Social Perception and Executive Function Following Stroke

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Declaration

"This thesis has been composed by myself and the work herein is my own."

Signed_

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Abstract

Components of social perception include the ability to recognise and interpret both verbal and non-verbal emotional cues, such as vocal tone and facial expression. Functional brain imaging studies have shown that the frontal cortex of the brain is more active during tasks involving social and emotional perception (Baron-Cohen et al., 1994). Individuals with frontal lobe lesions have been shown to have acquired difficulties in emotional and social functioning similar to those in which social functioning deficits are frequently observed, such as people with autism (Baron-Cohen, 1985). Difficulties in emotional perception has also been found in individuals who have sustained a brain injury (Cicone et al., 1980). Additionally, acquired social perception deficits have been observed in stroke patients (Happè et al., 1999). Executive functioning is also seen as being mediated by the frontal cortex (Dela Salla et al., 1998). The aim of this present study was to investigate executive function and social perception in post-stroke individuals.

The hypotheses were that stroke patients would show a reduced ability in social perception compared to matched controls and that executive functioning would be positively associated with social perception. Twenty-two individuals who had experienced a stroke were assessed on tasks of executive function and compared to a control group on tasks of emotional perception and social awareness.

The results were analysed within and between groups and are discussed with reference to theories linking executive function and social perception with the frontal cortex. The findings of this present study indicated no significant differences in the recognition of emotion between individuals who have sustained lesions to the brain following stroke and age-matched controls. Also, no significant differences were found on tasks of social perception relative to controls. However, there is some evidence to suggest that the control group may have performed at an unexpectedly low level. Significant and positive associations were observed between executive function and both emotion recognition tasks and tasks of social perception. Methodological issues and conclusions are discussed.

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Chapter One: Introduction

1.0 Introduction

A search for published research was undertaken using the following databases: PsychINFO; EMBASE; MEDLINE; and CINAHL. The key terms used included stroke, social perception, social awareness, social comprehension, executive function and Theory of Mind. No research was found that involved the three key areas of this thesis, i.e. stroke, social perception and executive function. A literature search of published material in the areas of neuropsychology, neurology, social psychology, neuropsychiatry and autistic spectrum disorders, amongst others, was also carried out. From the literature, material germane to the areas under investigation in this thesis was selected on the basis of relevance, significance or contrast to a given topic.

This introduction describes neurological aspects of stroke and then discusses psychological consequences of stroke on the individual. These include cognitive difficulties that may be experienced following damage to the frontal regions of the brain and a discussion of executive functioning with regard to emotional and social functioning. Also, descriptions of particular emotional and behavioural difficulties experienced by those who have suffered a stroke are discussed. The role of psychological competencies is discussed in the light of recent research findings, specifically the recognition of emotion in others and social awareness. Methodological issues surrounding the measurement of emotional recognition, social awareness and functioning are then addressed, followed by a description of the aims and hypotheses of the current study.

1.1 Stroke

1.1.1 Definition of Stroke

The terms 'stroke' or cerebrovascular accident (CVA) refer to the effects of an interruption to the blood supply of a localised area of the brain. This results in tissue damage and consequent disruption of function in the brain and is usually caused by obstruction of a cerebral blood vessel. Occlusion occurs in around 80% to 85% of individuals and in the remaining 15% to 20% of cases stroke is due to rupture of a blood vessel (haemorrhage). A wide range of disorders may be produced from pathology related to the blood vessels, which in itself may take many forms. Robinson (1998) suggested a classification of cerebrovascular disease based not on the aetiologies of underlying anatomical-pathological processes, which would be many and complex, but rather by using the means by which these processes manifest themselves.

Using this classification, cerebrovascular disease may be ordered into ischaemic disorders and haemorrhagic disorders. Ischaemic disorder cases can result from a number of causes, including the build up of fatty tissue on artery walls (thrombosis), a plug of thrombus material that has broken away (embolism) and narrowed vessels from thickening or hardening of the arteries (cerebral atherosclerosis). Ischemic disorder also includes transient ischaemic attacks (TIAs). TIA refers to recurrent episodes of temporary focal ischaemia with reversible neurological deficits and is linked to atherosclerotic thrombosis (Weinstein & Swenson, 1998). TIAs commonly last between 5 and 20 minutes, though may have a duration of seconds up to an accepted recovery period of 24 hours (Ross-Russell, 1983). During such an attack, the individual experiences sudden loss of neurological function, such as motor ability. This can often begin distally but may then progress to include the whole of one limb or lateral motor functions of the body. TIAs do not cause stroke but act like a mini stroke or indicator and may precede, occur with, or follow the development of a full stroke through cerebral or cerebellar artery occlusion. TIAs may occur in approximately one third of sufferers with no apparent permanent disability, while in another third the individual will go on to suffer a serious infarction.

