THE VICTORIA EMOTION RECOGNITION TEST

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ABSTRACT

Emotional disorders are common in people with brain damage. It is often difficult to determine whether such disorders are a result of a deficit in recognition, expression, or regulation of emotion due to brain damage per se, or if they are reactive to other functional limitations.

The Victoria Emotion Recognition Test (VERT) was developed to provide a standardized tool for the assessment of deficits in the recognition of facial and tonal affect. The VERT was constructed on the basis of neurophysiological and behavioural theories of emotion and neuropsychological theories of agnosia. The VERT consists of three subtests in which four emotions (angry, sad, happy and afraid) are presented at three levels of intensity. The visual subtest presents photographs of faces; the auditory subtest, audiotaped voice clips; and the auditory/visual subtest, both photographs and voice clips.

Psychometric results of the standardization studies suggest that the VERT measures an aspect of the recognition of facial and tonal emotion that is independent of more basic skills in face recognition and auditory nonverbal memory.

The theoretical construct of recognition of emotion

was investigated within the framework of an "affective agnosia". The results suggest that a broader concept of agnosia is necessary in order to include failures in recognition of emotion within this framework.

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Dedication

For

Murray Archibald Forbes Mountain

(wish he were here to see it)

and

Elizabeth May Mountain

(who, thank the Lord, is)

Introduction

Emotional disorders are common in people with brain damage (Brooks, 1984; Fordyce, Roueche & Prigatano, 1983; Gainotti, 1972; Goldstein, 1952; Grafman et al., 1986; Lezak, 1987; Miller, 1991; Mooney, 1988; O'Hara, 1988). Changes in personality and disruption in interpersonal relationships are frequently reported and can have detrimental effects on the efficacy of rehabilitation programs and on successful reintegration into the community (Klonoff, Snow & Costa, 1986; Prigatano, 1987). Even in cases in which physical and cognitive recovery have been good, family members, friends and co-workers often complain that the brain-damaged person is "just not the same person anymore". However, changes in personality are often difficult for families to describe precisely and instruments designed to measure psychopathology do not always delineate these personality changes adequately (Prigatano, 1987). Furthermore, it is often difficult to determine whether the emotional disorder is a function of the brain damage per se or if it is a reaction to the frustration and fears associated with brain damage.

Intact emotional function, as it may affect interpersonal relationships, implies adequate performance in three areas: (1) the ability to recognize emotion in other people accurately, (2) the ability to express emotion appropriately (both in terms of the appropriate emotion and the appropriate intensity of emotion) and (3) the ability to feel emotion (mood) appropriate to the situation. It is likely that these three components are behaviourally interrelated. For example, if emotion in other people cannot be recognized accurately, there may be a problem in expressing emotion appropriately, not because the function of emotion expression is not intact, but because the response is based on a misperception. Similarly, there is some evidence in the literature that mood may have an effect on the accuracy of recognition of emotion. For example, Zuroff and Colusny (1986) found that people with depression were more inaccurate than normals in matching photographs of facial expressions of emotion with the correct label for the emotion.

Although the behavioural presentation may suggest that the three components of emotion are strongly associated, evidence from studies of brain-damaged people suggests that recognition and expression of emotion and mood are neuroanatomically dissociable. The term "dissociable function" implies that damage to the neural substrate supporting the recognition of emotion will result in a deficit in that function, but not in expression of emotion or mood. Similarly, damage to the substrate supporting one of the other two emotion-related functions will result in a deficit in that function, but not in the ability to recognize emotion. Lieberman and Benson (1977) reported the case of a patient with pseudobulbar palsy, whose journal entries suggest that her recognition of emotion in others was adequate and her mood was appropriate, but her control of the intensity of her emotional expression was deficient. Ross (1981) reviewed a number of cases of patients with right hemisphere damage, who demonstrated deficits in either expression or recognition of emotional tone of voice. He proposed a classification of "aprosodia" comparable to the classification of aphasia in patients with left hemisphere damage. Etcoff (1986), in a review of the literature, concluded that sufficient evidence exists for a model which localizes the ability to express emotion to the anterior right hemisphere and the ability to recognize emotion in others to the posterior right hemisphere.

Thus, although it is possible that brain damage may result in a deficit in one component of emotion while the other two components remain functionally intact, the patient may exhibit dysfunctional emotional behaviour in one or more components. The clinician may have difficulty disentangling the behavioural presentation without an accurate assessment of the functional status of underlying emotional abilities and therefore be unable to recommend appropriate intervention.

To date, there are no studies reported in the literature in which deficits in emotion recognition or emotion expression, as measured by a psychological test, have been linked to dysfunctional emotional behaviour. Thus, it is not clear that such deficits have any effect on interpersonal relationships. Tests which might measure accuracy in emotional expression are difficult to transfer to a clinical setting. Such tests generally require the involvement of more than one blind rater or sophisticated equipment, not generally available in a clinical setting. It may be that the skill of the practiced clinician in observing behaviour is the best clinical measure of appropriate emotional expression. Similarly, clinical skill may be the best available measure of whether a patient's mood is appropriate to the situation. In order to include an objective component in the process, it seemed most useful to approach the problem of disentangling the components of emotion in a clinical setting by creating a measure of the ability to recognize emotion. The purpose of this study was to develop an instrument that would measure the ability to recognize emotion in other people and to provide a standardized tool for distinguishing a deficit in recognition of emotion due to brain damage from other dysfunctional emotional behaviour. Since the purpose of using the instrument clinically would also be to assess the effects of deficits in recognition of emotion on interpersonal behaviour, only stimuli involving people were used in the test.

Theoretical Considerations

Theory of Emotion

The construct of emotion is not well understood in psychology. Theories of emotion abound. No one approach to what emotion is, what purpose it serves, and which emotions are the "true" emotions has been widely accepted (see Arnold, 1970; and Plutchik and Kellerman, 1980 for reviews of theories of emotion).

The situation is similar in neuropsychology. Most studies in the neuropsychological literature have in fact been atheoretical in their approach to researching emotional function and typically standardized tests have not been used in assessing recognition and expression of emotion. Indeed, much of the focus in neuropsychological studies of emotion has been on attempts to localize the function of recognition or expression of emotion, rather than on attempts to study the function itself. Thus, many studies have presented stimuli in either the visual or auditory modality.

In the area of recognition of facial emotion, some researchers (e.g. Strauss and Moscovitch, 1981) have used selected faces from the Ekman and Friesen (1975) series to assess recognition of emotion. The six emotions (happy, sad, anger, fear, surprise, disgust) proposed by Ekman and Friesen have been well researched; however, there are some drawbacks to using stimuli from this series. First, a number of researchers (e.g. Sergent, 1989) have noted that subjects have some difficulty distinguishing between "surprise" and "fear" and also between "anger" and "disgust"; second, there is no comparable set of auditory stimuli. Although it has been demonstrated in the literature that failures in emotion recognition tend to present across modalities (Cicone, Wapner & Gardner, 1980; Blonder, Bowers & Heilman, 1991), it may be that <u>relative</u> strengths and weaknesses occur in individual patients. Thus, an instrument which assesses performance in both modalities may prove useful in prescribing rehabilitative measures.

In the area of recognition of tonal affect, the situation is similar. Researchers have tended to develop materials individually without consideration for underlying theory. Ross, Holzapfel & Freeman (1983) developed 'templates' for assessing appropriate verbal expression of some emotions. Vocalizations are tape recorded and analyzed using a pitch analyzer interfaced with a small computer. These templates could be used to generate stimuli for recognition tasks; however, the equipment required to do so is not easily available.

In summary, to date, studies of the recognition and expression of emotion have been directed towards enhancing the understanding of the functions from an empirical standpoint and therefore, each researcher has developed a different set of stimuli specific to the study at hand. These tools have not typically been based on any theoretical notion of emotion.

A theory of emotion advanced by Panksepp (1982) seemed to be useful as a basis on which to conceptualize emotion from a neuropsychological point of view. On the basis of animal brain research combined with anthropomorphic reasoning (that is, assuming that animals experience the same basic emotions as do humans), Panksepp hypothesized four primitive emotive circuits, mediating states of expectancy, rage, fear and panic. The expectancy circuit mediates approach-investigative behaviour and its activation is the appropriate response to positive incentives. It is the neural basis for emotions such as anticipation, hope and desire. The fear circuit mediates escape and flight and is activated by pain and threat of destruction, resulting in emotions such as anxiety, alarm and foreboding. The rage circuit is activated by body surface irritation, restraint and frustration and mediates aggressive behaviour. It is associated with emotions such as indignation, hate and anger. Finally, the panic circuit responds to social loss and is associated with emotions such as loneliness, grief and despair. Panksepp's description of the emotions arising from these four primitive emotive circuits seemed to match the four emotions described behaviourally by Ekman (happy, afraid, angry and sad) that have been shown to be most reliably discriminated (Ekman and Friesen, 1975).

Thus, the theoretical basis on which the four emotions (happy, sad, angry, afraid) were chosen for this study is a combination of the psychobiological theory of Panksepp and the behavioural theory of Ekman.

Theory of the Deficit - Affective Agnosia

The question has been debated in the literature as to whether failures in recognition of emotion can be considered a subset of a larger group of failures in recognition; such failures are called agnosias. Agnosia is a failure in recognition which is not attributable to a deficit in basic sensory processes, generalized mental deterioration, attention, anomia, or non-familiarity (Friedricks, 1969, cited in Bauer and Reubens, 1985). Geschwind (1965) has suggested that recognition is a multi-modal phenomenon; that is, recognition is manifested by an appropriate response to an object, which might be made in any one of a number of channels. Teuber (1968, cited in Bauer and Reubens, 1985) described agnosia as a deficit "bracketed by a failure in processing and a failure in naming". Thus, at the lowest level of deficit, the stimulus would be improperly perceived; at the highest level, improperly named. His definition of agnosia as "a normal percept that has somehow been stripped of its meaning" is probably the best description of the deficit.

Lissauer (1988) proposed a two-stage model of agnosia. At the apperceptive level, the basic sensory processes are intact, however the ability to copy the stimulus, discriminate whether two stimuli are the same or different or match the stimulus to a sample is deficient. At the associative level, the functions associated with the apperceptive level are intact, however the patient is unable to use the stimulus or describe how to use the stimulus correctly, match the stimulus within categories or point to the correct stimulus. Thus, Teuber's description refers to Lissauer's associative agnosia.

Heilman, Scholes and Watson (1975) coined the term <u>auditory affective agnosia</u> to describe a failure in comprehension of affective speech. The term has not become widely used and there is, in fact, some doubt that the failure to recognize affective information can be considered an agnosia (Lezak, 1983). Heilman and his colleagues failed to test the auditory discrimination capabilities of their patients, so it is not known whether basic sensory processes were intact. Furthermore, agnosia has most often been described as modality specific (see Bauer and Rubens, 1985) however, there is evidence in the literature that the failure to recognize emotional information can occur across modalities in the same patient (Cicone, Wapner and Gardner, 1980; Blonder, Bowers and Heilman, 1991).

Finally, there is some question as to whether affective agnosia is simply a special case of more basic deficits. It has been suggested that a deficit in recognition of facial affect is simply a special case of a deficit in facial recognition (Cicone et al., 1980). Similarly, as noted by Lezak (1983), because Heilman et al., 1975 failed to test for auditory discrimination in their study, it may be that a failure to recognize auditory affective information is simply a special case of a deficit in non-verbal auditory discrimination.

Ley and Bryden (1979) however, were able to demonstrate that a superiority in the left visual field for recognition of emotion is dissociable from the left visual field superiority for face recognition. Bowers et al. (1985) found that a deficit in recognition of affect in faces existed over and above any deficit in processing visuospatial information. Similarly, Etcoff (1984) demonstrated a dissociation between recognition of facial identity and recognition of facial affect. More recently, the results of a study by Blonder, Bowers and Heilman (1991) suggest that deficits in the recognition of both emotional tone (presented in semantically neutral sentences) and facial affect cannot be completely accounted for by more basic perceptual deficits, nor by a more encompassing deficit in understanding emotional information. Parry, Young, Saul and Moss (1991) were able to demonstrate that the dissociation can present even in cases of very mild impairment in facial identity recognition and facial affect recognition.

Neuroanatomical Substrate

Studies that have investigated the neural substrate supporting the recognition of emotion have almost without exception concluded that the right hemisphere is superior for the processing of emotional information (see Campbell 1982, and Silberman and Weingartner 1986, for reviews of the literature). The results of studies with normal subjects have supported the right hemisphere hypothesis. For example, a left visual field advantage for the accurate recognition of visually presented emotional material has been reported (Heller & Levy, 1981; Ley & Bryden, 1979; Strauss & Moscovitch, 1981). Futhermore, a left ear advantage for the recognition of emotional tone has been found (Bryden, Ley & Sugarman, 1982; King & Kimura, 1972; Ley & Bryden, 1982; Safer & Leventhal, 1977).

The results of studies that have investigated the effects of brain damage on the recognition of emotion are consistent with the results reported for normal subjects. There appears to be a greater deficit in the accuracy of recognition of emotion following damage to the right hemisphere than after damage to the left hemisphere. For example, a greater deficit following damage to the right hemisphere has been found in the recognition of facial affect (Borod, Koff, Lorch &

Nicholas, 1986; Bowers, Bauer, Coslett & Heilman, 1985; Cicone, Wapner & Gardner, 1980; DeKosky, Heilman, Bowers & Valentine, 1980; Kulikov & Siderova, 1985; Prigatano & Pribram, 1982; Roth, Bergquist & Novack, 1989); visually presented emotional scenes (Cicone et al., 1980; DeKosky et al., 1980); and emotionally toned vocal presentations (Cicone et al., 1980; Heilman, Scholes & Watson, 1975; Kulikov & Siderova, 1985; Ross, 1981; Schlanger, Schlanger & Gerstman, 1976; Tucker, Watson & Heilman, 1977).

Some question has been raised as to whether the operation of all aspects of emotion is entirely a function of the right hemisphere. Some investigators have reported left hemisphere specialization for positive emotions and right hemisphere specialization for negative emotions.

In the area of felt emotion or mood, Gainotti (1972) found that a majority of his patients with left hemisphere lesions demonstrated a "catastrophic" reaction, while the patients with right hemisphere lesions were more likely to exhibit "indifference" reactions. Robinson (1986) reported depression in patients following a stroke in either hemisphere. He observed that the severity of the depression appears to increase with proximity to the anterior pole in the left hemisphere while the reverse is true in the right hemisphere.

There has also been some evidence reported that the right hemisphere may control the facial expression of negative emotions and the left hemisphere the facial expression of positive emotions (Ahern and Schwarzt, 1979; Borod and Caron, 1980; Sackheim and Gur, 1978; Schwartz, Ahern and Brown, 1979). However, the implications of these results are difficult to interpret, given that the lateralization of posed versus spontaneous facial expression is not well understood (Etcoff, 1986). Borod et al. (1986) reported that subjects with right hemisphere damage were impaired as compared to subjects with left hemisphere damage for posed positive, spontaneous positive and spontaneous negative emotions, but not for posed negative emotions. There have been no studies reported in the literature that the hemispheres are specialized for the production of positive or negative tonal affect.

It has also been proposed that the right hemisphere is superior in the recognition of negative emotion, while the left hemisphere is superior for positive emotion. Reuter-Lorenz and Davidson (1981) reported faster reaction times to happy faces than to sad faces presented to the right visual field and faster reaction times to sad faces than to happy faces presented to the left visual field. Natale, Gur and Gur (1983) suggested that the right hemisphere may be superior in discriminating emotional valence, while the left hemisphere may have a perceptual bias towards positive aspects of emotional stimuli. These results have not been replicated and more recent evidence suggests that the right hemisphere mediates the recognition of both positive and negative emotions (Etcoff, 1984; Borod et al., 1986).

It has been suggested that the dissociation in valence of emotion has been more strongly demonstrated for mood and expression of emotion, functions thought to be mediated by anterior structures, than for recognition of emotion, which is thought to be mediated by posterior structures (Silberman & Weingartner, 1986). Borod & Koff (1989) have suggested that a left hemisphere specialization for positive emotion would be consistent with "approach" behaviours, not requiring high arousal levels and enhanced by linguistic communication, while a right hemisphere specialization for negative emotion would be more consistent with "avoidance/aggressive" behaviours, which might require higher arousal levels and more spatial, holistic skills.

Finally, Cancelliere and Kertesz (1990) found evidence of deficits in both expression and recognition of emotional information in patients with damage to either the right or left hemisphere. Using overlapping diagrams of area of brain damage, they discovered that the basal ganglia appeared to be the area most frequently affected in these patients. As noted by the authors, their patients were not assessed for deficits in tonal or facial discrimination or general level of confusion and therefore, these results must be interpreted with caution at this time.

In summary, the bulk of the evidence in the literature supports the hypothesis that the right hemisphere has a superior role in the recognition of both positive and negative emotion. However, there is evidence that the left hemisphere may play some role in the recognition of positive emotion. Within the right hemisphere, damage to the temporo-parietal area appears to disrupt recognition of both tonal and facial affect (Etcoff, 1986).

Developmental Changes in Recognition of Emotion

Neuropsychologists have tended not to study changes in the recognition of emotion over the life span, but rather to explore whether changes in lateralization of emotion might occur at different ages. For example, Moreno, Borod, Welkowitz and Alpert (1990), in studying changes in the right hemisphere with age, compared the performance of young (21-39 years), middle-aged (40-59 years) and old (60-81 years) females on tasks of expression and perception of emotion. The authors found no significant differences in laterality of emotion tasks as a function of age. They did not report whether differences in accuracy between age groups were observed. Similarly, Levine and Levy (1983), using the same perception task, reported right hemisphere biases in two groups of subjects, aged 5-17 and 70-80 years, but did not report any differences in accuracy of judgement. Saxby and Bryden (1985) found better performance in recognition of facial expressions of emotion when the information was presented to the left visual field in subjects 6-14 years old, but again, differences in accuracy of performance were not reported.

It might be assumed that, since these authors did not report any differences in performance across different age groups, none were observed. This conclusion is supported to some extent by work in developmental psychology (see Nelson, 1987 for a review of the development of recognition of emotion) which suggests that basic emotions are categorized and responded to accurately by the age of two years. Other work in developmental psychology which suggests that accuracy increases with age up to the age of about seven (e.g. Tremblay, Kirouac & Dore, 1987) may reflect developmental changes in verbal abilities, rather than in recognition of emotion. For example, the recognition task in this study involved matching photographs of emotional expressions to themes within a story. Similarly, Gates (1925) found an increase in accuracy of recognition of facial affect ranging from about 25 percent at age three to 94 percent at age fourteen in a task that required a verbal response to a photograph and the question "what is this person doing?". However, Maan and Bryson (1990) reported a similar increase in performance up to about the age of ten using Ekman and Friesen's faces with a match to sample paradigm, a task much less dependent on verbal skills.

In summary, developmental changes across the life span in recognition of emotion have not been extensively studied in neuropsychology. The literature suggests that a right hemisphere superiority for the recognition and expression of emotion is established by at least age five and that this pattern of lateralization persists into old age. No differences in accuracy of recognition have been reported after about age six. In the developmental literature, differences in performance reported up to the age of 14 years may reflect developmental changes in other cognitive skills, rather than in recognition of emotion per se.

Sex Differences in Recognition of Emotion

There has been very little reported in the area of sex differences in the recognition of emotion in the neuropsychology literature. The focus of study has been, like the research into age differences, on differences in lateralization. Those differences which have been reported are difficult to interpret and often contradictory. For example, Graves, Landis and Goodglass (1981) found evidence for a right hemisphere ability to read emotional words in males, but not in females. Strauss (1983), in an attempted replication of the study of Graves et al., found similar results, although neither the hemisphere nor the sex difference reached statistical significance. Strauss and Moscovitch (1981) reported a left visual field bias in the recognition of facial affect in pairs of photographs for females regardless of condition, while for males a right visual field bias was found if the same emotion was represented in both photographs. Safer (1981) found a right visual field advantage in recognition of facial affect in photographs in males, but not in females. He also found that females judged more accurately than males.

There is more evidence for sex differences in the recognition of emotion in the social psychology literature. Hall (1977), in a meta-analysis of 75 studies, reported that more studies found a female advantage than would occur by chance, the average effect size of the female advantage was significantly larger and more studies reported a significance level in the direction of a female advantage greater than .05, than would occur by chance. She also reported that the difference was substantially greater in studies that presented visual and auditory stimuli simultaneously, as compared to studies which investigated recognition of emotion within a single modality.

In summary, the neuropsychological literature provides scant evidence for a sex difference in the ability to recognize emotion. Stereotypically, females are often thought to be more attuned and responsive to the emotions of those around them. An analysis of the social psychology literature appears to validate this commonly held perception.

Failures in Recognition of Emotion in Other Clinical Groups

Failures in recognition of emotion have been reported in other clinical groups where there is no documented evidence of right hemisphere damage. Impaired social skills are often observed in many clinical groups and the question of whether these skills might be related to a reduced ability to recognize emotion in others has been studied by a number of investigators.

Allender and Kazniak (1989) found that patients with Alzheimer's Disease were impaired in their ability to name the emotion portrayed on faces and to match the emotional tone of a sentence with a drawing depicting the emotion. However, Albert, Cohen and Koff (1991) concluded that the differences in performance on emotion recognition tasks between their subjects with Alzheimer's Disease and a group of age-matched control subjects could be accounted for by the cognitive deficits exhibited by the AD subjects.

Jaeger, Borod and Peselow (1987) tested subjects with unipolar depression using a chimeric faces task and found a significant left-hemispace bias. However, compared to a control group, the bias for the depressed patients was significantly smaller. The authors suggest that a reduction in autonomic arousal associated with unipolar depression may result in reduced right hemisphere efficiency in processing affective information.

Williamson, Crockett, Hurwitz and Remick (1992) also found that patients with major depression made errors in recognition of affective information similar to the types of errors made by right hemisphere damaged patients. They suggest that the deficit may not be in processing emotional information per se, but rather in comprehending more general concepts of "same" versus "different" relationships.

