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Emotion Recognition and Empathy After Brain injury

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Abstract

Impairments of social behavior after cerebral damage are common. Studies suggest that in some brain-injured individuals the fundamental mechanisms underlying emotion recognition (Braun, Denault, Cohen & Rouleau, 1994; Jackson & Moffat, 1987) and empathy (Eslinger, 1998; Grattan, Bloomer, Archambault & Eslinger, 1994) are disturbed. To our knowledge, there has been no published research on the interaction between emotion recognition and empathy in brain-injured groups. The present study investigated how impairment in the ability to recognize visual and verbal emotion covaries with the ability to empathize (cognitively and emotionally). Specifically, it was hypothesized that poor ability to recognize emotion would positively correlate with socially inadequate forms of empathy. A group of individuals with brain injury and a normal control group were administered the Victoria Emotion Recognition Test (VERT), Hogan's Empathy Scale (EM) and the Questionnaire Measure of Emotional Empathy (QMEE). Results indicate that overall, individuals with brain injury had lower scores on all subscales of the VERT as well as on the EM. No differences were found between groups on the QMEE. The scores for both groups were found to correlate positively between the EM and VERT as well as between the EM and QMEE.

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Emotion Recognition and Empathy After Brain Injury

Inadequate social behavior is often the most devastating effect of brain injury. Frequently, there is good recovery of physical and cognitive abilities and the functional effect of any deficits evident can be addressed with compensatory strategies or devices. The primary impediment for most people with brain injury is the typical poor recovery of judgement, self control and social sensitivity (Lezak, 1983). Central to social adjustment and social sensitivity is the recognition of emotion: an essential prerequisite for empathy (Strayer, 1987). It follows then, that if emotional recognition is compromised, empathic ability may also be affected. A number of studies have revealed significant deficits in emotion recognition in people with brain injury (Adolphs, Damasio, Daniel, & Damasio, 1996; Borod, Cicero, Obler, Welkowitz & Erhan, 1999; Gainotti, 1999). Impairment of social behavior has also been associated with several forms of acquired brain damage, including stroke, traumatic brain injury, tumor, and aneurysm rupture with surgical repair (Grattan, Bloomer, Archambault & Eslinger, 1994). Brain-injured patients may exhibit personality disturbances such as irritability, anger, impulsiveness, rapid mood changes, inappropriate social responses, suspiciousness of others, self-centered behavior, insensitivity to others, and loss of drive or initiative (Prigatano, 1992). Patients with frontal lobe lesions have been described as insensitive, egocentric and lacking in the expression of mutual understanding or concern, often presenting with inappropriate comments (Eslinger, 1998). These social impairments may be a direct result of lack of empathy (Grattan & Eslinger, 1989).

Grant and Alves' (1987) have noted that "the bulk of the morbidity from brain injury

in survivors stems from neuropsychiatric and behavioral derangements" (p. 259). Such changes in personality and interpersonal relationships may be difficult to comprehend or tolerate (Braun, Baribeau, Ethier, Daigneault & Proulx, 1989; Lezak, 1988) presenting a serious barrier to management, rehabilitation and vocational adjustment. These changes are among the most difficult aspects of neurobehavioral impairments to assess and target for rehabilitation (Grattan and Eslinger, 1989; Klonoff, Costa & Snow, 1986; Prigatano, 1987). Moreover, deciphering whether personality changes are a result of the head trauma itself or if they are the product of frustration and fears arising from changes in functioning as a result of the injury proves to be an additional challenge (Mountain, 1993).

The study by Braun et al. (1989) provides a good example of the effects of brain injury on emotion recognition. This study compared 31 normals and 31 severely closed-head injured patients on the facial test of emotion (FTE) and a contextual task of emotion (CTE). The FTE consisted of 36 slides representing facial expressions of the six transcultural expressions as proposed by Ekman and colleagues, namely, joy, fear, sadness, anger, surprise and disgust. The subjects were required to name the appropriate emotion for each slide. The CTE consisted of correctly identifying the appropriate emotion for each of the 36 brief verbal narratives representing situations of a same sex individual expressing emotions. The closed-head injury (CHI) patients were impaired overall on the FTE but not the CTE. However, the ability to identify anger was significantly impaired on both tasks. It was concluded that a processing deficit of primary emotional material, specifically anger, does exist following CHI.

Grattan and Eslinger (1992) present the case study of DT to illustrate the effects of brain injury on empathy, as well as other psychological aspects. At the age of 33, 26 years after a trauma causing focal frontal lobe damage, patient DT was evaluated on standardized measures of empathy, psychosocial development, and aspects of personality. Results indicate that DT had a very limited capacity for empathic understanding, an inadequate identity development, difficulties in vocational adjustment, and a concrete level of moral reasoning. Additionally, it appeared that her social development remained at an early adolescent level. It was concluded that early frontal lobe damage has profound effects on social maturation and development.

The consequences of cerebral damage on empathic measures have only recently begun to be studied (Grattan, Bloomer, Archambault & Eslinger, 1994). As a result, there are no studies, to date, reported in the literature in which a head-injured sample has been identified as having deficits in empathy as a direct result of the ability to recognize emotion. The primary purpose of this study was to test the hypothesis that one aspect of social impairment observed in brain-damaged individuals (i.e., reduced empathy) may covary with the ability to recognize emotion. Since two forms of empathy (cognitive and emotional) have been previously identified with a brain-injured population (Eslinger, 1998), both will be examined in relation to emotion recognition.

Background

Emotion Recognition

Emotion represents a significant behavioral attribute and has been studied and

discussed through history. It can be considered the result of mood (the inner, subjective feelings), affect (the outer objective manifestations of feeling), drive, and cognitive control. Emotion is difficult to define and has been used, at best, only broadly and vaguely. Emotion can suggest an agitated, excited mental state (an emotional outburst) but more often some cognitive connotation is included. Thus, emotion has been called the "affective state of consciousness in which joy, sorrow, fear, hate, and the like is experienced" (New Webster's dictionary, 1975). Emotion, however, is a much broader term than this and brings together a variety of behavioral attributes including mood, affect and drive (Benson, 1984).

Our understanding of emotion has come a long way from the early contributions of Galen and the philosophers of the Dark Ages. It is no longer believed that, for example, an excess of a melancholic humor would produce a feeling of sadness; nor is it accepted that emotional problems result from the invading spirit of the Devil.

Current research shows that emotion can be influenced by neurologic disturbances that result from disorders involving diverse neuroanatomical structures (Benson, 1984). In a study by Kolb and Taylor (1981) subjects (20 normal controls and 58 patients who had undergone frontal cortical excision) were shown seven key photographs, each of which depicted one of the verbally categorizable emotions described by Ekman, Friesen and Ellsworth (1973). The subject was then shown 24 photographs of faces and was asked to match each of them with the key photograph that most closely expressed the same emotion. The results indicated that the patients with frontal and temporal lesions in the right hemisphere as well as frontal lesions in the left hemisphere were especially poor at matching.

This suggests that the right hemisphere plays a major role in appreciation of facial expression as well as the production of affective behavior while there is some contribution by the left frontal hemisphere. Patients with damage to the prefrontal temporal cortex or posterior parietal cortex of either hemisphere were impaired at matching facial expressions with verbal descriptions.

In a similar study, Rubinow and Post (1992) found that depressed patients were significantly impaired in the recognition of affect in facial, but not verbal, expression. Among the 7 affects measured, depressed patients made significantly fewer correct matches for sad, happy, and interested face items. Rubinow and Post (1992) suggest that patients with an affective disorder have a relatively selective right hemispheric dysfunction. In addition, they suggest that these patients are characterized by deficits in both receptive (perceptual) as well as expressive (behavioral/emotional) function.

The cognitive task of facial recognition is a useful investigative tool in the study of affective disorders because of the extent to which this cognitive process has been localized neuroanatomically and because of its potential role in interpreting and determining social behavior (Borod, Koff, Perlman, & Nicholas,1986; Gruzelier, Seymour, Wilson, Jolly & Hirsch,1988; Kolb & Taylor, 1996).

Empathy

In the broadest sense, empathy refers to the reactions of one individual to the observed experiences of another. Empathy has been considered by some investigators to be a cognitive phenomenon, with a resulting research focus on such "intellectual" processes as accurate perceptions of others. Dymond (1949), the first to introduce the cognitively based

theory, defined empathy as predictive accuracy, and developed measures useful in differentiating levels of cognitive social insight. A more recent and widely referenced (Chlopan et al. 1985; Eslinger, 1998; Grattan et al., 1994) definition of empathy is the one proposed by Hogan (1969) which states that empathy is the capacity to apprehend another person's situation in such a way that there is a potential for mutual sharing or understanding through an interpersonal relationship. This concept of empathy is central for understanding the nature of social interactions and to Hogan (1969), moral development. The dynamics of interpersonal relations rely on the empathic dispositions of the interacting individuals. That is, an individual's ability to role-take or to express social sensitivity to another person who, for example, is experiencing distress, will determine the degree of effective interaction. There has been a great deal of attention given to this aspect of social functioning (Gough, 1965; Hogan, 1969; Mead, 1934). Mead's writings (1934), for example, suggest that role-taking ability is the key variable in social functioning and that social sensitivity has origins in the central nervous system. Hogan (1969) maintains that empathy is an internal ability to adopt a broad moral perspective. Specifically, Hogan asserts that by taking a moral point of view, a person is said to consider the consequences of their actions for the welfare of others. Further, the individual has a willingness to put oneself in another person's place and will modify one's behavior as a result. Essentially, cognitive theorists argue that empathy involves the ability to take another's viewpoint or to infer their feelings.

Other researchers have used a definition of empathy stressing its emotional facets and have studied topics such as helping behavior (Mehrabian & Epstein, 1972) in which

emotional reactivity appears to play an important role (see Davis, 1983). Within this emotionally-based approach, empathy is defined as a vicarious emotional response to the perceived emotional experiences of others (Mehrabian and Epstein, 1972). Mehrabian (1972) operationalizes empathy by postulating that a person with a high level of emotional empathy is less likely to engage in aggressive behavior, particularly when the pain cues from the victim are immediate, and is more likely to engage in helping behavior when noticing distress in another. In general, the person experiences heightened responsiveness to another's emotional experience. Further, Mehrabian notes that the primary emotional component of empathic tendency is heightened arousal (i.e., higher empathic tendency people tend to be more aroused by other's emotional experiences, both positive and negative).

Agreement that empathy is a multifaceted phenomenon has steadily grown in recent years, with the sentiment expressed perhaps most clearly by Deutsh and Madle (1975). They advised that "in the event that new measures are developed, attempts should be made to . . . not represent a single construct, but rather multiple and perhaps related constructs that more valid measures can be developed than in the past" (p.277). In this respect, empathy can be referred to as the cognitive and emotional systems that coordinate social interactions that permit sharing of experiences as well as understanding of others. It is suggested, that by adopting both approaches and studying empathy as a multi-dimensional construct, more comprehensive results will be obtained (Eslinger, 1998; Eslinger, Satish and Grattan, 1996).

For the purposes of this paper, empathy refers to the cognitive and emotional processes that bind people together in various kinds of relationships that permit sharing of

experiences as well as understanding of others.