The presence of TIAs suggest that a thrombotic process is occurring (Robinson, 1998). Atherosclerotic thrombosis accounts for approximately one third of all strokes. This tends not to be a uniform process but rather one in which particular areas of the arterial system are affected more than others, particularly areas where arteries branch or bifurcate. Plaques consisting of material such as cholesterol cause narrowing of the arteries and thereby restrict the flow of blood to various regions of the brain. This may lead to the complete occlusion of a given vessel. The effects of this type of cerebrovascular disease can range from very minor to the catastrophic infarction of a large area of a particular hemisphere. Generally, the size of the region affected will often depend on the size of the vessel occluded.

Thrombi forming in the heart are another a common cause of cerebral embolism, accounting for a further third of cerebrovascular accidents. These result from a range of causes, including cardiac arrhythmias, congenital heart disease and infectious processes. These events tend to have a sudden onset with no prior warning. As with the pattern of atherosclerotic thrombotic effects described above, a large embolus may occlude a major vessel such as the internal carotid artery and cause a severe hemiplegia, or, if the embolus is small, it may result in a transient neurological deficit. This in turn may resolve over time as the embolus fragments and travels into smaller, more distal arteries with less obvious neurological consequences. This also occurs in lacunar strokes, which account for between 15% and 20% of all strokes cases (Sacco, 1994). The effects of the occlusion of smaller, penetrating cerebral arteries depend on the region involved. These emboli may result in motor or sensory deficits, or show no recognisable neurological deficits. The strong association of both atherosclerosis and hypertension with lacunae suggests that lacunar strokes may be a consequence of the atherosclerotic process extending into smaller arteries.

The fourth most frequent cause of stroke is due to intracranial haemorrhage producing bleeding within the cranial cavity. This can be due to a number of events, including intracerebral haemorrhage (ICH), associated with hypertension, or the rupture of arteriovenous malformations (AVMs) or saccular aneurysms. Brain tissue is damaged by the bleeding, which may be exacerbated by pressure effects. Neighbouring tissue may be displaced or compressed should the bleeding continue. Such cerebrovascular events often occur with little or no prior symptomotology and may be fatal in severe cases, particularly if vital areas of the brain are affected. In many cases pressure may temporarily affect the function of a particular area without actually damaging the brain tissue, thereby enabling recovery of function over time.

In aneurysms and AVMs, rupture may produce intracerebral as well as subarachnoid bleeding. The symptomotology may vary considerably depending on the extent of bleeding and the areas and functions affected by the event. Ruptured aneurysms or AVMs of the pial surface can cause subdural haematomas, which behave as space-occupying lesions and produce many of the symptoms and behaviours of stroke.

Figures presented by Wade (1988) from a study of almost one thousand patients, show an incidence of approximately two individuals in a thousand per year suggesting that stroke is not an uncommon disease. This figure is likely to be an underestimate as their study only considered individuals who presented at their GP's surgery and thus those who did not present were not included in the estimate. The Scottish Intercollegiate Guidelines Network (2002), report that stroke is the third most common cause of death in Scotland and the most frequent cause of severe adult disability. The number of individuals living with stroke and its consequences each year in Scotland is around 70,000, with approximately 15,000 new cases estimated annually.

1.2 Consequences of Stroke

The consequences of stroke can vary significantly among individuals. This is due to the fact that the definition of stroke does not specify damage to a particular cerebral blood supply, area or degree of damage and does not take into account personal characteristics. In some individuals there may be no apparent consequences from a cerebrovascular event, while in others the degree of impairment may be catastrophic. Common consequences of stroke include: hemiplegic limbs, communication difficulties, memory problems and perceptual deficits. Wade, Langton-Hewer, Skilbeck & David (1985) suggest the following frequencies of neurological deficits following stroke (Table 1):

TABLE 1.0: Neurological Deficits Following Stroke

Symptom	
Depression of consciousness	30% - 40%
Loss of motor power	50% - 80%
Dysphasia	30%
Sensory disturbance	25%

An important factor in which functions may be affected by stroke is the area of the brain that is affected. Other factors that may influence the consequence of stroke include the type and severity of stroke experienced, and the gender and age of the individual (Sorgato, Colombo, Scarpa & Faglioni, 1990). The influence of these factors will be discussed in more detail below.

1.2.1 Motor and Physiological

A very wide range of behaviours may be affected to a greater or lesser degree following a stroke, depending on which part of the brain has been affected. There are general patterns of behavioural and physiological functioning associated with different parts of the brain. For example, the lowest area of the brain stem is involved in basic life-maintaining functions of the central nervous system, such as respiratory control, blood pressure regulation and heartbeat, and any damage to this part of the brain may result in death. Studies have revealed a range of behaviours that can be induced when specific nuclei within the brainstem are stimulated. These behaviours include chewing, sucking and swallowing (Jospeh, 1996). These motor movements increase in complexity in relation to the distance from the basal areas of the brainstem.