Walker, McGuire and Bettes (1984) reported that subjects with schizophrenia performed significantly more poorly on emotion recognition tasks than either normal controls or subjects with an affective disorder. Although it has been proposed that the deficits evident in schizophrenia may be a result of left-hemisphere dysfunction, the authors did not find that the poor performance of the schizophrenic subjects could be accounted for in terms of reduced verbal abilities. Fineberg, Rifkin, Schaffer and Walker (1986) reported that the schizophrenic subjects in their study performed more poorly than either subjects with depression or normal controls on a task of emotion recognition. They also reported that the subjects with schizophrenia performed more poorly than subjects with depression on a task of facial identity. They offered the hypothesis that this pattern of performance (schizophrenics worse than depressives worse than normals) might be accounted for by a broader range of impairment in complex visual skills related to facial and emotion recognition in patients with schizophrenia.

MacDonald et al. (1989) compared the performance of high functioning autistic adults and a group of normal adults matched for nonverbal IQ and found the autistic group impaired on a number of tasks involving the expression and recognition of emotion. The impairment was evident across modalities. They noted that no one task differentiated the groups and that the adoption of a compensatory strategy might enable the autistic adults to perform adequately on some tasks.

Similar deficits have been noted in children with autism (Hobson, 1986) and schizophrenia (Walker, 1981). McCauley, Kay, Ito and Treder (1987) found evidence of a deficit in affective discrimination in girls with Turner's Syndrome that appeared to be independent of deficits in visuospatial skills and attention.

Children with learning disabilities are often noted to have deficits in social skills and to exhibit emotional dysfunction. However, it has been difficult to ascertain whether these difficulties are a reaction to the academic problems encountered by these children, or are a result of the the same brain dysfunction underlying the learning disability (Spreen, 1989). Wiig and Harris (1974) found that adolescents with learning disabilities were significantly poorer than normal adolescents at labelling emotions. Bachara (1976) reported that a group of learning disabled children (ages 7-12) made significantly more errors than normal children in assigning appropriate facial expressions to stories. It might be argued that deficits in language skills in these children contributed to their poor performance on these tasks. Ozols and Rourke (1985) investigated this possibility by testing two groups of learning disabled children (one group was described as having a language related learning disability and the second group appeared to have deficits in visuospatial skills) on tasks that required both verbal responses to affective information and nonverbal selection of affective stimuli. Both groups performed more poorly than normal controls on all of the tasks presented, but only the children with language-related learning disabilities performed significantly more poorly than normals on the tasks requiring verbal labelling or explanations.

Extensive work by Rourke and his colleagues (see Rourke, 1989 for a review of this work) has been done in an attempt to relate specific subtypes of learning disabilities to socioemotional dysfunction. Briefly, Rourke has hypothesized that a nonverbal learning disability (NVLD), characterized by deficits in complex novel problem solving and visuospatial organization skills, is a result of compromise of right hemisphere (particularly white matter within the right hemisphere) function. Using the Personality Inventory for Children (which is completed by the child's parent) as a measure of socioemotional dysfunction, Rourke has demonstrated that children with NVLD are reported to have more extensive emotional and interpersonal problems than children with learning disabilities not falling into this subtype. Attempts to correlate NVLD, in particular the difficulties in visuospatial organization, with deficits in recognition of emotion have been less successful. For example, Munson (1986) did not find that children whose test scores fit the NVLD profile, and who had been identified by their teachers as having interpersonal difficulties, performed significantly less poorly on the Profile of Nonverbal Sensitivity (Rosenthal, Hall, DiMatteo, Rogers & Archer, 1979)

In summary, there is some evidence in the literature that subjects without documented right hemisphere damage may exhibit deficits on tasks of emotion recognition. It seems likely that the impairment presenting in these clinical groups is a result of different contributing factors than the impairment evident in patients with circumscribed right hemisphere damage.

Available Instruments to Assess Recognition of Emotion

As discussed previously, there are instruments available to assess recognition of emotion. A review of the literature revealed very few instruments that have been standardized and even fewer which are used clinically. There are no listings for tests which purport to measure recognition of emotion in either the Tenth Mental Measurements Yearbook (Conoley and Kramer, 1989) or Tests in Print III (Mitchell, 1983).

Perhaps the most widely used test is the Brief Affect Recognition Test (BART; Ekman and Friesen, 1975). This test consists of 70 black and white slides of ten men and women portraying a neutral expression or one of six emotions: happy, sad, fear, anger, surprise and disgust. The slides were modified so that head size and brightness and contrast were kept as similar as possible. The slides chosen for inclusion in the BART were judged as portraying the intended emotion by 70% of the judges, when presented for ten seconds. The slides are typically presented tachistoscopically to subjects.

The Profile of Nonverbal Sensitivity (Rosenthal, Hall, DiMatteo, Rogers and Archer, 1979) consists of 220 videotaped segments, each lasting about two seconds. In each segment, the same young woman is presented simulating emotional reactions to 20 different social and emotional situations. Subjects are asked to judge which of two social/emotional situations is most likely to be associated with the emotion being portrayed. In the videotaped sequences, the young woman's face, or body, or face and body are presented, both with and without her voice. In addition, some segments present only the young woman's voice. All of the auditory information was electronically altered to eliminate linguistic clues. Eleven "channel" scores are generated as well as a total score are generated.

Faces was developed by O'Sullivan and her colleagues (1965, cited in O'Sullivan, 1982) to assess social intelligence. The test consists of black and white photographs of faces of men and women. Subjects are asked to match one of four response photographs to a target photograph with the same emotional meaning. No attempt is made in this test to elicit recognition of specific emotions. O'Sullivan (1982) also cites the Communication of Affect Receiving Test, (CARAT; Buck, 1976), which consists of 32 black and white videotape segments, each lasting about 25 seconds, showing the head and shoulders of 25 individuals as they watched four types of slides: pleasant, unpleasant, sexual and scenic. The subjects viewing the slides rated their own feelings of pleasantness or unpleasantness as they watched the slides. Subjects taking the CARAT are asked to judge which type of slide is being shown and how pleasant or unpleasant the viewer of the slides feels. The test yields two scores: accuracy in slide categories and the correlation between the self-rating and the observer rating of "pleasantness".

The Communicative Abilities in Daily Living test (CADL; Holland, 1980) was developed to assess communication and comprehension in daily situations. It includes items in which facial expression of emotion are presented. A total score is generated.

More recently, Cancelliere and Kertesz (1990) have developed the Battery of Emotional Expression and Comprehension (BEEC). This test consists of five subtests, assessing both the ability to recognize and to express emotion adequately. Three emotions (happy, sad and angry) and a neutral state are presented. In the first subtest, subjects are asked to repeat 16 sentences which have been presented in a neutral tone of voice and to infuse the sentence with the required emotion. In the second subtest, also consisting of 16 sentences, subjects are asked to repeat the sentence and the emotion presented. In the study in which this test is reported, the subjects' responses on the first two subtests were recorded and later judged by three raters. The third subtest requires subjects to identify the emotion presented in 20 semantically neutral sentences.

The fourth subtest requires subjects to identify the emotion in line drawings of situations, in which the target character is presented without facial features. The final subtest requires subjects to identify the emotion presented in 20 black and white photographs of faces.

All of the tests described above did not appear to be very useful in a clinical setting. The range of stimuli is limited to facial expression of emotion in the BART, Faces and CARAT. The PONS provides a better range of stimuli, but it is very long and not consistent with the materials and methodology used in experimental studies of deficits in recognition of emotion.

The BEEC shows some promise for clinical use; however, the first two subtests are not likely useful clinically, requiring as they do the involvement of three blind raters. Moreover, the criteria for item inclusion in this test was low. The authors report that only items in which the emotion was correctly identified by more than 65 percent of the control subjects were included in the "Identification of Emotional Faces" subtest.

With the exception of Munson's (1986) work, there have been no studies reported in the neuropsychological literature which have investigated the relationship between performance on these tests and socioemotional function.

Purpose of the Study

The purpose of this study was to develop a standardized instrument for the assessment of recognition of emotion and to investigate, as part of the validity studies in the development of the test, the operation of recognition of emotion in normal subjects. Despite the discrepancy in modality specificity between affective agnosia and other types of agnosia, it seemed that a deficit in the recognition of emotion was conceptualized best as a type of agnosia. Accordingly, the instrument (Victoria Emotion Recognition Test; VERT) was designed to test for failures in recognition at the apperceptive and associative levels and also to assess deficits in naming of emotions. Briefly, the VERT consists of three subtests: a "visual" subtest, in which photographs of faces depicting emotions are presented; an "auditory" subtest, in which audiotapes of voices depicting emotions are presented and; an auditory/visual subtest, in which photographs and audiotapes depicting emotions are presented simultaneously. The emotions are presented at three levels of intensity. A more detailed description of the dimensions of the VERT will be provided later in the text.

Based on the literature, the following hypotheses were made:

1. Performance on tests of facial recognition and auditory nonverbal memory and discrimination will be independent of performance on the subtests assessing recognition of facial and vocal affect. Previous studies (Blonder, Bowers & Heilman, 1991; Bowers et al., 1985; Etcoff, 1984; Ley & Bryden, 1979; Parry, Young, Saul & Moss, 1991) have found a dissociation between recognition of emotional information in faces and voices and more basic perceptual skills.

2. There will be a positive relationship between the test of emotion recognition and a test assessing the ability to associate social situations with facial and vocal emotion. It is postulated that similar abilities underly the skills required to perform these tasks.

3. There will be a negative relationship between a measure of mood dysfunction and the test of emotion recognition. The literature suggests that people with mood disorders do poorly on tests of emotion recognition.

4. Women will make more accurate judgements than men on all parts of the test, with the most advantage evident

on the subtest that combines visual and auditory stimuli. Evidence in the social psychology literature suggests that women will do better than men on a test of emotion recognition and that the difference between the sexes will be greatest when auditory and visual stimuli are presented simultaneously.

5. Performance on the test will be consistent over the age ranges assessed. Previous studies found no age-associated differences across the adult age span.

6. Performance on the test will be consistent across visual and auditory modalities. There is no evidence in the literature to suggest that the modality in which emotional information is presented affects the accuracy with which the information is recognized.

7. Based on the work of Ley and Bryden (1979), it is postulated that accuracy of judgement will be highest for extreme intensities of emotion and lowest for mild intensities of emotion.

8. Performance on the emotion recognition test will be enhanced by training. The rationale for this hypothesis is discussed on page 74.

The Victoria Emotion Recognition Test

Development of Test Materials

Rationale

The Victoria Emotion Recognition Test (VERT) was developed in order to provide a test that would be useful clinically and to test the hypotheses listed above. A review of the literature revealed some disadvantages in using previously developed test materials in a clinical setting. For example, the faces developed by Ekman and Friesen (BART; 1975) have no auditory counterpart; thus, it would not be possible to assess whether poor performance on the BART implied a comprehensive problem in recognition of emotional information, or whether compensatory strategies using another modality could be recommended. The auditory "templates" developed by Ross, Holzapfel and Freeman (1983) require equipment not typically available in a clinical setting. The Profile of Nonverbal Sensitivity (Rosenthal, Hall, DiMatteo, Rogers and Archer, 1979) can take in excess of an hour to administer, which is too long to be clinically useful. Finally, since it has been suggested that intensity of emotional expression may have some effect on accuracy of recognition (Ley and Bryden, 1979), it seemed likely that a test which included a measure of intensity would prove useful clinically.

Thus, the following considerations were taken into account in the development of the VERT: (1) the test equipment would be available in a clinical setting; (2) administration time would be within 15 to 20 minutes, so that the test could be incorporated, if considered appropriate, into a standard neuropsychological test protocol; (3) test scores could be used to describe specific areas of deficit within the ability to recognize emotion, including difficulties in discriminating intensity of emotion and; (4) appropriate rehabilitative measures could be prescribed using the pattern of performance of patients on the test.

Test Stimuli

The stimuli used in the VERT consist of photographs and voice clips on audiotapes depicting four emotions (happy, sad, angry, afraid) at three levels of intensity (mild, moderate, extreme). These test materials were produced in the Neuropsychology Clinic at the University of Victoria. The photographs were taken with a Nikon Nikkormat 35 mm. camera, with a Nikkor 80-200 lens and a

Braun BVC 370 auto flash, using Kodak TMX 5052 black and white film. Black and white film was chosen in order to reduce any bias in judgement of emotion due to the effects of colour. The camera was mounted on a tripod and the tripod was centred approximately 6 feet from a step-stool. Prior to the production sessions, a female volunteer was draped in black fabric and was photographed using a variety of camera and flash settings (see Appendix 1). A contact sheet was developed from these negatives. Two judges familiar with the study viewed the contact sheet, and decided that an F-stop of 11, shutter speed of 125, with an undiffused flash bounced off the ceiling produced the optimal photographic quality. All of the photographs, both in the test run and in the production sessions, were taken using a remote shutter release.

Audiotapes were produced using a Harmon-Kardon CD 191 cassette tape recorder with Dolby C, at 70 μs equalization and two Shure Unidyne B low impedence microphones. One Maxell XLII cassette tape was used to record each actor.

Five actors (three male, two female) were recruited from the Theatre Arts Department at the University and were paid $20.00 each for participating in the study. Prior to the production session, the actors were told only that they would be portraying some emotions and that they would be photographed and audiotaped as they portrayed these emotions. Production sessions were scheduled so that actors would not meet and they were asked not to discuss the session with the other actors until all sessions were completed. As each actor arrived for the session, they were told that they would be portraying four emotions (happy, sad, angry, afraid) at varying levels of intensity and were then given a printed sheet describing the emotions and intensities of emotion they should try to portray (see Appendix 2). The descriptions were based on Panksepp's discussion of the behaviours associated with each of the four primitive emotive circuits. Three levels of intensity (mild, moderate, extreme) were chosen since Ley and Bryden (1979) had reported that their normal subjects had had some difficulty in discriminating among five levels of intensity. On the advice of an instructor in the Theatre Arts Department, the actors were not given an opportunity to rehearse the emotions and windows were draped so that they would be unable to use their reflections as feedback.

The photography session was done first with all actors. The actor was asked to sit on a step-stool against a black background and the head and shoulders of the actor were wrapped in black fabric, thus reducing the chance that judgements of the emotion in the photographs might be biased by contextual cues. The actor was instructed to portray the emotion and intensity of emotion as cued and, when they felt the emotion to be appropriately portrayed, to lift the forefinger of their right hand, which was resting on their right knee. The order of emotions and intensities as cued is listed in Appendix 3. The sequence was repeated three times, for a total of 36 photographs for each actor. Due to technical problems (e.g., flash failing to fire), 36 photographs were produced for only two actors; 34 photographs were produced for two actors and 33 for one actor, for a total of 173 photographs.

Immediately following the photography session, each actor was seated at a table. They were given a list of nonsense phrases (see Appendix 4) and asked to practice pronouncing the words in the phrases, but to avoid rehearsing any emotional intonation. The microphones were placed approximately twelve inches in front of the actor and a sound level check was taken. The actor was cued for the emotion and intensity of emotion they were to portray in the sequence outlined in Appendix 3. Each actor started at a different point in the sequence of phrases in order to ensure that the same emotions and intensities were not restricted to the same nonsense phrases. The sequence was repeated three times, for a total of 36 voice clips for each actor, with the exception of one actor for whom (due to experimenter error) only 33 voice clips were taped. Thus, a total of 177 voice clips were produced.

Item Selection for the Research Form (VERT-R)

The film from the production sessions was developed at high contrast (to eliminate any traces of the draped fabric) into 3 x 5 photographs. At the same time, contact sheets were developed. Because many of the photographs were similar in appearance, it was hoped that the contact sheet would help to reduce confusion about the correct negative for each photograph. The photographs of each actor were numbered randomly from one to thirty-six. The audiotapes of each actor were dubbed randomly, within each actor, on to a single Maxell XLII cassette tape using a Sony 756 reel to reel tape recorder at 7 1/2 ips and no noise reduction, with Scotch Master tape.

Five judges, two male and three female, all graduate students in the the psychology department, were asked to sort the photographs and voice clips into twelve catagories (four emotions, each at three levels of intensity). The photographs and audiotapes were presented in a different order to each judge (see Appendix 5) in order to reduce potential practice effects.

The photographs and voice clips were ranked according to the consistency of judges' sorting. The criteria for ranking was as follows:

Rank 1: 100 percent agreement on emotion and intensity.
Rank 2: 100 percent agreement on emotion; one judge in disagreement on intensity by one degree (e.g. four judges rate as moderate; one judge rates as mild).
Rank 3: 100 percent agreement on emotion; one judge in disagreement on intensity by two degrees.
Rank 4: one judge in disagreement on emotion (e.g. four judges rate as angry; one judge rates as afraid); 100 percent agreement on intensity.
Rank 5: 100 percent agreement on emotion; two judges in disagreement on intensity by one degree in the same direction (e.g three judges rate as moderate, two judges rate as mild).

The rationale for this ranking was that emotion was the salient construct and that therefore at least 80% consistency should occur for the item to be included. Similarly, 80% consistency in intensity rating (i.e four out of five agree) among judges was considered likely to be a better item, even if the fifth judge was in disagreement by more than one degree.

Of the 173 photographs produced, 96 photographs achieved a ranking of five or better. Only the 63 photographs achieving a ranking of four or better were considered for inclusion in the test, since the disagreement in intensity in Rank 5 was felt to make the reliability of these items questionable. Using a chi-square analysis (SPSS/PC v.4.0), there was a significant difference in the frequency with which photographs portraying different emotions achieved a high consistency ranking. More photographs depicting happiness and fear and fewer photographs depicting sadness and anger achieved a rank of four or higher than was likely to occur by chance ($\chi^2(3) = 9.317$, $p = .025$). In order to ensure that a bias toward accurate recognition of positive versus negative emotion did not statistically affect the choice of photographs, the categories were collapsed, so that "sad", "angry" and "afraid" were grouped into a negative category and "happy" is considered as the positive category. There was no significant difference in the number of photographs in each category achieving a rank of four or higher ($\chi^2(1) = 2.683$, ns.). Similarly, there was a significant difference in the number of photographs depicting mild, moderate and extreme degrees of intensity which achieved a high consistency ranking, with a higher frequency of extreme intensities and a lower frequency of mild and moderate frequencies occurring than is likely by chance ($\chi^2(2) = 8.667$, $p = .013$). In order to ensure that a bias toward accurate recognition of extreme intensity versus less than extreme intensity did not affect the choice of photographs to be included, the intensity categories were collapsed into "extreme" and "less-than-extreme". No significant difference was revealed ($\chi^2(1)$ = .016, ns.) Table 1 summarizes the frequency of occurrence of emotions and intensities that achieved a ranking of four or better.

Table 1

Frequency of Emotions and Intensities in Photographs

	Mild	Moderate	Extreme	Total
Happy	7	6	12	25
Sad	4	2	3	9
Angry	3	2	7	12
Afraid	6	2	9	17
Total	20	12	31	63

Of the 177 voice clips produced, 61 achieved a ranking of four or better. In contrast to the results of the chi-square analysis of the ranking of photographs, there was no significant difference in the frequency with which voice clips depicting different emotions achieved a high consistency ranking lthough there was a trend for those voice clips depicting anger to occur more frequently ($\chi^2(3)$ = 7.525, p = .057). When the categories were collapsed into a positive and negative category, there was a highly significant difference, with voice clips depicting a negative emotion achieving a high consistency ranking with much greater frequency than voice clips depicting a positive emotion ($\chi^2(1) = 27.557$, $p < .001$). There was no significant difference in the categories of intensity achieving a high consistency ranking; however, there was a trend towards moderate levels of intensity occurring more frequently ($\chi^2(2) = 4.557$, $p = .102$). When the categories of intensity were collapsed into "extreme" and "not extreme", there was a significant difference, with voice clips depicting extreme degrees of intensity occurring less frequently ($\chi^2(2) = 10.246$, $p = 001$). (see Table 2).

Table 2

Frequency of Emotions and Intensities in Audiotapes

	Mild	Moderate	Extreme	Total
Happy	1	6	3	10
Sad	4	8	3	15
Angry	7	9	8	24
Afraid	3	5	4	12
Total	15	28	18	61

From the pool of 63 photographs, 37 photographs were chosen (13 of rank one; 14 of rank two; 4 of rank three and 6 of rank four). From the pool of 61 voice clips, 41 voice clips were selected (16 at rank one; 20 at rank two and 5 at rank four). Both the photographs and the voice clips were selected for inclusion in the test so that the best possible representation of each emotion at each level of intensity was presented by at least two actors. One exception was made in the case of the item portraying a mild intensity of happiness in the auditory modalitity, for which only one voice clip achieved a satisfactory ranking.

The 37 photographs were reprinted so that the faces were all approximately the same size and brightness and were then mounted on a black 8 1/2 x 11 sheet, enclosed in plastic and put into a three ring binder. The voice clips were dubbed from the original five tapes, controlling for variations in loudness, on to a single cassette tape. Some of the photographs and voice clips were presented more than once.

The research version of the VERT (VERT-R) was composed of three subtests, each consisting of 24 items. Based on well-established methodology in the literature, the stimuli in each subtest were arranged in pairs, so that the ability to determine whether the emotions and intensity of emotion portrayed were the same or different, as well as the ability to identify the emotion and intensity of emotion, could be assessed.

The first subtest consisted of 24 pairs of photographs; the second of 24 pairs of voice clips; and the third of 24 pairs comprised of a single photograph paired with a single voice clip. Two different actors were always presented in each item. The order and content (i.e., the emotion and intensity portrayed) of the items was the same in all subtests. Each emotion at each level of intensity was presented four times. Emotions and intensities were each presented with the keyed reponse "same" twelve times and "different" twelve times. Appendix 6 contains a sample of the score sheet for the VERT-R.