Importance of Emotion Recognition Ability

Recognition of emotion in facial expressions and verbal intonation is a perceptual-interpretive process that is highly developed in human and nonhuman primates, reflecting its social and behavioral importance. Social interchange requires that people master, to a degree, the ability to express and perceive affect on faces and in discourse (Braun, Baribeau, Ethier, Daigneault & Proulx, 1989). As previously mentioned, emotion recognition is singled out as one of the two cognitive prerequisites for empathy (the other being role taking) (Strayer, 1987). That is, affect recognition skills seem especially necessary for the fine-tuning of empathy for a specific individual in a given situation. The development of discrimination of emotions include perceptual skills, both within and across communication channels, as well as the use of situation information. Effectively, this means that in order to be able to express cognitive or emotional sharing of another person's joy or distress, a person must first be able to recognize facial expressions, verbal tones and situational cues. Specifically, development of knowledge of both social display rules and expressive styles are essential (Eisenberg & Strayer, 1987). Human infants may recognize emotion and facial expression when only several months of age (Trevarthen, 1985), and it has been suggested that disruption of the face-processing system contributes to the inappropriate social behavior and social ostracism that follows damage to the amygdala (Perrett et al 1982; Rubinow and Post, 1992).

Importance of Empathy

As the patterns of human behavior become increasingly interdependent (i.e., work-place teams, contract work-groups), adaptive social behavior does as well. One factor considered to be a contributor to positive human interaction and altruistic behavior is empathy. Recent studies suggest that empathy, a fundamental mechanism of social behavior, can be disturbed by acquired cerebral damage (Eslinger, 1998).

Empathy has been argued to be a fundamental component of moral judgement. Hoffman (1987; see pp 58-77 for further detail) discusses how moral principles are often presented as abstractions. When they are, however, formulated in actual life events where the people, situations and consequences are real, empathy becomes an instrumental tool in making decisions.

Gender Effects

Emotion

The social psychology literature tends to support the notion that females are more sensitive to the recognition of emotion. Hall (1978, 1984) reviewed 75 studies that pertained to the gender effects of the decoding of nonverbal cues. The findings revealed that females were more skilled than males in emotion recognition expressly when the information was delivered via two modalities (auditory and visual). Additionally, a study by Funder and Harris (1986) found that in undergraduates, female subjects scored significantly higher than the males on the Profile of Nonverbal Sensitivity (PONS).

Conversely, a study on 216 undergraduate students (131 female, 85 male) by Parker, Taylor and Bagby (1993) found no significant gender effect on the ability to recognize emotion from a still photo. Additionally, in studies by Mountain (1993) and Lowick (1995), gender effects in recognition of emotion were not found. There were no differences between males and females on their scores on the clinical version of the Victoria Emotion Recognition Test (VERT-C).

Altogether, the early literature supports the notion that females tend to be more aware of the emotions of those around them. There is, however, more recent evidence that gender differences in recognition of emotion are not as clearly defined as once presumed.

Empathy

Most studies of gender differences in empathy have been aimed at testing the stereotypic view that females are more empathetic than males. In the sociology literature,

it is often asserted that the variations in behavior between men and women are due to the socially prescribed norms where men are required to provide for the family and women are required to nurture and care for the family. From this perspective, nurturance and empathy are viewed as important qualities for the women to have, and unnecessary for men to have in order to carry out their roles (Lennon & Eisenberg, 1987).

The data from the research on gender differences and empathy appear to depend on how empathy is operationalized and the method in which the test is administered. The definitions of empathy vary. Mehrabian and Epstein (1972), for example, view empathy as an emotional phenomena. Hogan (1969), on the other hand, holds empathy to be a cognitive phenomena. The measures that the researchers develop reflect their respective paradigm, thus affecting how the results will appear. That is, gender differences in empathy may be an artifact of the method of measurement.

On the measurement of empathy through self-report scales (i.e., Mehrabian's Questionnaire Measure of Emotional Empathy, QMEE, and Hogan's Empathy Scale, EM), there are concerns about self-presentation. This may account for the observed sex differences on dispositional measures of distress and empathy. Although females consistently report more distress and empathy on self-report measures than do males, these sex differences tend to disappear when one takes physiological measures of the reaction to another's emotional distress (Batson, Fultz & Schoenrade, 1987). This pattern of results suggests that the observed sex differences on self-report measures may be due, at least in part, to differences in sex-role norms that make it more appropriate for females to report both upset, anxious feelings, and tender, compassionate feelings.

In a review of recent research concerning gender differences in empathy, Lennon and Eisenberg (1987) suggest that when demand characteristics were high and participants had conscious control of their responses (i.e., self-report), gender differences were large, favoring females. When demand characteristics were more subtle and subjects were unlikely to exercise control over their responding (physiological and somatic indices), no gender differences were found. Further, it was suggested that when measures were more likely to tap sympathetic responding (i.e., self-reports in some simulated situations and other reports), females appeared to be more emotionally reactive than males.

In sum, whether there is a true sex difference in emotional reactions to the distress of others, as opposed to reports of these reactions is not as yet clear. What is known, however, that when interpreting results, it is essential to consider the theoretical framework from which the results are derived.

Age Effects

Emotion

Many studies have been devoted to determining when the ability to recognize emotion develops. In one study, Trevarthen (1984) established that recognition of primary facial emotions (happiness, sadness and surprise) may be innate. Trevarthen's results indicated that neonates (average age, 36 hours) were able to recognize and imitate the emotions expressed by the experimenter.

Findings of age-related increases in the decoding of nonverbal, especially facial, expressive emotional cues (e.g., Morency & Krauss, 1982) support the notion that some

analytic skills are involved in recognition of emotion. Recognition of emotions conveyed by situational and verbal content is also important (Strayer, 1987). Children's situation understanding of emotions, studied by Barden, Zelco, Duncan, and Masters (1980) indicates commonly shared attributions regarding situation-emotion relationships across age, as well as age-related differences in the prevalence of certain situational explanations for emotions. Studies involving mixed messages among emotion cues suggest that these would likely promote confusion rather than empathy in young children, who seem less able than older children and adults to compare differing facial, vocal, and bodily emotional cues simultaneously (Strayer, 1987).

Studies with children aging from 3 to 12 indicate that there is an increase in the ability to recognize emotions over this age range (Dimitrovsky, 1964; Stifter & Fox, 1987) but after this point, the differences between children in their early teens and adults is negligible (Soppe, 1988). These results are consistent with the fact that development of the frontal lobes occurs in the early years of adolescence.

A study comparing the recognition of emotion through adulthood (Moreno, Borod, Welkowitz & Alpert, 1993) contrasted females in three age groups (ranging from 21 to 81), with 30 subjects per group, on a measure of facial emotion recognition, using happiness, surprise, disgust, and sadness. Analysis of the results indicate that age was not a factor in overall facial recognition in this study. Further, Jackson and Moffat (1987) found no significant correlation between age (mean age 40.8 years, SD = 14.3) and scores on measures of recognition of facial expression and postural expression in the control subjects.

Alternatively, some studies have indicated that perceptual difficulties (Etcoff, 1984),

response time, and cognitive attention problems (Tomkins & Flowers, 1985) may be more prominent in subjects over 60 as such processes decline in effectiveness. As summarized by Mountain (1993), the neuropsychological literature has not focused on the study of emotion recognition across the life span. The available literature does, however, indicate that there is no report of increased accuracy of recognition after the age of six. In case, Mountain (1993) indicated in her research that a sample of older subjects (average age = 72) performed significantly poorer on the VERT-C than those in the younger group on all three subtests. This is in contrast to the developmental literature discussed above.

Empathy

As individuals progress through the different stages of moral and psychosocial development, changes in empathy can be seen (Kolberg, 1969). At a very young age, some children have the capacity for empathic responsiveness as they have the cognitive reasoning abilities (Kaplan, 1977; Piaget, 1951; Zahn-Waxler, Radke-Yarrow & King, 1977), the implicit awareness that one's own psychological condition can differ from that of another, and a basic ability to assume the psychological role of others (Bretherton & Beeghly, 1982). The development of empathy begins as early as 2 months in mother-infant play where face to face interaction establishes affective synchrony (Thompson & Lamb, 1983). From this point, the development of empathy is established through social referencing at about 10 months, prosocial initiatives as toddlers and emotional sharing by school age (Barnett, 1987). By early teenage years people are capable of having an emotional reaction congruent to the perceived distress of someone else.

In one of the first studies that examined empathic response, Berger (1962) had

subjects observe a target person receive an electric shock to their arm. It was hypothesized that if the observers were responding to other's distress, they would exhibit a physiological reaction to the target person's reception of shock. The results were consistent with the assumption that people can experience emotion as a result of perceiving another in pain and becoming physiologically aroused. Subsequent research (Hygge, 1976; Milgram, 1963; Stotland, 1969) has provided additional evidence that people react emotionally as they effectively vicariously experience the pain of the target individual.

Studies investigating the effect of head trauma on empathy usually involve participants ranging in age from 12 to 81 years. There have been, however, two case studies that have examined the long-term psychological consequences of brain injury: patient JP (Ackerly, 1964) and patient DT (Grattan & Eslinger, 1992). In both cases, it was found that early childhood frontal lobe lesions resulted in life long social and emotional maladjustment. These patients remained at the developmental stage achieved at the time of injury as social maturation was arrested.

In summary, accounts of basic forms of empathy apparent at a very young age suggests a biological underpinning. In addition, children who have sustained frontal lobe lesions tend to remain at that level of empathic capability throughout their life. With age, the degree to which empathy is expressed is reflective of the level of social development.

Neurological and Neuropsychological Correlates

Emotion Recognition

Virtually any alteration of central nervous system (CNS) activity can change an individual's personality (Kolb, 1985). For example, impairments of movement, perception or language can affect how an individual behaves and is perceived by others. Further, such impairments will affect how the individual perceives others.

Over the past decade, a view has emerged that there is both a lateralization of control of certain emotional processes (right hemisphere being dominant) as well as a localization of control to the frontal and medial temporal regions. Although there are reports of important left hemisphere contributions to discrimination of facial identity and/or expression (Damasio, Damasio & Van Hoeson, 1982; Reuter-Lorenz & Davidson, 1981; Safer, 1981), most studies have indicated a greater contribution of the right hemisphere (Borod, Koff, Perlman & Nicholas, 1986; Ellis & Shepherd, 1975; Etcoff, 1984, Braun et al, 1994). The research literature supports the assertion that the right-hemisphere (primarily in the frontal and temporal lobes) plays a dominant role in the processing of content (Braun et al., 1994; George et al., 1996; Ley & Bryden, 1982) and identification of emotion expressed visually and verbally (Braun et al., 1994; Denes et al., 1984). Weddell (1994) suggested that emotion recognition may be mediated by frontal-striatal pathways. Bowers et al. (1991) and Young et al. (1995) have shown that patients with right (but not left) cerebral injuries tend to demonstrate an overall impairment in recalling, imaging, identifying, and visualizing facial and emotional expressions. Electrical stimulation of the right (but not left) middle temporal

gyrus also results in an inability to correctly label the emotion shown in faces (Joseph, 1996).