The cerebellum, in conjunction with the Pons, situated the top of the brain stem, regulates postural and kinaesthetic movement. Recent studies of cerebellar activity also indicate its involvement in other cognitive functions. The midbrain region is a small area forward of the hindbrain and includes the major portion of the reticular activating system as well as motor and sensory correlation centres. Lesions in this region of the brain have been found to result in particular types of tremor and extraneous movement involving localised muscle groups, as well as rigidity. The brainstem and areas of the midbrain are involved in vocalisations and speech. Faulty articulation in speech, which may result from a brainstem, forebrain or muscular lesion, are discussed further below. Damage to the thalamic areas would affect the sensory correlation centres that are involved in communications between lower and higher brain structures. Lesions in this area have been shown to affect body sensations, such as tactile discrimination and the perception of pain. Apraxic difficulties are also not uncommon, which can result in deficits of awareness of body parts and / or the position of the body in space. Paralysis down one side of the body (hemiplegia) is a common consequence of stroke and may affect either the arm or leg or both of the contralateral side of the affected hemisphere (King, 1990). As a stroke usually affects only one side of the brain, paraplegia or quadriplegia is very rare.

1.2.2 Cognition

Cognitive impairments usually result from damage to the forebrain regions. This part of the brain may be divided into the diencephalic structures, which include the thalamus, the hypothalamus, and the cerebrum – the largest structures of the brain containing the left and right hemispheres. As previously mentioned, damage to the thalamic regions of the brain would affect the sensory correlation centres that are involved in communications between lower and higher brain structures. The thalamus has also been shown to be involved in sleep and arousal functions but particularly in memory function (e.g. as seen in Korsakoff patients). Damage to this area of the brain can result in a dense verbal and visual anterograde amnesia (Graff-Radford, Van Hoesen & Brandt, 1990; von Cramon, Hebel & Shuri, 1989).

There are a number of cognitive symptoms that are often thought of as being characteristic of stroke, such as perceptual difficulties. A study by Diller and Winberg (1977) indicated a prevalence of 40% left-side visual neglect following a right-sided stroke. Heir, Mondlock & Caplan (1983) found a higher frequency of 85% in a study of 41 individuals who suffered a stroke in the right hemisphere. Such patients will ignore stimuli in the left side of their visual field. As previously mentioned, the type of stroke experienced can have an influence on the consequences. A thrombotic stroke, for example, located in the internal carotid artery may produce severe hemiplegia or if the blood flow of the middle cerebral artery (MCA) is disrupted, the posterior frontal, temporal and parietal areas may be expected to be affected due to their reliance on the MCA (Robinson, 1998).

If the vertebrobasilar system is obstructed, then infarcts may be expected in the inferior temporal or occipital lobes. Individuals with right hemisphere thrombotic strokes involving the MCA have been reported to show more functional impairment than those who suffer left hemisphere lesions (Kertesz, 1993). The more prevalent neuropsychological impairments, therefore, centre around disrupted visuospatial abilities and gestalt-type concept formation, which are more commonly functions of the right cerebral hemisphere (Lezak, 1995). Individuals who experience a left-sided CVA would be expected to show more aphasic difficulties. Thrombotic strokes involving the vertebrobasilar structure, such as an occlusion of the posterior cerebral artery, which branches from this system, may result in impairments of visual and memory functions. Around one third of obstructive strokes are due to cerebral emboli (Robinson, 1998). In these cases the obstruction is caused by an embolus, a free particle of fat or other tissue, that becomes lodged in a vessel thereby creating an occlusion.

The cerebral cortex is also involved in many of the behaviours and functions previously outlined. The parietal lobes, for example, are involved in visual attention, touch perception and the manipulation of objects. At a higher level, they also allow the integration of information from different sources that enables an individual to form an understanding of a single concept. Difficulties experienced following a stroke that has resulted in lesions in the parietal lobes may include anomia, agraphia, alexia and dyscalculia.

Damage to the occipital lobes can result in a range of vision-related difficulties. These include visual field deficits (difficulties in seeing objects in certain parts of the visual field), difficulties identifying colours, visual hallucinations, as well as problems with reading and writing. Visuo-perceptual difficulties are also related to damage of the temporal lobes, as are hearing ability and memory acquisition (Kolb & Wishaw, 1990).