Study 1 - Psychometric Studies of the VERT-R

Studies with the research form of the VERT were conducted with two major goals in mind. The first goal was to develop a short form, or clinical form of the VERT. Consequently, reliability studies of the test were carried out with a view to reducing the number of items to about 36, or half of the number of items in the long version. The second goal was to test the hypotheses listed above, both to determine the validity of the VERT and to investigate the function of recognition of emotion in relation to other functions that may mediate its operation.

Method

Subjects

Thirteen subjects, five men and eight women, all students in psychology classes at the University of Victoria were recruited. The age range of the female subjects was 20 to 36 ($M = 26.2$); the age range of the male subjects was 25 to 37 ($M = 28.8$). Mean number of years of education was 16.9. The subjects were paid $5.00 for participating in the study.

Test Materials

Victoria Emotion Recognition Test

The research version of the VERT is composed of three subtests, each consisting of 24 items. Since the stimuli are presented in pairs, 48 judgements of emotion and intensity must be made. The order and content (i.e., the emotion and intensity portrayed) of the items is the same in all subtests. Each emotion at each level of intensity is presented four times. Emotions and intensities are each presented with the keyed reponse "same" twelve times and "different" twelve times. Subjects are told that they will be seeing or hearing four emotions portrayed (angry, sad, happy, afraid) and that the emotions will be presented at one of three intensities (mild, moderate or extreme). Printed sheets are placed in front of the subjects to remind them of their choices.

Items are scored by assigning a point for each correct judgement made. A perfect score on each item would be achieved if the subject correctly matched the emotion as being the same or different (1 point), correctly identified both emotions (2 points), correctly matched the intensity as being the same or different (1 point) and correctly identifed both intensity levels (2 points). Thus, the maximum score possible on each item is six. Although for clinical purposes the components of each item which assess discrimination (match emotion and intensity) would be scored separately from the components which assess identification, the total score on each item was used in order to generate enough variance for statistical analysis.

The first subtest is designed to assess recognition of facial affect. Two photographs are presented simultaneously and the subject is first asked to decide if the emotion shown on the faces is the same or different and what emotion is being portrayed, then asked if the level of intensity of emotion is the same or different and what intensity is being portrayed.

The second subtest is designed to assess recognition of affect in tone of voice. Two voice clips are presented sequentially and the subject is asked, as in the first subtect, to decide if the emotion in the two voices is the same or different and what emotion is being portrayed; similarly, whether the intensity of emotion in the two voices is the same or different and what intensity is being portrayed.

The third subtest is designed to assess whether the ability to recognize emotion is affected by the presentation of stimuli in two modalities simultaneously. Simultaneous presentation of facial and tonal affect is more typical in daily life; therefore it seemed plausible that performance on this subtest might correlate more closely with difficulties in daily interactions. Although in normal subjects, it was expected that some sex effect would occur, primarily this subtest was included so that the effect of simultaneous presentation on accuracy of recognition in brain damaged patients could be assessed. In 20 of the 24 items, the same actor was used in both the visual and the auditory stimuli. In the remaining four items, actors of the same sex were used. A single photograph is presented in conjunction with a voice clip and, once again, the subject is asked to decide if the emotions portrayed are the same or different, what emotions are being portrayed, if the level of intensity of emotion is the same or different and what intensity is being portrayed.

No feedback was given to the subject as to whether the judgement was correct or incorrect throughout the test. There was no time limit imposed, although subjects were encouraged to guess if they appeared to be hesitating unduly. In order to reduce possible confounding effects of nonverbal auditory memory demands, subjects were allowed to replay the auditory stimuli once if they requested it.

A total score is generated, which gives an overall measure of the ability to recognize emotion. Individual subtest scores are also generated as are scores indicating the ability to match emotion, identify emotion, match intensity and identify intensity.

Other Tests

Other tests were administered in conjunction with the VERT in order to demonstrate construct validity; that is, to demonstrate that the VERT measures some aspect of recognition in emotion in other people (convergent validity) and does not measure more basic skills, such as discrimination of facial characteristics or discrimination or memory of nonverbal sounds or other aspects of emotion (discriminant validity). It seemed most appropriate to use standardized tests which have been used in previous neuropsychological studies for this purpose.

The Facial Recognition Test (FRT; Benton, Hamsher, Varney & Spreen, 1983) assesses the ability to identify and discriminate photographs of unfamiliar faces. The subject is required to match faces presented under three conditions: identical front view photographs; front-view with three-quarter photographs and; front view photographs under different lighting conditions. The short form of the test was used in this study. The FRT has been demonstrated to be sensitive to damage in the right posterior area of the brain (Benton et al., 1983).

The FRT was included in the procedure to investigate the relationship between the ability to discriminate unfamiliar faces and the ability to recognize and identify facial emotion as measured by the VERT. The FRT takes about five minutes to administer.

The Seashore Tonal Memory Test (TMT; Seashore, 1960) was originally designed as one subtest of the Seashore Measures of Musical Talent. The test consists of a series of musical tones, presented in pairs, in which one tone in the second series is different. The subject must identify which tone in the second series is different. The TMT has gained some credibility as a measure of right hemisphere damage (Karzmack, Heaton, Lehman and Crouch, 1985).

The TMT was included in this battery as a measure of non-verbal auditory discrimination and memory, to investigate the relationship between the ability to recognize tonal affect and the more basic function of tonal discrimination. The TMT takes about five minutes to administer.

From the available tests of emotion recognition, the Profile of Nonverbal Sensitivity (PONS; Rosenthal et al., 1979) was selected as the best measure, since it includes scores for both visual and auditory stimuli, with which to evaluate convergent validity of the VERT. Although the PONS presents dynamic stimuli, versus the static stimuli presented in the VERT, this difference was not considered to be unduly confounding. Roth, Berquist and Novack (1989) found no significant difference in performance on tasks involving either static (photographs) or dynamic (videotape) stimuli in a group of subjects with right hemisphere damage. The PONS is a videotape consisting of 220 short scenes. In each scene, the same young woman is seen or heard, or both seen and heard, portraying emotion appropriate to 20 different social situations. In the purely visual presentations, the subject views the woman's face, or her body from the neck to the knees (excluding the face) or her full figure (head to knees), but hears no sound. In the purely auditory presentations, the screen is blank and the young woman's voice is heard. Throughout the tape, when the woman's voice is heard, the content of her speech is masked, either by random splicing of words or by filtering out the high frequencies. Finally, some scenes are presented with both the visual and the auditory material.

Since the full PONS takes over 40 minutes to administer, for this study, all of the scenes in which the body or the full figure were presented, either alone or in conjunction with auditory material, were eliminated. Thus, only those scenes which are purely auditory or which present the face alone or the face in conjunction with auditory material were included. This shortened version of the PONS preserves the range of emotional situations portrayed in the full version, but consists of only 100 scenes. Normative data on these "channel scores" are available in the test manual.

As with the full PONS, the subject is required to choose which of two emotional situations is being portrayed in each scene. For example, the subject would be asked to decide if the affect being presented in the clip is more appropriate to a situation in which someone is "expressing jealous anger" or "talking to a lost child". This shortened version of the PONS takes about 20 minutes to administer.

The PONS was included in the study to investigate the relationship between the ability to associate facial or tonal affect with the appropriate social situation and the ability to recognize tonal and facial affect.

The Profile of Mood States (POMS; McNair, Lorr & Droppleman, 1971) is designed to measure the current affective state. The test is a checklist of 65 words that describe feelings (such as "shaky", "discouraged", "bitter" and "cheerful") presented on a five point Likert scale. Factor analytic studies of the POMS items reported in the manual identified six mood states:

tension-anxiety; depression-dejection; anger-hostility; vigor-activity; fatigue-inertia; and confusion-bewilderment. A total score (Total Mood Dysfunction; TMD) can also be calculated by summing the scores on the five "negative" mood states and subtracting the score on the "positive" mood state.

The subject is required to indicate how much (from "not at all" to "extremely") of each feeling he has been experiencing over the past week including the day of testing. Higher scores on the POMS indicate that the subject is reporting a higher level of emotional distress. The test takes about 5 minutes to administer.

The POMS was included in the study to investigate the effect of mood on the accuracy of recognition of emotion.

Procedure

The purpose of the study and the types of tasks that would be given to them was explained to each subject before they signed an informed consent (see Appendix 8). All subjects in the study were given the tests in the same order: (1) Facial Recognition Test (2) Tonal Memory Test (3) Profile of Nonverbal Sensitivity (4) Profile of Mood States and (5) Victoria Emotion Recognition Test. Subjects were asked to return in about two weeks to repeat the Profile of Mood States and the Victoria Emotion Recognition Test. Since there is evidence in the literature that mood can affect accuracy of recognition, the POMS was included in the re-test session. The battery took between one and one and one-half hours to administer.

Results

Five men and five women completed the entire test battery and returned for the retest session. Two women did not return for the retest and one woman only completed the VERT in the initial testing session. The test results of one male subject, who revealed after completing the second session that he had been struck by a car and had been in a coma for several weeks as a child, were eliminated from the study.

The three subtests of the VERT are referred to throughout the subsequent discussion as the visual subtest (recognition of facial affect), the auditory subtest (recognition of tonal affect) and the auditory-visual subtest (recognition of affect presented in both modalities simultaneously).

All of the statistical analyses reported were calculated using SPSS/PC+ (v. 4.0). Psychometric guidelines and criteria in test development were taken from Psychological Testing (Anastasi, 1988), Psychological Testing (Kaplan and Sacuzzo, 1982) and A Handbook of Test Construction (Kline, 1986).

Normative Studies

The subjects in this study scored slightly above the mean scores of the FRT, TMT and the means of the three channel scores of the PONS as reported in the test manuals (FRT: Benton et al., 1983; TMT: Seashore, 1960; PONS: Rosenthal et al., 1979). For the FRT and TMT, both males and females scored within one standard deviation of the norm. However, males scored in excess of one standard deviation of the norm on the "voices only" and "faces and voices" channel scores of the PONS and females scored in excess of one standard deviation on the "voices only" channel score.

Normative data on the total score of the POMS are not given in the manual. However, the scores of the subjects in this sample were not in excess of one standard deviation from the mean of the six factor scores of the POMS as reported in the test manual (McNair, Lorr & Droppleman, 1971). Table 3 shows the mean scores of the subjects on these tests compared to the means of the tests given in the manuals.

Table 3

Performance on Auxiliary Tests Given with the VERT-R

Mean (SD)

	Males		Females	
	Normative Sample	Study Sample	Normative Sample	Study Sample
FRT	45.4(3.96)	47.2(2.3)	45.4(3.96)	47.1(2.5)
TMT	25.0(4.6)	25.8(2.2)	25.0(4.6)	27.1(1.3)
PONSF	15.9(1.7)	17.0(1.4)	16.3(1.7)	17.4(1.4)
PONSV	24.3(3.0)	28.0(2.4)	24.9(2.9)	29.1(2.9)
PONSFV	33.3(1.7)	36.0(1.0)	34.5(1.7)	35.7(1.6)
POMS-T	12.9(6.8)	12.4(.07)	13.9(7.4)	12.7(.16)
POMS-D	13.1(10.5)	9.2(.37)	14.8(11.4)	13.8(.09)
POMS-A	10.1(7.8)	9.4(.09)	9.3(7.4)	6.0(.45)
POMS-V	15.6(6.0)	19.2(0.6)	15.6(6.6)	17.8(.33)
POMS-F	10.4(6.2)	7.6(.45)	10.7(6.8)	7.2(.51)
POMS-C	10.2(5.2)	8.8 (.27)	11.7(5.7)	8.7(.53)

Legend for Table 3

FRT - Facial Recognition Test

TMT - Tonal Memory Test

PONSF - Profile of Nonverbal Sensitivity - Faces

PONSV - Profile of Nonverbal Sensitivity - Voices

PONSFV - Profile of Nonverbal Sensitivity - Faces & Voices

POMS-T - Profile of Mood States - Tension

POMS-D - Profile of Mood States - Depression

POMS-A - Profile of Mood States - Anger

POMS-V - Profile of Mood States - Vigor

POMS-F - Profile of Mood States - Fatigue

POMS-C - Profile of Mood States - Confusion

Table 4 presents mean scores of the subjects on the VERT-R. Multivariate analysis revealed no significant difference in the scores of males and females on the whole VERT-R or on any subtest of the VERT-R ($F(3,9) = .613$, ns). A similar non-significant difference in performance between the sexes was demonstrated on the re-test of the VERT-R ($F(3,6) = .056$, ns).

Table 4

Performance on the VERT-R

Mean (SD) [N]

	Males		Females		Both	
	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
VERT-R Total	301.6 (29.2) [5]	310.6 (14.2) [5]	309.5 (20.3) [8]	309.8 (13.3) [5]	306.5 (23.3) [13]	310.2 (13.0) (10)
VERT-R Visual	98.8 (13.4) [5]	98.8 (6.5) [5]	99.9 (6.2) [8]	99.6 (3.3) [5]	99.5 (9.1) [13]	99.2 (4.9) [10]
VERT-R Auditory	104.4 (12.5) [5]	108.0 (2.9) [5]	104.6 (7.9) [8]	107.2 (4.7) [5]	104.5 (9.4) [13]	107.6 (3.7) [10]
VERT-R Auditory-Visual	98.4 (12.1) [5]	103.8 (10.0) [5]	105.0 (8.3) [8]	103.0 (7.5) [5]	102.5 (10.0) [13]	103.4 (8.3) [10]

There was also no significant difference demonstrated in performance between subtests; that is, the subjects did not perform significantly better on one subtest of the VERT-R as compared to the other subtests.

There was no significant difference in the total score between the initial testing session and the re-test (F(1,9)= 1.15, ns). The subjects did report significantly higher levels of emotional distress on the POMS in the initial session than they did on re-test (t(9)= 2.5, p = .034. Multivariate repeated analysis of the total score on the VERT and the POMS revealed a significant effect of score by time (F(1,9)= 9.24, p = .014.)

In order to investigate the effects of practice within subtests, the mean performance on the first half of each subtest was compared with the mean performance on the second half. Although the mean for the second half of each subtest was higher than than the mean for the first half in all subtests, differences between the halves of any single subtest were not significant (see Table 5).

Table 5

Performance on First Half versus Second Half of each Subtest of the VERT-R

Mean (SD)

	First Half	Second Half
Visual Subtest	48.85 (4.6)	50.54 (5.3)
Auditory Subtest	49.54 (6.9)	54.92 (5.0)
Auditory-Visual	50.0 (5.6)	52.46 (7.0)

It is desirable that the individual items on a test be neither too difficult nor too easy. In the case of the VERT, items with a mean score of zero or six would not be acceptable (Anastasi, 1983; Kline, 1986). An acceptable range of difficulty on the items was demonstrated for all three subtests. On the visual subtest, the mean score on the items ranged from 2.1 to 5.5. On the auditory subtest, the mean score on the items ranged from 2.2 to 5.6. On the auditory-visual subtest, the mean score of the items ranged from 3.2 to 5.7.

Reliability

The internal reliability of a test is an indication of the homogeneity of the test. The higher the internal reliability, the more likely it is that the test is measuring some discrete aspect of behaviour.

Inter-item reliablity is a measure of how well the individual items correlate with each other over-all and thus contribute to the description of a behaviour. The usual rule of thumb is that inter-item reliability should be approximately .7 in order to maximize the probability that the test is measuring a distinct construct (Anastasi, 1988; Kaplan & Sacuzzo, 1982; Kline, 1986).

Item-total correlations are an indication of the reliability of individual items. A subject who scores highly on the test over-all should score higher on an individual item than a subject whose over-all test scores are lower. The rule of thumb for item-total correlations is that the correlation coefficient for a test item should be approximately .2 or better (Anastasi, 1988; Kaplan & Sacuzzo, 1982; Kline, 1986).

The internal reliability of the VERT was calculated using the test scores of 12 subjects (7 female, 5 male). The test scores of two females who did not complete the entire test battery were included in these calculations. Inter-item reliability was calculated using Cronbach's alpha. For the full scale VERT, consisting of 72 items, alpha = .8589; for the visual scale, alpha = .7227; for the auditory scale, alpha = .6610; and for the auditory-visual scale, alpha = .7255. Item-total correlations (corrected so that the score on the individual item is not included in the calculation) for the full scale VERT ranged from -.3696 to .8416. The range of item-total correlations for the visual scale was from -.3506 to .6391; for the auditory scale was from -.4225 to .7410 and for the auditory-visual scale was from -.3364 to .7562.

The internal reliability of a test may also be evaluated by comparing the reliablity of the items in the first half versus the second half or by comparing the reliability of alternate items. Because the difficulty of the items in each subtest was thought to be greater at the beginning of the subtest and less at the end, split half reliability calculations would not have been appropriate. Similarly, because the content of each item is complex and may include components which are relatively more or less difficult, alternate item reliability would not contribute a useful evaluation of the internal consistency of the test.

Test-retest reliablity is a measure of the reliability of the test over time. It is important to know that performance on the test will be relatively consistent in spite of minor changes in mood, energy level or general well-being. Ten of the twelve subjects (five male, five female) returned for reassessment about two to three weeks after the initial testing session. Of the ten, five subjects (three female and two male), were writing mid-term examinations at the time of the initial assessment and may have been under more stress at the time of the initial assessment than when they were re-assessed.

Test-retest reliability was calculated using the Pearson Product-Moment correlation. For the full scale VERT, test-retest reliablity was .6965, for the visual subtest was .5735, for the auditory subtest was .4363 and for the auditory-visual subtest was .7346. Test-retest reliabilities based on total scores for individual items ranged from -.4603 to .9193.

Validity

Validity studies are conducted in order to determine that the test measures the construct of interest; in this case, the recognition of emotion. It is important to understand not only what the test is measuring (convergent validity), but also, what it is not (discriminant validity). Pearson Product-Moment correlations were calculated between the subtests of the VERT, between the full scale VERT and other tests administered and between the subtests of the VERT and other tests administered in order to contribute to an understanding of the nature of the construct measured by the VERT. The test results from 12 subjects (7 female and 5 male) were used to calculate the validity coefficients.

There was no significant relationship among subtests of the VERT. There was no significant relationship between the test of recognition of facial identity (FRT) and the visual subtest of the VERT (r = .2071, ns) for the 12 subjects. There was no significant relationship between the test of tonal memory and discrimination (TMT) and the auditory subtest of the VERT (r = .3613, ns)

Table 6

Correlations between the VERT-R and Auxiliary Tests

	VERTT (1)	VERTT (2)	VERT-V	VERT-A	VERT-A/V
FRT			.21		
TMT				.36	
PONST	.56*				
PONSF			.03		
PONSV				.51*	
PONSFV					-.16
POMS (1)	.01				
POMS (2)		-.13			

* p < .05

There was a significant positive relationship between the voices channel score (PONSV) on the PONS (a test of association of affect with social situation) and the auditory subtest (VERTA) of the VERT ($r = .51$, $p = .04$). There was also a significant positive relationship between the total score of the full scale VERT (VERTT) and the total of the three channel scores of the PONS (PONST) ($r = .5630$, $p = .028$). The relationship between the other two channel scores on the PONS and the related subtests of the VERT did not reach significance. There was no significant relationship demonstrated between the total score on the test of current mood state (POMS) and the total score on the VERT (VERTT) for the entire sample. Table 6 provides a summary of the relationships between these tests.

Factor analysis is another method of describing the relationship among tests in validity studies. The pattern of variables (tests) that load on a factor may help to determine if there is a relationship and what the character of that relationship might be. The number of subjects in this sample permits only exploratory factor analyses in order to generate hypotheses.

A factor analysis of the scores of twelve subjects, using principal components analysis and a varimax rotation, of the scores on the FRT, TMT, the total score on the PONS (PONST), the POMS and the total score on the VERT (VERTT) extracted two factors, accounting for 58.7 percent of the variance (see Table 7). The TMT, total score on the PONS and total score on the VERT loaded heavily on Factor 1 and the FRT loaded heavily on Factor 2. The POMS did not load substantially on either factor. A second factor analysis, also using principal components analysis and a varimax rotation, on the same tests, breaking the PONS into three channel scores and

Table 7

Factor Analysis using Total Scores - VERT-R

	Factor 1	Factor 2
FRT	-.10391	.93832
TMT	.70400	.18065
PONST	.91592	.29435
POMS	.02042	.03733
VERTT	.69943	-.31335

the VERT into three subtest scores, extracted four factors, accounting for 81.9 percent of the variance. All three subtests of the VERT and the "voices only" channel of the PONS loaded on the first factor. The TMT, the "faces only" and "faces and voices" channels of the PONS and the auditory subtest of the VERT loaded on Factor 2. The FRT loaded heavily on Factor 3 and to a lesser extent, so did the "faces only" channel of the PONS and the visual subtest of the VERT. The POMS loaded heavily on Factor 4. Table 8 summarizes the results of this factor analysis.

A factor analysis was also done of the items of the VERT-R within each subtest. The factor analysis extracted 8 factors for the visual subtest, 8 factors for the auditory subtest and 7 factors for the auditory-visual subtest. Although in this version of the VERT, items across subtests present the same configurations of emotions and intensities, the items did not load on the same factors across subtests.

Table 8

Factor Analysis Using Subtest Scores - VERT-R

	Factor 1	Factor 2	Factor 3	Factor 4
FRT	-.24917	.09813	.75879	.56065
TMT	.06670	.78273	-.17720	-.10089
PONSF	-.20722	.73601	.45733	-.24406
PONSV	.85262	.22445	-.02219	.19767
PONSFV	-.29835	.77367	-.09935	.30444
POMS	.02214	.05084	-.53511	.76062
VERTV	.75038	-.02350	.49768	.12037
VERTA	.58387	.55925	-.24907	-.19298
VERTVA	.90223	-.16162	.07621	.02622

Item Selection for the Clinical Form (VERT-C)

A review of the results of the studies with the research form of the VERT revealed that modifications would be needed in order to make the test clinically useful. The administration time for the 72-item VERT was approximately 30 minutes. Furthermore, inter-item reliability and test-retest reliability for some items was poor. The purpose of Study 4 was to reduce the administration time to about 15 minutes in order to enhance the utility of the test in a clinical setting. Although there was a risk of decreasing the internal reliability of the test by reducing the number of items, it was hoped that by choosing those items with the best inter-item and test-retest reliability, the risk would be minimized. The process of item selection was made more complicated by the need to preserve an acceptable range of difficulty in the test items and to present each of the emotions at each level of intensity at least twice in each modality.