Kolb and Whishaw (1996) reference a study by Cicone and associates who asked patients to match a target scene such as a man being robbed, with one of four other scenes that displayed the same emotion. Right hemisphere patients were more impaired than left hemisphere patients on both visual and verbal forms of the test. Using positron emission tomography (PET) George et al. (1996) documented increased activity in the right prefrontal cortex during detection of emotional prosody expressed in sentences. Using functional magnetic resonance imaging techniques (fMRI) on ten right-handed males with no history of neurological or audiological illness, Buchanan et al. (2000) found that the auditory detection of emotion compared with simple verbal detection resulted in significant activity in the right inferior frontal lobe.

In his review of studies that exemplify this view, Pinel (1997) found that right temporal and/or parietal lobe lesions produce talking in individuals that is characterized by excessive concern for their personal lives. For example, these patients have been found to exhibit paranoia that the family and friends are against them or don't believe them. Conversely, left lesions reduce talking and are associated with positive emotion. In addition, localized damage to the frontal lobes have been shown to hinder the production of facial expression.

The first systematic study to investigate the contrasting behavioral and emotional effects resulting from brain damage was done by Gainotti (1969). This study showed that catastrophic reactions occurred in 62% of his left hemisphere sample compared with only 10% of the right hemisphere sample. In contrast, indifference was found in 38% of right

hemisphere patients and 11% of left hemisphere cases. Later on, Gainotti (1972) evaluated a group of hemiplegics to evaluate absence of emotional response (anosognosia) and depression. Significant hemispheric differences were found. Many more right hemisphere damage patients showed some form of anosognosia, while a greater number of those with left hemisphere damage showed some degree of depression. From this, it was suggested that the emotional responses of the two hemispheres were different. Subsequent investigations have suggested that the right hemisphere can be considered dominant for emotion in the human, analogous to left hemisphere dominance for language (Bear, 1983). Thus, it has been supported that severe damage to the left hemisphere can lead to an emotional response (depression) while damage to the right hemisphere can produce anosognosia (Benson, 1984).

In addition to the focus of study on the localization and lateralization of emotional processes, there have been a concentration of studies on the effects of brain damage on perception of affective stimuli. Recognition of emotion expressed either visually or vocally has been shown to be poor in patients with right hemisphere damage (Heilman, Scholes & Watson, 1975). Kolb and Taylor (1981) examined the effects of cortical excision upon the perception of emotion in facial expression, the perception of emotion in verbal expression, and the spontaneous production of conversational speech. The first part of the study involved showing the patient seven key photographs of sadness, fear, happiness, anger, disgust, surprise and interest. The subject was then shown 24 photographs out of a magazine and was asked to match each to the appropriate key emotion picture. Those with right hemisphere lesions had impairment in matching the different faces displaying similar emotional states. In patients with unilateral focal excisions of frontal, temporal, or parieto-occipital cortex it

was found that lesions of the left hemisphere impaired the matching of verbal description to appropriate verbal categories of emotional states.

Kolb and Taylor (1981) observed a large reduction in spontaneous facial expression in patients with left or right frontal-lobe lesions, compared with patients with temporal- or parietal-lobe lesions. This is in contrast to the increased talking of the right-frontal-lobe lesion patients. The limited spontaneous talking of the patients with left frontal-lobe lesions supports previous reports on the impoverishment of spontaneous narrative speech. The frequent spontaneous talking of the right frontal lobe patients can probably be ascribed to the tendency of right frontal lesions to produce impulsiveness and rule-breaking behavior.

On the basis of studies of neurological and psychiatric patients it has been proposed that the right hemisphere plays a special role in the production of affective behavior and the perception of socially relevant stimuli such as facial expression and affective tone in voices (Lowick, 1995). Facial recognition is suggested to be identified in the amygdala, superior temporal sulcus, inferior temporal visual cortex, parietal cortex, and frontal cortex (Perrett, Rolls & Caan, 1982). Dysfunction of the facial recognition system may not only represent a perceptual deficit but may directly translate into behavioral alterations, perhaps via amygdala projections to cortical regions (e.g., orbitofrontal cortex) believed important in behavioral regulation (Rubinow & Post, 1992). Although face-responsive neurons have been identified in both hemispheres and facial perception appears to occur bilaterally, facial recognition shows hemispheric asymmetry with right hemisphere preference (Marzi, Tassinari, Tressoldi, Barry & Grabowska, 1985).

A study by Braun, Deneault, Cohen and Rouleau (1994) was aimed at determining

the extent to which lobectomy affects ability to discriminate facial identity or facial expression. They employed a facial identity matching task and a facial affect matching task. In general, the lobectomized patients were significantly impaired on both tasks. The site of lobectomy did not selectively influence performance on any one task, and it was concluded that all four brain regions (right/left temporal and right/left frontal) play equal roles in face processing, and that circuits more specifically dedicated to visual face processing, are probably located more posteriorly in the brain.

Overall, there is strong agreement that the temporal cortex plays a more important role in discrimination of facial identity and facial affect than do more posterior regions of the brain (Braun et al., 1994). In addition, temporal patients were more abnormal than frontal patients on a perceptual categorization task involving facial stimuli (Kolb, Milner & Taylor, 1983).

There is controversy regarding the valence of facial expressions and whether one hemisphere is dominant over the other depending on whether the emotions to be discriminated are positive or negative (Lowick, 1995; Reuter-Lorenz & Davidson, 1983; Sackheim, Greenberg, Weinman, Gur, Hungerbuhler & Geschwind, 1983). Braun et al. (1994) found that the cortex of the frontal lobes may contribute to various aspects of facial perception, including categorization of emotions and of identity of faces. In addition, it appears that this frontal contribution is not different from the temporal contribution. The processing of negative emotions was more impaired than positive emotions on both the FTE (facial test of emotion) and the CTE (contextual task of emotion).

Jackson and Moffat (1987) found that closed head-injured (CHI) patients are

impaired at identifying facial expressions. Identification of negative emotions was significantly more impaired than identification of positive emotions on a task similar to the FTE as well as on a task requiring subjects to label the emotion best representative of a given body posture.

Empathy

Mead (1934) suggested that role-taking ability is the key variable in social functioning and that social sensitivity has origins in the central nervous system. In a similar vein, recent research has adopted the multifaceted definition of empathy and has focused on the neurological processes involved in empathy and its production (Eslinger, 1998; Grattan 1994; Scott, Young, Calder, & Hellawell, 1997). However, the consequences of cerebral damage on performance on empathic measures have only recently begun to be studied. In a study by Eslinger, Satish and Grattan (1998) on the effects of acquired cerebral damage on performance on affectively- and cognitively-based measures, it was found that cerebral damage affected both types of empathy scores (emotional and cognitive).

Damasio, Tranel and Damasio (1990) in their study of patient EVR (who sustained damage to ventromedial frontal cortices) found that the bifrontal subject failed to generate somatic activation (via skin conductance) to socially significant stimuli. From this it can be inferred that empathic ability was compromised, as the prerequisite (recognizing socially significant stimuli) was not present.

In normal individuals, the ventromedial frontal cortices receive signals from various neural structures engaged in perception (visual, olfaction, audition, internal visceral and skeletal states). These signals arrive in the orbital region via multi-stage projections from

higher-order association cortices in temporal, parietal, and cortical regions (Pinel, 1997). Furthermore the ventromedial frontal cortices are the only known source of projections from frontal regions towards central autonomic control structures (Chavis & Pandya, 1976; Jones & Powell, 1970; Nauta, 1971). Damasio et al. (1990) propose that the ventromedial frontal cortices serve two purposes: to modulate incoming external and internal stimuli; and to activate somatic effectors in the amygdala, hypothalamus, and brainstem nuclei.

Disruptions to the aforementioned prefrontal regions cause profound disturbances in how people relate to others (Eslinger, 1998). Grattan, Bloomer, Archambault and Eslinger (1994) conducted a study aimed at finding a relationship between impairments in interpersonal functioning and cognitive flexibility (being able to generate and consider ideas and different response possibilities as well as in choice of behavioral responses and understanding of others) in individuals with frontal lobe injury. Based on the established notion that adult patients with acquired brain injury obtain significantly lower scores on an empirical measure of empathy compared to normal controls (Grattan and Eslinger, 1989) it was their hypothesis that there would be a positive correlation between measures of cognitive flexibility and empathy in subjects who sustained frontal lobe lesions in the dorsolateral, mesial or orbital sectors. The results indicated that empathy level was found to be significantly correlated with measures of cognitive flexibility supporting the hypothesis that the impairment in flexible thinking could represent a cognitive underpinning for alterations in empathy. Interestingly, it was found that left and right dorsolateral lesions caused significant impairment in cognitive flexibility and empathy. Grattan and Eslinger suggest that lack of empathy may have a cognitive basis in deficient flexibility of thinking. Overall, the

findings of this study support a model of functional-anatomic distinctions within the frontal lobe that encompasses cognitive and noncognitive mechanisms within a network of cerebral structures subserving complex social processes.

In a follow-up of the aforementioned study, Eslinger (1998) found significant correlations (.5-.6) between cognitive flexibility measures and empathy scores. Patients with acquired focal lesions of the frontal lobe in the dorsolateral region were found to have impaired empathy and cognitive flexibility suggesting that cognitive impairments limit ability to perceive, understand and interact adaptively with others. However, patients with orbitofrontal lesions exhibited normal cognitive flexibility but impaired empathy. Specifically, these patients would describe social matters accurately but would not guide their behavior in a socially acceptable way. Frontal lesion patients who had normal empathy scores experienced a more positive social and vocational outcome than patients with reduced empathy scores. These patterns of findings on the effects of different frontal lobe lesions lead to the notion that there might be an anatomic-functional correlation between dorsolateral frontal systems and predominantly cognitive aspects of empathic processing and orbitofrontal systems and emotional empathic processing.

Brain Injury and Emotion Recognition

Recovered brain injured patients often remain chronically compromised in their social relations (Damasio, Tranel & Damasio, 1990; Grattan & Eslinger, 1992; Weddel, 1980) and emotional stability (Levin, Grossman, Rose & Teasdale, 1979; O'Hara, C., 1988). It is generally agreed that these problems are among the most persistent and the most handicapping of all for CHI patients (Braun et al., 1989). Relatives of HI patients consider

the emotional changes (e.g., anxiety, childish behavior, depression) to be greater burdens than either their physical or cognitive impairments (Brooks & Aughton, 1979).

Following damage to ventromedial frontal cortices, adults with previously normal personalities develop abnormal social conduct and inadequate decision-making and planning that repeatedly lead to negative consequences. Damasio, Tranel and Damasio (1990) discuss the case study of patient EVR who had surgical resection of an orbitofrontal meningioma. Prior to this, EVR was a successful professional, husband and father. Following the ablation, EVR exhibited the prototypical pathology associated with such brain injury. Although his performance on IQ and memory tests remained in the superior range, his social conduct met the criteria for sociopathic disorder in the third edition of the Diagnostic and Statistical Manual. Although EVR could solve hypothetical ethical problems, when faced with such a problem in a real-life setting, he was unable to generate appropriate solutions.

