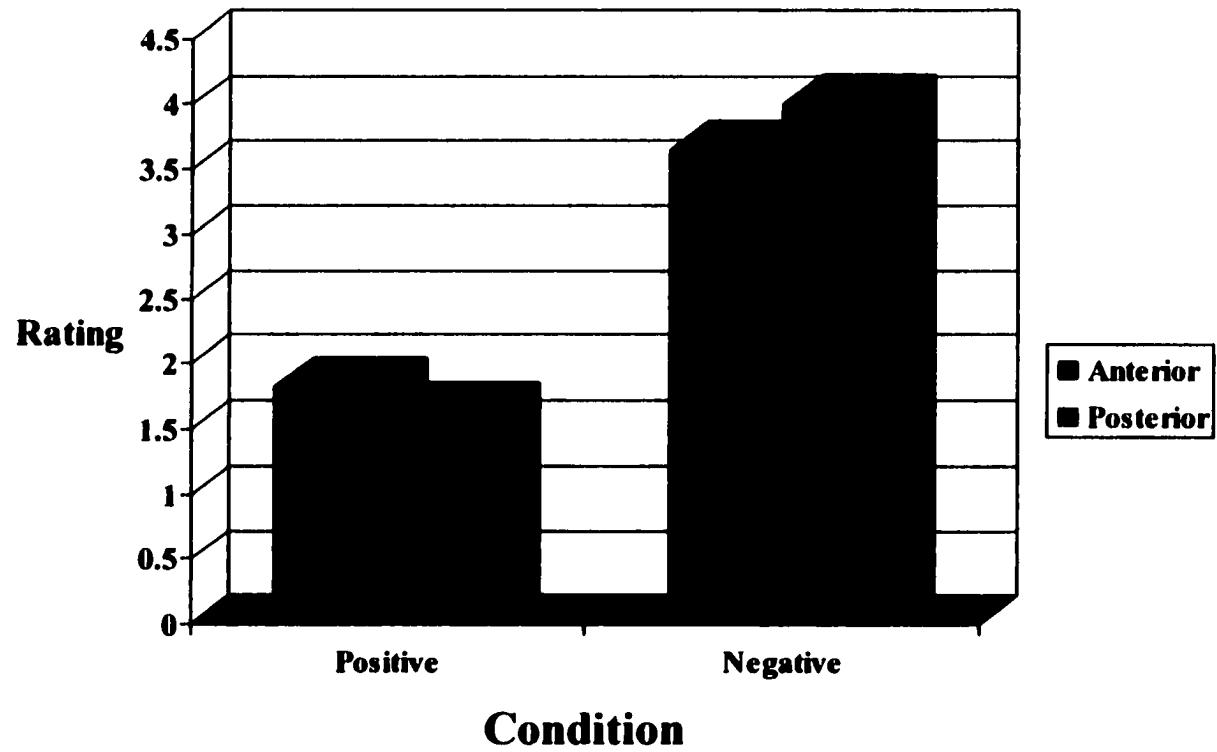


Figure 10. 2 x 2 (Lesion Site x Valence Condition) interaction for negative emotional intensity.

are recapitulated from previously described data, these effects will not be discussed unless significant effects of Gender occurred.

Right-Hemisphere Hypotheses

Accuracy and confidence. No main effects of Gender or related interactions for accuracy or confidence were calculated.

Emotional content and emotional intensity ratings. No main effects or interactions were produced.

Positive emotional content and positive emotional intensity ratings. The main effects of Gender, as well as the two- and three-way interactions at both the multivariate and univariate levels were not significant. No other findings were evidenced.

Negative emotional content and negative emotional intensity ratings. A Gender x Emotion Condition interaction occurred for the combined variables, multivariate $F(2,32) = 7.078, p = .003$. When conducting follow-up analyses on each dependent variable, the interaction was maintained for the negative emotion content rating, univariate $F(1,33) = 6.86, p = .013$, but not for the negative emotional intensity ratings, univariate $F(1,33) = .16, p = .688$. Differences were observed when comparing genders within a condition (see Figure 11). On the emotional narratives, $t(37) = 2.15, p = .037$, women ($M = 4.21, SD = .42$) produced significantly more negative content than men ($M = 3.88, SD = .48$). This group difference was not evidenced for the nonemotional narratives, $t(37) = 1.16, p = .253$. When comparing the emotional and nonemotional narratives within each gender group, men produced more negative content on the emotional ($M = 3.03, SD = .38$) than

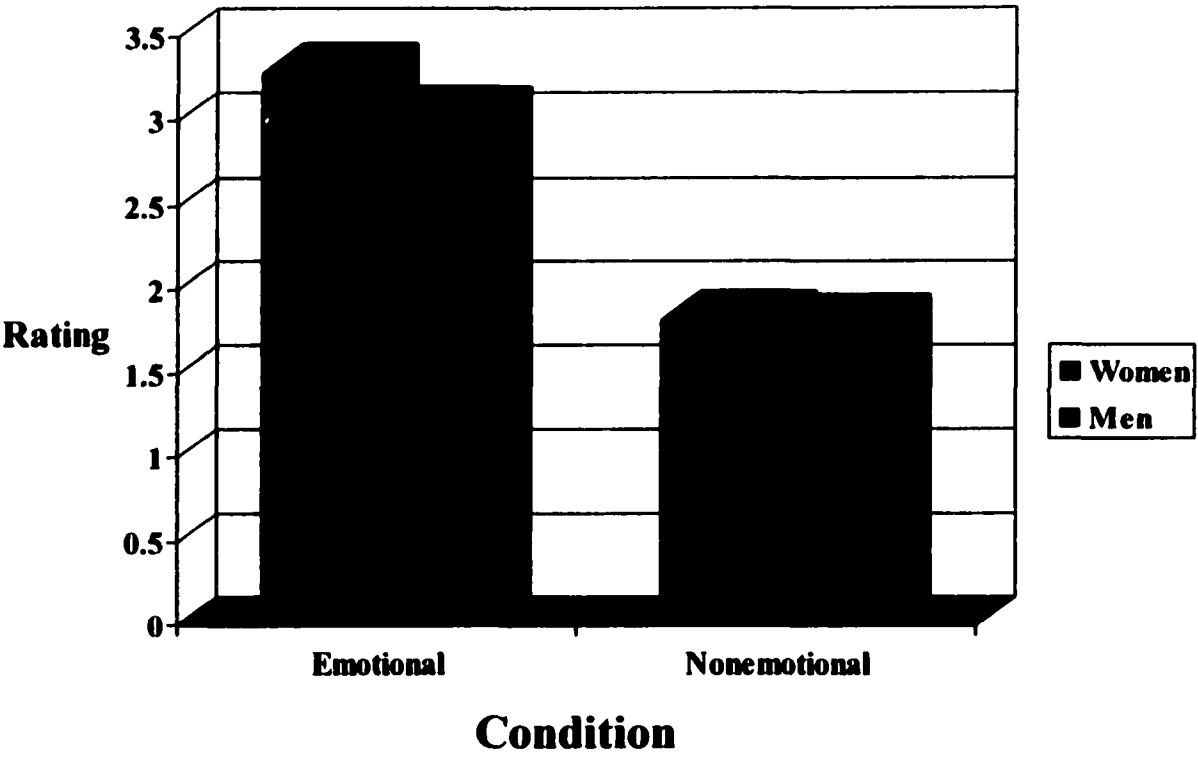


Figure 11. 2 x 2 (Gender x Emotion Condition) interaction for negative emotional content.

the nonemotional narratives ($M = 1.96$, $SD = .41$), $p = .000$. Similarly, women also expressed more content on the emotional narratives ($M = 3.30$, $SD = .33$) compared with the nonemotional narratives ($M = 1.82$, $SD = .47$), $p = .000$

Lastly, a Group x Gender interaction approached significance, multivariate $F(4,64) = 2.12$, $p = .082$. When applying the univariate procedures, however, no significant interaction effects were observed for either dependent variable, content: $F(2,33) = .91$, $p = .41$, intensity: $F(2,33) = 2.40$, $p = .11$.

Valence Hypotheses

Accuracy and confidence. No effects of Gender on the interactions emerged.

Emotional content and emotional intensity ratings. Findings for this MANOVA analysis were nonsignificant regarding Gender. When examining the univariate analyses however, a borderline Gender effect occurred on the content ratings, univariate $F(1,33) = 3.92$, $p = .056$. Further examination of this result revealed women ($M = 4.37$, $SD = .74$) to express more emotional content than men ($M = 3.98$, $SD = .71$) irrespective of narrative type.

Positive emotional content and positive emotional intensity ratings. A $2 \times 2 \times 2$ MANOVA was carried out, but Gender did not play a factor in any of the findings.

Negative emotional content and negative emotional intensity ratings. For this set of multivariate analyses, a significant multivariate main effect of Gender occurred, $F(2,32) = 7.13$, $p = .003$, revealing a significant univariate main effect for the negative emotional content ratings, $F(1,33) = 5.74$, $p = .022$, but not for the negative emotional

intensity ratings, $F(1,33) = .02$, $p = .883$. On these content ratings, females produced larger amounts of negative emotional content ($M = 3.01$, $SD = .43$) compared to males ($M = 2.75$, $SD = .42$).

These effects were modified by a significant multivariate interaction of Group x Gender x Valence Condition, $F(4,64) = 2.78$, $p = .034$. When the dependent variables were examined separately, however, the effect was not maintained: content; univariate, $F(2,33) = .88$, $p = .42$, intensity; univariate, $F(2,33) = .15$, $p = .25$.

Summary of Findings

Experimental Findings

The data revealed that the right-hemisphere hypothesis was not supported, but that cortical damage within the left hemisphere led to the production of less accuracy, less emotional content/intensity, and less positive content/intensity across all narratives (i.e., both emotional and nonemotional). These group differences were not found for the negative content and negative intensity ratings.

Support for the valence hypothesis was equivocal. Partial support for the valence hypothesis was potentially identified, such that the LBD group produced less emotion on the positive content/intensity ratings, but not on the negative content/intensity ratings. Furthermore, the LBDs performed more poorly on positive narratives than on negative narratives.

Damage to the anterior cortex of either hemisphere resulted in reduced emotional content/intensity and reduced positive emotional content/intensity across all narratives,

which is consistent with some findings in the literature (e.g., Wasserman, Borod, & Winnick, 1998). Ratings of negative emotional content/intensity and accuracy/confidence were not influenced.