The 72 items of the long version of the VERT were reviewed and compared on the dimensions of item content, item difficulty, actor depicting the emotion, corrected item-total correlation and test-retest correlation. The criteria for selection was that both the item-total correlation and the test-retest correlation must be greater than or equal to .2.

A total of 38 items achieved the desired criteria; 14 items in the visual subtest, 12 items in the auditory subtest and 12 items in the auditory-visual subtest. The range of difficulty for these 38 items in the visual subtest was from 3.2 to 5.5, in the auditory subtest was from 2.1 to 5.5 and in the auditory-visual subtest was from 3.4 to 5.1.

The 38 items achieving the desired criteria did not represent equal numbers of presentations of emotions and intensities across the three subtests. Table 9 presents the frequencies with which each emotion at each level of intensity is represented in these 38 items. Chi-square analysis did not reveal any significant differences in the frequency of occurrence of any emotion or level of intensity in any of the subtests. An analysis of the 26 items which include photographs (i.e. those in the visual subtest plus those in the auditory-visual subtest) also did not show any significant difference in the frequency of occurrence of any emotion or level of intensity; nor did a similar analysis of all of the voice clips.

Table 9

Frequency of Emotions and Intensities of Items Achieving Criteria

	VERTV	VERTA	VERTVA	Total
Happy-mild	4	1	(V)1 (A)2	8
-mod	3	2	0 1	6
-extr	2	2	1 3	8
Sad -mild	4	1	(V)2 (A)0	7
-mod	2	2	1 0	5
-extr	2	2	0 2	6
Angry-mild	1	4	(V)1 (A)1	7
-mod	2	3	2 1	8
-extr	2	2	1 0	5
Afraid-mld	3	2	(V)2 (A)0	7
-mod	2	1	0 2	5
-ext	1	2	1 0	4

In selecting the items for the clinical version of the VERT, no attempt was made to equalize frequency of presentation of each emotion at each level of intensity. However, it was felt that there should be at least two presentations of each emotion at each level of intensity in each modality. In addition, it seemed useful to attempt to keep the number of items in each subtest equal, so that the performance among subtests could be compared directly. The final item selection therefore included one item in the auditory subtest with an item-total correlation of .01 and a test-retest correlation of .79. The content of this item incorporated a mild presentation of sadness and increased the number of presentations of the mild intensity of sadness in the auditory modality to two.

The clinical version of the VERT was constructed with 12 items in each subtest, offering an equal number of presentations in each modality. In the presentation of emotions, "happy" is represented 20 times, "sad" 17 times, "anger" 18 times and "fear" 17 times. In the presentation of levels of intensity, "mild" is represented 25 times, "moderate" 24 times and "extreme" 23 times. Correct responses are keyed "same" 16 times and "different" 20 times for emotion and "same" 18 times and "different" 18 times for intensity.

Study 2 - Psychometric Studies of the VERT-C

The purpose of the psychometric studies was to determine the reliability of the clinical form of the VERT and to attempt to replicate the results of the validity studies done with the research form. The studies were conducted at the University of Victoria by a research assistant trained in the administration of the test battery.

The items chosen for the clinical version of the VERT were located throughout the research subtests; that is, the items demonstrating the greatest reliability in the research form were not clustered at the beginning, middle or end of the subtests. However, it was noted that subjects often appeared to be trying to make relative judgements, especially with regard to intensity. For example, they might remark that if they had said that this photo was moderately happy, then that photo must be extremely happy. It was hypothesized that performance on the test might be improved if subjects were given examples of different emotions at different levels of intensity at the beginning of each subtest. Accordingly, two sample items were appended to each subtest. The items chosen as examples had achieved a high consistency ranking when sorted by five judges. One sample item portrayed emotion at the same level of intensity and the other portrayed emotion at different levels of intensity. All four emotions were represented with the two sample items in each subtest. For example, the first sample item for the visual subtest portrayed a moderate degree of happiness paired with an extreme degree of anger. The second sample item portrayed a moderate degree of sadness paired with a moderate degree of fear.

In addition to the seven hypotheses investigated in the study of the research form of the VERT, the following hypothesis was made:

8. performance on the emotion recognition test will be enhanced by training.

Method

Eighteen subjects were recruited in Psychology classes at the University of Victoria. All of the subjects completed the test battery described previously (FRT, TMT, PONS, POMS and the clinical form of the VERT) and returned in two to three weeks to be retested on the POMS and the VERT-C. Eight of the subjects (4 male and 4 female) were given training on the VERT-C. Training consisted of the presentation of two examples which included all four emotions and at least two levels of intensity prior to each subtest. Ten subjects (5 male and 5 female) were not given training. The group of subjects who received training had a mean age of 24.1 years (range 22 to 28 years) and had completed an average of 17.5 years of education. The group of subjects who did not receive training had a mean age of 24.8 years (range 20 to 38 years) and had completed an average of 16.3 years of education. All of the subjects were paid $5.00 for participating in the study.

Results

Normative Studies

As with the subjects involved in the studies with the VERT-R, the mean scores of the subjects in these studies was above the mean score of the FRT and TMT and all three channel scores of the PONS as reported in the test manuals. The mean scores of these subjects were within one standard deviation of the test mean, with the following exceptions: females who received training scored in excess of one standard deviation on the "voices only" channel score of the PONS; males who received training scored in excess of one standard deviation on the "faces and voices" channel score of the PONS; males who did not receive training scored in excess of one standard deviation on the "voices only" and the "faces and voices" channel scores of the PONS.

The mean scores of all of the subjects were within one standard deviation of the test means of the six factor scores of the POMS, with one exception: females who received training reported feeling angry at a level in excess of one standard deviation ($z = 1.11$). Table 10 summarizes the mean scores of the subjects who received training on these tests as compared to the mean scores of the tests given in the test manuals. Table 11 summarizes the scores of the subjects who did not receive training.

Multivariate analysis revealed no significant difference in the scores on the full VERT-C between the group that received training and the group that did not ($F(3,14) = .55$, ns). Further univariate analysis revealed no significant difference in performance on any of the subtests between the group which received training and the group which did not. Table 12 provides scores of both groups on the full VERT-C and on the three subtests. Table 13 presents the mean scores of the subjects by sex on the VERT-C. Multivariate analysis revealed no significant group by sex effect on the full VERT-C or on any of the subtests. Further univariate analysis revealed no significant difference between the scores of the two groups or between the sexes on any of the subtests of the VERT-C. Multivariate analysis of the test-retest scores of all

18 subjects revealed a significantly better performance on re-test for the total score on the VERT ($F(1,17) = 8.8$, $p = .009$), but no significant difference in scores on individual subtests ($F(2,16) = .228$, ns).

Table 10

Performance on Auxiliary Tests Given with the VERT-C

Subjects Receiving Training

Mean (SD)

	Males (4)		Females (4)	
	Normative Sample	Study Sample	Normative Sample	Study Sample
FRT	45.4(3.96)	49.3	45.4(3.96)	47.25
TMT	25.0(4.6)	26.0	25.0(4.6)	26.7
PONSF	15.9(1.7)	16.0	16.3(1.7)	17.0
PONSV	24.3(3.0)	27.0	24.9(2.9)	28.8
PONSFV	33.3(1.7)	36.0	34.5(1.7)	35.3
POMS-T	12.9(6.8)	13.0	13.9(7.4)	13.8
POMS-D	13.1(10.5)	12.8	14.8(11.4)	15.5
POMS-A	10.1(7.8)	14.3	9.3(7.4)	17.5
POMS-V	15.6(6.0)	12.3	15.6(6.6)	15.0
POMS-F	10.4(6.2)	13.5	10.7(6.8)	10.3
POMS-C	10.2(5.2)	11.3	11.7(5.7)	11.0

Table 11

Performance on Auxiliary Tests Given with the VERT-C

Subjects Not Receiving Training

Mean (SD)

	Males (5)		Females (5)	
	Normative Sample	Study Sample	Normative Sample	Study Sample
FRT	45.4(3.96)	47.0	45.4(3.96)	48.4
TMT	25.0(4.6)	25.5	25.0(4.6)	27.4
PONSF	15.9(1.7)	15.8	16.3(1.7)	16.8
PONSV	24.3(3.0)	27.4	24.9(2.9)	25.6
PONSFV	33.3(1.7)	35.4	34.5(1.7)	35.6
POMS-T	12.9(6.8)	14.4	13.9(7.4)	8.0
POMS-D	13.1(10.5)	17.0	14.8(11.4)	6.0
POMS-A	10.1(7.8)	14.2	9.3(7.4)	8.0
POMS-V	15.6(6.0)	14.8	15.6(6.6)	20.8
POMS-F	10.4(6.2)	11.2	10.7(6.8)	7.4
POMS-C	10.2(5.2)	10.4	11.7(5.7)	6.6

Legend for Tables 10 & 11

FRT - Facial Recognition Test

TMT - Tonal Memory Test

PONSF - Profile of Nonverbal Sensitivity - Faces

PONSV - Profile of Nonverbal Sensitivity - Voices

PONSFV - Profile of Nonverbal Sensitivity - Face &
Voices

POMS-T - Profile of Mood States - Tension

POMS-D - Profile of Mood States - Depression

POMS-A - Profile of Mood States - Anger

POMS-V - Profile of Mood States - Vigor

POMS-F - Profile of Mood States - Fatigue

POMS-C - Profile of Mood States - Confusion

Table 12

Performance on the VERT-C by Group

Mean (SD)

	No Training (10)		Training (8)	
	Time 1	Time 2	Time 1	Time 2
VERT-C Total	164.3 (8.9)	174.4 (11.9)	163.8 (8.2)	166.0 (10.3)
VERT-C Visual	52.9 (4.2)	56.7 (6.7)	53.5 (4.2)	56.0 (5.4)
VERT-C Auditory	55.5 (3.9)	59.0 (3.1)	56.5 (4.3)	53.8 (3.5)
VERT-C AuditoryVisual	55.9 (3.1)	58.7 (3.8)	56.5 (4.3)	56.3 (4.7)

Table 13

Performance on the VERT-C by Sex

Mean (SD)

	No Training (10)		Training (8)	
	Males	Females	Males	Females
VERT-C Total	166.2 (9.5)	162.4 (8.9)	161.0 (9.4)	166.5 (7.0)
VERT-C Visual	52.6 (4.0)	53.2 (4.8)	52.0 (2.7)	55.0 (5.3)
VERT-C Auditory	57.6 (3.8)	53.4 (2.9)	53.3 (5.1)	54.3 (3.9)
VERT-C AuditoryVisual	56.0 (2.9)	55.8 (3.7)	55.7 (6.2)	57.3 (1.7)

As with the results of the analysis of practice effects within subtests on the VERT-R, there was no evidence that the performance of the subjects improved from the first half to the last half of the test, either for the group which received training or for the group which did not. In fact, in both groups, the mean score on the second half of some subtests was lower than that on the first half. Table 14 compares the mean scores of subjects in both groups on the first and last halves of each subtest.

Table 14

Performance on First and Last Halves on Subtests of the VERT-C

Mean (SD)

	Training		No Training	
	First Half	Last Half	First Half	Last Half
Visual	27.5 (3.0)	26.1 (2.4)	27.1 (3.3)	26.1 (2.5)
Auditory	26.4 (3.7)	23.6 (2.7)	26.4 (3.0)	29.3 (2.5)
Visual/Aud	23.9 (3.6)	26.7 (1.4)	28.9 (3.0)	26.5 (2.5)

Reliability

The internal reliability of the VERT-C appeared to suffer from the reduction of the number of items to 36. Moreover, when the data from both the trained and the untrained group was analyzed separately, the reliability of the test was worse for the trained group. Combining the scores of the two groups for reliability analysis did not improve the reliability co-efficients substantially. For the purpose of making a direct comparison with the VERT-R, only the data from the untrained group (with whom the adminstration of the test was the same as the group that was given the VERT-R) are reported here.

Using Cronbach's alpha, the inter-item reliability for the full VERT-C was .35, for the visual scale was .37, for the auditory scale was -.1 and for the auditory-visual scale was -.32. Individual item-total correlations ranged from .58 to -.28 in the visual scale, from .29 to .-64 in the auditory scale and from .45 to -.7 in the auditory-visual scale. Table 15 provides a comparison of item-total and test-retest correlations for individual items on the research form and the clinical form of the VERT. As with the VERT-R, it was not considered appropriate to evaluate the reliablity of the test using either split-half or alternate item reliability calculations.

Test-retest reliabilities for the full test and subtests continued to be satisfactory in the clinical form. The test-retest correlation for the full VERT-C was .86, for the visual scale was .81, for the auditory scale was .75 and for the auditory-visual scale was .[illegible] Individual item test-retest correlations ranged from [illegible] to -.4.

Table 15

Characteristics of Items on VERT-R and VERT-C

Scale	VERT-R			Content	VERT-C		
	Item #	R i/t	R t/r		Item #	R i/t	R t/r
V I S U A L	3	.4	.6	A3/H3	1	-.1	.04
	6	.2	.6	F2/H2	2	-.2	-.2
	7	.2	.5	S1/S3	3	.1	.8
	8	.6	.4	A2/H3	4	.4	-.2
	9	.4	.5	F1/F2	5	.2	-.1
	10	.6	.8	F3/H1	6	.4	.8
	12	.4	.7	S2/S2	7	.3	-.4
	13	.6	.4	F1/S3	8	-.1	.8
	15	.5	.6	A1/F1	9	.4	.3
	18	.5	.3	H2/A3	10	-.2	.4
	23	.7	.6	H1/A2	11	.6	.5
	24	.6	.3	S1/S1	12	.5	-.5

Table 15
Characteristics of Items on VERT-R and VERT-C

Scale	VERT-R			Content	VERT-C		
	Item #	R i/t	R t/r		Item #	R i/t	R t/r
AUDITORY	1	.5	.2	H3/H3	1	-.1	-.3
	2	.2	.2	F3/F3	2	-.1	.5
	5	.3	.6	A3/A1	3	.1	.6
	6	.4	.7	F2/H2	4	-.4	.6
	7	.6	.4	S1/S3	5	.2	0.0
	12	.5	.4	S2/S2	6	.2	.2
	13	.4	.7	F1/F3	7	.2	.6
	15	.2	.5	A1/F1	8	.3	.4
	18	.3	.6	H2/A3	9	-.6	-.2
	21	.6	.4	A2/A2	10	-.3	.6
	22	.1	.8	S1/H1	11	.1	.2
	23	.3	.3	H1/A2	12	.2	0.0

Table 15
Characteristics of Items on VERT-R and VERT-C

Scale	VERT-R			Content	VERT-C		
	Item #	R i/t	R t/r		Item #	R i/t	R t/r
AUDITORY VISUAL	1	.6	.4	H3/H3	1	.4	0.0
	3	.5	.4	A3/H3	2	.3	-.2
	7	.7	.4	S1/S3	3	-.5	-.1
	8	.6	.8	A2/H3	4	.4	.4
	10	.5	.6	F3/H1	5	.3	.1
	13	.5	.6	F1/S3	6	-.2	-.3
	14	.4	.3	H1/H2	7	.4	.6
	16	.2	.5	A1/A1	8	.2	.6
	19	.5	.4	S2/F2	9	-.5	.1
	20	.4	.4	F1/F2	10	.2	.6
	21	.8	.9	A2/A2	11	-.4	-.4
	22	.5	.6	S1/H1	12	-.7	-.1

Ri/t=item/total reliability;Rt/r=test/retest reliability

Content: H=Happy; S=Sad; A=Angry; F=Afraid

1=Mild; 2=Moderate; 3=Extreme

Validity

Since training appeared to have a minimal effect on the scores of the subjects, data from the two groups was collapsed for the purpose of increasing statisical power. The analysis of the collapsed data (N = 18) revealed a strong correlation between the total score on the PONS and the total score on the VERT-C (r = .7118, p = .001) and moderate correlations between the visual subtest of the VERT-C and the faces only channel score on the PONS (r = .4796, p = .04), the auditory subtest of the VERT-C and the voices only channel score on the PONS (r = .56, p = .02) and the auditory-visual subtest of the VERT-C and the faces and voices channel score on the PONS (r = .48, p = .05). No significant relationships were demonstrated between the FRT and the visual subtest of the VERT-C, between the TMT and the auditory subtest of the VERT-C or the POMS and the total score on the VERT-C (either on initial testing or on re-test). Furthermore, there was no significant relationship among the subtests of the VERT-C. Table 16 provides a summary of the relationships among these tests, using the scores of all 18 subjects.

Table 16

Correlations between the VERT-C and Auxiliary Tests

	VERTT (1)	VERTT (2)	VERT-V	VERT-A	VERT-A/V
FRT			.17		
TMT				-.02	
PONST	.71***				
PONSF			.48*		
PONSV				.56*	
PONSFV					.48*
POMS (1)	-.15				
POMS (2)		-.27			

* p < .05

*** p < .001

The results are comparable to the pattern of relationships demonstrated with the VERT-R in that there is a significant positive relationship between the total score on the VERT and the total score on the PONS and also between the auditory subtest of the VERT and the "voices only" channel score on the PONS. With the larger sample size used in the VERT-C study, the relationship between the visual subtest of the VERT and the "faces only" channel score on the PONS and the relationship between the auditory-visual subtest of the VERT and the "faces and voices" channel score of the PONS also achieved significance.

A factor analysis, using principal components analysis with a varimax rotation, of the total scores of all 18 subjects extracted two factors, accounting for 64.9% of the variance. The total score on the VERT-C, the PONS and the POMS loaded on Factor 1, while the FRT and TMT loaded on Factor 2. Table 17 presents the results of this factor analysis.

Table 17

Factor Analysis using Total Scores - VERT-C

	Factor 1	Factor 2
FRT	.09938	.81083
TMT	.08398	.68496
PONST	.83681	.35406
POMS	.71896	-.33938
VERTT	.75343	.27567

A similar factor analyis using total scores with the VERT-R also extracted two factors, however, the loading pattern was somewhat different. With the data from the VERT-R study, the TMT, PONST and VERTT loaded on the first factor, while the FRT loaded on the second factor. The POMS did not load heavily on either factor.

A second factor analysis of the data from the 18 subjects in the VERT-C study, also using principal components analysis and a varimax rotation, breaking the PONS into the three channel scores and the VERT into three subtest scores, extracted four factors, accounting for 75.6 percent of the variance. The auditory and auditory-visual subtests of the VERT and the "voices only" and "faces and voices" channel score of the PONS loaded on Factor 1. The visual subtest of the VERT and the "faces only" channel score of the PONS loaded on Factor 2. The FRT and TMT loaded on Factor 3, while the POMS loaded on Factor 4. Table 18 provides a summary of the factor loadings.

A similar factor analysis done on the data from the study with the VERT-R showed a somewhat comparable pattern of factor loadings. In that analysis, four factors were also generated. As in the factor analysis done with the VERT-C, the "voices only" channel score of the PONS and the auditory and auditory-visual subtest of the VERT loaded on Factor 1, however, the visual subtest of the VERT also loaded on this factor. The tests loading on Factor 2 are not comparable in the two studies. The FRT loaded on Factor 3 in both studies and the POMS loaded on Factor 4.

In comparing the factor analysis of the subtest scores in the two studies, the analysis done with the data from the study with the VERT-C seems to provide more straightforward results. The increase in the number of subjects in the study with the VERT-C is most likely the best explanation for this improvement. In absolute terms, the number of subjects in the VERT-C study is still very small and the results therefore must be considered to be exploratory only.

Table 18

Factor Analysis using Subtest Scores - VERT-C

	Factor 1	Factor 2	Factor 3	Factor 4
FRT	.30440	-.06272	.83875	-.25240
TMT	-.14461	.32356	.70849	.21779
PONSF	-.00804	.81464	.17681	.22434
PONSV	.72340	.04744	.38072	.29812
PONSFV	.61775	.44724	-.06744	.28380
VERTV	.12541	.79090	.04509	-.25010
VERTA	.82935	.39734	-.02296	.11219
VERTAV	.79440	-.24236	.04425	-.05492
POMS	.20287	-.01122	-.01686	.89004

Study 3 - Recognition of Emotion in Older Subjects

Since the population most frequently described as demonstrating deficits in recognition of emotion in the neuropsychological literature are patients with strokes and strokes occur more frequently in older subjects, it seemed useful to investigate the performance on the VERT of older subjects who do not have any neurological compromise.

Method

A sample of nine subjects over the age of 65 (mean age = 72) was recruited. In order to investigate the effects of education on performance on the VERT, both university-educated subjects and subjects with less than university education were included in the older group. Four of the subjects had university level education and five had secondary school graduation or less. None of the subjects with post-secondary education had majored in psychology. None of the subjects had any documented neurological disorder. There were five males and four females in the group.

The subjects in this older group were administered the clinical version of the VERT (VERT-C) on one occasion only. None of the supplementary tests were administered to this group.

Results

The performance on the VERT-C by the older group was compared to the performance of the 18 subjects who were administered the VERT-C. Multivariate analysis revealed that the scores of the older group were significantly poorer than those in the younger group on all three subtests of the VERT-C and on the total score (visual subtest: $F(1,25) = 34.77$, $p < 001$; auditory subtest: $F(1,,25) = 57.55$, $p < 001$; auditory/visual subtest: $F(1,25) = 89.19$, $p < .001$; total score: $F(3,23) =34.78$, $p <.001$). There was no significant difference in performance between males and females or between subjects with university education and those with less than university education. The mean scores of the two groups are provided in Table 19.