It is possible that an impaired ability to recognize emotions accurately (Braun et al., 1989) may be a significant factor in the chain of events which produce maladaptive social and emotional behavior (Jackson & Moffat, 1987). Neuropsychological studies of emotional recognition indicate the specific involvement of the right hemisphere in the expression, understanding and storage of affective information. In their study of brain injury patients and emotional recognition, Jackson and Moffat (1987) report that the head injured group (15 right-handed males; average time since injury = 6.5 years) were more impaired on the recognition of negative emotions than positive emotions. No relationship between age, verbal IQ and emotional recognition could be found in either subject group.

Young, Aggleton, Hellawell and Johnson (1995) investigated face processing

impairments in a 51 year old female with a partial bilateral amygdalotomy. Prior to the surgery, the subject was able to recognize familiar faces. Following the operation however, she had generalized difficulties with name retrieval of familiar faces. In contrast, her ability to match simultaneously presented photographs of unfamiliar faces was unimpaired. Also experienced were deficits in the recognition of emotion in people's faces. This confirms that the amygdala plays a role in learning and social behavior.

Borod, Cicero, Obler, Welkowitz, Erhan, et al. (1998) examined emotional perception in stroke patients (11 right-brain-damaged (RBD) and 10 left-brain-damaged (LBD)) across 3 communication channels: facial, prosodic, and lexical. Hemispheric specialization for emotion was tested via right-hemisphere (RH) and valence hypotheses, and relationships among channels was determined. RBD participants were significantly more impaired in identification tasks than LBD.

In sum, it is generally agreed upon that the social and behavioral implications of CHI are significant. It is suggested that impairment in recognition of facial affect is a major contributing factor to this outcome. Studies have shown that there seems to be greater impairment in recognizing negative emotion rather than positive emotions. Also, it has been shown that the amygdala plays a role in emotion recognition and that RBD (more than LBD) may result in decreased ability to identify emotion.

Brain Injury and Empathy

Significant disturbances of higher cognition and social behavior are often disabling consequences of damage to the frontal lobes (Grattan & Eslinger, 1992). The classic example of Phineas Gage (Harlow, 1868), the young railroad worker who acquired a massive

frontal lobe lesion, illustrates the effects that such damage can have on social adaptation and development. While this and other case examples illustrates the profound and pervasive effects that CHI can have, there is little information available regarding the long-term consequences of childhood frontal lobe lesion. One of the first such studies was done by Grattan and Eslinger (1992) with patient DT.

DT sustained damage in the left frontal cortex and white matter. There were no observable abnormalities in the right frontal lobe. A single photon emission tomography (SPECT) study revealed abnormally low bilateral cerebral blood flow. Extensive evaluation indicated significant impairments in self-regulation and executive functioning. This included difficulty in sustained attention and concentration, lack of cognitive flexibility, difficulty in planning and regulation of goal-directed activity, and poor environmental judgements. DT obtained a very low score on the Empathy Measure (total = 27, - 2 SD) suggesting that she had difficulty understanding another person's situation. Her MMPI profile indicated an atypical pattern of responses, associated with a chronic history of social maladjustment.

In sum, the long-term result of childhood CHI as exhibited in DT illustrates a persistent pattern of disturbed psychological development and adaptive social behavior leaving her unable to acquire particular psychosocial skills beyond the level of early adolescence.

Purpose

The purpose of this study is twofold:

1. To expand on the study by Lowick (1995) determining whether individuals with

brain injury exhibit deficits in emotion recognition (as detected by the VERT) and in emotional and cognitive empathy (as measured by the EM and QMEE, respectively). It is hypothesized that individuals with brain injury will have lower scores (as compared to the normal control group) on the subscales of the VERT as well as on the EM and QMEE.

2. Provided these deficits exist, the relationship between empathy and emotion recognition will be analysed. It is hypothesized that individuals who have deficits in emotion recognition will have deficits in both forms of empathy and those without deficits in emotion recognition (i.e., normal controls) will have an intact ability to empathize.

Method

Subjects

This study employed two subject groups: a brain-injured sample and a control group. The brain-injured individuals were recruited on a voluntary basis from Brain Injury Services of Northern Ontario (BISNO) and St. Joseph's Hospital. The 20 participants in this group included 14 males and 6 females. (A detailed description of the brain injury group can be found in the results section.) The control group (8 males and 14 females) were recruited from two Lakehead University undergraduate psychology classes. Students who participated earned 3% toward their final grade.

Participants were screened (via questionnaire) for confounding variables such as:

1) Language: The ability to understand English (in written or verbal form) was required due to the nature of the test instructions and questionnaires.

2) Vision: Individuals who were visually impaired to the extent that they could not see aspects of the VERT were not included in the study.

3) Cultural background: The cultural and/or ethnic background of the individuals was noted in the demographic form. A post hoc analysis of cultural differences in: judgements of type and intensity of facial expression, interpretation of and emotional/cognitive reactions to social situations was conducted.

4) Etiology of brain-injury: The experimental subject group was restricted primarily to those who sustained traumatic brain injury at least 1 year prior to testing.

5) Prior mild head injuries in control group: Individuals who had previously sustained a moderate to severe degree of concussion were not included.

All participants met the requirements of these criteria.

Assessment Measures

Emotion Recognition Test

VERT

The Victoria Emotion Recognition Test (VERT; Appendix A) was developed by Mountain (1993). It is a measure that can be useful for the measurement of failures in recognition of emotion as well as to study the function of recognition of emotion. The test involves the simultaneous presentation of pairs of photographs (visual channel), pairs of voice clips (auditory channel) and a combination of the two (visual-auditory channel). The emotions of anger, happiness, sadness and fear are presented at mild, moderate and severe levels on each channel. The subjects are required to determine whether the emotions portrayed in each pair were the same or different, name the emotions, judge the intensities

as the same or different, and indicated the intensity level of each emotion depicted.

Empathy Scales

Hogan Empathy Scale (EM)

Hogan's Empathy Scale (EM; Appendix B), completed in 1969, was designed to measure the ability of an individual to "put himself in another person's shoes." According to Hogan's conception of empathy, people who are more empathic should be more socially aware, better adjusted, and more caring about the feelings of others (Hogan, 1969). His definition of social acuity is related to his definition of empathy in that highly empathic subjects are more aware of the environment than those with low empathy. Because empathy plays a central role in many phases of social psychology, Hogan (1969) felt that a valid and easily administered measure would be useful. Up until this point, there had been a variety of attempts to create such a measure, however, most had not received stellar reviews. For example, the earlier measures such as the Empathy Test (Kerr, 1947), the Test of Social Insight (Cassel, 1963) and the Chapin Social Insight Test (Chapin, 1942) raised methodological questions by reviewers (e.g., Chlopan, 1985) and lacked validity.

The 64 items of Hogan's Empathy Scale include 31 from the California Personality InventoryI, 25 from the MMPI and 8 from various experimental testing forms used in studies at Berkeley. Hogan used 100 military officers, 45 research scientists and 66 student engineers in designing the questionnaire. With the Q sort description of each person, they were each given an empathy rating. Further, the empathy ratings were correlated in each sample with the standard scales of the the California Psychological Inventory (CPI; Gough, 1964) the MMPI and the Chapin Social Insight Test. Through item-analysis of the

responses of the high-rated versus the low-rated groups were compared and using the chi-square and the Fisher's exact statistic, 64 of the 957-item pool were selected (32 true, 32 false).

Hogan reports a correlation of .58 between social acuity and empathy (Chlopan, 1985). The EM has been used to assess empathy in relation to a number of personality variables, such as anxiety, locus of control, autonomy and socialization. Chlopan (1985) reported that those who scored higher on the EM were less anxious and better adjusted (e.g., finding inverse relationships with the phobic cluster, obsessiveness, and depression). Further support for the negative relation between the EM scale and anxiety comes from Davis' (1983) personal distress subscale. In sum, the studies relating empathy to personality variables have generally shown that the highly empathic individual (as measured on the EM/ Hogan scale) is less anxious, less depressed and generally better adjusted than their less empathic counterpart (Chlopan, 1985). Empathic subjects also seem to have less discrepancy between self-ratings, test scores, and peer ratings of femininity, social insight, and empathy than do nonempathic subjects (Mills & Hogan, 1978). It is notable that, regardless of whether patients rated themselves or family members rated them, reports indicate similar scores on the EM (Bardenhagen, Bowden, Shields, McKay, Smith, Vogrin, Collins & Cook, 1999; Eslinger, 1998).

The Questionnaire Measure of Emotional Empathy (QMEE)

Mehrabian and Epstein (1972) advanced the notion that although there is a cognitive component involved in empathy, in their view, it is the lack of an adequate emotional processing component that results in an inability to be empathetic (Mehrabian & Epstein,

1972).

The QMEE (Appendix C) is a 33-item test in which the respondent answers each item on a scale from very strong disagreement (-4) to very strong agreement (+4). This measure includes seven intercorrelated subscales. In personality studies using QMEE, empathy was found to correlate significantly with a measure of social interest suggesting that highly empathic people have the ability to become aroused by others in distress, a factor that probably plays a large role in positive social encounters (Chlopan, 1985). Highly empathic individuals tend to show a great amount of social concern and tend to screen irrelevant environmental information less. In another study, it was shown that individuals who expressed their reaction to a situation with facial expression scored higher on the empathy scale (Chlopan, 1985).

Upon critical review of measures of empathy, only two scales, the QMEE and Hogan's EM scale have a number of studies supporting their validity and reliability (Chlopan, 1985; Eslinger, 1998). These measures involve two different aspects of empathy; the literature on the QMEE indicates that it is measuring vicarious emotional arousal and may even be tapping a general tendency to be arousable in various situations, whereas the literature on the EM indicates that this scale is measuring role-taking ability and may even be tapping an aspect of adequate social functioning. Eslinger's study on the multidimensional nature of empathy in brain-injured subjects (1998) employed the QMEE and EM as valid measures of the emotional and cognitive forms of empathy. Taken together, these two scales measure empathy as the ability to (a) become emotionally aroused to the distress of another and (b) take the other person's point of view, in order to have true

empathy. If one accepts these definitions of empathy then these two scales seem to provide a basis for the measurements of empathy.

Procedure

Prior to testing, the relevant methods and details of the study were explained to the participants and the consent form (Appendix D) was read and signed. Participants were given a participant number and then asked to complete the Demographic Sheet (Appendix E). Participants who had difficulty reading or writing were administered the demographic questions orally. Following this, all participants were administered the VERT. To control for sequencing effects, the administration of the QMEE and the EM was counterbalanced. Because the majority of the brain injury group had difficulty reading (i.e., poor vision, problems with reading comprehension, slow processing speed) each participant was given a copy of the test to follow along as it was read to them. Upon completion of testing, each participant was debriefed and offered the opportunity to receive a summary of the results which would be mailed to them when available. The entire procedure took, on average, 50 minutes for the control group and 90 minutes for the brain injury group.

Results

Group Descriptions

A total of 42 participants completed the test session: 22 undergraduate students and 20 individuals who had sustained brain injury. All participants met the inclusion criteria.