Frontal lobe functioning, which is explored in more detail later, includes initiating behaviours in response to stimuli in the environment, awareness of ourselves and others and emotional regulation (Malloy, Cohen & Jenkins, 1998). Observed behavioural difficulties following damage to this part of the cortex include emotional lability, loss of ability to sequence complex motor movement, social interaction deficits and what has been termed 'personality changes'. Difficulty using expressive language may also be experienced with lesions in this area, particularly around Broca's area which is involved in speech production and processing rules of grammar. Other speech problems may be more dysarthric in nature, usually a consequence of motor disturbances involving mouth and throat muscles. Such speech and language problems are quite common following stroke, with around 25% of stroke sufferers having aphasic difficulties and about a third having dysarthria (Wade, et al., 1985; Brocklehurst, Andrews, Richards & Laycock, 1978). The severity and type of cognitive impairments following stroke can vary significant among individuals and affect processes central to social interaction and communication. These include language, visual perception, attention and memory.

1.2.3 Emotion

Plutchik (1984) describes emotion as a reaction to an appropriate stimulus. Such a reaction would include perception, expressive psychomotor behaviours and subjective experience. Neuroanatomical and neurophysiological structures related to emotion have been identified at different levels of the nervous system, including cortical, subcortical and limbic areas. Damage to the thalamic regions of the brain can lead to a reduction in emotional capacity and responsiveness, including a flat affect and apathy with loss of spontaneity and drive (Butters & Stuss, 1989). However, Cummings & Mendez (1984) and Robinson, Boston, Starkstein & Price (1988) reported transient manic episodes with right thalamic lesions.

There are a number of manifestations of impairments in emotional functioning following stroke. Stroke survivors may present with impaired emotional functioning because of a lesion in an area that normally inhibits or mediates emotional reaction. Several studies have examined the role of the right hemisphere in emotional processing. Researchers have described the non-verbal and multi-dimensional aspects involved in conveying emotions, such as facial expression and voice tone or quality (Joanette, Goulet & Hannequin, 1990; Borod, 1998). The left hemisphere is normally viewed as dealing with content (i.e. words), whereas individuals with right hemisphere damage have been shown to have an impaired ability in identifying the features of emotionally-laden stimuli, in both auditory and visual conditions (e.g. Borod & Koff, 1990). The different dimensions of emotional stimuli such as facial expression, gestures and tone of voice appear to be processed by independent areas of the brain and therefore can show deficits independently of each other.

Studies in which sodium amobarbital has been used to inactivate one hemisphere (Wada technique) suggest that individuals can react to stimuli in different ways, either positively or negatively depending on which hemisphere is disinhibited. Individuals whose left hemisphere was inactivated were found to be more tearful and depressed than individuals whose right hemisphere was inactivated. The mood of the latter group was found to be more positive and they reported feelings of euphoria (Lee, Loring, Meador & Brooks, 1990; Nebes, 1978). Some researchers have also suggested that emotional perception may be influenced by ageing, perhaps showing a decline over time as occurs with cognitive functions. However, a study of 90 normal adult females assigned to either a younger, middle-aged or older group showed no overall changes in accuracy of the perception of emotion across the different groups (Moreno, Borod, Welkowitz & Alpert, 1993).

Some researchers have questioned whether there are different rates of ageing between the different cerebral hemispheres. Emotional perception is seen as being chiefly a function of the right hemisphere and may deteriorate if the right hemisphere was found to age more quickly than the left. McDowell, Harrison & Demaree (1994) investigated the hemi-ageing hypothesis but found little evidence to support the view of hemispheric ageing in relation to emotional processing. However, findings from this study suggested that elderly subjects had more difficulty processing negative affect, while their ability to process positive affect was equal to that of younger subjects. A further study looking at the use of gestures as cues to decoding emotion by younger and older adults found differences between the two groups (Montepare, Koff, Zaithik & Albert, 1999). While both younger and older adults were found to be able to accurately identify emotion, older adults made more overall errors, especially when evaluating negative emotion. Another study suggests that the ability to recognise facial affect demonstrates a progressive decline across the lifespan, particularly with regard to anger (Brogole & Weisman, 1995).

The above research suggests there may a number of factors that influence emotional functioning following stroke. These include the location of the lesion, and the form of the emotional stimuli (e.g. auditory or visual). There is some further evidence that age may also influence emotional functioning, particularly in the processing of negative emotions. Age and hemispheric location of lesion, particularly those affecting the right hemisphere will be discussed further in later sections.

1.2.4 Affect

Mental health issues, particularly anxiety and depression, are commonly experienced by stroke survivors (Robinson, 1998). Symptoms associated with these conditions, such as apathy, withdrawal and irritability, are likely to influence psychosocial behaviours. Robinson (1998) describes depression as being one of the most frequent emotional disorders experienced by stroke survivors that also has a significant impact on rehabilitation and recovery. A community study looking at the prevalence of depression in post-stroke survivors found 15% of 129 individuals showed major depression at 4 months following stroke with 8% showing symptoms of dysthymia (Burvill, Johnson, Jamrozik, Anderson, Stewart-Synne & Chakira, 1995). The prevalence of depression in hospitalised patients was found to be similar to that of community samples, with 27% of 103 individuals meeting the criteria outlined in the Diagnostic and Statistical Manual of Mental Disorders (3rd edition) for major depression, while 20% were found to meet the criteria for dysthymic depression (Robinson, Starr, Kubos & Price, 1983).