Table 19

Scores of Older and Younger Subjects - VERT-C

Mean (SD)

	Older Group [N = 9]	Younger Group [N = 18]
VERT-C	128.0 (9.0)	164.1 (8.4)
Visual	45.0 (.87)	53.2 (4.1)
Auditory	40.3 (5.8)	54.7 (4.0)
Auditory/Visual	42.7 (3.3)	56.1 (3.6)

Discussion

The purpose of this group of studies was twofold: one, to develop a standardized test that could be used in a clinical setting to assess deficits in the recognition of emotion; and two, as part of the validity studies, to investigate the function of recognition of emotion in normal subjects, using the standardized test. Since an understanding of the psychometric characteristics of the VERT is important in evaluating its utility as a valid tool in the investigation of the characteristics of the function of recognition of emotion, the psychometric results will be discussed first, followed by a discussion of the results of the studies in terms of the hypotheses postulated above.

Psychometric Characteristics

Normative Studies

The results of the studies are generally consistent with the results reported in the literature. However, a relatively small number of subjects was used in each of these studies and therefore the results can only be considered as preliminary indications of the utility of the VERT as a measure of the ability to recognize emotion. Moreover, the subjects who participated in these studies, while not all psychology majors, were perhaps more interested in human behaviour, in particular in the emotional functioning of humans than the average person might be. Certainly, the scores of these subjects on the auxiliary tests administered were consistently higher than the normative mean and on some of the subtests of the PONS, were in excess of one standard deviation higher than scores for U.S. college students reported in the test manual.

The normative data generated in these studies must therefore be used with caution. Further studies with other normal groups will be needed to ascertain whether the scores of these subjects are inflated.

Reliability

The relatively small variance in performance evident in these studies suggests that recognition of emotion is not an ability with a wide range of skill in the normal population. Indeed, if the intensity factor is eliminated, many of the items on the VEPT show no variance at all. Therefore, decrements in performance on the VERT need be only minimal in order for the score of "impaired" subjects to be significantly lower than the scores of the normal subjects in these studies. This rather tight distribution of scores in the normal population is not uncommon in tests that are sensitive to brain damage. The implication is that the ability to recognize emotion is one in which deficits can be apparent with relatively mild brain damage and might exist in the absence of clear impairment in other functions.

The minimal variance in test scores of these normal subjects leads to problems in the statistical analysis of the data. The issue is one of complexity versus homogeneity. Standard psychometric theory in test development is based on the assumption that a test will measure a distinct construct that is normally distributed in the population. Recognition of emotion may be a distinct construct, but the ability is not normally distributed. In order to generate enough variance so that statistical analysis of the data is possible, the construct must be made more complex. In the case of the VERT, the intensity score and the emotion score were collapsed in order to generate variance. Thus, each individual item score has at least two attributes. Furthermore, each item requires the subject not only to discriminate whether the stimuli presented are the same or different, but also to name them.

A regression analysis, using the four operations in the VERT (match emotion, identify emotion, match intensity, identify intensity) as the independent variables and the total score as the dependent variable showed that "match intensity" contributes 66 percent of the variance to the test and "identify intensity" contributes another 12 percent. Thus, 78 percent of the variance in the test was accounted for by the intensity factor. For these normal subjects, there was very little variance evident in their ability to recognize the emotion presented.

O'Sullivan (1982) has discussed this issue of complexity versus homogeneity in the development of tests that measure the ability to recognize facial expressions of emotion. Typically, the lack of variation in performance of normal subjects in identifying emotion has been dealt with by making the construct more complex. However, increasing the complexity of the task reduces the homogeneity of the test. Therefore, the internal reliability of such tests is consistently very poor. By comparison, the results achieved with the VERT are quite good. For example, Cronbach's alpha on the VERT-R visual subtest (24 items) was .72 and on the VERT-C (12 items) was .37. The alpha for the "faces only" channel score of the PONS, which consists of 20 items, is .39. In her review of tests that have been developed to measure recognition of facial affect, O'Sullivan (1982) related that The Communication of Affect Receiving Ability Test (CARAT; Buck, 1976, cited in O'Sullivan, 1982) reported an alpha of .56 on 32 items and that Ekman and Friesen's Brief Affect Recognition Task (1974, cited in O'Sullivan, 1982) had an alpha of .41 to .67 with 70 items. O'Sullivan (1982) also reported in this review that on Faces (O'Sullivan et al., 1965, cited in O'Sullivan, 1982) the internal reliability on 30 items was .37.

O'Sullivan (1982) suggested that most of the tests which she reviewed need to be lengthened in order to achieve acceptable levels of internal reliability. This suggestion is clearly relevant to the VERT. The internal reliability of the VERT-R with twice as many items is much better than that of the VERT-C. Increasing the number of subjects (i.e., using the scores of all 18 subjects administered the VERT-C) did not improve the internal reliability. Thus, it appears that an increase in items, rather than an increase in subjects is the key to improved internal reliability. It must be noted that the two groups which were given the VERT-C did not experience identical administrations and the internal reliability of the test administered with examples was substantially lower than that of the test administered without examples. It seems reasonable to speculate that this reduction in internal reliability of the test as administered with examples is a result of an increase in complexity. Further research with a larger group of subjects given the same administration of the test may help to clarify the effects of group size versus number of items on internal reliability.

Thus, in comparison with existing measures, the internal reliability of the VERT is probably acceptable for research purposes. The results suggest that the use of the longer version is preferable, especially if the goal of the research is to study the function of recognition of emotion in normals. The internal reliability of the clinical version may be sufficient if the goal of the research is to compare the performance of brain-damaged subjects with that of normal subjects.

Test-retest reliabilities for both the VERT-R and the VERT-C were acceptable and suggest the the VERT is a reasonably stable measure over time. O'Sullivan (1982) has suggested that test-retest reliability may not be a useful psychometric measure in a test that measures ability to recognize emotion. In her review, she reports that she and her colleagues (1965, cited in O"Sullivan, 1982) found that mood state can have an effect on accuracy of recognition of affect in faces.

She recommends that a measure of mood state ought to be given in conjunction with the re-test as well as on the initial testing.

The POMS, a measure of current mood state, was administered with the VERT on initial testing and on re-test. In these studies, the results of the effects of mood state on accuracy of recognition were mixed. The subjects who were adminstered the VERT-R reported significantly higher levels of emotional distress in the initial testing session, but there was no significant difference in performance between the scores from the two testing sessions. The subjects administered the VERT-C reported higher levels of emotional distress in the initial testing session, but the difference in levels of emotional distress between the first and second testing sessions was not significant. These subjects performed significantly better on re-test. More research with larger sample sizes may help to clarify the effect of mood state on performance on the VERT. It seems likely, given these results, that the administration of a measure of mood state in conjunction with the VERT would be prudent.

In spite of these reported changes in mood state, the test-retest reliability of the VERT was acceptable. In comparison with the CARAT (Buck, 1976), which O'Sullivan (1982) reported has a test-retest reliability of -.18 on the "pleasantness" score, the VERT, for which the lowest subtest test-retest reliability was .44, appears to be acceptably stable in the presence of substantial reported changes in mood state.

Validity

The validity of a test is an indication that the test is measuring the construct that it was designed to measure. The results of these studies with the VERT suggest that the VERT is measuring a construct that has some positive relationship with the construct measured by the PONS. The correlation between the VERT-R and the PONS was significant as was the correlation between the VERT-C and the PONS (collapsing the data from the trained and untrained groups). This relationship suggests that some underlying construct, likely having something to do with recognition of emotion, is being tapped by the VERT. The task required of subjects taking these two tests is different; the PONS requires the association of a social situation with the emotion portrayed, while the VERT requires the identification of an emotion at a given level of intensity. However, the strength of the correlation between these two tests which was demonstrated in these studies seems to indicate that a similar construct is being tapped.

The nonsignificant relationships between the VERT and the POMS, FRT and TMT suggests that, whatever the similarity is between the VERT and the PONS, it is not simply skill in test-taking. The nonsignificant relationship between the FRT and both the VERT-R and the VERT-C suggests that the VERT is not measuring a facial identification construct. Similarly, the nonsignificant relationship between the TMT and both versions of the VERT suggests that auditory discrimination and nonverbal memory are also not being measured by the VERT. Finally, the nonsignificant relationship between the VERT and the POMS suggests that the VERT is not measuring a broader "emotion" construct.

O'Sullivan (1982) suggests that discriminant validity can be demonstrated by examining the relationship among subtests intended to measure a different construct. Although the subtests of the VERT loaded on the same factor with the scores on the VERT-R, the visual and auditory subtests loaded on different factors with the scores on the VERT-C. In addition, correlations among the three subtests of the VERT were not significant, using scores from both versions of the VERT. These results suggest that, in normals, the ability to recognize emotion in the faces of other people is not strongly related to the ability to recognize emotion in other people's voices. As discussed previously, the literature suggests that brain damaged people who demonstrate deficits on such tasks tend to be dysfunctional in recognition of emotion in both modalities. This discrepancy may be a reflection of the extent of the brain damage in the subjects tested or possibly a reflection of the small sample sizes in these studies. Research using the VERT with brain-damaged subjects will be necessary in order to explore this issue further.

The factor analyses of the data from these studies were conducted in order to generate hypotheses about the nature of the VERT. The results may only be considered as useful in developing hypotheses for future research, given the small number of subjects used.

The factor analyses of the data generated in the study with the VERT-R are particularly difficult to interpret. The lack of clarity in the pattern of factor loadings is most likely a result of the small number of subjects used in that study. The factor analysis of the total scores on the tests administered suggests a strong relationship among the TMT, PONS and VERT, while the FRT did not seem to be related to the other tests adminstered at all. An examination of the factor analysis using the subtest scores of the PONS and the VERT clarified the picture only minimally. Again, the FRT loaded strongly on a factor, however the "faces only" subtest of the PONS and the visual subtest of the VERT also loaded on this factor, albeit less strongly. This factor might therefore be considered as a construct having to do with the visual processing of facial information. The POMS alone loaded strongly on a factor, suggesting a construct having to do with reported mood state. The other two factors generated in this analysis were less straightforward to interpret and did not particularly add to a clearer understanding of the relationship among these tests.

The factor analysis using the total scores of the VERT and PONS of the 18 subjects in the VERT-C study provided a somewhat clearer picture. In this analysis, the total score of the VERT, PONS and the POMS loaded on Factor 1, while the FRT and TMT loaded on Factor 2. This pattern of loadings suggests that Factor 1 represents a construct having something to do with emotion, while Factor 2 represents a construct having to do with more basic sensory input interpretation. The factor analysis using the subtest scores of the 18 subjects in the VERT-C study provided the most interpretable pattern of loadings. As with the factor analysis using subtest scores and the VERT-R data, the POMS loaded on Factor 4 by itself, suggesting that awareness of current mood state is not related to recognition of emotion. As in the analysis using total scores, the FRT and TMT loaded on Factor 3, suggesting that the interpretation of more basic sensory data is not related to recognition of emotion. The "faces only" channel score of the PONS and the visual subtest of the VERT loaded strongly on Factor 2, suggesting that the ability to recognize emotion in faces is independent of the ability to recognize emotion in voices. The "voices only" and "faces and voices" channel scores of the PONS and the auditory and auditory/visual subtests of the VERT loaded on Factor 1.

This loading pattern might indicate that the recognition of auditory emotional information is the more critical component in recognizing emotional information, if auditory and visual information are presented simultaneously. Subjects frequently commented that the auditory subtest was the hardest, however, there was no significant difference in scores between the visual and auditory subtests. It may be that recognition of emotional tone of voice requires more effort, without measurable difference in accuracy in normal subjects.

The factor analysis of the individual test items of the VERT-R extracted 8 factors for the visual subtest, 8 factors for the auditory subtest and 7 factors for the auditory-visual subtest. No clear patterns of characteristics were evident within these factors. In the visual subtest, the most consistent characteristic appeared to be that of a specific emotion. For example, of the total number of presentations of emotions in the items loading on Factor 1, "fear" appears 50% of the time. However, in the auditory and auditory-visual subtests, while the loading patterns are even less clear than in the visual subtest, the most consistent characteristic appears to be the actor.

These loading patterns may be a reflection of different information processing approaches when the individual is presented with tasks in different modalities. However, it is also possible that the loading patterns reflect a "masking" characteristic of the test itself. The photographs, as presented in the test, were highly doctored to minimize individual characteristics. The faces are presented surrounded by black and the prints were modified so that the size and brightness of the faces were made as similar as possible. In the audiotapes, nonsense words were used so that any personal associations with the language context of the statements would be eliminated. Also, an attempt was made to reduce variations in loudness. However, individual characteristics of the actors' voices were preserved. It would be useful to attempt to "mask" the individual characteristics (if, in fact, it is possible to do that without reducing the fidelity of the presentation of emotion). Alternatively, it may be possible to address the issue by presenting only one actor's voice.

The rather large number of factors extracted for each subtest in this analysis is another indication of the extent of the complexity of the items, which resulted in low internal reliability when the number of items was reduced.

In summary, the results of these preliminary studies with the VERT suggest that construct validity, specifically convergent and discriminant validity, has been demonstrated. The VERT does appear to be measuring some aspect of recognition of emotion in others, and does not appear to be measuring discrimination of facial characteristics, memory for auditory nonverbal information or a broader "emotion" construct. Replication of these studies and studies using other measures theoretically related to the VERT will, of course, be necessary before any strong conclusions can be drawn as to the nature of the construct measured by the VERT. However, the results are strong enough that investigations into the ecological validity (the relationship of performance on the VERT to everyday emotionally dysfunctional behaviour) could be undertaken with some confidence.

Hypotheses

In addition to the psychometric studies done during the development of the VERT, a number of theoretical issues were investigated. Specifically, eight hypotheses were made in an attempt to further an understanding of the function of the ability to recognize emotion.

Hypothesis 1: Performance on tests of facial recognition and auditory nonverbal memory and discrimination will be independent of performance on the subtests assessing recognition of facial or vocal affect.

There was no clear relationship demonstrated between the FRT and the TMT and the corresponding subtests of the VERT. These results are consistent with the results of other studies (Blonder, Bowers and Heilman, 1991; Bowers et al., 1985; Etcoff, 1984) and suggest that the ability to recognize emotion (as measured by the VERT and tasks similar to the VERT) is independent of the ability to discriminate structural facial characteristics (FRT) and the ability to discriminate and retain in memory, nonverbal auditory information (TMT).

Hypothesis 2: There will be a positive relationship between the test of emotion recognition and a test assessing the ability to associate social situations with facial and vocal emotion.

Strong evidence of a positive relationship between the VERT and the PONS was demonstrated in these studies. Although the demands of these two tests are different and the test materials are different (photographs and audiotapes versus videotape) the results suggest that people without brain damage who are good at one are likely to be good at the other. The ability to recognize emotion as measured by tasks similar to the VERT has been fairly consistently localized to the posterior right hemisphere. It seems likely that the PONS, which seems to require an integration of emotion recognition and a memory or knowledge of particular social situations, would make some demand on frontal lobe systems. A comparison of the performance on these two tests of subjects with focal brain damage may provide more information about the relationship between the VERT and the PONS. If a double dissociation could be demonstrated between these two tests; that is, if subjects with damage in the posterior area do poorly on the VERT, but adequately on the PONS, while subjects with frontal damage do well on the VERT, but poorly on the PONS, it might be postulated that the strong relationship between the tests in normal subjects reflects a tendency to take advantage of all the information that is available in a situation, while the subjects with brain damage tend to respond in a more stimulus-specific manner. However, if subjects with brain damage in either the posterior or frontal area do poorly on both tests, we might hypothesize that intact function of the ability measured by the VERT is necessary in order to perform adequately on the PONS.

The results of such a line of research might indicate whether compensatory strategies could be used with patients exhibiting emotional/interpersonal deficits.

Hypothesis 3: There will be a negative relationship between a measure of mood dysfunction and the test of emotion recognition.

No relationship was demonstrated consistently between the POMS and the VERT. Because the POMS is a measure of mood dysfunction, high scores are indicative of higher levels of emotional distress. Thus, the implication of the hypothesis was that subjects reporting higher levels of emotional distress would perform more poorly on the VERT. O'Sullivan (1982) has discussed the effect of mood on accuracy of facial affect recognition and has suggested that current mood state can affect the test-retest reliablity of such measures. The fact that no such relationship was demonstrated in these studies may simply be a reflection of the lack of variance in mood state in these normal subjects.

In order to investigate this issue more fully, it might be useful to test subjects who are experiencing and reporting higher levels of emotional distress than were reported by subjects in these studies. There is evidence in the literature that subjects suffering from depression do poorly on tests of recognition of emotion. It may be that a certain level of distress has to be reached before accuracy of emotion recognition is affected. Alternatively, perhaps the relationship between mood state and recognition of emotion noted by O'Sullivan (1982) has something to do with personality characteristics such as how well the person performs at any task when they are upset. It is also possible that certain moods may affect accuracy with a specific emotion; for example, if the subject is angry, does that affect accuracy with anger; or perhaps feeling angry affects sensitivity to a quite different emotion, such as sadness. Perhaps the level of emotional distress affects the interpretation of intensity rather than recognition of emotion.

These speculations could not be investigated statistically in these studies due to the small number of subjects involved. However, future research on this issue may provide valuable information in the treatment of brain-damaged patients with emotional dysfunctions.

Hypothesis 4: Women will make more accurate judgements than men on all parts of the test, with the most advantage evident on the subtest that combines visual and auditory stimuli.

Based on studies in the social psychology literature (Hall, 1975) and some results published in the neuropscychology literature (e.g. Safer, 1981), it was expected that women would do better than men on the VERT. There was no support for this hypothesis demonstrated in these studies. These results may be reflective of the sample, in that men in psychology classes may be better at emotion recognition than is typical. However, Rosenthal et al. (1974) also reported no sex differences on the PONS.

Geschwind (1965) suggested that recognition is manifested as a response; perhaps females appear more skilled at emotion recognition because they are more comfortable and overt in their response to it (even in some testing situations). If verbal description is required as part of the task, a female superiority in verbal skills may explain better performance on the test.

In summary, the results of these studies suggest that decoding skills in recognition of emotion are equally efficient for males and females. If differences in ability are apparent in everyday activity, perhaps the differences are due to variations in socialization.

Hypothesis 5: Performance on the test will be consistent over the age ranges assessed.

Since there had been no differences reported in the literature in performance between younger and older adults and recent work by Borod and her colleagues (1993; personal communication) had not found any age effect on performance, the significant age effect found in this study was surprising. Given the possible confounding effects of education (none of the older subjects and almost all of the younger subjects were students in psychology), locale and customs (subjects in the younger group were from Victoria; subjects in the older group from Thunder Bay and Toronto) and the small sample size, these results must be interpreted with caution. None of the auxiliary tests administered to the younger group were given to the older group; thus although none of the subjects in the older group reported any neurological impairment, it is possible that other deficits may have contributed to the poorer performance demonstrated.

Further research with larger groups of older and younger subjects matched on education will be necessary to unravel some of these confounding effects.

Hypothesis 6: Performance on the test will be consistent across visual and auditory modalities.

No significant differences were evident in performance on the visual and auditory subtests of the VERT. While individually there may be some variation in skill between decoding emotional information in faces and decoding such information in tone of voice, the data from these studies suggests that, for normal subjects, the ability to recognize emotion in others is independent of the modality in which the information is presented. Interestingly, most subjects in the study reported finding the auditory subtest much harder than the visual subtest. Within the visual subtest, subjects often remarked that they found one actor or another more difficult. These subjective reports of difficulty did not seem to have any effect on accuracy of recognition.

Hypothesis 7: Accuracy of judgement will be highest for extreme intensities of emotion and lowest for mild intensities of emotion.

There was no indication in these studies that emotions were identified more accurately if they were presented at an extreme intensity. In order to facilitate the recognition of specific emotions, more items containing extreme intensities were presented in the early part of the test. However, the mean performance on the first half of each subtest was not significantly different from that on the second half. These results may reflect a learning effect that was counteracted by the increasing difficulty of items. That is, as the subject became more familiar with the emotions being presented, perhaps accuracy increased <u>in spite of</u> the increase in items presented at mild or moderate levels of accuracy. Further studies which counterbalance the presentation of extreme and mild intensities in the early part of the test would be necessary in order to investigate this question more fully.

Hypothesis 8: Performance on the emotion recognition test will be enhanced by training.

The results did not support this hypothesis. There was no significant difference in performance on the full VERT-C or on any of the subtests on initial testing between the group who were given examples and those who were not.

Rosenthal and his colleagues (1979) found substantial improvement in peformance in the last half of the PONS as compared to the first half. However, in a further investigation into the effects of direct training (consisting of a 90-minute session which included information about the development of the PONS and practice in making judgements about affective information similar to that presented in the PONS), no significant enhancement of performance on the PONS was found.

Given Rosenthal's (1979) results and the fact that there was little evidence of improved performance on retest in these studies, it seems unlikely that more extensive training would significantly enhance performance on the VERT. Furthermore, it seems possible that more training would result in the measurement of a slightly different construct. If subjects are extensively trained in specific test materials, it seems likely that they would try to match to an external template rather than an internal template; that is, they would attempt to match to the examples given in the training period, rather than relying on an internal judgement. Thus, extensive training may add a memory component to the test that would only serve to further reduce homogeneity.

It would be desirable to develop programs to train people with deficits in recognition of emotion in compensatory strategies. The VERT may prove to be a useful evaluation of the efficacy of such training.

Theoretical Considerations and Outlook for Future Studies

The small number of subjects in these studies limits the conclusions that can be drawn. However, the fact that the results from the study with the VERT-R were in a large part replicated with the VERT-C allows for some speculation as to the nature of recognition of emotion, as measured by this test.