The control group consisted of 8 males and 14 females. They ranged in age from 19 to 30 (M = 22.73, SD = 1.13), with an education range of 14 to 17 years (M = 15 years). There were 20 right-handed participants (7 males, 13 females) and 2 left-handed participants (1 male, 1 female).

The brain-injured group consisted of 14 males and 6 females. They ranged in age from 18 to 54 (M = 36.7, SD = 10.44), with an education range of 12 to 17 years (M = 13 years). There were 16 right-handed participants (11 males, 5 females) and 4 left-handed participants (3 male, 1 female). The average number of years post-injury was 6.03 (range = 1 to 26 years).

Table 1. Description of participants with brain injury.

Participant	Age	Gender	Hand	Years post	Cause of BI	Length of coma	Time in hospital
101	35	M	Right	4	Physical attack	1½ months	3 months
102	34	M	Right	26	Impaled by rod	n/a	1 day
103	33	M	Right	2	Drug overdose	2 months	1½ yrs
104	22	M	Right	4	MVA	3months	1 months
105	41	M	Left	4	MVA	5 days	4 months
106	45	M	Left	6	Motorcycle accident	15 days	5 months
107	18	M	Right	5	Bicycle accident	24 hrs	1½ months
108	50	M	Right	11	Physical attack	10 days	3 months
109	44	M	Right	1½	MVA	4 months	6 months
110	30	M	Right	12	MVA	8 months	2 yrs
111	36	M	Left	3	Physical attack	7 weeks	2 yrs
112	40	F	Right	8	MVA	3½ weeks	13½ months
113	39	M	Right	3 ½	MVA	0	2 months
114	29	F	Right	3	MVA	1 day	2 ½ months
115	43	F	Right	5 ½	Aneurysm	0	2 weeks
116	44	M	Right	1 ½	MVA	0	<1 day
117	54	M	Right	5 ½	Plane crash	0	3 days
118	20	F	Right	4 ½	MVA	7 days	5 months
119	25	F	Right	9 ½	MVA	6 ½ weeks	6 months
120	52	F	Left	1	Stroke	0	3 weeks

Brain-Injury Group Versus Control Group

The primary measures of interest in the present study were the Victoria Emotion Recognition Test (VERT), Hogan's Empathy Measure (EM) and Mehrabian and Epstein's Questionnaire Measure of Emotional Empathy (QMEE). One main purpose for conducting this study was to determine whether deficits in emotion recognition and emotional and cognitive empathy (as measured by the aforementioned tests) are present in individuals who have sustained brain injury, and further, to identify the extent, if any, of such impairment. The other conceptual question of this study was to determine the nature of the relationship between empathy and emotion recognition. It was hypothesized that individuals with brain injury would attain lower scores the VERT, EM and QMEE. Further, it was postulated that those with emotion recognition difficulties would have deficits in empathic responding and those without deficits in emotion recognition (i.e., normal controls) would have an intact ability to empathize. The following sections deal with these questions.

VERT Scores

As previously indicated, the VERT is a test of an individual's ability to recognize and identify dichotically presented emotions (happiness, sadness, anger, and fear) and their intensities as they are presented in the form of a picture or audio clips. The VERT has nine possible outcome scores: total visual channel, total auditory channel, total visual/auditory channels, match emotions, identify emotions, match intensities, identify intensities, overall total, and total time to complete the test. Using SPSS for Windows (Version 9), independent samples t-tests were performed to compare the brain-injury and control groups on these nine

VERT scores (see Table 2a and 2b). The control group performed significantly better (p's < .002) on all nine scores indicating that overall, the control group was better able to recognize and identify emotions and their intensity across both the visual and auditory channels.

Empathy scores

As previously discussed, two measures of empathy were used in this study: Hogan's Empathy Measure (EM), which is said to target the cognitive aspects of empathy and the Questionnaire Measure of Emotional Empathy (QMEE), which is intended to measure capacity for emotional empathy. Results from SPSS ANOVA are indicated in the following sections.

Independent samples t-tests were performed to compare the brain-injury and control group on their EM scores (see Table 3). In contrast to the brain-injury group, the control group ($M = 41.77$, $SD = 5.94$) performed significantly better on the EM ($t(40) = 4.52$, $p < .001$) than the brain injury group ($M = 33.55$, $SD = 5.83$).

QMEE

Overall comparison of the groups using independent samples t-tests on the QMEE did not reveal significant differences ($t(40) = 1.79$, $p = .081$) between the control group ($M = 38.0$, $SD = 24.09$) and the brain injury group ($M = 23.7$, $SD = 27.65$) (see Table 4).

Table 2(a). Group Statistics for VERT Scores

	Head Injury	N	Mean	Std. Deviation	Std. Error Mean
TOTAL VISUAL	no	22	48.64	4.32	.92
	yes	20	42.10	5.82	1.30
TOTAL AUDITORY	no	22	49.00	4.51	.96
	yes	20	39.90	6.85	1.53
TOTAL VIS/AUD	no	22	52.09	5.81	1.24
	yes	20	41.60	6.77	1.51
GRAND TOTAL	no	22	149.73	10.72	2.29
	yes	20	123.60	14.69	3.29
MATCH EMOTION	no	22	27.50	2.72	.58
	yes	20	24.90	2.47	.55
IDENTIFY EMOTION	no	22	57.27	4.39	.94
	yes	20	46.65	7.21	1.61
MATCH INTENSITY	no	22	23.18	3.06	.65
	yes	20	19.35	3.53	.79
IDENTIFY INTENSITY	no	22	41.77	4.75	1.01
	yes	20	32.70	6.10	1.36
MINUTES	no	22	15.3182	3.1227	.6658
	yes	20	23.7500	6.8739	1.5370

Table2(b). Independent Samples Test for VERT scores

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
TOTAL VISUAL	Equal variances assumed	1.724	.197	4.159	40	.000	6.54	1.57	3.36	9.7
TOTAL AUDITORY	Equal variances assumed	3.991	.053	5.128	40	.000	9.10	1.77	5.51	12.6
TOTAL VIS/AUD	Equal variances assumed	.052	.820	5.402	40	.000	10.49	1.94	6.57	14.4
GRAND TOTAL	Equal variances assumed	1.149	.290	6.626	40	.000	26.13	3.94	18.16	34.1
MATCH EMOTION	Equal variances assumed	.375	.544	3.231	40	.002	2.60	.80	.97	4.2
IDENTIFY EMOTION	Equal variances assumed	3.506	.068	5.826	40	.000	10.62	1.82	6.94	14.3
MATCH INTENSITY	Equal variances assumed	.060	.807	3.766	40	.001	3.83	1.02	1.78	5.8
IDENTIFY INTENSITY	Equal variances assumed	2.200	.146	5.407	40	.000	9.07	1.68	5.68	12.4
MINUTES	Equal variances assumed	10.8	.002	-5.198	40	.000	-8.4318	1.6220	-11.710	-5.153

Table 3(a). Group Statistics for EM Scores

	Head Injury	N	Mean	Std. Deviation	Std. Error Mean
EM	no	22	41.77	5.94	1.27
	yes	20	33.55	5.83	1.30

Table 3(b). Independent Samples Test for EM Scores

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std.Error Difference	Lower	Upper
EM	Equal variances assumed	.075	.786	4.520	40	.000	8.22	1.82	4.55	11.90

Table 4(a). Group Statistics for QMEE Scores

	Head Injury	N	Mean	Std. Deviation	Std. Error Mean
QMEE	no	22	38.00	24.09	5.14
	yes	20	23.70	27.65	6.18

Table 4(b). Independent Samples Test for QMEE Scores

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
QMEE	Equal variances assumed	.253	.617	1.791	40	.081	14.30	7.99	-1.84	30.44

A Relationship Between Emotion Recognition and Empathy

While the first hypothesis was found to hold true for the VERT and EM, it did not for the QMEE. Specifically, the brain injury group differed from the normal control group with lower scores on the emotion recognition and cognitive empathy, however, no differences were observed between the groups on the emotional measure of empathy. To address the second conceptual issue, bivariate correlations between the measures were performed. The EM was found to correlate significantly ($p < .05$) on the following subscales of the VERT: total visual channel ($r = .527$), total visual/auditory channel combined ($r = .454$), the overall VERT score ($r = .503$), identification of emotion ($r = .54$), and identification of intensity ($r = .483$). The QMEE did not, however, correlate with any of the subscales on the VERT. In a bivariate correlation analysis of the two empathy measures, scores on the QMEE and the EM were found to correlate for the brain injury group ($r = .576$, $p < .01$) and for both groups combined ($r = .472$, $p < .01$), but not for the control group ($r = .224$).

Demographics and Dependent Variables.

Bivariate correlations of the nine VERT scores, the EM and the QMEE were made with the demographic variables of age, education, gender, and handedness. As is depicted in Table 5, there was only one significant correlation, which occurred between gender and the QMEE in the brain injury group ($r = .574$, $p < .01$).

Table 5. Bivariate correlations for control/brain injury groups on outcome measures with demographic factors.

MEASURES		AGE	EDUC	GENDER	HAND
HOGAN	Pearson Correlation	.173	.101	-.160	-.205
		-.046	.335	.379	.084
	Sig. (2-tailed)	.442	.656	.478	.359
		.849	.149	.100	.726
QMEE	Pearson Correlation	.209	-.034	.309	.114
		-.319	.312	.574	-.171
	Sig. (2-tailed)	.350	.879	.162	.613
		.170	.180	.008*	.472
ID EMOTION	Pearson Correlation	.300	-.279	-.260	-.168
		-.295	.281	.172	-.028
	Sig. (2-tailed)	.175	.209	.242	.456
		.207	.231	.468	.905
ID INTENSITY	Pearson Correlation	-.036	-.013	.146	.152
		-.204	.399	.143	-.101
	Sig. (2-tailed)	.872	.953	.516	.500
		.388	.081	.547	.672
MATCH EMOTION	Pearson Correlation	.313	-.106	-.391	.178
		-.353	-.141	.154	-.083
	Sig. (2-tailed)	.157	.637	.072	.427
		.127	.554	.516	.728
MATCH INTENSITY	Pearson Correlation	.293	-.153	-.143	.034
		-.190	.263	-.162	-.160
	Sig. (2-tailed)	.186	.496	.524	.882
		.423	.312	.496	.501
TOTAL AUDITORY	Pearson Correlation	.316	-.101	-.129	.072
		.089	.219	-.219	-.404
	Sig. (2-tailed)	.152	.655	.569	.751
		.708	.354	.354	.077
TOTAL VISUAL	Pearson Correlation	.116	-.108	-.267	-.010
		.057	.102	.085	.256
	Sig. (2-tailed)	.609	.632	.230	.964
		.264	.668	.723	.277
TOTAL VISUAL/AUD	Pearson Correlation	.166	-.193	-.038	.051
		.261	.434	.321	-.045
	Sig. (2-tailed)	.460	.388	.867	.823
		.334	.056	.168	.849
GRAND TOTAL	Pearson Correlation	.270	-.191	-.182	.054
		-.334	.343	.079	-.108
	Sig. (2-tailed)	.225	.395	.417	.813
		.150	.139	.740	.650

Gender Effects

It remains, however, that the two groups differ in gender and it is therefore important to explore whether this demographic variable might have been responsible for the group differences reported alone. To test this, independent samples t-tests were examined within and between each group on each outcome measure.