Methodological Findings

The emotional narratives were always rated as having higher amounts of emotional content and emotional intensity compared with the nonemotional narratives. The nonemotional narratives, however, were found to contain a minimal amount of emotional content and emotional intensity. Additionally, the negative narratives were generally rated as having more emotional content and intensity than the positive narratives.

Second, the negative narratives were generally rated as having more emotional content and more emotional intensity than the positive narratives. In addition, the negative ratings for all stimuli were generally higher than the positive ratings.

Lastly, raters were more confident of their accuracy ratings for the nonemotional narratives than for the emotional narratives.

This set of findings is consistent with previous investigations and provides substantiation for the ecological validity of this study. In light of this evidence, the lack of right-hemisphere and valence effects most likely did not result from a poorly constructed paradigm.

Exploratory Findings

Regarding gender, women produced more negative emotion than men on the

negative emotional content ratings, but not on the negative emotional intensity ratings.

No gender differences were observed for any other set of ratings.

Discussion

The primary goal of this study was to examine whether neuropsychological theories of emotion (i.e., right-hemisphere hypothesis and valence hypothesis) were supported when emotional content and emotional intensity were examined through the production of autobiographical narratives. This investigation also evaluated whether intra- and interhemispheric cortical lesions differentially impacted emotional processes. Second, to assess whether right-hemisphere deficits hampered the production of thematic accuracy on emotional lexical tasks, the variable of accuracy was included. Lastly, the effects of gender on emotional functioning were also assessed.

Primary Findings

The results of this study were as follows: 1) The right-hemisphere hypothesis was not supported, but the data revealed that cortical damage within the left hemisphere led to the production of less accuracy, emotional content/intensity, and positive content/intensity across all narratives (i.e., both emotional and nonemotional). These group differences were not found for the negative content/intensity ratings. 2) Support for the valence hypothesis was not evidenced. Rather left-hemisphere deficits were demonstrated for the same sets of ratings across positive and negative narratives. 3) Damage to anterior cortices resulted in reduced expression of emotional content/intensity and positive emotional content/intensity. Negative emotional content/intensity and accuracy/confidence measures were not influenced. 4) Women produced more negative emotion than men for the negative emotional content ratings, but not for the negative

emotional intensity scale. 5) Emotional narratives were always rated as having higher amounts of emotional content and intensity compared with the nonemotional narratives; however, the nonemotional narratives were found to contain a minimal amount of emotion. 6) Negative narratives were generally rated as having more emotional content and intensity than the positive narratives. 7) Raters were more confident of their accuracy ratings for the nonemotional narratives than for the emotional narratives.

Right-Hemisphere Hypothesis

The right-hemisphere hypothesis was not supported by any finding from the present study. These results are concordant with several studies examining the perception of lexical emotion (Blonder, et al., 1991; Bowers, Coslett, Bauer, Speedie, & Heilman, 1987; Cicone et al., 1980; Lalande, Braun, Charlebois, & Whitaker, 1992; Ostrove, Simpson, & Gardner, 1990). The present findings however, were inconsistent with a number of investigations that have identified right-hemisphere deficits during the expression and experience of emotion, (Bloom et al., 1990, 1992, 1993; Borod et al., 1985; Borod, Rorie, Haywood et al., 1996; Borod, Rorie, Pick, et al., 2000; Cicone et al., 1980; Cimino et al., 1991; DeKosky, Heilman, Bowers, & Valenstein, 1980; Etcoff, 1984; Gardner et al., 1983; Schmitt, Hartje, & Willmes, 1997; Wechsler, 1973).

Somewhat surprising was the fact that findings from the current study revealed left-brain-damaged individuals to exhibit poorer performances on certain rating scales compared with the right-brain-damaged and healthy control groups. This unexpected finding was consistently observed for the accuracy rating, the emotional content/intensity

ratings, and the positive emotional content/intensity ratings, but not for the negative emotional ratings. No group differences were observed for the negative emotional ratings. Although these findings could be construed as partial support for the valence hypothesis, there does not appear to be consistent evidence across the data to support this idea. An alternative interpretation follows.

It is possible that the 3 groups performed differently based on several factors (i.e., residual language deficits in the LBDs and improvement in emotional processing in the RBDs). The unexpected LBD finding may have resulted from residual aphasic symptoms, which led to poorer development of the narrative structures. Studies using similar paradigms have identified left-hemisphere deficits, but always in conjunction with diminished emotional performances in RBD groups. For example, two studies found that in addition to the RBD deficits for emotion, the LBD group produced less verbal output (Borod, Koff, et al., 1985; Cicone et al., 1980). In fact, Borod, Koff et al. (1985) identified their left anterior group as being the most impaired, which is not surprising given that damage to the frontal cortex often results in expressive aphasia. Both of these studies screened for severe language deficits prior to the experimental task, but the authors later recognized that mild aphasic symptoms might have been unaccounted for during testing. Specific explanations concerning why language difficulties may have resulted in the diminished output were limited, and they were not discussed in light of the emotional deficits observed in the RBD group. The implications of such deficits will be discussed in detail below.

Valence Hypothesis

Another objective of the study was to examine whether lexical emotional functioning was operating according to the valence hypothesis: positive emotions mediated by the left hemisphere and negative emotions by the right hemisphere (Davidson, 1984; Silberman & Weingartner, 1986). Although some versions of the hypothesis attribute asymmetrical functions to an entire hemisphere (Davidson, 1984; Ehrlichman, 1987; Silberman & Weingartner, 1986), this study chose to use more recent conceptualizations of the hypothesis (Borod, 1993; Bryden, 1982; Heller 1993; Tucker, Luu, & Pribram, 1995) and examined whether valence was differentiated by anterior cortical pathology.

The findings from this study did not appear to support this conjecture and they did not corroborate existing findings from the handful of studies that examined valence in expressive lexical emotion paradigms. These latter studies have sometimes substantiated the hypothesis via uni- or bilateral findings. These valence effects however, have been observed more consistently in normal individuals than in brain-damaged populations, and mainly in perceptual studies of lexical emotion (Borod et al., 1998; Wexler, Schwartz, Warrenburg, Servis, & Tarlatzis, 1986; Ziehenr & Zenhausem, 1984).

In this study, several of the Lesion Side x Valence Condition interactions showed the LBD group to perform more poorly on the positive emotional content and intensity ratings. More specifically, on both scales, the RBD and HC groups produced more positive emotional content and intensity across the positive narratives compared to the

LBD group. The positive emotion ratings for the negative narratives approached floor effects for all three groups. Although these findings could be used as partial support for the hypothesis, such an argument would be better substantiated had the Lesion Side x Valence Condition been significant for only the positive emotional ratings. This was not the case, as the LBD's performance was also poor across the accuracy and emotional content/intensity ratings.

The question remains as to why these patterns of findings emerged. Several potential explanations are discussed in the sections below.

Months-Post Onset

One possible explanation for why the right-hemisphere and valence hypotheses were not supported may be that the BD groups in this study, compared with other investigations, had more months occurring between the onset of their CVAs and the initiation of the study. The more commonly observed right-hemisphere deficit may reflect a disruption in the expression/experience of emotion soon after a neurological incident, but not later in time. The increased amount of time that accrues prior to an individual being tested may result in recovery of emotional function and subsequently, nonsignificant findings. This would not be surprising, as many cognitive abilities (e.g., language) have been shown to improve within the first two years following a stroke. Concerning language, much of the recovery appears to spontaneously occur within the first 6 months and then plateaus as the years progress (Fazzini, Bachman, & Alpert, 1986; Kertesz, 1993, Pedersen, Jorgensen, Nakayama Raaschou, & Olsen, 1995; Sarno &

Levita, 1979).

Only two investigations to this researcher's knowledge have examined the recovery of emotional functions; both assessed the comprehension of emotion (Egelko et al., 1989; Zgaljardic, Borod, & Sliwinski, 2001). In the Egelko et al. (1989) investigation, several emotional perception tasks were administered at seven weeks and 10 months following CVAs in RBD and LBD patients. The RBD groups improved in their ability to perceive faces depicting emotion, but the LBDs showed no change. The authors noted that this was most likely due to ceiling effects. No improvements were observed on auditory emotional perception tasks. Zgaljardic et al., (2001) examined emotional perception for faces, words, and prosody in RBD, LBD and HC groups across an approximate two-year time span. They found a gender effect, such that emotional recovery in lexical channels occurred for men with right-hemisphere pathology, but not women. This was in contrast to a lack of improvement in facial and prosodic channels for any group.

One way to examine whether functional recovery impacted this investigation would be to compare the MPO for the three groups in this study and those participating in other protocols. Unfortunately, most of the published studies in this domain do not provide information regarding the number of MPO for their BD participants. This makes it difficult to consider whether this factor plays a significant role. There are a few documented data sets, however, that might support this supposition. For example, the participant groups involved in the Borod et al.'s 1996 and 2000 studies of emotional

intensity and features of discourse were tested sooner than this set of participants.

Although their LBD group ($\underline{M}$ = 18.3 months, $\underline{SD}$ = 31.2 months) was fairly similar to ours ($\underline{M}$ = 16.0 months, $\underline{SD}$ = 14.3 months), their RBD group was tested, on average, one year earlier ($\underline{M}$ = 23.0 months, $\underline{SD}$ = 40.2 months) than the individuals in this study ($\underline{M}$ = 38.1 months, $\underline{SD}$ = 41.2 months). This suggests that the cortex may have reorganized or compensated for the emotional deficits by the second year following the stroke.

It could also be hypothesized that if recovery of function were related to time, than the number of MPO would be positively correlated with the level of impairment. In order to assess this factor, correlations between MPO and the experimental variables were examined. This was first run for all the BD participants. No significant correlations emerged and all relationships were minimal (i.e., -.188 to .190). The correlations were then rerun separately for each group. All of the coefficients, but one, were nonsignificant and very weak. The one significant result was found for the LBD group. An inverse relationship was identified for the nonemotional condition on the confidence ratings (coefficient = -.564, p = .045). This finding most likely occurred by chance; however, it is interesting to note that the increased number of MPO was associated with more confidence in the raters' decisions for the nonemotional narratives (see below: confidence). Recall that when the ANOVA analyses were run on the confidence ratings, raters felt surer of their accuracy decisions for the nonemotional narratives compared to the emotional narratives.