There has been some argument in the literature about whether a deficit in the recognition of emotion can be considered as an "affective agnosia". Goldberg (1990) has argued that agnosia is in effect a type of amnesia, in which deficits at the level of an apperceptive agnosia result from damage to the right posterior area of the brain, while deficits at the associative level of agnosia result from damage to the left posterior area. Following this line of reasoning, a deficit in the recognition of emotion, which has been most frequently demonstrated following damage to the right hemisphere, would be a failure at the apperceptive level. Using Lissauer's definition of apperceptive agnosia, the implication is that brain damaged subjects who perform at an impaired level on tasks of emotion recognition do not only fail to categorize the emotional information correctly, but would be unable to discriminate whether the emotions being presented were the same or different.

The results of these studies with the VERT, having been conducted with normals, do not lend themselves to an investigation of Goldberg's hypothesis. However, the design of the test seems appropriate for investigation of this proposition. Research with brain-damaged subjects may help to elucidate whether deficits in recognition of emotion fall theoretically within the definition of an "agnosia".

Geschwind (1965) has suggested that recognition is best understood in terms of a response to a stimulus. This conceptualization implies the intact function not only of posterior sensory cortex, but also more anterior motor cortex, or, perhaps, the connection between the two. Following Geschwind's line of reasoning, the impact of failures in recognition of emotion on interpersonal function will have to be evaluated taking into account the adequate functioning of response systems.

Finally, the neural substrate that supports basic emotional function is most certainly subcortical (Benson, 1984; Panksepp, 1986; Papez, 1937). While there has been some suggestion that mood can have an effect on performance on tests of recognition of emotion, the functional relationship between mood, which implies accurate recognition of emotion within the self, and recognition of emotion in others is not clear.

Derryberry and Tucker (1992) have suggested that backward projections from paralimbic to neocortical areas may imply that emotion representations formed in the paralimbic area can influence neocortical representations of emotional stimuli. They further suggest that, because paralimbic areas tend to be highly polymodal, receiving and integrating information from many sensory modalities, these areas may function as a source of a distinct feeling tone, which can be associated quickly with specific sensory neocortical representations. Although most studies in the literature have found that damage to the right posterior cortex can result in failures in recognition of emotion, Cancelliere and Kertesz (1990) reported that the basal ganglia was the area most consistently damaged in subjects demonstrating failure on tasks requiring comprehension of emotional prosody as well as visual recognition of emotional situations and faces.

The function of recognition of emotion is, of course, a much broader construct than that which is measured by the VERT or similar tests. The ability of an individual to understand the emotional information in the environment is clearly important to successful interaction, and, in a more primitive context, survival. This importance implies a likelihood that some redundacy is built into the neural systems that support recognition of emotion. It may be that an inability to recognize emotion in daily life can result from damage to a number of areas in the brain. The specific subset of emotion recognition skills, as measured by the VERT and similar tasks, seems likely to be supported by a right posterior neural substrate. Perhaps damage in other areas of the brain affects different aspects of the ability to recognize emotion; aspects that are not assessed with a test such as the VERT. Further research will be needed in order to clarify the operation of this function and the neural substrates that support its various aspects.

The theoretical framework in which failures in recognition of emotion can be understood is also not well understood at this time. If these failures are to be considered an "agnosia", presumably the theoretical characteristics of agnosia should be demonstrable. Specifically, it should be possible to demonstrate apperceptive and associative levels of deficit and it should be possible to demonstrate that the deficit is modality specific. Using an information processing approach, an agnosia might be described in terms of the model in Figure 1.

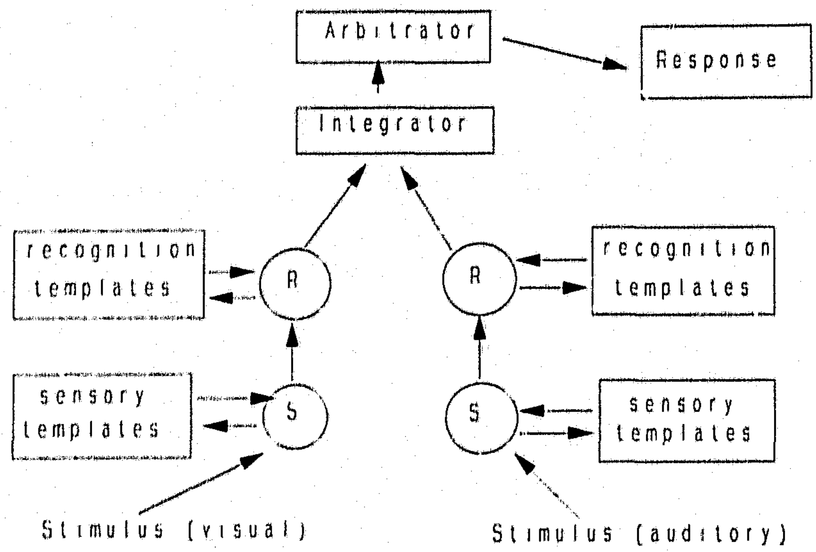

Figure 1

This model implies that there is a redundancy in the function of recognition, such that compensatory strategies may easily be implemented. In this model, sensory modules, each with their own set of templates, match incoming sensory information to the appropriate template. These sensory modules can evaluate whether the physical characteristics of a stimulus can be matched to an available template, but are unable to assign meaning to the stimulus. If a successful match is made, they forward that information to a recognition module. The recognition module too has a set of templates, to which the incoming information is compared. If a successful match is made, that is, if meaning is assigned to the incoming stimulus, the information is forwarded to an integrator, whose purpose is to integrate the information coming in from the various recognition modules and attempt to match a representation of a stimulus with a specific set of characteristics. That information (matched or unmatched) is forwarded to an arbitrator where an appropriate response to the stimulus is formulated and forwarded to response systems. Using this model, failures in the sensory module to match the incoming stimulus to an available template would be considered an apperceptive agnosia. Failures in the recognition module to do the same would be considered an associative agnosia. Since the integrator can receive information from a variety of recognition modules and furthermore, contains the complete set of characteristics of a specific object, a failure in a particular channel can be compensated for by the information available from the remaining intact channels. Thus, this figure is an adequate representation of an agnosia, both as defined by Lissauer and in terms of the modality specificity noted by Bauer and Rubens (1985).

If we apply this model to failures in recognition of emotion, we see that damage must be located at a level higher than the sensory or recognition modules, i.e. at least at the level of the integrator, since the evidence in the literature from studies with brain-damaged subjects suggests that a failure in either channel does not allow for accurate recognition. Thus, apperceptive and associative levels of agnosia and modality specificity cannot be demonstrated, using this model to explain failures in recognition of emotion.

An alternative model is presented in Figure 2. In this model, the sensory module includes templates for all channels in which emotional information is presented. Thus, the sensory characteristics of emotions are collapsed and the purpose of the module is simply to match general emotional information. The recognition module in this model matches the emotional information to a specific emotion and forwards the information to an arbitrator, which formulates an appropriate response. In this model, failures could occur at an apperceptive level or an associative level and thus deficits in recognition of emotion might fit within the category of agnosia, if we accept that agnosias are not necessarily modality specific.

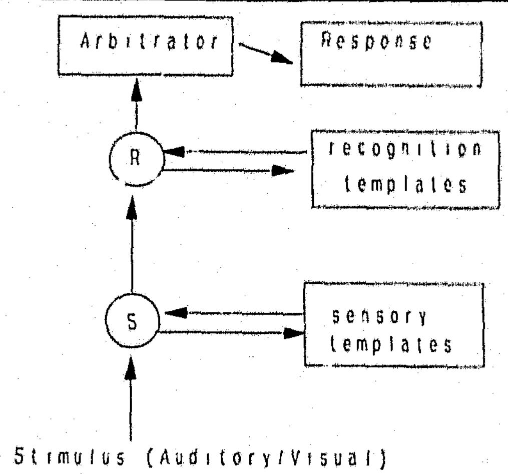

Figure 2

The results of the studies done with the VERT do not support either model strongly. The lack of significant correlation between subtests of the VERT suggests that the model in Figure 1 explains the function more accurately. However, the strong correlation between the VERT and the PONS suggests that the basic characteristics of emotional information may be stored within a single system, thus giving some support to the model in Figure 2. Further research with brain-damaged subjects will be necessary in order to investigate this issue more fully. However, the VERT appears to be an instrument that may well be helpful in attempts to clarify whether failures in recognition of emotion can be classified as an agnosia.

Summary

In summary, these studies suggest that the VERT has potential as a useful tool in the measurement of recognition of emotion. The reliability of the test is not as strong as is suggested by Anastasi, 1988, Kaplan and Sacuzzo, 1982 or Kline, 1986. However, in comparison to other tests which attempt to measure similar abilities, the reliability is acceptable. The validity studies suggest that the VERT is measuring an aspect of recognition of emotion that is independent of more basic skills and of a broader "emotional" construct. The rather tight distribution of scores implies that the ability to recognize emotion is not normally distributed, but rather is an ability that is evident within a narrow range of performance in normals. Performance did not appear to be affected by sex or training. There was some evidence of an age effect on performance.

The purpose of these studies was to develop a standardized instrument for the measurement of failures in recognition of emotion and to investigate the function of recognition of emotion in normal subjects. The results suggest that the VERT would be a useful tool in the further investigation of the theoretical, functional and structural facets of this construct.

References

Ahern, G.L. & Schwartz, G.E. (1979). Different lateralization for positive and negative emotion. Neuropsychologia, 17, 693-698.

Albert, M.S., Cohen, C. & Koff, E. (1991). Perception of affect in patients with dementia of the Alzheimer type. Archives of Neurology, 48, 791- 795.

Allender, J. & Kazniak, A.W. (1989). Processing of emotional cues in patients with dementia of the Alzheimer's type. International Journal of Neuroscience, 46, 147-155.

Arnold, M.B. (Ed.) (1970). Feelings and emotions. New York: Academic Press.

Bachara, G. (1976). Empathy in learning disabled children. Perceptual and Motor Skills, 43, 541-542.

Bauer, R.M. & Rubens, A.B. (1985). Agnosia. In K.M. Heilman and E. Valenstein (Eds.) Clinical Neuropsychology, (2nd ed.) (pp. 187-242). New York: Oxford University Press.

Benson, D.F. (1984). The neurology of human emotion. Bulletin of Clinical Neurosciences, 49, 23-42.

Benton, A.L., deHamsher, K., Varney, N.R. & Spreen, O. (1983). Contributions to Neuropsychological Assessment. New York: Oxford University Press.

Blonder, L.X., Bowers, D & Heilman, K.M. (1991). The role of the right hemisphere in emotional communication. Brain, 114, 1115-1127.

Borod, J.C. (1992). Interhemispheric and intrahemispheric control of emotion: a focus on unilateral brain damage. Journal of Consulting and Clinical Psychology, 60, 339-348.

Borod, J. and Caron, H.S. (1980). Facedness and emotion related to lateral dominance, sex and expression type. Neuropsychologia, 18, 237-242.

Borod, J.C. & Koff, E. (1989). The neuropsychology of emotion: Evidence from normal, neurological and psychiatric populations. In E. Perecman (Ed.) Integrating Theory and Practice in Clinical Neuropsychology (pp. 175-215).Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Borod, J.C., Koff, E. Lorch, M.P. & Nicholas, M. (1986). The expression and perception of facial emotion in brain-damaged patients. Neuropsychologia, 24, 181-191.

Bowers, D., Bauer, R.M., Coslett, H.B. & Heilman, K.M. (1985). Processing of faces by patients with unilateral hemisphere lesions: 1. Dissociation between judgements of facial affect and facial identity. Brain and Cognition, 4, 258-272.

Brooks, N. (1984). Introduction. In N. Brooks (Ed.), Closed Head Injury: Psychology, Social and Family Consequences (p.3). New York: Oxford University Press.

Bryden, M.P., Ley, R.G. & Sugarman, J.H. (1982). A left-ear advantage for identifying the emotional quality of tonal sequences. Neuropsychologia, 20, 83-87.

Campbell, R. (1982). The lateralisation of emotion: a critical review. International Journal of Psychology, 17, 211-229.

Cancilliere, A.E.B. & Kertesz, A. (1990). Lesion localization in acquired deficits of emotional expression and comprehension. Brain and Cognition, 13, 133-147.

Cicone, M., Wapner, W. & Gardner, H. (1980). Sensitivity to emotional expressions and situations in organic patients. Cortex, 16, 145-158.

Derryberry, D. & Tucker, D.M. (1992). Neural mechanisms of emotion. Journal of Consulting and Clinical Psychology, 60, 329-338.

DeKosky, S.T., Heilman, K.M., Bowers, D. & Valenstein, E. (1980). Recognition and discrimination of emotional faces and pictures. Brain and Language, 9, 206-214.

Ekman, P. & Friesen, W.V. (1975). Unmasking the face: A guide to recognizing emotions from facial clues. Eaglewood Cliffs, New Jersey: Prectice-Hall.

Etcoff, N.L. (1984). Selective attention to facial identity and facial emotion. Neuropsychologia, 22, 281-295.

Etcoff, N.L. (1986). The neuropsychology of emotional expression. In Advances in Clinical Neuropsychology, 3, New York, Plenum Press.

Feinberg, T.E., Rifkin, A., Schaeffer, C. & Walker, E. (1986). Facial discrimination and emotional recognition in schizophrenia and affective disorders. Archives of General Psychiatry, 43, 276-279.

Fordyce, D.J., Roueche, J.R. & Prigitano, G.P. (1983). Enhanced emotional reactions in chronic head trauma patients. Journal of Neurology, Neurosurgery and Psychiatry, 46, 620-624.

Gainotti, G. (1972). Emotional behavior and hemispheric side of lesion. Cortex, 8, 41-55.

Gates, G.S. (1925). A test for ability to interpret facial expression. Psychological Bulletin, 22, 120.

Geschwind, N. (1965). Disconnection syndromes in animals and man. Brain, 88, 237-294, 585-644.

Goldberg, E. (1990). Associative agnosias and the functions of the left hemisphere. Journal of Clinical and Experimental Neuropsychology, 12, 467-484.

Goldstein, K. (1952). The effect of brain damage on personality. Psychiatry, 15, 245-260.

Grafman, J., Vance, S.C., Weingartner, H., Salazar, A.M. & Amin, D. (1986). The effects of lateralized frontal lesions on mood regulation. Brain, 109, 1127-1148.

Graves, R., Landis, T. & Goodglass, H. (1981). Laterality and sex differences for visual recognition of emotional and non-emotional words. Neuropsychologia, 19, 95-102.

Hall, J.A. (1978). Gender effects in decoding nonverbal cues. Psychological Bulletin, 85, 845-857.

Heilman, K.M., Scholes, R. & Watson, R.T. (1975). Auditory affective agnosia: disturbed comprehension of affective speech. Journal of Neurology, Neurosurgery, and Psychiatry, 38, 69-72.

Heller, W. & Levy, J. (1981). Perception and expression of emotion in right-handers and left-handers. Neuropsychologia, 19, 263-272.

Hobson, R.P. (1986). The autistic child's appraisal of expressions of emotion. Journal of Child Psychology and Psychiatry, 27, 3.

Jackson, H.F. & Moffat, N.J. (1987). Impaired emotional recognition following severe head injury. Cortex, 23, 293-300.

Jaeger, J., Borod, J. & Peselow, E. (1987). Depressed patients have atypical hemispace biases in the perception of emotional chimeric faces. Journal of Abnormal Psychology, 96, 321-324.

Karzmark, P., Heaton, R.K., Lehman, R.A.W. & Crouch, J. (1985). Utility of the Seashore Tonal Memory Test in neuropsychological assessment. Journal of Clinical and Experimental Neuropsychology, 7, 367-374.

Kline, P. (1986). A Handbook of Test Construction. New York: Academic Press.

Klonoff, P.S., Snow, W.G. & Costa, L.D. (1986). Quality of life in patients 2 to 4 years after closed head injury. Neurosurgery, 19, 735-743.

Kulikov, M.A. & Sidorova, O.A. (1985). Idenitification of intonational and facial expressions of emotion by patients with organic lesions of the right or left hemisphere. Soviet Neurology and Psychiatry, 35, 75-87.

Levine, S.C. & Levy, J. (1986). Perceptual asymmetry for chimeric faces across the life span. Brain and Cognition, 5, 291-306.

Ley, R.G. & Bryden, M.P. (1979). Hemispheric differences in processing emotions and faces. Brain and language, 7, 127-138.

Ley, R.G. & Bryden, M.P. (1982). A dissociation for right and left hemispheric effects for recognizing emotional tone and verbal content. Brain and Cognition, 1, 3-9.

Lezak, M. (1983). Neuropsychological Assessment. (2nd Ed.). New York: Oxford University Press.

Lezak, M. (1987). Relationships between personality disorders, social distrubances, and physical disability following traumatic brain injury. Journal of Head Trauma Rehabilitation, 2, 57-69.

Lieberman, A. & Benson, D.F. (1977). Control of emotional expression in pseudobulbar palsy. Archives of Neurology, 34, 717-719.

Maan, C. & Bryson, S.E. (1990). Processing of facial identity and emotion: A developmental study. Paper presented at the Annual Convention of the Canadian Psychological Asssociation, Ottawa.

Macdonald, H., Rutter, M., Howlin, P., Rios, P., Le Conteur, A., Evered, C. & Folstein, S. (1989). Recognition and expression of emotional cues by autistic and normal adults. Jouranl of Child Psychology and Psychiatry and Allied Disciplines, 30, 865-877.

McCauley, E., Kay, T., Ito, J. & Treder, R. (1987). The Turner Syndrome: Cognitive deficits, affective discrimination and behavior problems. Child Development, 58, 464-473.

McNair, D.M., Lorr, M. & Droppleman, L.F. (1981). Profile of Mood States. San Diego, California: Educational and Industrial Testing Service.

Miller, L. (1991). The "other" brain injuries: Psychotherapeutic issues with stroke and brain tumor patients. Cognitive Rehabilitation, 9, 10-16.

Mooney, G.F. (1988). Relative contributions of neurosphysical, cognitive, and personality changes to disability after brain injury. Cognitive Rehabilitation, 6, 14-20.

Moreno, C.R., Borod, J.C., Welkowitz, J. & Alpert, M. (1990). Lateralization for the expression and perception of facial emotional as a function of age. Neuropsychologia, 28, 199-209.

Munson, J. (1986). Social perception skill and social adjustment in underachieving children classified according to pattern of academic disability. Unpublished doctoral dissertation, University of Victoria, Victoria.

Natale, M, Gur, R.E. & Gur, R.C. (1983). Hemispheric asymmetries in processing emotional expressions. Neuropsychologia, 21, 555-565.

Nelson, C.A. (1987). The recognition of facial expression in the first two years of life:

Mechanisms of development. Child Development, 58, 889-909.

O'Hara, C. (1988). Emotional adjustment following minor head injury. Cognitive Rehabilitation, 6, 26-33.

O'Sullivan, M. (1982). Measuring the ability to recognize facial expression of emotion. In P. Ekman (Ed.) Emotion in the Human Face. (pp. 281-317). Cambridge: Cambridge University Press.

Ozols E.J. & Rourke, B.P. (1975). Dimensions of social sensitivity in two types of learning-disabled children. In B.P. Rourke (Ed.), Neuropsychology of Learning Disabilities: Essentials of Subtype Analysis. (pp. 281-301). New York: The Guilford Press.

Panksepp, J. (1982). Toward a general psychobiological theory of emotions. The Behavioral and Brain Sciences, 5, 406-467.

Parry, F.M., Young, A.W., Saul, J.S.M. & Moss, A. (1991). Dissociable face processing impairments after brain injury. Journal of Clinical and Experimental Neuropsychology, 13, 545-558.

Papez, J.W. (1937). A propsed mechanism of emotion. Archives of Neurology and Psychiatry, 38, 725-743.

Plutchik, R. & Kellerman, H. (Eds.) (1980). Emotion: Theory, research and practice: Vol 1. Theories of Emotion. New York: Academic Press.

Prigatano, G. (1987). Psychiatric aspects of head injury: problem areas and suggested guidelines for research. BNI Quarterly, 3, 2-9.

Prigatano, G.P. & Pribram, K.H. (1982). Perception and memory of facial affect following brain injury. Perceptual and Motor Skills, 54, 859-869.

Reuter-Lorenz, P. & Davidson, R. (1981). Differential contributions of the two cerebral hemispheres to the percepetion of happy and sad faces. Neuropsychologia, 19, 609-613.

Robinson, R.G. (1986). Post-stroke mood disorders. Hospital Practice, 83-89.

Rosenthal, R., Hall, J.A., DiMatteo, M.R., Rogers, P.L. & Archer, D. (1979). Sensitivity to nonverbal communication: the PONS test. Baltimore: Johns Hopkins University Press.

Ross, E. (1981). The aprosodias: Functional-anatomic orgainization of the affective components of language in the right hemisphere. Archives of Neurology, 38, 561-569.

Ross, E.D., Holzapfel, D. & Freeman, F. (1983). Assessment of affective behavior in brain-damaged patients using quantitative acoustical-phonetic and gestural measurements. Neurology, 33(suppl), 219-220.

Roth, D.L., Bergquist, T.F. & Novack, T.A. (1989). Emotional perception of continuous nonverbal displays following right hemisphere lesions. Paper presented at the meeting of the International Neuropsychological Society, Vancouver.

Rourke, B.P. (1989). Nonverbal learning disabilities; the syndrome and the model. New York: The Guilford Press.

Sackeim, H. & Gur, R.C. (1978). Lateral asymmetry in intensity of emotional expression. Neuropsychologia, 16, 473-481.

Safer, M.A. (1981). Sex and hemisphere differences in access to codes for processing emotional expressions and faces. Journal of Experimental Psyhcology: General, 110, 86-100.

Saxby, L. & Bryden, M.P. (1985). Left visual-field advantage in children for processing visual emotional stimuli. Developmental Psychology, 21, 253-261.

Schlanger, B.B., Schlanger, P. & Gerstman, L.J. (1976). The perception of emotionally toned sentences by right hemisphere-damaged and aphasic subjects. Brain and Language, 3, 396-403.