Within Groups

Males and females were compared within gender and within each group on the EM, QMEE and the nine VERT scores with SPSS ANOVA procedures. Means and standard deviations for all participants on each measure are presented in Table 6 (a). There were no significant differences between males and females in the control group on any of the measures (see Table 6(b)) . Similarly, males and females in the brain injured group did not differ on the VERT scores or the EM, however, there was a significant difference on the QMEE ($t(18) = -2.97$, $p < .05$) with females ($M = 47.33$, $SD = 27.41$) performing significantly better than the males ($M = 13.57$, $SD = 21.46$) (see Table 6(c)).

Table 6(b). Independent Samples Test for the Comparison of Males vs. Females in the Control Group

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
HOGAN	Equal variances assumed	.993	.331	.724	20	.478	1.93	2.66	-3.63	7.49
QMEE	Equal variances assumed	.314	.581	-1.453	20	.162	-15.13	10.41	-36.83	6.58
TOTVISU	Equal variances assumed	.199	.660	1.239	20	.230	2.34	1.89	-1.60	6.28
TOTAUDIT	Equal variances assumed	.565	.461	.580	20	.569	1.18	2.03	-3.06	5.42
TOVISAUD	Equal variances assumed	2.034	.169	.169	20	.867	.45	2.64	-5.06	5.95
GRANDTOT	Equal variances assumed	.935	.345	.828	20	.417	3.96	4.79	-6.02	13.95
MATCHEM	Equal variances assumed	.251	.622	1.900	20	.072	2.16	1.14	-.21	4.53
IDEMOT	Equal variances assumed	1.258	.275	1.207	20	.242	2.32	1.92	-1.69	6.33
MATCHINT	Equal variances assumed	.305	.587	.648	20	.524	.89	1.38	-1.98	3.77
IDINTEN	Equal variances assumed	2.112	.162	-.661	20	.516	-1.41	2.13	-5.86	3.04
TIME TO COMPLETE	Equal variances assumed	.792	.384	.481	20	.636	.6786	1.4100	-2.2627	3.6198

Table 6(c): Independent Samples Test for Comparison of Males vs. Females in the Brain Injury Group

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
HOGAN	Equal variances assumed	8.189	.010	-1.735	18	.100	-4.69	2.70	-10.37	.99
QMEE	Equal variances assumed	.144	.708	-2.974	18	.008	-33.76	11.35	-57.61	-9.91
TOTVISU	Equal variances assumed	3.379	.083	-.360	18	.723	-1.05	2.91	-7.16	5.06
TOTAUDIT	Equal variances assumed	.836	.373	.952	18	.354	3.19	3.35	-3.85	10.23
TOVISAUD	Equal variances assumed	.040	.844	-1.437	18	.168	-4.62	3.21	-11.37	2.13
GRANDTOT	Equal variances assumed	.511	.484	-.337	18	.740	-2.48	7.34	-17.90	12.95
MATCHEM	Equal variances assumed	.578	.457	.662	18	.516	.81	1.22	-1.76	3.38
IDEMOT	Equal variances assumed	.017	.898	-.742	18	.468	-2.64	3.56	-10.13	4.84
MATCHINT	Equal variances assumed	.067	.798	.696	18	.496	1.21	1.75	-2.45	4.88
IDINTEN	Equal variances assumed	.545	.470	-.614	18	.547	-1.86	3.02	-8.21	4.50
TIME TO COMPLETE	Equal variances assumed	.652	.430	.173	18	.865	.5952	3.4432	-6.6386	7.8290

Between groups

VERT

Closer inspection of these results indicate that males in the control group performed significantly better than males in the brain-injury group on all scores ($p < .05$). Similarly females in the control group performed significantly better than females in the brain-injury group on all scores ($p < .05$).

EM

In comparing within gender between groups it was found that the males in the control group ($M = 43.00$, $SD = 4.84$) performed significantly better than the males in the brain-injury group ($M = 32.14$, $SD = 6.43$) on the EM ($t(20) = 4.136$, $p = .001$). There was no difference found amongst females' scores on the EM between the two groups ($t(18) = 1.54$, $p = .141$).

QMEE

Within gender comparison between the control and the brain injury group did not elucidate the mechanism of why gender was significantly correlated with the QMEE in the brain injury group. While both sexes in the control group scored higher means than their counterparts in the brain injury group, this difference did not reach significance (males: $t(20) = 1.55$, $p = .138$; females: $t(18) = -0.312$, $p = .759$) .

Altogether, the correlations suggest that while the groups differ demographically these differences (most notably that of gender) do not seem to contribute to the overall group differences on the outcome measures.

Summary

To summarize, two groups (a control group and a group who have sustained brain injury) were administered three tests: the EM, the QMEE and the VERT. Using SPSS, statistical analyses were performed to compare the two groups on the three outcome measures. While the groups appeared to be heterogeneous on the demographic factors of age, education, gender and handedness, these factors did not appear to play a direct role in the results of the tests as indicated by bivariate correlations and ANCOVA. It is postulated that these factors (i.e., lower education, larger proportion of males) are, however, representative of the brain injury population (this will be addressed in the discussion section). In the overall comparison of groups, independent t-tests revealed a significant difference on the EM ($t(40) = 4.52$, $p < .001$) and the VERT ($p < .05$ on all nine scores, see Table 2(b) for t-scores). There was not, however, a significant difference between groups on the QMEE ($t(40) = 1.791$, $p = .081$). Bivariate correlations showed that EM and most of the VERT subscales were significantly correlated but the QMEE and VERT were not correlated. Further, significant correlations were found for combined group scores on the EM and QMEE but not when the scores for the control group were analyzed separately.

To elucidate the role of gender in the overall scores independent samples t-tests for between gender within groups and for within gender between groups were performed. The t-test for the comparison of males versus females within groups revealed no significant differences on any of the scores between males and females in the control group. When comparing males versus females in the brain injury group it was observed that there were no significant differences on the EM and VERT scores, but there was a significant difference, with females performing better than males, on the QMEE ($t(18) = -2.974$, $p < .05$).

Discussion

The purpose of this study was twofold: First, to determine whether brain injury patients exhibited deficits in emotion recognition (as detected by the VERT) and in emotional and cognitive empathy, (as measured by the EM and QMEE, respectively); second, provided these deficits exist, to determine whether the scores on the ability to recognize emotions covary with the scores on the ability to express empathy. The following two sections outline the results of the present study in relation to previous findings on deficits in empathy and emotion recognition in brain-injured samples. Following this, the results for both cognitive phenomena are integrated and discussed relative to their implications to the research literature as well as their relevance to clinical practice. Finally, comments regarding limitations to the present design are made and suggestions for the path of future research are advanced.

Empathy

As previously described, this study targeted two forms of empathy: cognitive empathy, as measured by the EM, and emotional empathy as measured by the QMEE. Results indicate that there was an overall difference between the groups on the EM. While there was no within group gender difference found, between group differences were seen when comparing males (control scores exceeding brain injury group scores) but not when comparing females on the EM. The findings for the present control group ($M = 41.77$, $SD = 5.94$) are comparable to those found by Hogan (1969).

With respect to the comparison of the EM data from the brain injured group ($M = 33.55$, $SD = 5.94$) to previous research, it is seen that Bardenhagen et al. (1999) report

similar EM scores for two male patients. The present EM findings are somewhat higher than those reported by Grattan et al. (1994): frontal brain injury M = 27.17, SD = 3.27; nonfrontal brain injury M = 27.55, SD =2.79.

With respect to the scores on the QMEE, there was no overall difference observed between the groups. When looking at differences in scores between males and females on the QMEE within the groups, no difference was found in the control group, but there was a difference within the brain injury group as the females had higher scores of emotional empathy than the males. No between group differences were found (i.e., males in control group did not differ significantly from those in the BI group, and likewise for females). In comparison to Mehrabian and Epstein's normative data (1972) it is evident that their mean scores, (males: M = 23, SD = 22; females: M = 44, SD = 21) are very close to those obtained for the control group in the present study (males: M = 28.38, SD = 21.86; females M = 43.5, SD = 24.31.). In contrast to the two case studies presented by Bardenhagen et al. (1999), the males (in the present brain injury group) generated much lower scores than HB (M = 43), and NL (M = 36). No studies were found to indicate specific QMEE means for females with brain injury. It is interesting to note, however, that while not significant, the mean score for females in the brain injury group was greater than that for the females in the control group. Similar results have been found in a small proportion (5%) of brain-injured patients, where heightened emotional empathy is parallelled with more symptoms of anxiety (Bardenhagen et al., 1999).

A possible explanation for the brain injured females scoring close to the same level as the control group females on the EM, and attaining higher scores than the brain injured males on the QMEE might be related to the severity of brain injury. The average length of

coma for males was 44.9 (with 36% lasting less than 2 days) and for females was 11 days (with 50% lasting less than 2 days). While this explanation may fit the findings for the empathy measures, it does not follow for the emotion recognition findings where there was no difference between the males and females in the brain injury group on the VERT scores, but there were significant differences for both sexes between the groups.

It is noteworthy to mention the significant correlation between the two empathy measures that were intended to measure and target broadly different aspects of the construct. Hogan's Empathy Measure has been reported to involve personality variables such as anxiety and socialization. Individuals who score higher on the EM were previously found to be better adjusted, have better social insight and less susceptible to depression (Davis, 1983; Hogan, 1969; Mills & Hogan, 1978). Mehrabian and Epstein's QMEE has been reported to be sensitive to an individual's ability to be aroused in socially distressful situations. It appears, through the present findings, that these measures share more commonalities than originally thought. With respect to the difference in findings between the two measures (i.e., individuals in the brain injury group scored significantly lower scores on the EM but not the QMEE), it is plausible that the EM is more sensitive to social adjustment and negative emotional states than the QMEE and this was reflected in the responses of the brain injured group. Further, the fact that the correlation between the measures was not significant in the control group suggests that there are qualitative differences between the groups.

Emotion Recognition

Compared to normal controls, individuals in the brain injury group performed significantly lower on all aspects of the VERT. No demographic factors were found to be

responsible for the overall findings. Lowick's (1995) study of the VERT with a brain injured sample (which, incidentally, was very similar demographically to the group in the present study) also found no demographic differences contributing to overall results. Lowick found no difference between gender (which is supported by Mountain's (1993) normative data) and no effect of education or age on any of the VERT subscales.

Taken together, the present study partially supports the first hypothesis as it has been shown that compared to normal controls, individuals with brain injury (refer to Table 1) generated significantly lower empathy scores on the EM and the VERT but not the QMEE. Further, with respect to the second hypothesis (i.e., scores on the ability to recognize emotions will covary with scores on the ability to express empathy) it was demonstrated that the VERT positively correlated with the EM but there was no significant correlation with the QMEE. Together, it appears that individuals impaired on the ability to recognize emotion exhibit deficits on the measure of cognitive empathy but not emotional empathy.

The Evaluation of Emotional Situations

While empathy does not affect a person's ability to perceive emotion in others, empathy can play an important role in the interpretation of an emotionally-loaded situation, and subsequently the person's cognitive, emotional, and behavioral response to that situation. The next section integrates the findings on emotion recognition and empathy.