Overall, these data did not lend support to the notion that an increased amount of

time following a stroke played a role in the recovery of emotional function.

Cognitive and Metacognitive Factors

Another potential explanation regarding the lack of right-hemisphere and valence effects may be that emotional deficits were masked by the metacognitive and/or linguistic demands of the task. The original goal of the paradigm was to have participants reexperience past emotional events to their fullest capacity. In doing this, they would presumably activate some of the original neural circuitry and subsequent emotion involved in the experience. Yet, it is possible that in asking participants to use higher-order thought and/or language processes, instead of facial and prosodic channels, the cognitive aspects of the task became more salient than the emotional. Several researchers have posited that although processed differently, emotion and cognition cannot be totally separated, and that at any point during a task, one of the functions can take precedence over the other depending on task demands (Barnard & Teasdale, 1991; Gainotti et al., 1993; Lewis, Sullivan & Michaelson, 1984; Leventhal 1984; Robinson, Kubos, Starr, Rao, & Price, 1984; Scherer, 1984, 1994; Zajonc, 1980).

This idea may be better understood by examining lateralization theory. Unilateral specialization models posit that only one hemisphere can engage in a specific process (i.e., language) or subprocess (i.e., phonetics) irrespective of the other hemisphere's properties and capabilities (Allen 1983; Dax 1865; Kinsbourne, 1974). Some of the unilateral models also propose that although each hemisphere has the capacity to perform a function, only one hemisphere can actually support the underlying process due to

evolutionary determined information processing systems (Gainotti et al., 1993; Tucker, 1981, 1986).

To complicate this matter, the execution of higher-order cognitive (i.e., metacognitive) tasks seemingly activates bihemispheric processes and subprocesses, which are differentially mediated by complex intra and interhemispheric neural systems (Alexander, Benson, & Stuss, 1989; Allen, 1983; Joannette et al., 1990). Such models are often termed “cooperative” or “parallel” in that the two hemispheres process various aspects of a task simultaneously, but independent of each other. Eventually, each piece of information is pooled into the final stage of output, which in this study occurred at the level of language.

Based on these models, one needs to consider whether these findings were generated by the demands of the task, defects in the final outcome measure, language, and/or disruption in emotion processes. The left-hemisphere effect found in both the right-hemisphere and valence analyses would more likely reflect disruptions in expressive language output or task demands, but not in emotion. If the neural lesions had disrupted emotional processes, then a specific pattern of results would have occurred for only the emotional ratings and not the overall accuracy scores. This was not the case, as the left-hemisphere deficit was observed in all but the negative emotional ratings (see below). This LBD deficit may then have resulted from either a disruption in general left-hemisphere information processing systems or a specific language deficit. Tucker's (1986, 1981) explanation that the left hemisphere is superior in processing analytical,

controlled, and propositional information would support such a perspective.

Recall that when analyzing group performances on the accuracy scale, the LBD group produced less accurate narratives than those of the RBD and NC groups. This was somewhat surprising as there is evidence suggesting that right-hemisphere lesions interrupt the thematic structure and overall integrity of discourse (Borod et al., 2000; Foldi et al., 1983; Joannette et al., 1990). To assess whether the low accuracy scores of the LBD group masked poorer emotional functioning, the primary analyses were rerun controlling for the accuracy measure. After the statistics were recomputed, the findings remained the same. This indicates that the diminished accuracy ratings did not account for the lack of right-hemisphere or valence effects. They also suggest that the left-hemisphere effect was not due to group differences in accuracy, but more likely to language deficits.

Potential Language Deficits

As left-hemisphere pathology is linked to microstructural deficits in language, we chose to further examine whether any of our language measures (i.e., fluency, word count, and aphasia) shaped the resultant emotion findings.

Fluency. The left-hemisphere group may have experienced problems with the production of language at the level of the sentence (e.g., syntax, word selection, and fluency). The LBD group and the anterior group, in certain instances, performed more poorly on the word fluency tasks compared with the NCs and sometimes with the RBDs. If such difficulties adversely influenced the LBDs' ability to formulate and produce

meaningful lexical materials linked to the task demands, the raters would perceive their narratives as less accurate and less emotional.

Recall that few significant correlations emerged when comparing the combined scores of the BD groups to the screening measures. However, the majority of the significant coefficients were related to either measures of fluency and/or the BDAE subtests. To examine whether a higher number of such correlations was observed for the LBD group, the coefficients were recomputed for each BD group separately. For the RBD group, one significant coefficient emerged (FAS x negative emotional content for the nonemotional narratives: $r = -.536$, $p = .032$). For the LBDs, only three significant coefficients were obtained (FAS x negative emotional content for the emotional narratives, $r = -.597$, $p = .031$; FAS x positive emotional intensity for the negative narratives, $r = -.612$, $p = .026$; Animal Naming x negative emotional intensity for the emotional narratives $r = .587$, $p = .035$). These findings most likely occurred by chance, but to explore whether group differences in language expression affected emotion functioning, the primary analyses for Emotion and Valence Conditions were recomputed, controlling for both fluency variables. This was done for both Lesion Side and Lesion Site. It was understood that by adding these variables on a post-hoc basis, the power of the analyses was drastically reduced. Interestingly, no significant findings were obtained, suggesting that the fluency variables did not account for a significant portion of the variance.

Word Count. Another approach to examining fluency would be to look at the total number of words each group generated. Although the groups did not differ when

comparing counts across intra- or interhemispheric lesion sites, differences may have occurred in the number of meaningful units or types of tokens (i.e., words) produced. A few narratives from each group were randomly selected and informally examined for the presence of word repetitions, incomplete or illogical phrases, interjections, and fillers ("um"), among other atypical utterances lacking in meaningful content. Many of the narratives in the BD groups appeared to have more of these items than the healthy controls, but it was not clearly apparent that differences occurred between the two BD groups. If the LBD group produced an increased number of these items, a breakdown in meaningful language may have resulted and subsequently, diminished amounts and intensities of accuracy and emotional content/intensity. Such a hypothesis would have to be explored in future studies by computing the type and number of tokens occurring in each narrative and then reanalyzing the data accounting for these measures. If this supposition were correct, the LBD group would presumably have produced more semantically void language than the RBD and HC groups. This explanation seems plausible as such deficits (e.g., simplified complexity, content, and length) are commonly associated with various types of aphasia (Alexander et al., 1989; Berko-Gleason et al., 1980; Ulatowska, North, & Macaluso-Haynes, 1981; Ulatowska, Freedman-Stern, Doyel, Macakuso-Haynes, & North, 1983).

Residual aphasic symptoms. One last approach to understanding the LBD deficit was to examine whether the presence of residual aphasic symptoms impacted the findings. Remember that some of the LBDs in this study presented with a history of

aphasia and/or mild aphasic symptoms at the time of testing. At the beginning of the study, attempts were made to obviate this potential problem by using several measures to screen for severe to moderate aphasia. As the investigation was only concerned with the presence of severe/moderate aphasia, mild language deficits were not fully assessed diagnostically. This left the possibility that it was the confluence of remaining aphasic symptoms in some of the participants, which contributed to the present findings.

In an effort to better identify the presence of remaining symptoms in the LBD participants, they were contacted after the study was completed and asked to return for more thorough language testing. Those individuals who returned were administered the complete BDAE and an abbreviated Boston Naming Test. Eleven of the original 13 participants in this study were reevaluated. Two were unable to return. Based on this testing, seven of the remaining 11 participants continued to present with a mild residual aphasia, in addition to their history of more significant aphasia (see Table 6: this protocol was developed for the larger study). The four remaining participants achieved scores within normal limits on all the tasks, suggesting that no aphasic symptoms were present at the time of testing. For the two individuals who did not return, medical records and testing observations were used to help determine the extent of any language deficit present at the time of the initial testing. Using all this information, it was not possible to divide the LBDs into diagnostic groups (i.e., type of aphasia) following clinical standards. It was possible however, to equally divide the groups into individuals presenting with mild residual aphasic symptoms ($N = 7$) compared to those without ($N = 6$).

Two (Emotion Condition: emotion/nonemotion) x 2 (Aphasia Group: no current symptoms/mild residual symptoms) mixed-factorial ANOVAs were calculated using each of the eight rating scales. For accuracy, confidence, negative emotional content, and negative emotional intensity, all findings were nonsignificant. Significant main effects for Aphasia Group were obtained for the following ratings: emotional content, $F(1,11) = 6.23, p = .03$; emotional intensity, $F(1,11) = 8.57, p = .01$; positive emotional content, $F(1,11) = 23.84, p = .000$ and positive emotional intensity, $F(1,11) = 14.84, p = .003$. For the significant findings, the participants with no history of aphasia always scored higher on the content or intensity ratings than those with aphasia. No significant interactions emerged.

Next, eight additional 2 x 2 ANOVAs were calculated using Valence Condition instead of Emotion Condition. Although most effects paralleled the previous set of analyses, the pattern of findings was somewhat different. Again nonsignificant findings were observed for accuracy, confidence, and negative emotional intensity. Trends for the main effect of Aphasia Group were identified for the following variables: emotional intensity, $F(1,11) = 3.94, p = .07$; positive emotional content, $F(1,11) = 3.47, p = .09$; and positive emotional intensity, $F(1,11) = 3.54, p = .09$. For these findings, those individuals without residual aphasia symptoms performed better than those with language difficulties. For negative emotional content, a significant main effect for Aphasia Group was observed, $F(1,11) = 4.88, p = .05$, with the nonaphasic group ($M = 2.71, S.D. = .52$) producing more content than the aphasic group ($M = 2.45, S.D. = .23$).

Although the main effect of Condition did not emerge, a significant interaction resulted for the Aphasia Group x Valence Condition on the emotional content rating, $F(1,11) = 5.79, p = .035$. This is interesting, because the main effect of Aphasia Group was nonsignificant. When post-hoc comparisons were calculated comparing the two conditions within each group, the findings for the nonaphasic group were nonsignificant $t(11) = 1.12, p = .32$, but were significant for the mild aphasic group, $t(11) = 4.04, p = .01$, such that they performed better on the negative than the positive narratives. On the positive narratives, the groups did not differ from each other, $t(11) = .16, p = .87$; however, for the negative narratives, group comparisons were significant, $t(11) = 3.28, p = .01$ revealing that the nonaphasic group ($M = 4.14, S.D. = .66$) performed better than the aphasic group.