Schwartz, G.E., Ahern, G.L. & Brown, S.L. (1979). Lateralized facial muscle response to positive and negative emotional stimuli. Psychophysiology, 16, 561-571.

Sergent, J. (1990). Furtive incursions into bicameral minds. Brain, 113, 537-568.

Shapiro, B. & Danly, M. (1985). The role of the right hemisphere in the control of speech prosody in propositional and affective contexts. Brain and Language, 25, 19-36.

Silberman, E.K. & Weingartner, H. (1986). Hemispheric lateralization of functions related to emotion. Brain and Cognition, 5, 322-353.

Spreen, O. (1989). The relationship between learning disability, emotional disorders and neuropsychology; Some results and observations. Journal of Clinical and Experimental Neuropsychology, 11, 117-140.

Strauss, E. (1983). Perception of emotional words. Neuropsychologia, 21, 99-103.

Strauss, E. & Moscovitch, M. (1981). Perception of facial expressions. Brain and Language, 13, 308-322.

Suberi, M. & McKeever, W.F. (1977). Differential right hemisphere memory storage of emotional and non-emotional faces. Neuropsychologia, 15, 757-768.

Tremblay, C., Kirouac, G. & Dore, F. (1987). The recognition of adults' and children's facial expressions of emotion. The Journal of Psychology, 12, 341-350.

Tucker, D.M., Watson, R.T. & Heilman, K.M. (1977). Discrimination and evocation of affectively intoned speech in patients with right parietal disease. Neurology, 27, 947-950.

Walker, E. (1981). Emotion recognition in disturbed and normal children. Journal of Child Psychology and Psychiatry, 22, 263-269.

Walker, E., McGuire, M. & Bettes, B. (1984). Recognition and identification of facial stimuli by schizophrenics and patients with affective disorder. British Journal of Clinical Psychology, 23, 37-44.

Williamson, S., Crockett, D., Hurwitz, T. & Remick, R. (1992). A comparison of the matching of emotional information by depressive and organic patients. Archives of Clinical Neuropsychology, 7, 233-242.

Wiig, E. & Harris, S. (1974). Perception and interpretation of nonverbally expressed emotions by adolescents with learning disabilities. Perceptual and Motor Skills, 38, 239-245.

Zuroff, D.C. & Colusny, S.A. (1986). Emotion recognition in schizophrenic and depressed inpatients. Journal of Clinical Psychology, 42, 411-417.

Appendix

Appendix 1

Camera and Flash Settings for Test Run

Photo	F-Stop	Shutter Speed	Flash
1	5.6	60	direct/straight
2	5.6	60	direct/bounced
3	5.6	60	diffused/straight
4	5.6	60	diffused/bounced
5	5.6	125	direct/straight
6	5.6	125	direct/bounced
7	5.6	125	diffused/straight
8	5.6	125	diffused/bounced
9	8	60	direct/straight
10	8	60	direct/bounced
11	8	60	diffused/straight
12	8	60	diffused/bounced
13	8	125	direct/straight
14	8	125	direct/bounced
15	8	125	diffused/straight
16	8	125	diffused/bounced
17	11	60	direct/straight
18	11	60	direct/bounced
19	11	60	diffused/straight
20	1	60	diffused/bounced
21	11	25	direct/straight
22*	11	125	direct/bounced
23	11	125	diffused/straight
24	11	25	diffused/bounced

* setting chosen for production photographs

Appendix 2

Instructions to Actors

You will be portraying four emotions. For each emotion, you will portray three levels of intensity (mild, moderate, extreme). The descriptions of each emotion written below are intended to give you a general idea of the emotional state I would like you to try to depict. For each description, you need to think about three memories or situations that would make you feel that emotion at a mild, moderate and extreme level of intensity.

Sad
Think about losing something or someone that is important to you. Think about the grief, the loneliness, of being separated from someone you depend on...

Happy
Think about getting something you really want, or finding that someone you care about alot, cares about you, too. You are full of anticipation, hope, desire...

Fear
Think about being full of anxiety and alarm...perhaps there is pain involved...perhaps there is the threat of your own destruction...

Anger
Think about being completely frustrated...you can't have something you really want...you can't do something you really want to do...you are full of hate and anger...

Appendix 3

Order of Emotions and Intensities as cued to each Actor

Prior to the beginning of the production session, each actor was told that the intensity of emotion would be cued as a number (1 = mild; 2 = moderate; 3 = extreme).

sad 1 2 3

angry 1 2 3

happy 1 2 3

afraid 1 2 3

This sequence was repeated three times.

Appendix 4

Phrases used in the Production of the Audiotapes

1. Alny fren mith stan. [first actor begins here]
2. Beeb glep mose sumet.
3. Bevy haxel oren tonish. [second actor begins here]
4. Dane hipe ruthel gorp.
5. Upat rall hust dochy. [third actor begins here]
6. Ese kige rass wead.
7. Whis rell leck elom. [fourth actor begins here]
8. Entey loar chomble sert.
9. Lurt soche wost gleep. [fifth actor begins here]
10. Ova baitsa fevey maso.

Appendix 5

Order of Photographs and Tapes as Presented to Judges

The judges were presented with either the photographs or the tapes first. The judges saw all of the photographs of each actor before seeing the photographs of the next actor. However, the order of presentation of each actor was varied and within the photographs of each actor, some judges started at photo #1 and some at photo #36. Similarly, the order of presentation of the actors' audiotapes was varied, but within each actor's audiotape, the order of presentation was the same.

Judge	Photos/Tapes	Photos	Tapes
1	P,T	T N P R G	R P N T G
2	T,P	R T N P G	N T G R P
3	P,T	G P N R T	G R P N T
4	T,P	T R N G P	T G R P N
5	P,T	P G T R N	P N T G R

T = Tammy
N = Nick
P = Pia
R = Rob
G = Glen

Appendix 6

Research form of the Victoria Emotion Recognition Test

Subject number___________

Date ___________

Victoria Emotion Recognition Test

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

Visual Recognition

This test looks at how well you can recognize 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		
	Match	Identify		Match	Identify	
1.	<u>S</u> D	A.	A S <u>H</u> F	<u>S</u> D	A.	1 2 <u>3</u>
		B.	A S <u>H</u> F		B.	1 2 <u>3</u>
2.	<u>S</u> D	A.	A S H <u>F</u>	<u>S</u> D	A.	1 2 <u>3</u>
		B.	A S H <u>F</u>		B.	1 2 <u>3</u>
3.	S <u>D</u>	A.	<u>A</u> S H F	<u>S</u> D	A.	1 2 <u>3</u>
		B.	A S <u>H</u> F		B.	1 2 <u>3</u>
4.	S <u>D</u>	A.	A <u>S</u> H F	<u>S</u> D	A.	1 2 <u>3</u>
		B.	A S H <u>F</u>		B.	1 2 <u>3</u>
5.	<u>S</u> D	A.	<u>A</u> S H F	S <u>D</u>	A.	1 2 <u>3</u>
		B.	<u>A</u> S H F		B.	<u>1</u> 2 3
6.	S <u>D</u>	A.	A S H <u>F</u>	<u>S</u> D	A.	1 <u>2</u> 3
		B.	A S <u>H</u> F		B.	1 <u>2</u> 3
7.	<u>S</u> D	A.	A <u>S</u> H F	S <u>D</u>	A.	<u>1</u> 2 3

		B.	A **S** H F		B.	1 2 **3**
8.	S **D**	A.	**A** S H F	S **D**	A.	1 **2** 3
		B.	A S **H** F		B.	1 2 **3**
9.	**S** D	A.	A S H **F**	S D	A.	**1** 2 3
		B.	A S H **F**		B.	1 **2** 3
10.	S **D**	A.	A S H **F**	S **D**	A.	1 2 **3**
		B.	A S **H** F		B.	**1** 2 3
11.	S **D**	A.	A S **H** F	S **D**	A.	1 **2** 3
		B.	**A** S H F		B.	1 2 **3**
12.	**S** D	A.	A **S** H F	**S** D	A.	1 **2** 3
		B.	A **S** H F		B.	1 **2** 3
13.	S **D**	A.	A S H **F**	S **D**	A.	**1** 2 3
		B.	A **S** H F		B.	1 2 **3**
14.	**S** D	A.	A S **H** F	S **D**	A.	**1** 2 3
		B.	A S **H** F		B.	1 **2** 3
15.	S **D**	A.	**A** S H F	**S** D	A.	**1** 2 3
		B.	A S H **F**		B.	**1** 2 3
16.	**S** D	A.	**A** S H F	**S** D	A.	**1** 2 3
		B.	**A** S H F		B.	**1** 2 3
17.	**S** D	A.	A **S** H F	S **D**	A.	1 2 **3**
		B.	A **S** H F		B.	1 **2** 3
18.	S **D**	A.	A S **H** F	S **D**	A.	1 **2** 3
		B.	**A** S H F		B.	1 2 **3**
19.	S **D**	A.	A **S** H F	**S** D	A.	1 **2** 3
		B.	A S H **F**		B.	1 **2** 3
20.	**S** D	A.	A S H **F**	S **D**	A.	**1** 2 3
		B.	A S H **F**		B.	1 **2** 3
21.	**S** D	A.	**A** S H F	**S** D	A.	1 **2** 3
		B.	**A** S H F		B.	1 **2** 3
22.	S **D**	A.	A **S** H F	**S** D	A.	**1** 2 3
		B.	A S **H** F		B.	**1** 2 3
23.	S **D**	A.	A S **H** F	S **D**	A.	**1** 2 3
		B.	**A** S H F		B.	1 **2** 3
24.	**S** D	A.	A **S** H F	**S** D	A.	**1** 2 3

B.	A **S** H F	B. **1** 2 3

Total correct:
Emotion — Intensity

Match______ Identify______ 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 Match	Emotion Identify		Intensity Match	Intensity Identify	
1.	**S** D	A.	A S **H** F	**S** D	A.	1 2 **3**
		B.	A S **H** F		B.	1 2 **3**
2.	**S** D	A.	A S H **F**	**S** D	A.	1 2 **3**
		B.	A S H F		B.	1 2 **3**
3.	S **D**	A.	**A** S H F	**S** D	A.	1 2 **3**
		B.	A S **H** F		B.	1 2 **3**
4.	S **D**	A.	A **S** H F	**S** D	A.	1 2 **3**
		B.	A S H **F**		B.	1 2 **3**
5.	**S** D	A.	**A** S H F	S **D**	A.	1 2 **3**
		B.	**A** S H F		B.	**1** 2 3
6.	S **D**	A.	A S H **F**	**S** D	A.	1 **2** 3
		B.	A S **H** F		B.	1 **2** 3
7.	**S** D	A.	A **S** H F	S **D**	A.	**1** 2 3
		B.	A **S** H F		B.	1 2 **3**
8.	S **D**	A.	**A** S H F	S **D**	A.	1 **2** 3
		B.	A S **H** F		B.	1 2 **3**
9.	**S** D	A.	A S H **F**	S **D**	A.	**1** 2 3
		B.	A S H **F**		B.	1 **2** 3
10.	S **D**	A.	A S H **F**	S **D**	A.	1 2 **3**

			B.	A S **H** F			B.	**1** 2 3
11.	S	**D**	A.	A S **H** F	S	**D**	A.	1 **2** 3
			B.	**A** S H F			B.	1 2 **3**
12.	**S**	D	A.	A **S** H F	**S**	D	A.	1 **2** 3
			B.	A **S** H F			B.	1 **2** 3
13.	S	**D**	A.	A S H **F**	S	**D**	A.	**1** 2 3
			B.	A **S** H F			B.	1 2 **3**
14.	**S**	D	A.	A S **H** F	S	**D**	A.	**1** 2 3
			B.	A S **H** F			B.	1 **2** 3
15.	S	**D**	A.	**A** S H F	**S**	D	A.	**1** 2 3
			B.	A S H **F**			B.	**1** 2 3
16.	**S**	D	A.	**A** S H F	**S**	D	A.	**1** 2 3
			B.	**A** S H F			B.	**1** 2 3
17.	**S**	D	A.	A **S** H F	S	**D**	A.	1 2 **3**
			B.	A **S** H F			B.	1 **2** 3
18.	S	**D**	A.	A S **H** F	S	**D**	A.	1 **2** 3
			B.	**A** S H F			B.	1 2 **3**
19.	S	**D**	A.	A **S** H F	**S**	D	A.	1 **2** 3
			B.	A S H **F**			B.	1 **2** 3
20.	**S**	D	A.	A S H **F**	S	**D**	A.	**1** 2 3
			B.	A S H **F**			B.	1 **2** 3
21.	**S**	D	A.	**A** S H F	**S**	D	A.	1 **2** 3
			B.	**A** S H F			B.	1 **2** 3
22.	S	**D**	A.	A **S** H F	**S**	D	A.	**1** 2 3
			B.	A S **H** F			B.	**1** 2 3
23.	S	**D**	A.	A S **H** F	S	**D**	A.	**1** 2 3
			B.	**A** S H F			B.	1 **2** 3
24.	**S**	D	A.	A **S** H F	**S**	D	A.	**1** 2 3
			B.	A **S** H F			B.	**1** 2 3

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.

Time	Emotion Match		Emotion Identify	Intensity Match		Intensity Identify
1.	**S** D	A.	A S **H** F	**S** D	A.	1 2 **3**
		B.	A S **H** F		B.	1 2 **3**
2.	**S** D	A.	A S H **F**	**S** D	A.	1 2 **3**
		B.	A S H **F**		B.	1 2 **3**
3.	S **D**	A.	**A** S H F	**S** D	A.	1 2 **3**
		B.	A S **H** F		B.	1 2 **3**
4.	S **D**	A.	A **S** H F	**S** D	A.	1 2 **3**
		B.	A S H **F**		B.	1 2 **3**
5.	**S** D	A.	**A** S H F	S **D**	A.	1 2 **3**
		B.	**A** S H F		B.	**1** 2 3
6.	S **D**	A.	A S H **F**	**S** D	A.	1 **2** 3
		B.	A S **H** F		B.	1 **2** 3
7.	**S** D	A.	A **S** H F	S **D**	A.	**1** 2 3
		B.	A **S** H F		B.	1 2 **3**
8.	S **D**	A.	**A** S H F	S **D**	A.	1 **2** 3
		B.	A S **H** F		B.	1 2 **3**
9.	**S** D	A.	A S H **F**	S **D**	A.	**1** 2 3
		B.	A S H **F**		B.	1 **2** 3
10.	S **D**	A.	A S H **F**	S **D**	A.	1 2 **3**
		B.	A S **H** F		B.	**1** 2 3
11.	S **D**	A.	A S **H** F	S **D**	A.	1 **2** 3
		B.	**A** S H F		B.	1 2 **3**
12.	**S** D	A.	A **S** H F	**S** D	A.	1 **2** 3
		B.	A **S** H F		B.	1 **2** 3
13.	S **D**	A.	A S H **F**	S **D**	A.	**1** 2 3
		B.	A **S** H F		B.	1 2 **3**

14.	S D	A.	A S H F	S D	A.	1 2 3
		B.	A S H F		B.	1 2 3
15.	S D	A.	A S H F	S D	A.	1 2 3
		B.	A S H F		B.	1 2 3
16.	S D	A.	A S H F	S D	A.	1 2 3
		B.	A S H F		B.	1 2 3
17.	S D	A.	A S H F	S D	A.	1 2 3
		B.	A S H F		B.	1 2 3
18.	S D	A.	A S H F	S D	A.	1 2 3
		B.	A S H F		B.	1 2 3
19.	S D	A.	A S H F	S D	A.	1 2 3
		B.	A S H F		B.	1 2 3
20.	S D	A.	A S H F	S D	A.	1 2 3
		B.	A S H F		B.	1 2 3
21.	S D	A.	A S H F	S D	A.	1 2 3
		B.	A S H F		B.	1 2 3
22.	S D	A.	A S H F	S D	A.	1 2 3
		.	A S H F		B.	1 2 3
23.	S D	A.	A S H F	S D	A.	1 2 3
		B.	A S H F		B.	1 2 3
24.	S D	A.	A S H F	S D	A.	1 2 3
		B.	A S H F		B.	1 2 3

Total correct:
Emotion   Intensity

Match______ Identify______Match______ Identify______

****

Summary Scores

Task/ Modality	Visual	Auditory	Audit/Vis	Total
Match Emotion				
Identify Emotion				
Match Intensity				
Identify Intensity				
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. Seven 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. visual recognition
6. auditory recognition
7. visual/auditory recognition

Appendix 7

Clinical Form of the Victoria Emotion Recognition Test

Subject number_______

Date ___________

Victoria Emotion Recognition Test

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 recognize 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.

FOR THE GROUP GETTING SAMPLES:

Let's try a few and I'll show you what I mean.

Sample 1: For example, this person is moderately happy; this person is extremely angry (point) so you would say the emotions are different...happy and angry...and the intensities are different...moderately and extremely.

Sample 2: For this one, you would say the emotions are different...sad and afraid... and the intensities are the same...moderate.

	Emotion Match		Emotion Identify	Intensity Match		Intensity Identify	Score
1.	S D	A.	A S H F	S D	A.	1 2 3	______
		B.	A S H F		B.	1 2 3	
2.	S D	A.	A S H F	S D	A.	1 2 3	______
		B.	A S H F		B.	1 2 3	
3.	S D	A.	A S H F	S D	A.	1 2 3	______
		B.	A S H F		B.	1 2 3	

4.	S **D**	A.	**A** S H F	S **D**	A.	1 **2** 3	______
		B.	A S **H** F		B.	1 2 **3**	
5.	**S** D	A.	A S H **F**	S **D**	A.	**1** 2 3	______
		B.	A S H **F**		B.	1 **2** 3	
6.	S **D**	A.	A S H **F**	S **D**	A.	1 2 **3**	______
		B.	A S **H** F		B.	**1** 2 3	
7.	**S** D	A.	A **S** H F	**S** D	A.	1 **2** 3	______
		B.	A **S** H F		B.	1 **2** 3	
8.	S **D**	A.	A S H **F**	S **D**	A.	**1** 2 3	______
		B.	A **S** H F		B.	1 2 **3**	
9.	S **D**	A.	**A** S H F	**S** D	A.	**1** 2 3	______
		B.	A S H **F**		B.	**1** 2 3	
10.	S **D**	A.	A S **H** F	S **D**	A.	1 **2** 3	______
		B.	**A** S H F		B.	1 2 **3**	
11.	S **D**	A.	A S **H** F	S **D**	A.	**1** 2 3	______
		B.	**A** S H F		B.	1 **2** 3	
12.	**S** D	A.	A **S** H F	**S** D	A.	**1** 2 3	______
		B.	A **S** H F		B.	**1** 2 3	

Total score ______

Total correct:

Emotion / Intensity

Match______ Identify______ 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.

FOR THE GROUP GETTING SAMPLES:

Sample 1: Here's an example of what I mean (play sample). The first voice you heard was extremely angry and the second voice was extremely happy, so you would say the emotions are different...angry and happy...and the intensity is the same...extreme.

Sample 2: Here's another. For this one you would say the emotions are different...sad and afraid...and the intensities are also different...mild and moderate. Now try the next one.

	Emotion			Intensity			Score
	Match	Identify		Match	Identify		
1.	<u>S</u> D	A.	A S <u>H</u> F	<u>S</u> D	A.	1 2 <u>3</u>	______
		B.	A S <u>H</u> F		B.	1 2 <u>3</u>	
2.	<u>S</u> D	A.	A S H <u>F</u>	<u>S</u> D	A.	1 2 <u>3</u>	______
		B.	A S H <u>F</u>		B.	1 2 <u>3</u>	
3.	<u>S</u> D	A.	<u>A</u> S H F	S <u>D</u>	A.	1 2 <u>3</u>	______
		B.	<u>A</u> S H F		B.	<u>1</u> 2 3	
4.	S <u>D</u>	A.	A S H <u>F</u>	<u>S</u> D	A.	1 <u>2</u> 3	______
		B.	A S <u>H</u> F		B.	1 <u>2</u> 3	
5.	<u>S</u> D	A.	A <u>S</u> H F	S <u>D</u>	A.	<u>1</u> 2 3	______
		B.	A <u>S</u> H F		B.	1 2 <u>3</u>	
6.	<u>S</u> D	A.	A <u>S</u> H F	<u>S</u> D	A.	1 <u>2</u> 3	______
		B.	A <u>S</u> H F		B.	1 <u>2</u> 3	
7.	S <u>D</u>	A.	A S H <u>F</u>	S <u>D</u>	A.	<u>1</u> 2 3	______
		B.	A <u>S</u> H F		B.	1 2 <u>3</u>	
8.	S <u>D</u>	A.	<u>A</u> S H F	<u>S</u> D	A.	<u>1</u> 2 3	______
		B.	A S H <u>F</u>		B.	<u>1</u> 2 3	
9.	S <u>D</u>	A.	A S <u>H</u> F	S <u>D</u>	A.	1 <u>2</u> 3	______
		B.	<u>A</u> S H F		B.	1 2 <u>3</u>	
10.	<u>S</u> D	A.	<u>A</u> S H F	<u>S</u> D	A.	1 <u>2</u> 3	______
		B.	<u>A</u> S H F		B.	1 <u>2</u> 3	
11.	S <u>D</u>	A.	A <u>S</u> H F	<u>S</u> D	A.	<u>1</u> 2 3	______
		B.	A S <u>H</u> F		B.	<u>1</u> 2 3	
12.	S <u>D</u>	A.	A S <u>H</u> F	S <u>D</u>	A.	<u>1</u> 2 3	______
		B.	<u>A</u> S H F		B.	1 <u>2</u> 3	

Total score ______

Total correct:

Emotion   Intensity

Match______ Identify______   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.

FOR THE GROUP GETTING SAMPLES:

Sample 1: Here's an example. This person looks moderately afraid and the voice you heard was moderately happy, so you would say that the emotions are different...afraid and happy... and the intensities are the same...moderate.