The present study has demonstrated some interesting findings and raises an intriguing question. Specifically, why is there a difference between the brain injury group and control group on the cognitive measure of empathy (EM) and recognition of emotion (VERT) but not the emotional measure of empathy (QMEE)? With respect to this question, one possible

explanation might be that the psychometric differences between the QMEE and EM are responsible for the close-to-significance-but-not-quite ($p = .08$) results. The EM is a forced-choice format which leaves less room for social desirability response bias, has a smaller SD (<4) in the normative data and allows levels of cognitive empathy to be assessed more readily. The QMEE (which has a SD > 20 in all reported studies) leaves a lot of room for variation between individuals (it is a 9-point scale) and is vulnerable to social desirability response bias and extreme response scores.

Another reason for the difference between the findings in the EM and QMEE might be supported by the proposal that the cognitive system of empathy lies in the dorsolateral frontal system and the emotional system of empathy involves a broader range of structures including the orbitofrontal system and limbic system. Perhaps the lesions sustained by the participants are predominantly localized to areas of the dorsolateral frontal system.

Related to the nature of the brain injury is the issue of "knowing" versus "doing". Lezak (1983) and Prigatano (1987) have pointed out that a common consequence of brain injury, especially with damage to the frontal areas, is that the patients know how they ought to feel and ought to act but they fail to carry out the behavior. In other words, the patients recognize a situation and know how they should react, but fail to experience the appropriate emotions and do not behave accordingly. Perhaps the QMEE is too "face valid". It is conceivable that the participants in this study knew how to respond appropriately to the items (thus scoring comparably to the control group), however they did not actually attribute emotions to their responses nor could they translate their response to a real-life situation.

"Cognitive style" is a term introduced by Klein (1954). A maladaptive coping style, which can be the result of organic or psychological trauma, contributes to an interference

with the interpretation of the reality around an individual. One consequence of a maladaptive coping style is a reversion to a pattern of egocentricity. Miller (1998) indicates that it is common to see some form of egocentricity in individuals who have sustained some form of head trauma. According to Wood (1988), the thinking of frontal-injured patients is too concrete and egocentric too allow subtle forms of social perception to change behavior. Cognitive impairments such as diminished insight or loss of social awareness prevent the patient from perceiving the subtle cues that control human behavior. With respect to the brain injured individuals in the present study, it can be suggested that their cognitive style has been affected by the trauma resulting in some impairments (i.e., in the EM but not the QMEE) in evaluating social situations and difficulty in behaving in a socially desirable way. Related to this may be the suggestion of O'Hara (1988) that some forms of brain injury result in the inability of the neural mechanisms to generate the arousal required to effect an emotional experience within the individual. It might be said then, that the inability to recognize emotions and to have cognitive empathic awareness (which might be inferred as egocentricity or lack of personal insight) is a result of injury to certain brain regions and the ensuing disruption in arousal pathways.

While there are limitations to the present study (discussed later) the general findings suggest that impairments in emotion recognition systems parallel those in cognitive empathy as the brain injured group had significantly lower scores on the emotion recognition and cognitive empathy tasks, and these tasks were shown to be highly correlated. Intuitively it makes sense that in order for one to conceptualize an emotion experienced by someone else they would have to be able to recognize and identify the outwardly expressed emotion. It would be presumptuous, however, to suggest from the present data that one is a prerequisite

for the other. One could speculate though, that traumatic brain injury to the frontal and temporal regions predominantly in the right hemisphere can result in the destruction of a neural system common to the processes of emotion recognition and empathy.

Clinical Implications

For many family members and friends of individuals who have sustained brain injury, one of the most difficult after-effects to deal with is the patient's inappropriate social behaviour and decline in social sensitivity. As discussed in the early sections of this paper, these aspects of social adjustment rely on the individual's ability to perceive and represent the emotions and intentions of other people. There have been numerous papers and suggestions on social rehabilitation for those with brain injury. One of the common themes in all of these reports is that early detection of brain injury and resulting psychosocial disorders is important in the rehabilitation process.

Bardenhagen et al. (1999) suggest that the behavior of patients who have inappropriate reactions to emotional situations may be amenable to family education and a skills acquisition programme for the patient which focuses on improving their adaptive reactions to a range of emotional and situational cues. In a study by Olver, Ponsford and Curan (1996) it was shown that at five years post-injury there continued to be increased cognitive, emotional and behavioral changes, and between two and five years post-injury there was an increase in unemployment. Olver et al. (1996) strongly recommend ongoing psychosocial rehabilitation for a number of years after the injury. Grattan et al. (1994) suggest that rehabilitation for individuals with impairments in empathy should include training to develop alternate solutions to social situations.

These suggestions together with the findings of this study can be made into a more

inclusive recommendation for rehabilitation. Specifically, if empathy is dependent on the actual perception and understanding of emotion, it then follows that rehabilitation training should involve re-learning the basic emotions (what they "look" like, what they "sound" like and what they feel like) and then incorporating these emotions into more complex social situations where the individual will have to perceive social and emotional cues (i.e., context, facial expressions, body language) and consider the alternatives and their outcomes. This process should be started early and should involve family members.

Limitations

One of the main limitations and one that is common to the study of brain-injury at large is teasing apart the effects of the injury and the effects of personal loss resulting in a lifestyle change. Many of the people in the brain-injury group were faced with the loss of independence, relationships, the ability to work, and many aspects of their pre-injury lifestyle. While some had excellent family support systems, others did not. These and other factors may have contributed to the overall findings.

Another limitation relates to the nature of the injury. Some participants sustained more severe injuries and were in a coma longer than others. Additionally, while the general region of the injury was established, this does not elucidate whether diffuse damage occurred elsewhere in the brain

With respect to sample selection, the participants (who were all volunteers) were contacted through their neuropsychologist or their community support program. As a result, all participants in this study are involved in some form of contact and rehabilitation program with professionals and others who have sustained brain injury. This sample therefore, excludes individuals with brain injury who have not received external support.

Final limitations include the availability of brain injured participants and sample size. In general research, it is recommended than an n = 20 is the lower limit. In neuropsychological research, however, many of the studies have fewer than 20 subjects, and a large percentage are case studies. The nature of this form of research is time consuming as the assessment measures are quite long to administer and score (which requires patience on the part of the participant and the researcher), it requires personal interaction and behavioral observations, and participants are a select group of people who are not readily available. For this reason, the literature base has taken a long time to develop and is the result of a cumulative process. The present study had 20 brain injured participants who represent only a small proportion of the brain injured population. Future studies could offer results more generalizable to the brain injured population with larger sample sizes with adequately sized subgroups with identified areas of brain damage.

Future Research Considerations

Research has been done on the aspect of recognition and identification of emotion and its attributed valence (i.e., negative valence with anger or sadness, positive valence with happiness; see Young et al., 1995). Also, work has been done on the lateralized perception of positive and negative emotions (Joseph, 1996 for review). Investigating the role of lateralization of injury (using advanced imaging techniques such as MRI or fMRI) on the valence effect of emotion recognition and empathy would contribute to the conceptualization of the related processes of emotion recognition and identification, and empathic understanding and responding. Related to imaging techniques and localization of injury, it may serve to follow up on the suggestion made by O'Hara (1988) and investigate the

possibility that the impairments in recognition and response to emotional and social cues experienced by many brain injured individuals may be related to some dysfunction in the arousal systems.

The research literature appears to be lacking in the outcome of psychosocial rehabilitation programs specifically related to social sensitivity, emotion recognition and the ability to empathize or behave empathetically. By following up on recommendations made in this research area and reporting clinical outcomes, investigators can evaluate these outcomes and offer suggestions, and as a result, further the benefit of the patient. It is proposed that in a rehabilitation setting, the VERT and the EM could be used as viable screening instruments to identify impairments in emotion recognition and empathic functioning and predict an individual's ability to engage in adaptive daily functioning. From this, the interpersonal functioning rehabilitation program for could be designed to the patient's identified deficits. It is felt that the precision of the QMEE is not adequate to serve such a function in a rehabilitation environment, however, it could be beneficial to design a single empathy assessment tool that would accurately assess both cognitive and emotional aspects of empathy.

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Appendix A: VERT Subject Response Form

Subject number_____

Date _____

Victoria Emotion Recognition Test

Summary Scores

Task/Modality	Visual	Auditory	Visual/Auditory	Total
Match Emotion				
Identify Emotion				
Match Intensity				
Identify Intensity				
(Time)				
Total				

Transfer the five total scores from each of the three subtests to the Scores chart. Sum the matching and identifying scores and the time scores across modalities. Sum the modality scores across tasks (excluding the time scores). Eight composite scores are obtained:

1. the ability to match emotion across modalities
2. the ability to identify emotion across modalities
3. the ability to match intensity of emotion across modalities
4. the ability to identify the intensity of emotion across modalities
5. total response time across modalities
6. visual recognition
7. auditory recognition
8. visual/auditory recognition

Instructions to tester: Read the instructions below to the subject. Circle the response given by the subject (the correct answer is underlined).

Visual Recognition

This test looks at how well you can recognise emotion on other people's faces and in other people's voices. First I am going to show you some pictures of people's faces. These people are portraying one of these four emotions (show card and read) and they may be showing a little bit, a moderate amount or a great deal of that emotion (show card). On each page you will see two pictures. I want you to tell me whether the emotion on the two faces is the same or different and what emotion is being portrayed. Then I want you to tell me if the intensity in the two pictures is the same or different and what intensity is being portrayed. Let's try one and I'll show you what I mean.

	Emotion		Intensity		Score
	Match	Identify	Match	Identify	
1.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
2.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
3.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
4.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
5.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
6.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
7.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
8.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
9.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
10.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
11.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
12.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
				Total score	____

Total correct:
Emotion

Match_____ Identify_____

Intensity

Match_____ Identify_____

Auditory Recognition

This next part is a lot like the test we just did, except this time you are going to hear two voices. The words that are being spoken are not real words - don't worry about what the voices say -just tell me if the emotion in these voices is the same or different and what emotion is being portrayed. Also, I want you to tell me whether the intensity is the same or different and what intensity is being portrayed.

	Emotion		Intensity		Score
	Match	Identify	Match	Identify	
1.	S D	A. An S H Fr B. An S H Fr		S D	A. 1 2 3 B. 1 2 3	____
2.	S D	A. An S H Fr B. An S H Fr		S D	A. 1 2 3 B. 1 2 3	____
3.	S D	A. An S H Fr B. An S H Fr		S D	A. 1 2 3 B. 1 2 3	____
4.	S D	A. An S H Fr B. An S H Fr		S D	A. 1 2 3 B. 1 2 3	____
5.	S D	A. An S H Fr B. An S H Fr		S D	A. 1 2 3 B. 1 2 3	____
6.	S D	A. An S H Fr B. An S H Fr		S D	A. 1 2 3 B. 1 2 3	____
7.	S D	A. An S H Fr B. An S H Fr		S D	A. 1 2 3 B. 1 2 3	____
8.	S D	A. An S H Fr B. An S H Fr		S D	A. 1 2 3 B. 1 2 3	____
9.	S D	A. An S H Fr B. An S H Fr		S D	A. 1 2 3 B. 1 2 3	____
10.	S D	A. An S H Fr B. An S H Fr		S D	A. 1 2 3 B. 1 2 3	____
11.	S D	A. An S H Fr B. An S H Fr		S D	A. 1 2 3 B. 1 2 3	____
12.	S D	A. An S H Fr B. An S H Fr		S D	A. 1 2 3 B. 1 2 3	____
					Total score	____

Total correct:

Emotion

Match_____ Identify_____

Intensity

Match_____ Identify_____

Visual/Auditory Recognition

This next part is just like the first two tests, except this time, I'll show you a picture and let you listen to a voice at the same time. Tell me if the emotion on the face and in the voice is the same or different and what emotion is being portrayed. Then tell me if the intensity is the same or different and what intensity is being portrayed.