Additional 2 (Aphasia Group) x 2 (Lesions Site) x 2 (Condition) ANOVAs were calculated for each rating scale within the Emotion, as well as the Valence Conditions. No main effects of Lesion Site or interactions emerged.

The pattern of findings for Aphasia Group paralleled those for the primary analyses, suggesting that the presence of mild aphasia symptoms affected the LBDs' ability to produce narratives that included emotional, as well as positive emotional content and intensity. However, the residual symptoms did not appear to affect accuracy, confidence, or negative emotional ratings.

These findings indicate that some form of a language deficit may have contributed to the primary LBD findings, but not for negative emotion. It is interesting that the

negative emotional content and intensity measures were the only scales on which the LBD deficit, as well as much of the aphasic groups' difficulties were not observed. This may have resulted from a facilitation effect.

Potential Facilitation Effects

A number of investigations have demonstrated that emotional content can facilitate disrupted language processes (i.e., reading, repeating, and writing single words) in aphasic individuals with left brain-damage (Landis, Graves, & Goodglass, 1982; Ramsberger, 1996; Reuterskiold, 1991; Roeltgen, Sevush, & Heilman, 1983). Mechanisms underlying this effect have been attributed to a number of factors (e.g., higher levels of physiological arousal and increased saliency of the stimuli). No single factor however, has been consistently supported across different investigations.

Recent studies have observed this facilitation effect in paradigms examining lexical emotion perception (Cicero et al., 1999) and lexical emotion expression (Bloom et al., 1993; Borod, et al., 2000). In the Borod et al. (2000) study, facilitation effects occurred only for positive materials. Interestingly, in the Cicero et al. (1999) investigation, the facilitation effect occurred in a subgroup of LBD participants who only had language deficits as identified on a complex sentence identification task. The authors suggested that the more demanding the language task, the more likely a facilitation effect might occur. This seems plausible given that those individuals who have had several months of language recovery would demonstrate residual deficits in more complex language tasks.

In the present study, the main effects of Valence Condition revealed that the negative narratives were rated with more emotional content/intensity than the positive narratives across all ratings. Additionally, the negative emotional content/intensity ratings tended to be higher than the positive emotional content/intensity measures, irrespective of narrative type. It is possible that the increased levels of negative emotion resulted in a more salient emotional experience, which aided the LBD group in expressing emotional language and thereby obviated the condition effect. A body of literature indicates that the production of negative emotion is associated with greater activation, arousal, expression, and feeling than that produced by positive emotion.

In addition to generating higher levels of arousal, facilitation effects also appear to be driven by the valence of the materials and the type of representations/memories used in a paradigm. For example, in normals, more negative, than positive events have been remembered during the recollection of affective terms (MacLeod & Matthews, 1991; Williams, 1988). This has also been evidenced in studies involving personal memories (Scherer & Tannenbaum, 1986; Thomas & Diener, 1990). In contrast, some studies have found that positively valenced linguistic materials (e.g., words) are better remembered than negative materials (Ali & Cimino, 1996; Strauss, 1983). These differences appear to result from whether a task includes self-referential/episodic (more intense negative experiences) memories compared to semantic memories (more intense positive experiences)(Blaney, 1986). Although the memory components of the current study are not discussed in-depth, the autobiographical/self-referential nature of the task may have

contributed to the observed effect for negative emotion.

Bower (1981) constructed a cognitive viewpoint of emotion and memory that provides a theoretical basis for why such facilitation occurs. Bower's schema is framed within an association network theory. Discrete emotional memories are regarded as having emotional representations/units (or what is often termed a "node") in memory stores that are linked to various perceptual and cognitive codes, which are developed during the experience of an event. When an emotional event occurs, related mental and verbal propositions are also developed and encoded into the network. Additional propositions or nodes may be incorporated into the network upon future recall.

Following the activation of a specific node, any elements (i.e., autonomic arousal, perceptual elements, or subjective feelings) which were experienced during the original encoding of the event have an increased likelihood of being activated and thus recalled. If, however, the threshold of a unit is not exceeded or the links among the nodes are weak, activation of the emotional episode may not begin or incomplete recall may occur.

In this study, as no interactions were evidenced between the Emotion/Valence Condition and Lesion Side or Lesion Site, it is possible that the demands of the task (i.e., recall of autobiographical memories) did not sufficiently activate emotional pathways (e.g., arousal and memory stores). Thus, support for the right-hemisphere or valence hypotheses was not evidenced. The activation of negative emotional states and/or topics did exceed thresholds however, which led to the facilitation of the mild language deficits. It would be interesting if future studies examined whether a facilitation effect could be

manipulated based on the type of valence and dependent measures used in a paradigm, as well as the level of arousal.

Intrahemispheric Effects

Several effects of Lesion Site emerged when intrahemispheric lesion site was included in the analyses described above. The analyses that were calculated to explore this issue excluded the HC group and then divided the remaining participants based on the anterior or posterior location of their lesions. Recall that the anterior group included those individuals with pure anterior lesions, as well as anterior plus posterior lesions. This latter category was added due to the great difficulty in finding LBD individuals with anterior lesions who did not have frank aphasia or who were unable to complete the screening tasks due to significant cognitive impairments.

Main effects of caudality were only observed for the emotional and positive emotional content and intensity ratings, but not for the negative emotional ratings. Regarding the right hemisphere hypothesis analyses, the data revealed that the posterior group performed better on the ratings of emotion and positive emotion than did the anterior group. However, when similar analyses were applied to the valence hypothesis, main effects of caudality were observed only for the positive emotion ratings, showing the same posterior superiority. The main effects for the Valence Condition were modified by a Valence Condition x Lesion Site interaction.

These findings are somewhat concordant with studies of emotional expression via nonverbal channels (i.e., face; for review, see Borod, 1993) (posed expression: Kolb &

Taylor, 1990; Weddell, Miller, & Trevarthen, 1990; spontaneous expression: Kolb & Milner, 1981; Weddell, Trevarthen, & Miller, 1988) which have also found decreased expressive abilities in individuals with anterior compared to posterior lesions. Posterior participants involved in a single study of lexical emotional perception, which assessed emotional memory for words and sentences, also performed better than their anterior counterparts (Wasserman, Borod, & Winnick, 1998). A number of studies, however, have not reported such caudality effects when investigating the perception and expression of lexical emotion (Bloom et al., 1992, 1993; Borod, et al., 1985, 1996, 2000; Cimino et al., 1991).

Is it possible that this posterior advantage is linked specifically to emotional functioning? This question is difficult to answer, as the frontal cortex is believed important in the regulation of sequencing, drive, control, emotion, and self-analysis operations (Alexander et al., 1989; Davidson, 2000; Heilman & Gilmore, 1998). These neural areas seem to be convergence zones for information, which is processed throughout other areas of the brain (Allman, Hakeem, Erwin, Nimchinsky, & Hof, 2001; Davidson, 1992, 1993) and transferred to prefrontal areas for expression and self-regulation (Davidson & Irwin, 1999; Heller 1990, 1993). Based on the numerous activities related to the anterior cortices and the structure of the present methodology, it would be difficult to provide an interpretation concerning what the data specifically reflect.

One potential confound that can be examined, however is the estimated size of the

lesions. The extent of neural damage in the anterior groups may have been much greater than those with only anterior or posterior lesions, because the former group included some participants with lesions in both quadrants. It is possible that the greater amount of damaged cortex led to more impairment in producing the narratives; however, there are two caveats to this. First, when the participant performances were compared for those individuals with anterior only and anterior plus posterior lesions, mean scores were not greatly different via observation. Second, the anterior deficits occurred only for emotional and positive emotional content/ intensity ratings and not for negative ratings. The lack of findings for the negative emotional ratings may reflect some qualitative differences in how the brain processes valenced emotion and/or the potential facilitation effects.

Gender

Regarding the impact of gender on emotional functioning, there were limited findings. When the Group x Gender x Condition (Emotion or Valence) MANOVAs were conducted, a Gender x Emotion Condition interaction was evidenced only for the negative emotional content rating. Women produced significantly more negative emotional content than did men in the emotional condition. A main effect of Gender was also identified in the Valence Condition on the emotional content and negative emotional content ratings. These findings suggest that women produced more content across both the negative and positive narratives than men.

These data are consistent with other studies, which show women producing more

intense emotional experiences and emotional expressions than men (Grossman & Wood, 1993; Lang et al., 1993; Larsen & Diener, 1987). Women have also demonstrated better abilities in decoding the expression of others (Brody & Hall, 1993; Hall, 1978). Although valence has rarely been examined in these studies, a few investigations suggest that women process valenced stimuli better than men do (Grossman & Wood, 1993; Lang et al., 1993). Most of these studies, however, have examined facial, not lexical emotion.

Why did gender differences not emerge for the other ratings or for the negative emotional intensity ratings? Within the literature examining gender and emotion, one of the more consistent findings is that women report fear more intensely and frequently than most other emotions (Dillon, Wolf, & Katz, 1985; Gullone, 2000; Highlen & Johnston, 1979). This advantage has also been shown for sadness (Asthana & Mandal, 1998). In the current study, gender differences for negative emotional content may have reflected the female predisposition to experience increased negative emotion. For the negative intensity measure, levels of negative emotion may not have been high enough to elicit gender-based expressive differences.

General Findings Related to the Emotion Condition

Recall that the main effects of Emotion Condition revealed that participants expressed more emotional content and intensity for the emotional narratives compared with the nonemotional. Overall, the nonemotional narratives contained some amount of emotionality indicating that the elicitation of personal experiences cannot be viewed as purely nonemotional. This is consistent with several studies of lexical production, which

were assumably nonemotional, but contained minimal emotional content (Borod et al., 1996; Cimino et al., 1991). Although there was some emotion present in the nonemotional narratives in the aforementioned studies, it was clearly small enough that differences in emotional functioning could still be elucidated.