Sample 2: Here's another one. For this one, you would say that the emotions are different...sad and angry and the intensities are different...mild and extreme. Now you try one.

	Emotion			Intensity			Score
	Match		Identify	Match		Identify	
1.	**S** D	A.	A S **H** F	**S** D	A.	1 2 **3**	______
		B.	A S **H** F		B.	1 2 **3**	
2.	S **D**	A.	**A** S H F	**S** D	A.	1 2 **3**	______
		B.	A S **H** F		B.	1 2 **3**	
3.	**S** D	A.	A **S** H F	S **D**	A.	**1** 2 3	______
		B.	A **S** H F		B.	1 2 **3**	
4.	S **D**	A.	**A** S H F	S **D**	A.	1 **2** 3	______
		B.	A S **H** F		B.	1 2 **3**	
5.	S **D**	A.	A S H **F**	S **D**	A.	1 2 **3**	______
		B.	A S **H** F		B.	**1** 2 3	
6.	S **D**	A.	A S H **F**	S **D**	A.	**1** 2 3	______
		B.	A **S** H F		B.	1 2 **3**	
7.	**S** D	A.	A S **H** F	S **D**	A.	**1** 2 3	______
		B.	A S **H** F		B.	1 **2** 3	
8.	**S** D	A.	**A** S H F	**S** D	A.	**1** 2 3	______
		B.	**A** S H F		B.	**1** 2 3	
9.	S **D**	A.	A **S** H F	**S** D	A.	1 **2** 3	______
		B.	A S H **F**		B.	1 **2** 3	

10.	S D	A.	A S H F	S D	A.	1 2 3	______
		B.	A S H F		B.	1 2 3	
11.	S D	A.	A S H F	S D	A.	1 2 3	______
		B.	A S H F		B.	1 2 3	
12.	S D	A.	A S H F	S D	A.	1 2 3	______
		B.	A S H F		B.	1 2 3	

Total correct: Total score ______

Emotion Intensity

Match______ Identify______ Match______ Identify______

****

Summary Scores

Task/ Modality	Visual	Auditory	Audit/Vis	Total
Match Emotion				
Identify Emotion				
Match Intensity				
Identify Intensity				
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. Seven 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. visual recognition
6. auditory recognition
7. visual/auditory recognition

Appendix 7

Informed Consent

I agree to participate in the research project, conducted by Mary Ann Mountain, which investigates the ability to recognize and identify facial and vocal emotion. The nature and purpose of this research and the types of tasks that I will be required to do has been explained to me. I understand that I may withdraw from the study at any time without penalty and without giving my reasons for withdrawal. I also understand that my test results will not be indentified with my name in any way.

_________________________ _________________________

Name (print) Signature

_________________________ _________________________

Date Witness

Appendix 8

Raw Data

1. Item scores on 13 subjects - VERT-R

```
SUBJNO 1-2 T1ITEM1 TO T1ITEM24 3-50 T1ITEM25 TO
T1ITEM48 3-50 T1ITEM49 TO T1ITEM72 3-50 T2ITEM1
TO T2ITEM24 4-51 T2ITEM25 TO T2ITEM48 4-51
T2ITEM49 TO T2ITEM72 4-51.
BEGIN DATA.
1 6 6 4 2 3 2 1 2 2 5 6 4 2 4 4 4 1 4 3 1 6 5 4 4
  4 2 3 1 5 4 5 3 3 5 4 6 4 4 3 2 5 3 6 3 2 6 6 2
  4 4 4 4 4 1 1 4 6 5 4 4 4 4 5 6 3 6 4 4 2 4 6 4



2 4 3 4 4 3 4 3 5 4 5 4 4 4 4 6 4 4 4 4 2 6 4 4 6
  3 2 3 4 3 4 5 1 2 6 4 4 3 6 6 6 4 4 2 4 2 6 6 6
  4 4 3 3 4 4 2 4 3 6 4 6 4 2 4 4 4 4 4 4 4 6 3 4
   4 4 4 4 4 4 5 6 4 4 4 4 4 4 5 4 2 4 4 2 4 6 4 4
   6 2 4 2 4 4 5 3 6 6 4 2 3 6 6 6 4 6 2 4 2 6 6 6
   6 4 4 3 3 4 3 4 4 6 5 2 4 6 6 4 1 6 3 6 4 6 6 4
3 4 3 4 4 5 3 6 4 2 4 4 4 4 6 5 4 5 5 3 2 4 6 4 6
  4 1 4 1 3 2 6 5 6 6 3 2 3 5 6 4 5 4 4 4 4 6 5 6
  4 4 6 3 4 3 5 4 2 6 4 4 2 4 4 6 4 6 4 2 4 6 6 4
   4 4 4 1 3 3 6 4 2 4 5 4 3 6 2 4 6 6 4 1 6 6 4 4
   4 1 4 1 6 2 6 4 5 6 4 4 4 6 6 4 5 6 4 6 4 6 6 4
   4 4 4 4 5 3 4 4 2 6 4 4 2 4 4 4 5 6 3 2 4 4 4 6
4 6 6 5 4 3 4 5 4 4 5 4 4 3 4 5 4 4 4 4 2 6 5 4 6
  4 4 4 2 4 4 5 2 6 6 4 4 5 6 6 6 6 6 2 4 2 4 6 4
  4 4 4 4 3 3 3 4 2 6 4 4 2 6 6 6 2 6 3 6 4 6 6 4
   6 6 5 4 3 4 5 4 4 5 4 4 3 4 5 4 4 4 4 2 6 5 4 6
   4 4 4 2 4 4 5 2 6 6 4 4 5 6 6 6 6 6 2 4 2 4 6 4
   4 4 4 4 3 3 3 4 2 6 4 4 2 6 6 6 2 6 3 6 4 6 6 4
5 4 6 4 2 5 4 2 6 6 6 4 4 5 6 6 4 1 6 4 2 4 5 4 6
  4 2 4 3 4 6 6 4 4 6 6 4 5 4 6 4 5 5 4 5 2 6 5 2
  4 6 4 3 5 4 5 4 4 6 4 4 5 4 6 6 2 6 4 6 4 6 6 2
   4 4 4 4 5 4 2 6 6 6 4 4 5 4 5 4 3 6 4 2 6 6 4 4
   6 4 4 2 4 4 6 4 5 6 6 4 5 6 6 4 6 5 2 4 4 4 6 2
   4 4 4 4 3 4 5 4 2 6 6 6 5 6 6 4 4 6 4 6 4 6 6 2
6 4 4 5 4 5 2 5 6 2 4 4 4 3 4 6 2 4 4 4 2 4 6 4 6
  4 1 4 2 6 5 6 5 5 4 4 4 5 6 6 6 5 3 4 6 4 6 6 4
  4 4 4 3 3 2 5 4 3 6 4 6 4 4 6 6 4 6 4 5 6 6 6 6
   4 4 4 4 3 3 5 6 4 5 5 4 4 6 3 4 4 4 4 2 6 6 4 6
   6 2 6 2 6 5 5 5 6 6 4 6 5 6 4 6 6 4 2 3 6 4 6 4
   4 6 6 4 3 2 5 6 4 6 4 6 5 4 5 4 2 6 4 6 6 6 4 6
7 4 4 4 3 5 3 6 6 4 6 4 6 5 4 6 6 5 6 4 2 6 5 4 6
  6 3 4 2 2 4 6 2 6 6 4 6 5 6 6 4 6 4 4 3 4 6 6 4
  6 6 6 4 5 3 5 5 3 6 6 6 4 6 4 6 4 4 4 2 4 4 6 4
   4 4 4 1 0 4 4 4 2 6 4 6 4 4 4 4 5 5 4 2 6 5 4 6
```

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   6 2 4 6 3 4 6 3 5 6 4 6 6 5 6 2 6 4 6 3 4 4 5 2
   6 6 6 4 6 3 6 6 1 6 6 4 4 6 4 2 4 6 4 4 6 6 6 4
8 4 6 4 3 6 4 5 4 2 5 6 4 4 6 6 4 2 6 4 2 1 6 4 4
  4 1 6 4 6 6 6 4 5 5 4 6 4 6 6 4 6 6 6 4 6 3 4 4
  4 4 4 4 6 4 3 3 1 5 6 4 3 4 3 4 4 6 1 4 2 4 3 2
   4 4 4 3 3 4 2 6 6 5 6 4 4 6 6 4 2 4 2 6 3 5 3 3
   4 4 4 2 5 6 6 4 4 5 6 6 5 4 4 4 6 6 2 4 6 3 3 4
   4 6 4 2 3 4 4 4 6 5 4 6 6 6 6 4 4 4 2 4 2 5 6 2
9 4 4 4 1 4 4 3 4 4 5 4 4 4 4 4 4 4 4 6 1 2 6 3 6
  3 1 4 3 3 2 5 3 4 4 4 2 2 2 6 4 6 4 4 4 2 2 3 6
  4 4 4 4 4 4 2 3 4 4 4 6 3 4 4 2 2 6 4 2 1 4 6 6
   4 4 4 4 3 3 3 5 4 6 4 6 6 4 3 2 4 6 4 4 2 6 4 6
   4 4 4 4 1 3 5 4 6 5 3 6 5 4 6 4 6 6 2 4 6 2 6 4
   4 6 4 4 3 3 5 3 2 5 4 6 2 4 5 2 2 6 6 6 2 4 6 4
103 4 3 4 2 3 5 4 1 3 4 4 3 4 4 4 4 4 3 1 2 4 2 4
  6 2 4 3 3 2 5 2 6 5 4 6 2 6 6 6 5 6 3 4 4 6 6 6
  4 4 4 4 3 3 2 2 4 6 4 6 3 4 6 6 3 6 4 1 1 2 4 4
   6 4 4 2 4 3 5 5 2 3 4 4 3 4 3 4 5 4 4 2 2 4 2 6
   6 2 6 2 4 4 6 2 6 6 6 6 3 4 5 4 5 6 4 4 4 5 6 6
   4 4 4 1 5 3 5 3 3 5 4 4 5 4 4 6 2 6 1 6 2 2 4 4
116 4 4 4 4 2 5 4 2 5 4 4 3 6 3 4 6 6 4 2 4 6 4 6
  6 4 4 4 6 3 6 4 6 5 4 6 3 6 4 4 5 4 1 2 6 6 6 4
  6 4 4 3 3 3 5 3 2 6 4 4 3 6 4 4 5 6 6 4 6 6 6 4
   6 6 4 2 4 3 6 4 2 4 5 4 4 4 3 2 4 5 4 2 4 4 6 6
   4 3 4 2 6 4 5 4 4 4 4 6 4 4 4 4 6 5 4 4 4 4 5 6
   4 4 4 4 3 3 5 3 3 5 6 6 3 6 4 4 4 5 4 4 6 4 5 6
126 6 4 4 3 4 5 6 2 5 4 4 5 4 6 2 4 4 6 6 4 4 4 6
  6 4 4 2 6 5 6 3 4 6 4 6 5 6 6 6 5 4 2 4 6 4 6 3
  6 6 6 4 5 4 5 4 6 6 4 6 5 5 5 4 2 5 6 6 6 6 4 4


136 4 4 4 3 2 4 4 2 5 4 6 3 4 6 6 4 4 4 1 4 6 4 6
  6 4 4 2 4 4 6 5 6 6 6 2 4 5 6 6 6 4 1 5 4 6 5 4
  6 4 4 3 5 4 4 4 4 6 6 2 3 6 4 6 1 6 4 4 6 6 4 6
```

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**************************************************
```

2. Item scores on 18 subjects - VERT-C

```
SUBJNO 1-2 SEX 3-4 GROUP 5-6 T1I1 TO T1I12 7-30
T1I13 TO T1I24 31-54 T1I25 TO T1I36 55-78/T2I1 TO T2I12
7-30
T2I13 TO T2I24 31-54 T2I25 TO T2I36 55-78.
BEGIN DATA.
 1 1 0 6 3 5 4 6 5 3 4 4 4 4 4 4 4 4 2 6 4 6 6 6 4 4 6 6
4 3 4 6 4 4 4 6 4 4 6
      6 5 6 6 4 6 4 4 6 6 4 6 6 4 5 3 6 6 6 5 6 4 4 6 6
6 5 6 5 6 6 4 2 4 4 4
```

```
 2 1 0 6 6 5 5 2 5 4 4 4 6 4 4 6 4 5 5 6 6 5 5 5 6 4 5 6
4 3 4 3 3 6 4 6 4 4 6
       6 4 5 5 6 6 6 5 3 6 6 6 6 4 4 5 6 4 4 5 6 6 6 6 6
6 6 6 5 4 6 4 6 4 6 4
 3 1 0 3 4 6 6 3 6 4 3 4 6 6 4 4 6 5 4 5 4 5 6 6 4 6 6 6
6 5 6 6 4 5 4 2 6 3 4
       6 4 5 6 4 6 6 4 6 6 5 4 6 4 5 4 6 6 4 6 4 6 4 6 6
6 6 5 6 4 6 6 6 6 4 4
 4 1 0 4 4 3 4 2 5 4 5 3 4 3 4 4 4 3 6 5 4 5 3 6 4 4 5 6
6 5 4 5 3 4 2 4 2 4 6
       4 4 4 4 3 5 4 4 4 4 3 6 6 4 6 4 5 4 5 4 4 4 4 5 6
4 2 6 6 6 4 4 3 2 4 6
 5 1 0 6 3 2 6 4 3 4 6 4 6 4 4 6 4 4 6 5 4 4 6 6 2 4 5 6
6 4 6 6 4 6 4 4 4 4 6
       6 4 3 6 2 3 6 6 4 6 3 6 6 4 5 6 4 6 5 6 6 2 4 6 6
6 6 6 5 3 6 4 4 4 4 6
 6 0 0 6 3 5 6 6 6 4 5 4 4 6 6 6 2 6 4 6 4 5 6 6 2 6 4 6
6 5 4 6 4 6 4 4 6 4 4
       6 5 5 4 4 6 6 5 5 4 6 4 6 4 6 4 3 6 5 6 6 4 4 6 6
6 5 6 5 5 6 4 6 4 4 6
 7 0 0 6 4 1 6 4 3 6 3 4 4 4 2 6 2 2 6 5 2 5 4 6 6 4 6 6
6 3 4 5 6 6 4 4 6 6 3
       4 2 3 4 2 5 4 3 2 4 6 6 4 2 3 4 6 4 5 6 6 4 6 6 6
4 5 4 6 4 6 4 4 6 4 4
 8 0 0 4 4 6 4 4 3 4 4 4 6 4 4 6 1 6 2 6 2 4 4 6 6 6 5 6
4 5 4 6 5 4 4 6 2 4 6
       6 4 6 6 4 3 3 5 3 4 6 4 6 2 6 4 6 4 4 6 6 6 6 5 6
6 5 5 6 4 4 4 6 2 4 4
 9 0 0 4 4 3 6 4 6 6 6 6 4 4 4 4 4 3 4 5 4 4 4 6 4 3 4 4
3 5 3 5 6 4 2 4 2 6 6
       6 4 5 4 4 6 2 6 4 4 3 6 6 2 3 4 5 4 4 6 6 4 4 6 6
6 6 4 6 4 4 4 2 6 3 4
10 0 0 6 4 3 6 6 6 4 4 6 4 4 4 6 3 6 2 6 4 5 6 6 4 3 4 6
4 6 3 5 4 4 6 3 5 4 4
       6 6 3 6 4 6 4 5 6 6 4 6 6 4 5 4 5 6 5 6 6 4 4 6 6
4 6 4 6 4 6 6 2 6 4 6
11 1 1 6 6 5 6 2 3 4 5 5 4 3 4 6 2 6 6 6 4 5 6 6 6 4 3 6
6 6 6 5 5 4 1 4 6 6 5
       4 4 5 6 4 6 4 6 5 4 4 6 6 4 5 4 5 4 5 4 6 6 2 4 6
6 6 5 6 5 6 2 6 4 6 2
12 1 1 4 4 3 4 4 3 4 4 6 4 4 4 6 1 5 3 6 4 5 4 4 6 4 6 6
4 6 6 6 4 6 4 6 6 6 2
       6 6 3 6 6 6 6 4 6 6 4 4 4 2 6 4 5 4 4 5 6 6 4 4 6
6 5 5 5 5 6 2 3 6 4 6
13 1 1 6 6 2 6 4 6 2 5 3 4 5 4 4 2 3 4 5 4 5 6 4 4 4 5 6
4 3 3 6 5 6 4 3 4 4 5
       4 4 2 4 4 6 4 6 4 4 4 4 4 3 3 6 4 6 6 6 6 4 5 5 6
4 1 3 6 6 4 4 5 4 6 5
14 1 1 4 4 5 6 4 6 4 5 4 4 4 4 6 0 3 4 6 6 4 6 4 4 4 4 6
4 3 4 5 1 4 4 6 4 4 4
       6 4 3 4 4 6 4 5 6 4 3 4 6 4 6 3 6 2 3 4 6 6 4 6 6
6 3 6 6 5 6 6 4 4 2 4
```

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15 0 1 6 4 6 4 2 6 2 5 4 6 4 4 4 3 3 3 4 4 5 6 4 4 4 6 6
6 4 6 6 3 4 4 4 4 6 4
       6 4 4 4 4 6 4 6 3 6 4 4 6 4 6 3 6 3 4 4 6 4 6 5 6
6 6 4 5 6 4 4 6 6 4 4
16 0 1 6 4 3 6 6 6 6 4 6 6 3 6 6 3 6 6 5 4 3 3 4 4 4 4 6
6 4 5 6 5 6 4 4 6 3 4
       4 4 5 6 4 6 4 3 5 6 3 6 6 1 5 6 6 2 3 4 6 6 4 4 6
6 4 5 6 5 4 2 4 6 3 3
17 0 1 4 4 2 3 5 6 4 4 3 6 3 6 6 6 4 3 5 6 5 6 4 4 4 4 6
4 3 4 6 5 4 4 4 6 6 3
       4 3 3 4 4 6 4 4 4 4 5 4 6 4 3 3 4 2 4 2 6 4 4 5 6
6 2 6 5 2 6 4 3 2 4 2
18 0 1 6 4 5 4 4 5 6 6 4 4 4 4 6 6 6 3 5 2 3 6 6 6 4 5 6
6 6 3 5 6 6 4 4 4 4 4
       6 4 6 6 6 6 4 6 4 6 3 6 6 2 5 4 6 2 3 6 6 2 4 5 6
6 6 4 5 3 4 4 6 6 6 5
```

3. Total test scores with VERT-R

```
 SUBJNO 1-3 SEX 4-5 FRT 6-8 TMT 9-11 PONSF 12-14
PONSV 15-17 PONSFV 18-20 POMS1 21-24 VERTV 25-28
VERTA 29-32 VERTVA 33-36 POMS2 37-40.
BEGIN DATA.
1  0 45 27 16 27 35  11  87  92  97
2  0 49 27 20 24 36   0  99  96  94  -1
3  0 49 29 17 32 37  22 101  99 101 -11
4  0 47 26 17 29 33 -18 105 106 102 -12
5  1 49 24 18 30 36 -19 106 106 110 -28
6  0 43 25 16 29 35  75  98 111 111  14
7  1 45 27 16 31 35  22 114 109 113  20
8  1 47 27 18 27 37  54 102 116  88   8
9  1 50 23 15 25 35  63  93  83  91  68
10 1 45 28 18 27 37  21  79 108  90   8
11 0 50 28 18 31 36  92 102 109 107  19
12 0 47 28 18 32 38      99 111 108
```

4. Total test scores with VERT-C

```
 (ME 1-3 IE 4-6 MI 7-9 II 10-12)* VERTT1 13-16 PONSF
17-19 PONSV 20-22 PONSFV 23-25 FRT 26-28 TMT 29-31 POMS1
32-35 POMS2 36-39 VERTT2 40-43 SEX 44-45 VERTV1 46-48
VERTA1 49-51 VERTVA1 52-54 VERTV2 55-57 VERTA2 58-60
VERTVA2 61-63.
BEGIN DATA.
```

33	63	27	50	173	16	32	38	50	30	55	32	172	1	53	60	60	59	54	59
31	64	24	45	164	16	27	38	45	26	51	73	172	1	48	54	62	63	54	55
29	60	23	41	153	16	23	33	49	29	-3	43	161	1	53	48	52	50	58	53
32	65	16	41	154	16	26	35	45	19	34	33	167	1	54	51	49	53	56	58
29	63	22	45	159	15	28	34	50	28	81	22	173	0	52	50	57	55	57	61
33	66	24	50	173	17	30	37	47		-9	19	163	0	62	52	59	56	53	54
29	57	29	47	162	19	28	34	50	27	34	37	144	0	50	57	55	49	47	48
34	64	23	51	172	17	29	36	50	25	104	64	176	0	56	58	58	63	51	62
31	66	20	46	163	16	28	37	49	27	-2	19	178	1	52	56	55	63	60	55
32	63	27	51	173	17	31	37	49	25	43	-20	189	1	55	62	56	64	62	63
29	65	28	52	174	19	25	37	45	27	87	33	188	1	56	61	57	62	61	65
30	60	23	38	151	14	27	33	45		137	77	158	1	46	53	52	49	55	54
28	59	28	55	170	13	26	33	47	23	-3	-9	176	1	54	56	60	55	61	60
32	68	30	46	176	18	26	38	50	28	-21	-9	182	0	59	57	60	60	60	62
30	59	22	48	159	15	24	34	49	21	11	8	156	0	47	53	59	44	55	57
28	63	22	47	160	16	28	36	49	29	46	-10	171	0	51	54	55	54	61	56
30	61	21	40	152	16	23	35	45	30	29	-4	163	0	52	49	51	54	54	55
30	61	25	49	165	19	27	35	49	29	10	-10	183	0	57	54	54	62	61	60

*ME = MATCH EMOTION
IE = IDENTIFY EMOTION
MI = MATCH INTENSITY
II = IDENTIFY INTENSITY