	Emotion		Intensity		Score
	Match	Identify	Match	Identify	
1.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
2.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
3.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
4.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
5.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
6.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
7.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
8.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
9.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
10.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
11.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
12.	S D	A. An S H Fr B. An S H Fr	S D	A. 1 2 3 B. 1 2 3	____
				Total score	____

Total correct:
Emotion

Match_____ Identify_____

Intensity

Match_____ Identify___

Appendix B: Hogan Empathy Scale

Please answer all questions. If you agree with a statement or feel that it is true about you answer TRUE. If you disagree with a statement, or feel that it is not true about you, answer FALSE.

TRUE	FALSE	
____	____	1. A person needs to "show off" a little now and then.
____	____	2. I liked "Alice in Wonderland" by Lewis Carrol.
____	____	3. Clever, sarcastic people make me feel very uncomfortable.
____	____	4. I usually take an active part in the entertainment at parties.
____	____	5. I feel sure that there is only one true religion.
____	____	6. I am afraid of deep water.
____	____	7. I must admit I often try to get my own way regardless of what others may want.
____	____	8. I have at one time or another in my life tried my hand at writing poetry.
____	____	9. Most of the arguments or quarrels I get into are over matters of principle.
____	____	10. I would like the job of a foreign correspondent for a newspaper.
____	____	11. People today have forgotten how to feel properly ashamed of themselves.
____	____	12. I prefer a shower to a bathtub.
____	____	13. I always try to consider the other fellow's feelings before I do something.
____	____	14. I usually don't like to talk much unless I am with people I know very well.
____	____	15. I can remember "playing sick" to get out of something.
____	____	16. I like to keep people guessing what I'm going to do next.
____	____	17. Before I do something I try to consider how my friends will react to it.
____	____	18. I like to talk before groups of people.
____	____	19. When a man is with a woman he is usually thinking about things related to her sex.
____	____	20. Only a fool would try to change our American way of life.
____	____	21. My parents were always very strict and stern with me.
____	____	22. Sometimes I rather enjoy going against the rules and doing things I'm not supposed to.
____	____	23. I think I would like to belong to a singing club.
____	____	24. I think I am usually a leader in my group.
____	____	25. I like to have a place for everything and everything in its place.
____	____	26. I don't like to work on a problem unless there is the possibility of coming out with a clear-cut unambiguous answer.
____	____	27. It bothers me when something unexpected interrupts my daily routine.
____	____	28. I have a natural talent for influencing people.
____	____	29. I don't really care whether people like me or dislike me.
____	____	30. The trouble with many people is that they don't take things seriously enough.
____	____	31. It is hard for me just to sit still and relax.
____	____	32. Once in a while I think of things too bad to talk about.
____	____	33. I feel that it is certainly best to keep my mouth shut when I'm in trouble.
____	____	34. I am a good mixer.
____	____	35. I am an important person.

36. I like poetry.
37. My feelings are not easily hurt.
38. I have met problems so full of possibilities that I have been unable to make up my mind about them.
39. Often I can't understand why I have been so cross and grouchy.
40. What others think of me does not bother me.
41. I would like to be a journalist.
42. I like to talk about sex.
43. My way of doing things is apt to be misunderstood by others.
44. Sometimes without any reason or even when things are going wrong I feel excitedly happy, "on top of the world."
45. I like to be with a crowd who plays jokes on one another.
46. My mother or father often made me obey even when I thought that it was unreasonable.
47. I easily become impatient with people.
48. Sometimes I enjoy hurting persons I love.
49. I tend to be interested in several different hobbies rather than to stick to one of them for a long time.
50. I am not easily angered.
51. People have often misunderstood my intentions when I was trying to put them right and be helpful.
52. I am usually calm and not easily upset.
53. I would certainly enjoy beating a crook at his own game.
54. I am often so annoyed when someone tries to get ahead of me in a line of people that I speak to him about it.
55. I used to like hopscotch.
56. I have never been made especially nervous over trouble that any members of my family have gotten into.
57. As a rule I have little difficulty in "putting myself into other people's shoes."
58. I have seen some things so bad that I almost felt like crying.
59. Disobedience to the government is never justified.
60. It is the duty of a citizen to support his country, right or wrong.
61. I am usually rather short-tempered with people who come around and bother me with foolish questions.
62. I have a pretty clear idea of what I would try to impart to my students if I were a teacher.
63. I enjoy the company of strong-willed people.
64. I frequently undertake more than I can accomplish.

Appendix C: Questionnaire Measure of Emotional Empathy

For each of the following statements, indicate your answer by circling the appropriate number.

1. It makes me sad to see a lonely stranger in a group.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

2. People make too much of the feelings and sensitivity of animals.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

3. I often find public displays of affection annoying.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

4. I am annoyed by unhappy people who are just sorry for themselves.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

5. I become nervous if others around me seem to be nervous.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

6. I find it silly for people to cry out of happiness.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

7. I tend to get emotionally involved with a friend's problems.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

8. Sometimes the words of a love song can move me deeply.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

9. I tend to lose control when I am bring bad news to people.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

10. The people around me have a great influence on my moods.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

11. Most foreigners I have met seemed cool and unemotional.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

12. I would rather be a social worker than work in a job training center.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

13. I don't get upset just because a friend is acting upset.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

14. I like to watch people open presents.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

15. Lonely people are probably unfriendly.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

16. Seeing people cry upsets me.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

17. Some songs make me happy.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

18. I really get involved with the feelings of the characters in a novel.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

19. I get very angry when I see someone being ill-treated.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

20. I am able to remain calm even though those around me worry.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

21. When a friend starts to talk about his problems, I try to steer the conversation to something else.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

22. Another's laughter is not catching for me.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

23. Sometimes at the movies I am amused by the amount of crying and sniffling around me.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

24. I am able to make decisions without being influence by people's feelings.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

25. I cannot continue to feel OK if people around me are depressed.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

26. It is hard for me to see how some things upset people so much.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

27. I am very upset when I see an animal in pain.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

28. Becoming involved in books or movies is a little silly.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

29. It upsets me to see helpless old people.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

30. I become more irritated than sympathetic when I see someone's tears.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

31. I become very involved when I watch a movie.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

32. I often find that I can remain cool in spite of the excitement around me.

-4	-3	-2	-1	0	+I	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

33. Little children sometimes cry for no apparent reason.

-4	-3	-2	-1	0	+1	+2	+3	+4
very strongly disagree	strongly disagree	disagree	slightly disagree	no opinion	slightly agree	agree	strongly agree	very strongly agree

Appendix D: Consent Form

I agree to participate in the research project, conducted by Amy Darling, which investigates the ability to recognize and identify facial and vocal emotion and the capacity to interpret emotions in a variety of social settings. The nature and purpose of this research has been explained to me and I have read and understood the information letter.

As a participant, I understand that the test session will take place at St. Joseph's Hospital and I will be asked to complete four questionnaires which will take approximately 1½ hours. Three questionnaires are paper and pencil format which include questions, but are not limited to: age, gender, history of brain injury, and aspects of emotions experienced by myself and others. If I require assistance reading or recording your answers, assistance will be provided. The fourth test, which will take about 30 minutes, involves the simultaneous presentation of emotions through two pictures, two sound recordings, and of a combination of a picture and a sound recording. I understand that I will be asked whether the emotions displayed in the photos or sound clips are the same, to identify the emotion(s) and to identify whether the intensity in the presented emotions are the same or different. While it is anticipated that the testing experience will be a pleasant one I understand that if at any point I feel distressed, I can withdraw without consequence and a counselor will be made available to me if required.

I understand that my participation is completely voluntary and that I may withdraw from the study at any time without penalty and without giving my reasons for withdrawal. If I feel emotionally or physically upset following the testing session, I am aware that a counselor will be made available to me. I also understand that my test results will not be identified with my name in any way.

I have been informed that all data will be kept in a securely locked file at Lakehead University for seven years. The test results and other data will be identified only by number (not by name), and will be kept in a separate location from this consent form. Upon completion, results of this study will be made available upon request.

_____ _____

Name (print) Signature

_____ _____

Date Witness

Appendix E: Demographic Sheet (Controls)

Participant Question Sheet

* Note: Your identity will be kept strictly confidential. Results will be coded by number, and no information which could identify you will be released.

Testing Date:_____ Participant Number:_____

Date of Birth:_____ Age:_____
(dd/mm/yy)

Gender: M / F What hand do you write with? right / left

What is your first language? _____

Ethnic Background (check the one that best applies to you):
___ Native Canadian ___ Asian ___ African-American ___ Caucasian
___ Other (specify)

What is your marital status? ___ Single ___Married ___ Divorced ___ Widowed

Do you live with anyone? (specify who) _____

Currently, what is your highest achieved level of education: ___ high school
___ college
___ university, year ____

Have you ever had a serious head injury? _____

Have you ever had an accident resulting in unconsciousness? _____

If so, for how long were you unconscious? _____

Have you ever had a seizure? _____

Have you ever had blackouts or fainting spells? _____

Are you currently taking any medications? (specify) _____

Have you ever been diagnosed with a psychiatric disorder? _____

Appendix E (Cont'd): Demographic Sheet (BI Group)

Participant Question Sheet

* Note: Your identity will be kept strictly confidential. Results will be coded by number, and no information which could identify you will be released. Try to answer the questions as best as you can. Feel free to ask for clarification.

Testing Date:_____ Participant Number:_____
Date of Birth:_____ Age:____
(dd/mm/yy)
Gender: M / F What hand do you write with? right / left
What is your first language? _____

Ethnic Background (check the one that best applies to you):
___ Native Canadian ___ Asian ___ African-American ___ Caucasian
___ Other (specify)

What is your marital status? ___ Single ___Married ___ Divorced ___ Widowed

Do you live with anyone? (specify) _____

What is your highest achieved level of education: ___ grade school (grade) _____
___ high school (grade) _____
___ college (diploma) _____
___ university (degree) _____

What is (or has been) your major occupation? _____

How and when did you sustain your injury?_____

If applicable, how long were you: in a coma? _____ hospitalized?_____

Did you return to your previous occupation after sustaining the injury?_____

Prior to the accident, what is the last thing that you can remember? _____

After the accident, what is the first thing that you can remember?_____

Are you currently taking any medications? (specify) _____

Have you ever been diagnosed with a psychiatric disorder? _____