General Findings Related to the Confidence Rating

On the confidence rating, nonemotional narratives were rated with higher confidence than the emotional narratives. This is not surprising as the nonemotional memories require more types of procedural knowledge (i.e., watching TV, going shopping) than do emotional memories, which are generally self-referential. Since the mean accuracy scores, as well as the ICCs, were high, the variability in the confidence scores most likely was due to the experiences of the raters when judging the materials. The average rater was likely to feel more comfortable in judging the accuracy of nonemotional themes, because these daily routines are generally comparable among people. This is in opposition to an emotional event, which could include any number of referents; many unfamiliar to the rater. Furthermore, when evaluating emotional events, raters' reactions may have been biased by personality traits.

Conclusions and Future Directions

The results from this examination of emotional content and intensity through an expressive lexical modality, did not support the right-hemisphere or valence hypotheses. A left-hemisphere deficit, however, did occur for ratings of accuracy, general emotion, and positive emotion, but not negative emotion. This may have occurred for several

reasons.

First, the absence of right-hemisphere and valence effects may have been related to the fact that emotional functions in the RBD group had begun to recover with time, leading to less observable deficits. As only two studies have examined recovery of emotional processes (i.e., perception) however, it is difficult to elaborate on this supposition. One approach to discerning such factors would be to identify and assess participants soon after a CVA occurs and then to chart their progress over time. Having complete MRI or CAT scans on each participant would also allow for more specific identification of lesion size and location. Such knowledge may help to better match subjects, as well as chart their recovery.

Second, the left-hemisphere findings may potentially reflect language deficits at the level of the word, sentence, or narrative. Although quantitatively, word fluency and total number of words did not appear to contribute variance to the group findings, qualitative differences may have been present (e.g., the number of nonmeaningful words or utterances). This would have led to the production of narratives, which were perceived by raters as being less thematically intact and thereby less emotional. To identify whether these factors actually played a role, future studies would need to conduct specific linguistic analyses at the levels of word, sentence, and discourse.

The continued presence of residual language deficits may have potentially resulted in the LBD group's performance. The data from the LBDs were reexamined accounting for those participants with and without mild residual language deficits. Individuals with

continued difficulties were found to perform more poorly on the ratings than those without language deficits. It is interesting that this left-hemisphere deficit was not observed for the negative emotional ratings. Since the overall ratings for negative emotion and the negative narratives were higher than the other scales, it is possible that negative emotion facilitated language functioning in the left-hemisphere group. This effect of emotion (e.g., increased arousal or saliency of stimuli) on language is sometimes termed the facilitation effect.

One way this effect could be investigated more closely would be to examine the expression of lexical emotion using one basic negative emotion (e.g., fear or disgust) and one basic positive emotion (e.g., happy) that involve maximal arousal or intensity. It is possible that in using the average performance across the five negative emotions (varying in degree of intensity), valence and facilitation effects were masked or neutralized in the current study.

The validity of a facilitation effect also has several clinical and rehabilitative implications. Clinically, these findings suggest that it would be important for professionals to assess lexical emotional deficits in individuals with neural damage. Such findings should then be shared with their families, caretakers, and medical professionals. If an increased understanding of emotional deficits can be imparted to these individuals, many of the oversights or confusions, which occur in working with such patients, might be avoided (e.g., perceptions that the patient presents little emotion except when they are upset).

Having this knowledge would also prove helpful in formulating specific rehabilitation goals and charting recovery of function. For example, one rehabilitation goal for brain-damaged individuals is to stimulate neural systems that aid in the recovery or compensation of cognitive/emotional processes. If the arousal or saliency underlying negative emotions indeed facilitates language production, clinicians may want to find ways to utilize either negative emotions or the underlying processes to aid in treatment. For example, individuals with strokes often seem to focus on the negative aspects of their lives rather than the positive. Caregivers and medical professionals acknowledge these difficulties, but often attribute them to personality states or traits. However, if negative or highly intense emotions were easier to express than positive or low intensity emotions, then stroke patients would require specific help in developing their ability to express the latter types of emotions. Several researchers have suggested that the use of emotionally based communication and socialization activities (e.g., talking about personal experiences) may help to foster language in individuals with aphasia (Barr, 1988; Bloom et al., 1993; Lawton, 1991; Lyons, 1989).

Future research could study this by examining the factors (e.g., arousal and experienced emotional intensity) believed to underlie facilitation effects. Again, these investigators may also want to consider using one or two basic emotions instead of several examples to potentially provide a clearer picture of the data. Lastly, conducting in-depth diagnostic language assessments when screening participants may help to identify whether language deficits interfere with the ability to express emotion. Taken

together, the data from such protocols might help to elucidate how emotional processes interact with language functions.

Several additional isolated findings were also identified during this study. When caudality was examined, both the right and left anterior groups performed more poorly on the emotional and positive emotional scales, but not the negative ratings. This may have occurred for similar reasons discussed above, or reflected disruption in the processing of complex information, irrespective of emotional content. Although the inclusion of anterior plus posterior lesions did not appear to contribute to these findings, future studies may want to include a pure anterior group to help determine the effects of these more localized lesions.

Although more emotion was elicited for the emotional narratives, the nonemotional narratives contained minimal amount of emotional content and intensity. This finding has been identified in several other studies and did not appear to affect the results described above.

Finally, minimal effects were elicited when Gender was added to the analyses. Within the negative ratings, women were observed to produce more negative emotional content than men. This is in accordance with studies that have demonstrated that women process negative emotions better than men. To examine these issues more in-depth, future studies would most likely want to include larger sample sizes, which contained equal numbers of males and females.

Appendix A

Narrative Examples

Anger

LBD participant. On August 1st, 19XX I telephoned XXX XXX to arrange for a vacation and I told them I'd like to travel from N.Y. to Orlando. I told her what days I would leave. It was on a Sunday towards the end of august and return on Friday. So she made the arrangements and she asked, "would you like a window seat?" And I said, "yes." And she said, "which hotel do you want to stay in?" And I said, "the dolphin." And at the end she said, which of course she had many people plus myself...and she said, "ah, how will you pay for it?" And I said, "ah, my visa card." So I gave her the number and the expiration date. So that's the end of the conversation. And it was about ten days before departure date. I didn't receive the tickets or the boarding passes or anything. So it was about ten days. I called TWA and I gave them the ah...it's like a reservation number. And I said, "when am I gonna get these tickets?" And she puts me on hold and she said, "oh, you're canceled." And I said, "what?" My red was so red like a tomato. Said, "what do you mean canceled?" She said, "you didn't pay for it." I said, "wait a minute, let's start again shall we?" I said, " we made the reservation on August 1st and I gave her all the information. The day of departure, the day of return, which hotel, the times. And she put me on hold a couple of times. And so what happened to the money. I said, "well you tell me, because I used the credit card." So after a while she called back and said, "ah we'll do something about it for ya." So they said, OK." They have the flight numbers; departure dates were all confirmed. But then she said, "no, the hotel is not available anymore." And at that time, I said ah, since I'm canceled, I will stay canceled. So I hung up the phone and I was so very upset about it.

Watched TV

RBD Participant. The last time I watched TV was uh, uh Tuesday night and my wife uh, uh, was ironing and uh we had the television on in the uh, uh, kitchen. And it was a program...shall I tell about the program? Uh, uh, (C - Yep.) Program about um an English uh, fellow uh, uh, going across ah, Africa. And uh started out uh, uh, by train, and uh the...the train had people riding on top off it uh, uh. And uh it was an unbelievable but...but s...sort of a fun uh, uh, kind of a thing, but then when they got to the end of end of the railroad uh, uh, they were heading toward Ethiopia, and they came into the Sudan and uh, uh, uh that country is so desolate. And uh there were uh, uh, uh robbers out there. They're worrying uh, that they had to have papers to get from one place to uh, uh, another and uh, they finally uh, changed to uh, uh, uh...they got trapped in one city. They couldn't get permits to leave uh, uh, and they finally got a permit to leave. And uh they...they got uh, uh, uh into terrible mud, the buses uh, uh, all got stuck and uh, uh, it took 'em hours. They were supposed to meet another caravan of trucks to get 'em out of there uh, uh. They missed that caravan. It was...it was just a horrible experience. But it's uh, uh, not that easy to go across Africa I guess. (C - A little bit more.) And uh, uh, uh, it's to be continued next time but they did arrive uh, uh, uh, to the uh, western border of Ethiopia, uh, uh, and that's where they left us and uh apparently the worst is ahead uh, uh, because uh, that's where there quite a few uh, uh, uh, uh, uh, terror lords or whatever they call 'em, and there...there uh, uh, things to worry about. Got robbed and everything. The robbers uh, uh, just have realize that they didn't have anything with them, and ah, they were at their mercy uh, uh. They went by camel part of the way. And uh, that part of world, uh, uh...what impressed me was that that part of world is...is so un...uh, uh, almost uninhabitable and the poor people who live there, and there are thousands of 'em who live in that part uh, uh, of the world, and they starve. And they just about make uh...just earn a living uh, uh. And it makes you thankful that we live here in America. Uh, uh.