Astrom (1996), in a prospective study, examined the prevalence and course of general anxiety disorder (GAD) and co-morbid depression in a population-based cohort of 80 individuals following acute stroke over a 3-year period. The prevalence of GAD was found to be 28% in the acute stage with no significant reduction in the subsequent 36-month period. This study also showed that in the acute stage GAD with co-morbid depression was found to be associated with left hemisphere lesions, whereas anxiety alone was found to be associated with right hemisphere damage. Robinson (1998) also reported a significantly higher frequency of right hemisphere lesions in individuals with anxiety-alone disorders, with a correspondingly significantly higher frequency of left hemisphere lesions in individuals with depression (with or without co-morbid anxiety). These findings suggest that anxiety and depression are associated with stroke and show that mental health issues are commonly found in individuals who have suffered a stroke. Also, not least because of the lengthy period of the conditions, they are very likely to impact on psychosocial functioning of this group.

1.2.5 Gender and Age Differences

Age may have an influence on the type of stroke expected and the general associated neuropsychological consequences. Embolic strokes, for example, are more commonly associated with cardio-vascular disease, which tends to occur at an earlier age than strokes of a thrombotic nature (Lezak, 1995). Additionally, gender has been shown to be associated with the areas of the brain in which lesions occur. More strokes involving the anterior regions of the brain were found in female patients compared to men in a study by Damasio, Tranel, Spradling & Allinger (1989), with associated differences in the nature of their aphasic disorders.

1.2.6 Localisation and Recovery of Function

In addition to the cognitive disturbances that may be seen following a lesion in an area involved in a specific function, electrophysiological studies and observation of post-stroke patients suggest impairments can occur in areas of the brain relatively distant from the lesion site. Such cognitive deficits may be seen as secondary diffuse effects as a result of oedema and other physiological reactions. Stroke patients, therefore, often display signs of bilateral or diffuse damage in the early post-stroke stages. Theories of the processes of cognitive impairment following stroke reflect either behavioural or organic explanations. Techniques developed to compensate for activities that are impaired following stroke, such as alternative behavioural strategies, may be developed consciously or unconsciously by the individual and are the focus of rehabilitation programmes designed to assist individuals overcome cognitive and behavioural impairments.

At an organic level, improvement in cognitive function usually occurs as a result of the receding effects of the depression of activity in areas outwith the immediate lesion site. Other theories of recovery in cognitive functioning post-stroke have been forwarded following evidence from animal studies suggesting the regeneration of axons – reactive synaptogenesis or sprouting (e.g. Marciano, Green & Stachowiak, 1992). Other organically-based theories of cognitive recovery are centred around observations of improvements seen in young infants where some reorganisation of cerebral function may be seen. In such cases, undamaged areas in a given hemisphere become significantly involved in functions usually seen as being under the control of the opposite hemisphere (Campbell, Bogen & Smith, 1981; Smith, 1984). More commonly, however, recovery of language function may be seen in the first few months following a stroke. Language disturbances such as aphasia, for example, usually resolve within four weeks if at all, and less than 25% of non-fluent patients one month post-stroke are fluent at six months (Knopman, Selnes, Niccum, 1983).

1.3 Executive Function

The frontal lobes of the brain play a significant role in behaviour and cognition. They have found to be implicated in distinctive 'frontal' syndromes, particularly following damage to the prefrontal, medial-frontal and orbitofrontal areas. Recent studies have described a number of fronto-subcortical circuits linking areas of the frontal lobes to subcortical structures within the brain. The frontal lobes mediate aspects of a number of cognitive functions, including language, motor functions, attention and concentration, and executive functions (Lezak, 1995). However, the true nature of the frontal lobes is a matter of continued speculation due to the varied presentation and pattern of impairments following lesions to this area of the cortex. Some individuals demonstrate quite pronounced deficits in cognitive functioning and / or changes in their personality, which may present as socially inappropriate or disinhibited behaviours (Joseph, 1996).

One of the first cases highlighting the effects of damage to the frontal lobes was that of Phineas Gage (Harlow, 1868). This individual sustained damage following the violent passage of an iron bar through the left frontal lobe, destroying much of this region of the cortex, with the likelihood of sustaining damage to the right frontal region in the process. From reports, Gage did not appear to have suffered significant cognitive damage inasmuch as he continued to work and be self-reliant in the years following his injury. However, there was a significant change in his personality from being an honest, reliable and apparently 'good businessman' pre-morbidly, to showing poor judgement, obstinacy, using profane language and being inconsiderate of others post-injury (Macmillan, 1986). Observations of individuals who had sustained frontal lobe injury during the First World War enabled clinicians to formulate a 'frontal lobe syndrome', in addition to identifying specific cognitive impairments following damage to particular regions of the frontal cortex (Benton, 1991).