Went for a Walk

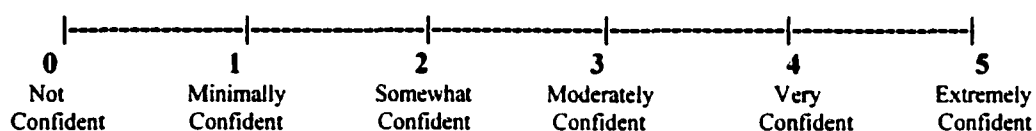
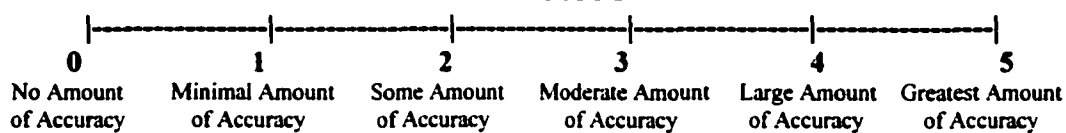
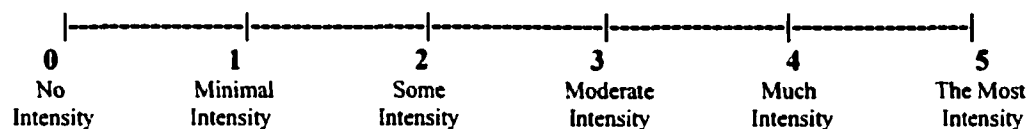
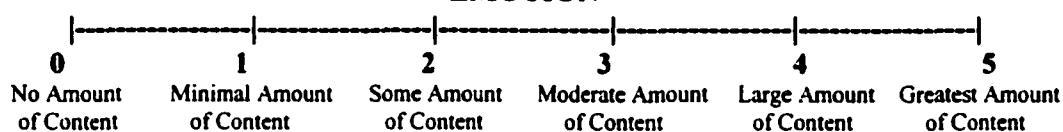
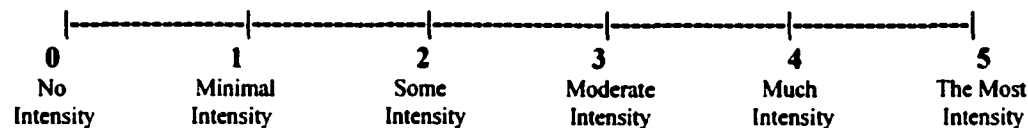
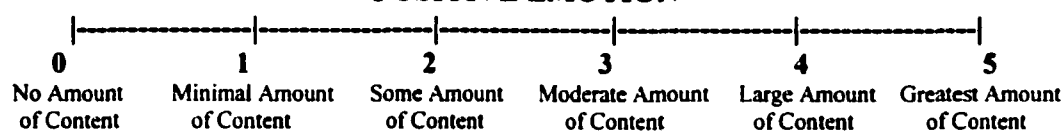
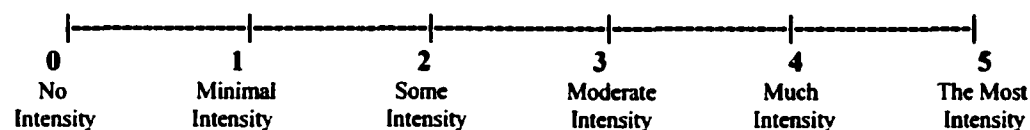
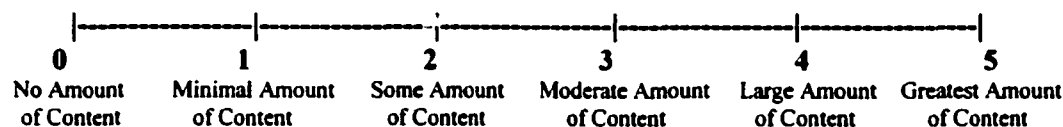
HC participant. Ok. I'm a walker and I really overdue it because I'm trying to...I have a lack of... deficiency, iron deficiency. So I tire easily. So until I get that built up, I really shouldn't be doing as much walking as I do. But I'm a walker and if I once get out of the house, which is everyday, I take off and I just keep going. So I had taken two blouses downtown, Essex St., for alteration and then decided I needed some buttons to go with one. So the shopper start out. Um, I walked. I told my neighbor later, I think I walked from the Bronx to the Bowery. I walked all through the west 37th and 38th street and ah...looking for in the button district. Then I walked down. There was a shoe sale down on 21st and Broadway so I walked down there and, uh, then along the way if I find...remember anything else I wanted to get and I'm going through the neighborhood, I stop and do that. So that took, uh, most of the afternoon. I got home and I still have no buttons.

Pleasant Surprise

RBD participant. I was pleasantly surprised about a month ago when my daughter called me and I realized that normally she does not do that. I realized that she normally does not do that, where she didn't want anything or ask me to do anything. And I also realized that it does not happen that often. And that was a very pleasant surprise and that's the way I want it. She's a very busy woman with a career and children. Um, that was a pleasant surprise. (C - Anything more you can say about that?) No, not really.

Appendix B

Rating Scales

ACCURACY**EMOTION****POSITIVE EMOTION****NEGATIVE EMOTION**

Appendix C

Training Materials

Rating Sessions - Emotional Lexical Discourse

Training Session - Emotional Content

Part 1 - Introduction and Definition. The purpose of this investigation is to examine individuals' abilities to produce stories (i.e., narratives) about various topics. You will be asked to read a number of narratives and rate them on a scale of emotional content (EC) and a scale of emotional intensity (EI). Before you begin rating, the group will be provided with definitions, instructions, and examples. The group will then rate a set of examples and discuss any strategies, questions, or difficulties that arise. Lastly, you will be asked to use these scales to rate a large set of narratives over the course of a few days.

The first scale you will learn about is emotional content (EC). EC refers to the amount of information in a narrative that conveys some form of emotion, irrespective of the topic/s. Another way to think about this is to consider how much emotionally imbued information is expressed in a narrative. Although you will be using the words and sentences to help you understand the narrative, you should not focus on the meaning of each discrete element, but how, when put together, they relate emotion. Some narratives may be very short versus very long. Some may include words or sentences that do not make much sense. Some sentences may be grammatically poor. No matter what the language in the narrative is like, your job is to use whatever output is available to determine how much overall EC the narrative conveys. It is important that you make your decisions based on the amount of EC expressed within the narrative and not on your own personal beliefs and/or reactions concerning the narrative.

To complete these ratings, you will use a 6-point Likert scale. Remember that you will need to determine how much EC is conveyed throughout the entirety of the narrative and not necessarily base your decision on just one specific instance of emotion. For example, one person may relate a narrative that focuses on a single event about a birthday party and most of the content is emotional. Another person may also talk about a birthday party, but most of the information is not emotional in nature. In comparison, some narratives may include several emotional topics (e.g., happiness or sadness) and/or events (e.g., taking a test or making dinner), which are interspersed throughout the story and/or occur in discrete sections of the narrative. Remember, irrespective of the number of events and emotions that are included in a single narrative, the EC rating is determined by how much of the entire narrative is emotional in nature. It may be obvious that this is somewhat of a subjective process and you should note that there are no absolute right or wrong answers.

In the initial part of today's session, I will provide you with an understanding of the scale and as a group, we will try to come to an understanding about how to rate these

narratives. In this way you will learn from each other by sharing the strategies you used to determine your ratings. Remember that later you will be rating narratives on your own.

In order to learn about the scale we will go through each level of the 6-point Likert scale.

"0" - "no amount of emotional content". The narrative contains no EC. The information is entirely nonemotional. It has no emotional information.

"1" - "a minimal amount of emotional content". This is the lowest amount of EC, which means that the narrative conveys a minimal range or very little EC. Another way to think about this is that 1-20% of the narrative's overall information is emotional.

"2" - "some amount of emotional content". The narrative conveys some EC; less than the middle point on the scale (i.e., 3), but more than the first point (i.e., 1). Another way to think about this is that 21-40% of the narrative's overall information is emotional.

"3" - "a moderate amount of emotional content". This is the midpoint on the scale, which indicates a medium amount of EC. Another way to think about this is that 41-60% of the narrative's overall information is emotional.

"4" - "a large amount of emotional content". The narrative conveys a lot of EC; more than the midpoint (i.e., 3), but not the most (i.e., 5). Another way to think about this is that 61-80% of the narrative's overall information is emotional.

"5" - "the greatest amount of emotional content". This is the greatest amount of EC, which means that the narrative conveys the greatest range of EC. Another way to think about this is that 81-100% of the narrative's overall information is emotional.

Any questions about the scale before we move on to some examples?

Now we are going to examine each level of the EC rating scale and read narratives that are illustrative of that level. The following items are sample narratives, similar in structure to those that you will ultimately rate. We will review why each narrative best represents that level. If you are unsure of why a rating was chosen or you disagree with any rating, please ask and we will discuss the example. As you read each narrative, note that the amount of EC is determined by how much overall emotional information is included in each narrative. Do you have any questions? Turn in your booklet to the first example ("1") and read the narrative to yourself, while I read it aloud. (Note for Examiner: After reading each narrative, point out which aspects of the narrative helped determine the rating level).

Narrative number one receives a rating of **"0" - "no amount of emotional content"**. This narrative contains no amount of emotional information and is entirely descriptive. Any questions? **(Reread for narrative two.)**

Narrative number three receives a rating of **"1" - "a minimal amount of emotional content"**. This narrative appears to be mostly descriptive, but has a little emotional information. This falls within the smallest range of EC conveyed. Any questions? **(Reread for narrative four.)**

Narrative number five receives a rating of **"2" - "some amount of emotional content"**. This narrative conveys some amount of emotional content. Any questions? **(Reread for narrative six.)**

Narrative number seven receives a rating of “3” - “a moderate amount of emotional content”. This narrative illustrates a medium amount of emotional content. Any questions? (**Reread for narrative eight.**)

Narrative number nine receives a rating of “4” - “a large amount of emotional content”. This narrative conveys much emotional content. Any questions? (**Reread for narrative ten.**)

Narrative number eleven receives a rating of “5” - “the greatest amount of emotional content”. This narrative has the utmost emotion. This falls within the largest range of emotional content conveyed. Any questions? (**Reread for narrative twelve.**)

Do you have any general questions before we proceed?

Training Session – Emotional Intensity

Part 1 - Introduction and Definition. You will now be asked to learn about the second scale regarding emotional intensity (EI). This scale will also be used to rate the narratives, but note that the EC and EI scales will be measuring different things. Before you begin rating, the group will be provided with definitions, instructions, and examples. The group will then rate a set of examples and discuss any strategies, questions, or difficulties that arise. Lastly, you will be asked to use this scale, in addition to the EC scale, to rate a large set of narratives over the course of a few days.

Emotional intensity (EI) refers to the magnitude of emotion that an individual has conveyed in his/her narrative. That is, what is the overall degree of EI expressed in a narrative irrespective of the topic/s (e.g., taking a walk, buying a book, sadness, or happiness) specified in the narrative. EI is different from EC. Remember, EC assesses how much overall emotional information is contained within the narrative. In contrast, EI examines what is the intensity of the emotional information that was selected during the EC rating.

Similar to the EC rating, you will again be using words and sentences to help you understand the narrative, but you should focus on how the selected elements, put together, relate EI. Remember that some narratives may be very short versus very long. Some may include words or sentences that do not make much sense and some sentences may be grammatically poor. No matter what the language is like, your job is to determine the degree of EI that is found within the previously selected EC. It is important that you make your decisions based on the level of EI expressed within the narrative and not on your own personal feelings or reactions concerning the narrative.

To complete these ratings, you will use a 6-point Likert scale to assess the overall intensity of the emotional information expressed in the previously selected EC. To do this you will have first rated the narrative for EC. After this is completed, you will use only this selected portion of EC to base your rating of EI.

Similar to EC, the EI is rated irrespective of the number or type of emotion/s included in the narrative. For example, after identifying how much EC is included in a narrative about a birthday, someone may decide that the degree of emotional intensity is very high. For example, one person may relate a narrative about a single event (e.g., a

birthday) in which most of the selected content is very emotionally intense. Another person may focus their narrative on a similar occurrence, but most of the selected EC is not emotionally intense. In comparison, some narratives may include several emotions (e.g., sadness or happiness) and/or several events (e.g., taking a test or making dinner). Remember, irrespective of the number of events and emotions that may be included in a single narrative, you should determine the degree of EI based only on the content selected during the EC rating. It may be obvious that this is somewhat of a subjective process and you should note that there are no absolute right or wrong answers.

In the initial part of today's session, I will provide you with an understanding of the scale and as a group, we will try to come to an understanding about how to rate these narratives. In this way, you will learn from each other by sharing the strategies you used to determine your ratings. Remember that later you will be rating narratives on your own.

In order to learn about the scale we will go through each level of the 6-point Likert scale.

"0" - "no emotional intensity". The previously selected EC conveys no EI.

"1" - "minimal emotional intensity". This is the lowest degree of EI, which means that the previously selected EC conveys very little or minimal EI.

"2" - "some emotional intensity". The previously selected EC conveys some EI; less than the middle point on the scale (i.e., 3), but more than the first point (i.e., 1).

"3" - "moderate emotional intensity". This is the midpoint on the scale, which indicates a medium amount of EI.

"4" - "much emotional intensity". The previously selected EC conveys a lot of EI; more than the midpoint (i.e., 3), but not the most (i.e., 5).

"5" - "the most emotional intensity". This is the highest degree of EI, which means that the previously selected EC conveys the most EI.

Any questions about the scale before we move on to some examples?

Now we are going to return to the example narratives you saw for EC and show you how each narrative is illustrative of a level on the EI rating scale. Remember that the following items are sample narratives, similar in structure to those that you will ultimately rate. We will discuss why each narrative best represents that level. If you are unsure of why a rating was chosen or you disagree with any ratings, please ask and we will discuss the example. As you read each narrative, note that the overall degree of EI should be determined based on the previously selected EC portions of the narrative. Do you have any questions? Turn in the booklet to the first example ("1") and read the narrative to yourself, while I read it aloud. (Note for Examiner: After reading each narrative, point out which aspects of the narrative helped determine the rating level).

Narrative number __ received an EC rating of __. It also receives an EI rating of **"0" - "no emotional intensity"** - The previously selected emotional content contains no emotional intensity.

Narrative number __ received an EC rating of __. It also receives an EI rating of **"0" - "no emotional intensity"** - The previously selected emotional content contains no emotional intensity.

Narrative number __ two received an EC rating of __. It also receives an EI rating

of **"1" - "minimal emotional intensity"**. The previously selected emotional content contains very little emotional intensity. Any questions?

Narrative number __ two received an EC rating of __. It also receives an EI rating of **"1" - "minimal emotional intensity"**. The previously selected emotional content contains very little emotional intensity. Any questions?

Narrative number __ received an EC rating of __. It also receives an EI rating of **"2" - "some emotional intensity"**. The previously selected emotional content contains some degree of emotional intensity. Any questions?

Narrative number __ received an EC rating of __. It also receives an EI rating of **"2" - "some emotional intensity"**. The previously selected emotional content contains some degree of emotional intensity. Any questions?

Narrative number __ received an EC rating of __. It also receives an EI rating of **"3" - "moderate emotional intensity"**. The previously selected emotional content contains a medium degree of emotional intensity. Any questions?

Narrative number __ received an EC rating of __. It also receives an EI rating of **"3" - "moderate emotional intensity"**. This selected emotional content contains a medium degree of emotional intensity. Any questions?

Narrative number __ received an EC rating of __. It also receives an EI rating of **"4" - "much emotional intensity"**. This selected emotional content contains a lot of emotional intensity. Any questions?

Narrative number __ received an EC rating of __. It also receives an EI rating of **"4" - "much emotional intensity"**. This selected emotional content contains a lot of emotional intensity. Any questions?

Narrative number __ received an EC rating of __. It also receives an EI rating of **"5" - "the most emotional intensity"**. This selected emotional content contains the utmost emotional intensity. Any questions?

Narrative number __ received an EC rating of __. It also receives an EI rating of **"5" - "the most emotional intensity"**. This selected emotional content contains the utmost emotional intensity. Any questions?

Do you have any general questions before we proceed?

Training Session - Emotional Content and Emotional Intensity

Part 2 – Conferencing. Now we will practice rating some narratives together. Your second booklet contains individual narratives on a page accompanied by EC and EI scales. Read the first narrative to yourself and then place your rating for EC in the space labeled, "EC - 1st rating". Next, note what level of content was selected, and then based only on this amount of EC determine the degree of EI. Remember that the rating of EI is based on the previously selected amount of EC and not necessarily the entire narrative. After you have selected your EI rating place your selection in the space labeled, "EI - 1st rating". After everyone has completed the first item, you will state your ratings aloud to the group. Please listen to how others rated the narrative so you can judge how your choice compared to the rest of the group. If most of you agree on the levels of EC and EI,

we will not need to have much discussion, since agreement among you will be high. If the ratings are disparate, we will discuss your choices in-depth. After the discussion, if you feel that you would like to re-rate the narrative, please do so in the space labeled "EC - 2nd rating" and "EI - 2nd rating". If you have not changed your mind, leave the "2nd rating" spaces blank. After the second rating, you will again state your ratings aloud so that I can keep track of the different responses and the group can see how each narrative was recoded. We will again discuss your strategies in deciding which ratings were most appropriate. Such a discussion will help the group to further consider the various ways to determine a rating level. If at any point you need to reread the examples, please ask to see them again.

Training Session - Emotional Content and Emotional Intensity

Part 3 - Inter-class correlation/reliability determination. Now you will rate some narratives yourself using the 6-point Likert scales of EC and EI. Please keep in mind the definitions and discussions we had during the previous training sessions. Any questions? Here is your third booklet. Do not open it yet. This booklet is very similar to the ones you used previously. On each page there is a single narrative accompanied by the EC and EI rating scales. After reading a single narrative please first circle your choice for the EC rating using the scale on the same page. Make sure that you completely and clearly circle your choice. Then based on the amount of content selected for the EC rating, determine the magnitude of EI. Do not skip ahead to any items. Work at your own pace and take your time. We will take a break after you are all through. Any questions before you start? If you have any questions during the rating session, see me or raise your hand. OK? Begin.

(Note - Upon completion of this phase, Interclass Correlations (ICC) will be calculated and must be over 80% to proceed to the final rating session. If ICC is below 80%, the examiner will identify any areas that were not comprehended by the rater or other difficulties that may have arisen. In this event, a review of materials will occur at the specified level of training. Retraining will continue using new samples of narratives until an ICC of 80% is achieved.)

Training Session - Emotional Content and Emotional Intensity

Part 4 - Instructions for final rating procedures. Do you recall the EC and EI scales that you used to rate the sample narratives? Now I will give you the final packet of narratives to be rated on these two scales. These booklets are exactly the same as those you used previously. Please note that you will be rating each narrative for EC first. After you have determined the EC rating for a specific narrative, you will then rate the selected amount of content using the EI scale. After completing both scales proceed to the next item. Do not go back to an item once it is completed. Also do not skip ahead to any item. Work at your own pace and take your time. If you have any questions during the rating session, feel free to approach me or raise your hand. Any questions? Begin.

Appendix D

Correlation Tables

Correlation Coefficients between the Accuracy and Confidence Ratings.

Ratings								
Emotion Condition					Valence Condition			
	Acc E	Conf E	Acc NE	Conf NE	Acc P	Conf P	Acc N	Conf N
Emotion Condition								
Acc E	-	-	-	-				
Conf E	.528**	-	-	-				
Acc NE	.420**	.090	-	-				
Conf NE	.143	.051	.347*	-				
Valence Condition								
Acc P					-	-	-	-
Conf P					.580**	-	-	-
Acc N					.255	-.058	-	-
Conf N					.154	-.107	.492**	-
.05 .01 .001 <u>Note:</u> Acc - Accuracy; Conf - Confidence; E - Emotional Condition; NE - Nonemotional Condition; P - Positive Condition; N - Negative Condition								

Correlation Coefficients between the Emotional Content and Intensity Ratings.

Ratings							
Emotion Condition				Valence Condition			
ECont E	ECont NE	EInt E	EInt NE	ECont P	ECont N	EInt P	EInt N
Emotion Condition							
ECont E	-	-	-	-	-	-	-
ECont NE	.502**	-	-	-	-	-	-
EInt E	.700**	.627**	-	-	-	-	-
EInt NE	.472*	.947**	.640**	-	-	-	-
Valence Condition							
ECont P				-	-	-	-
ECont N				.670**	-	-	-
EInt P				.792**	.447**	-	-
EInt N				.448**	.593**	.548**	-

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Note: ECont - Emotional Content; EInt - Emotional Intensity; E - Emotional Condition; NE - Nonemotional Condition; P - Positive Condition; N - Negative Condition

Correlation Coefficients between the Positive Emotional Content and Intensity Ratings.

Ratings								
Emotion Condition				Valence Condition				
	PECont E	PECont NE	PEInt E	PEInt NE	PECont P	PECont N	PEInt P	PEInt N
Emotion Condition								
PECont E	-	-	-	-				
PECont NE	.320*	-	-	-				
PEInt E	.872**	.428**	-	-				
PEInt NE	.281	.939**	.400*	-				
Valence Condition								
PECont P					-	-	-	-
PECont N					.413**	-	-	-
PEInt P					.844**	.424**	-	-
PEInt N					.407*	.874**	.489**	-

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Note: PECont - Positive Emotional Content; PEInt - Positive Emotional Intensity; E - Emotional Condition; NE - Nonemotional Condition; P - Positive Condition; N - Negative Condition

Correlation Coefficients between the Negative Emotional Content and Intensity Ratings.