Following a review of the literature, Goldman-Rakic (1993), concluded that the frontal lobes subserve a range of cognitive and behavioural functions, including, attention, reasoning and planning, the utilisation of past experience in current situations, initiation, verbal and constructional fluency, spatial orientation, inhibition, social affect and aspects of personality. It can be seen, therefore, that the functions of the frontal lobes are both significant and varied. Grafman, Sirigu, Spector & Hendler (1993) noted that impairments seen in individuals who have suffered frontal lobe damage may also be seen in individuals with a variety of sub-cortical neurological disorders. This suggests that the pre-frontal cortex may not have a specific significance to given cognitive functions but are part of a widespread neural network that incorporates the frontal lobes. This view, however, would much diminish the concept of localisation of function, for which there is a substantial body of evidence.

Throughout the literature the terms 'frontal functioning' and 'executive functioning' are frequently used interchangeably. However, a number of researchers point out that these are not analogous terms. Support for this view comes from studies in which individuals who display no behavioural features of frontal lobe damage, such as disinhibition, impulsivity, or social inappropriateness, show poor performance on tests of frontal lobe functioning (Anderson, Damasio, Jones & Tranel, 1991; Reitan & Wolfson, 1994). Additionally, there are also individuals who present as frontally impaired who show no difficulty in their performance of these tasks (Eslinger & Damasio, 1985; Shallice & Burgess, 1991; Brazzelli, Colombo, Della Sala & Spinnler, 1994). Phillips (1997) describes executive functioning as the '*...processes responsible for the control of cognition and the regulation of behaviour and* *thought... [and] is critical in everyday life in order to initiate, monitor and terminate behaviour patterns.'* These processes are viewed primarily as being mediated by the pre-frontal cortex. A number of researchers have documented deficits in executive functioning following damage to the frontal lobes in cases of neurological pathology, such as cerebrovascular disease, as well as lesions following traumatic brain injury (e.g. Della Sala, Gray, Spinnler & Traveli, 1998).

Executive functioning is seen as being closely linked to a range of cognitive functions. However, executive deficits appear to have a more global impact on a wide range of behaviours while a number of cognitive abilities remain relatively intact (Lezak, 1995). Thus, executive function may be viewed as having an influence greater than the sum of its component parts. Deficits in executive functioning are often associated with personality changes and are frequently reported by family members and those close to impaired individuals. Increased impulsivity and deficits in motivation and the ability to plan, organise and sequence actions are not uncommon (Malloy et al., 1998). Such deficits often have a severe negative impact on the individual's ability to self-care or engage in the activities of everyday living. There is an over-reliance on previously used actions, with the individual often becoming inflexible in both reasoning and in their patterns of behaviour. Difficulties in problem-solving can result in anxiety, irritation and frustration if the individual is faced with novel situations.

Altered psychosocial and emotional functioning following damage to the brain includes disinhibited or socially inappropriate behaviours, impulsiveness, irritability and misinterpretation of other's moods (Benton, 1991). The reported changes in personality, psychosocial functioning and emotional functioning seen following many types of brain damage reflect difficulties in a number of domains. Individuals with social and emotional changes following lesions in the frontal regions of the brain have been shown to be severely impaired in emotion-related learning relative to individuals without injury in this area (Rolls, Hornack, Wade & McGrath, 1994). This study also showed a highly significant correlation between impaired emotional learning and disinhibited and socially inappropriate behaviour exhibited in individuals with lesions in the frontal cortex. These findings support the view that executive functioning and emotional functioning are correlated and individuals who demonstrate impairments in one domain also exhibit deficits in the other. An examination of executive functioning following a cerebrovascular event will be discussed below.

A number of neuropsychological tests are commonly used to assess executive functioning. Among the more common are the Wisconsin Card Sort Test (WCST) (Heaton, 1981) and tests of verbal fluency, such the FAS test (Benton, 1968), with of evidence to suggest that impaired performance on such tests reflect deficits observed with executive disorders (Lezak, 1995). However, in a critical review of the literature examining the usefulness of both the WCST and measures of verbal fluency, Reitan and Wolfson (1994) urge caution in their use. Their conclusions suggest that while both these measures are sensitive to damage to frontal lobe functions, they are not capable of exclusivity in doing so but are also susceptible to lesions in other areas of the brain, thus raising issues of sensitivity and specificity.