Ratings								
Emotion Condition				Valence Condition				
	NECont E	NECont NE	NEInt E	NEInt NE	NECont P	NECont N	NEInt P	NEInt N
Emotion Condition								
NECont E	-	-	-	-				
NECont NE	.228	-	-	-				
NEInt E	.742	.475**	-	-				
NEInt NE	.234	.933**	.470**	-				
Valence Condition								
NECont P					-	-	-	-
NECont N					.210	-	-	-
NEInt P					.855**	.162	-	-
NEInt N					.114	.672**	.128	-

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Note: NECont - Negative Emotional Content; NEInt - Negative Emotional Intensity; E - Emotional Condition; NE - Nonemotional Condition; P - Positive Condition; N - Negative Condition

Correlation Coefficients between the Accuracy and Confidence Ratings and the Subject Characteristic Variables.

	Acc E	Conf E	Acc NE	Conf NE	Ratings		Acc N	Conf N
					Acc P	Conf P		
Subject Variables								
MPO	.150	-.015	.083	-.188	.155	-.029	.105	.014
Gender	.182	.066	.077	-.053	.084	-.173	.185	.225
Age	-.212	-.082	-.275	-.041	.017	.076	-.290	-.147
Race	.012	.178	-.036	.060	-.090	.004	.065	.224
Education	.057	.015	.128	-.128	.006	-.233	.064	.221
Occupational Status	.083	.066	.111	-.148	.138	-.064	.019	.145
BDAE-COM	-.325*	-.106	-.227	.239	-.224	-.043	-.280	-.086
BDAE-CIM	-.063	.060	-.086	.002	-.142	.055	-.006	.053
BDAE-SP	-.031	.118	.029	.043	.038	.127	-.061	.076
MDRS-ATTN	-.300	-.162	-.258	-.075	-.318*	-.194	-.201	-.050
MDRS-MEM	-.021	.060	.194	.067	-.107	-.080	.048	.123
WM-LMI	.163	.273	.445**	.049	.112	-.011	.149	.298
WM-LMII	.203	.339*	.458**	.214	.193	.171	.150	.281
BDI	.040	.141	-.079	.155	-.081	-.057	.108	.234
FAS	.320*	.371*	.127	-.026	.431**	.330*	.165	.169
BDAE AN	.131	.180	.430**	.214	-.004	-.042	.179	.235

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Note: Acc - Accuracy; Conf - Confidence; E - Emotional Condition; NE - Nonemotional Condition; P - Positive Condition; N - Negative Condition
MPO: Months Post-Onset; WAIS INFO: WAIS Information Subtest; WAIS BD: WAIS Block Design Subtest; BDAE COM: Boston Diagnostic Aphasia Examination - Commands; BDAE CIM: Complex Ideational Material; BDAE SP: Reading Sentences and Paragraphs; MDRS-ATTN: Mattis Dementia Rating Scale - Attention Subscale; MDRS - MEM: Mattis Dementia Rating Scale - Memory; WM - LMI: Wechsler Memory Scale - Logical Memory I; WM - LMII: Wechsler Memory Scale - Logical Memory II; BDI: Beck Depression Inventory; FAS: Controlled Word Association Test; BDAE AN: BDAE Animal Naming

Correlation Coefficients between the Emotional Ratings and the Subject Characteristic Variables.

	ECont E	ECont NE	EInt E	EInt NE	Ratings ECont P	ECont N	EInt P	EInt N
Subject Variables								
MPO	.076	.012	.179	-.044	.056	.075	.159	.144
Gender	.274	.115	.206	.040	.290	.215	.204	.147
Age	-.278*	-.151	-.028	-.043	-.148	-.336*	.066	-.101
Race	.269	.095	.265	.064	.254	.234	.292	.171
Education	.173	.212	.183	.316*	.065	.221	.133	.160
Occupational Status	.159	.228	.199	.349*	.137	.148	.203	.146
BDAE-COM	-.311*	-.072	-.113	-.025	-.268	-.292	-.164	-.036
BDAE-CIM	.019	.098	-.025	.199	-.109	.105	-.121	.033
BDAE-SP	.043	.046	.126	.176	-.070	.129	.098	.124
MDRS-ATTN	-.015	.242	.008	.194	-.032	-.008	.026	-.024
MDRS-MEM	-.045	.279	.057	.308	-.130	.023	-.097	.171
WM-LMI	-.048	.284	.141	.354*	-.006	-.075	.137	.112
WM-LMII	.073	.171	.122	.271	-.031	.133	-.011	.190
BDI	.082	-.238	.000	-.229	.037	.102	-.041	.024
FAS	.125	.350*	.337*	.355*	.151	.085	.274	.323*
BDAE AN	-.160	.062	.122	.126	-.216	.069	-.099	.247

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Note: ECont - Emotional Content; EInt - Emotional Intensity; E - Emotional Condition; NE - Nonemotional Condition; P - Positive Condition; N - Negative Condition
MPO: Months Post-Onset; WAIS INFO: WAIS Information Subtest; WAIS BD: WAIS Block Design Subtest; BDAE COM: Boston Diagnostic Aphasia Examination -
Commands; BDAE CIM: Complex Ideational Material; BDAE SP: Reading Sentences and Paragraphs; MDRS-ATTN: Mattis Dementia Rating Scale - Attention Subscale; MDRS
- MEM: Mattis Dementia Rating Scale - Memory; WM - LMI: Wechsler Memory Scale - Logical Memory I; WM - LMII: Wechsler Memory Scale - Logical Memory II; BDI:
Beck Depression Inventory; FAS: Controlled Word Association Test; BDAE AN: BDAE Animal Naming

Correlation Coefficients between the Positive Emotional Ratings and the Subject Characteristic Variables.

	PECont E	PECont NE	PEInt E	PEInt NE	Ratings PECont P	PECont N	PEInt P	PEInt N
Subject Variables								
MPO	.107	.020	.097	.066	.153	-.008	.190	-.027
Gender	.075	.180	-.026	.100	.137	-.075	.086	-.167
Age	.083	-.063	.065	-.090	-.163	.048	.033	.066
Race	.075	-.218	.008	-.125	.127	-.020	.060	-.078
Education	-.188	.231	-.124	.230	-.101	-.208	-.033	-.141
Occupational Status	.078	.302	.105	.301	.124	-.023	.185	-.008
BDAE-COM	.079	-.280	.157	-.271	-.043	.229	-.008	.302
BDAE-CIM	-.192	-.085	-.122	-.030	-.294	-.004	-.186	.020
BDAE-SP	.066	-.138	.204	-.074	.041	.058	.177	.169
MDRS-ATTN	-.141	.120	-.057	.022	-.140	-.076	-.036	-.058
MDRS-MEM	-.041	.085	-.071	.142	-.068	-.062	-.071	-.117
WM-LMI	-.071	.222	-.014	.304	-.050	-.105	-.031	-.006
WM-LMII	-.036	.087	-.038	.166	-.085	.008	-.077	-.014
BDI	.012	-.319*	.031	-.258	-.034	.049	-.006	.053
FAS	.317	.283	.210	.421**	.364*	.051	.317	-.031
BDAE AN	-.229	.138	-.230	.182	-.106	-.306	-.152	-.225

*.05 ** .01 ***.001

Note: PECont - Positive Emotional Content; PEInt - Positive Emotional Intensity; E - Emotional Condition; NE - Nonemotional Condition; P - Positive Condition; N - Negative Condition; MPO: Months Post-Onset; WAIS INFO: WAIS Information Subtest; WAIS BD: WAIS Block Design Subtest; BDAE COM: Boston Diagnostic Aphasia Examination - Commands; BDAE CIM: Complex Ideational Material; BDAE SP: Reading Sentences and Paragraphs; MDRS-ATTN: Mattis Dementia Rating Scale - Attention Subscale; MDRS - MEM: Mattis Dementia Rating Scale - Memory; WM - LMI: Wechsler Memory Scale - Logical Memory I; WM - LMII: Wechsler Memory Scale - Logical Memory II; BDI: Beck Depression Inventory; FAS: Controlled Word Association Test; BDAE AN: BDAE Animal Naming

Correlation Coefficients between the Negative Emotional Ratings and the Subject Characteristic Variables.

	NECont E	NECont NE	NEInt E	Ratings NEInt NE	NECont P	NECont N	NEInt P	NEInt N
Subject Variables								
MPO	.043	-.075	-.056	-.143	.005	.026	-.0162	-.017
Gender	.337*	-.164	-.007	-.070	.187	.334*	.041	-.030
Age	-.033	-.108	.141	-.052	.172	-.115	.092	.131
Race	.194	.287	.238	.174	.035	.204	.090	.231
Education	-.482	.098	.382	.244	.358*	.360*	.233	.275
Occupational Status	.297	-.061	.214	.094	.218	.243	.098	.182
BDAE-COM	-.403**	.220	-.003	.127	-.157	-.420**	-.019	.014
BDAE-CIM	.137	.430**	.273	.403**	.235	.010	.306	.144
BDAE-SP	.220	.395**	.381*	.389**	.102	.228	.140	.392**
MDRS-ATTN	.068	.127	.068	.201	.155	-.007	.023	.054
MDRS-MEM	-.113	.247	-.052	.264	-.180	.013	-.292	.134
WM-LMI	.182	.191	.142	.244	.137	.174	-.053	.230
WM-LMII	.078	.117	.152	.159	.012	.114	.020	.192
BDI	.055	.064	-.021	-.044	.122	.014	.065	-.057
FAS	-.079	-.074	.080	-.012	-.408*	.136	-.338*	.294
BDAE AN	.157	-.137	.258	-.103	.044	.157	.008	.272

*.05 **.01 ***.001

Note: NECont - Negative Emotional Content; NEInt - Negative Emotional Intensity; E - Emotional Condition; NE - Nonemotional Condition; P - Positive Condition; N - Negative Condition; MPO: Months Post-Onset; WAIS INFO: WAIS Information Subtest; WAIS BD: WAIS Block Design Subtest; BDAE COM: Boston Diagnostic Aphasia Examination - Commands; BDAE CIM: Complex Ideational Material; BDAE SP: Reading Sentences and Paragraphs; MDRS-ATTN: Mattis Dementia Rating Scale - Attention Subscale; MDRS - MEM: Mattis Dementia Rating Scale - Memory; WM - LMI: Wechsler Memory Scale - Logical Memory I; WM - LMII: Wechsler Memory Scale - Logical Memory II; BDI: Beck Depression Inventory; FAS: Controlled Word Association Test; BDAE AN: BDAE Animal Naming

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