1.3.1 Executive Function and Stroke

As previously indicated, intact executive functioning is critical in everyday life in order to initiate, monitor and terminate behaviour patterns (Phillips, 1997). Lezak (1995) conceptualises executive functioning as comprising of four main components: volition; planning; purposeful action; and effective performance. These functions are seen as necessary for appropriate, activity-related behaviours and impairments in these areas may be observed in post-stroke patients (Robinson, 1998). In addition to these deficits, there are also psychosocial impairments associated with damage to the frontal lobes, particularly in relation to the recognition of emotional expression. For example, impairments in identifying facial and emotional expression have been shown in individuals who exhibit socially inappropriate behaviours (Hornak, Rolls & Wade, 1996). These deficits form part of the presentation of changes in cognitive and intellectual functioning and personality which may be seen in individuals who had suffered a cerebrovascular event, particularly involving the anterior regions of the cerebral cortex. Overall, problems in executive functioning and psychosocial functioning are likely to contribute to the difficulties experienced by a number of stroke patients.

The consequences of impaired frontal lobe functioning are multi-faceted and can include perseverative behaviours, decreased working memory, reduced temporal memory, and inefficient learning, which may also be exacerbated by impulsivity and emotional lability (Malloy et al., 1998). The link between executive functioning and the frontal lobes may have implications for developing or maintaining relationships as individuals with frontal lesions have been shown to experience a deterioration in psychosocial functioning (Lezak & O'Brien, 1990). This in turn may have negative consequences for the well-being of the individual. There is considerable literature describing the range of affective disorders often experienced following stroke (e.g. Robinson, 1998). Bogonsslavsky (2003) outlined the importance for professionals of recognising alterations in emotional functioning and behaviour post-stroke because of the impact of these changes on the affective state of the individual and the high incidence of depression in this group (see Robinson, 1998). Additionally, neuropsychological impairments, including deficits in executive functioning is likely to have an impact on the rehabilitation of stroke survivors. In a review of the literature looking at predictors associated with poor outcome, cognitive and behavioural difficulties were highlighted as being the most important, along with age and severity of event (Jeffery & Good, 1995).

1.4 Social Functioning

The concept of social functioning can be defined in a number of ways. Here it is used to mean the competencies an individual possesses that enable him or her to interact appropriately with others in a range of situations. Social competence has been described by McFall (1982) as the effectiveness of an individual's performance on a given task, where the individual's skills are used to gauge competence. They subsequently defined social skills as the component processes that allow an individual to behave in a competent manner. Social skills and social competencies are fields that have attracted a large amount of research and cannot be fully explored within the constraints of this present study. Therefore, the two elements of effective social competence that will be focussed upon here are the recognition of emotion and social awareness. The latter is a complex concept that involves a range of abilities involving both self-awareness and an awareness of others. The perception, needs and beliefs of others are issues that have been investigated extensively in studies involving Theory of Mind (Baron-Cohen, Leslie & Frith, 1985). Theory of Mind can be defined as the ability to ascribe independent mental states to both oneself and others in order to explain and predict behaviour. Independent states of mind involve the desires, beliefs, intentions and feelings held by an individual. This research has focused on the skills involved in interpersonal behaviours and has important implications for successful social functioning.

1.4.1 Theory of Mind

The term Theory of Mind (ToM) was first used by Premack & Woodruff (1978) in their studies of non-human primates and subsequently adopted by Baron-Cohen and colleagues as an explanation for the psychosocial deficits frequently observed in autistic individuals (Baron-Cohen et al., 1985). This view suggests that the developmental process that normally occurs around four years of age, whereby children learn that other people hold beliefs and desires independently, either fails to develop or is in some way impaired in autism. This view suggests that such individuals are specifically impaired in a number of social, communicative and imaginative skills. ToM, therefore, may be considered a cognitive mechanism enabling the ability to view the world from another's standpoint (or 'mind-read'). Baron-Cohen et al., (1985), explored this hypothesis on twenty autistic children with mental ages well above four years of age using a false belief task (a scenario in which the child's own belief is different to that of one of the characters involved). Fourteen children with Down's syndrome who all had a mental age lower than four years were also tested. Of the twenty autistic children, only four passed the task, whereas all but two of the Down's syndrome group passed. ToM abilities appear to be independent of other cognitive functions, as many autistic children have been shown to perform poorly on such tasks yet show average or above average intelligence (Happè, 1994).

Functional brain imaging studies have shown that the frontal regions of the brain are more active during ToM tasks that during control tasks. A single photon emission computerised tomography (SPECT) study testing twelve normal adult male subjects (age 20-24 years) indicated significant activation of the right orbito-frontal cortex (Baron-Cohen, Ring, Moriarty, Schmidt, Costa & Ell, 1994). The ToM hypothesis postulates that there is a developmental deficit in ToM abilities in autism, but similarities have been noted between the behaviour of autistic children and adults who have suffered damage to the frontal lobes (Damasio & Maurer, 1978). A number of studies have provided some evidence that such a deficit may result following trauma to the brain. Happé et al., (1999) investigated this hypothesis in a group of nineteen individuals (10 males and 9 females, mean age 64 years) who had sustained lesions to the right hemisphere following a stroke on a range of ToM-related and control materials. A control group of nineteen healthy individuals (10 males and 9 females, mean age 73) were also tested. Happé and her colleagues found the stroke survivors to be significantly worse in their attribution of mental states and this deficit was not shown to be a function of task difficulty. A related study on five left-hemisphere stroke patients (4 males and 1 female, mean age 67 years) revealed no difficulty in mental state attribution in this group (Happé, Brownell & Winner, 1999).

These findings suggest that psychosocial difficulties seen in individuals with right hemisphere damage may be due to an acquired impairment in ToM abilities. There are, however, important methodological considerations in Happé's study that should be highlighted. The number of participants in each of the groups was low, therefore, factors such as gender and age could not be investigated. There was also a considerable range in time since event (e.g. from 12 months to 21 years post-stroke) and the pre-morbid ability of the participants was not fully explored. Additionally, language and communication difficulties are more common in individuals who have sustained damage to the left hemisphere and all the participants in this study with left hemisphere damage had expressive dysphasia. The task materials were modified to accommodate these difficulties, which may well have influenced the results. These studies do indicate that some individuals appear to sustain impaired psychosocial functioning following damage to the brain, but do not clearly identify the source as being located in the right hemisphere.

Impaired ToM abilities have also been found following frontal lobe surgery, where pre-morbid ToM functioning was documented (Happé, Malhi & Checkley, 2001). Evidence of impaired ability to understand subtle emotional and social cues have also been found following traumatic brain damage. An individual with relatively preserved frontal lobe functioning was found to be impaired on tasks that required the interpretation of social skills, which reflected her day-to-day functioning (Cicerone & Tanenbaum, 1997). While some of these studies involve single case studies, there is considerable evidence of poor psychosocial functioning being a common sequelae of acquired brain injury (e.g. Ownsworth, McFarland & Young, 2000). Overall, the evidence suggests that impairment in ToM abilities may be acquired following lesions to the brain, particularly the frontal regions of the brain. Social interaction difficulties seen in autistic individuals with impaired ToM may well be reflected in adults who have suffered a stroke.

ToM deficits may be correlated with executive functioning due to the involvement of the frontal lobes. Individuals with frontal lobe injury can show reduced social abilities through, for example, impaired self-regulation and reduced insight, and experience deterioration in social relationships or social isolation as a consequence (Lezak & O'Brien, 1990). Indifference regarding the well-being of others, an ego-centric attitude, loss of warmth and lack of empathy are alterations in emotional and social behaviours that others find difficult to accept (Wood, 2001). Such changes in emotional behaviour have been reported following lesion in the frontal areas of the brain (Damasio, Tranel & Damasio, 1990). It may be hypothesised, therefore, that damage to the frontal lobes can result in a reduced ability to understand the mental states of others. The consequence of this would be poor social functioning.

1.4.2 Recognition of Emotion

Research has shown that some individuals have difficulty in the perception of affect through facial expression following damage to the brain. Identification and discrimination abilities in face perception is found to be impaired in some individuals following brain lesion, particularly when the lesion is located in the right posterior area of the brain (Hamsher, Levin & Benton, 1979; Benton, 1980). A number of other studies have indicated that deficits in the perception of facial affect or emotion may also be a consequence of lesions in the right cerebral hemisphere (e.g. Cicone, Wapner & Gardner, 1980). This study investigated thirty-nine patients with unilateral brain injury, of which twenty-one had right hemisphere lesions (mean age 49) and eighteen had left hemisphere lesions (mean age 58). Two groups of controls matched to the brain injured groups in terms of age, socio-economic status and education levels were also assessed. The first control group were ten in-patients recruited from non-neurological wards and thirteen individuals who had received bi-frontal leucotomies approximately 15 years earlier as a treatment for schizophrenia. The materials used included a range of emotion-related materials in different modalities (e.g. visual/pictorial; aural/verbal). The results revealed that both the right-hemisphere and frontal patients exhibited difficulties in facial recognition with the right-hemisphere group demonstrating reduced abilities in all modalities. Methodological considerations, however, include a lack of specific lesion location in some individuals, with quite extensive damage being recorded in others. Additionally, the inclusion of individuals as controls with significant mental health conditions who had also received psychosurgery is questionable and likely to introduce a number of confounding variables.

In a study looking at the effect of posterior and frontal lesions upon the ability to recall facial emotion, individuals with frontal lesions were found to be impaired in relation to controls (Prigatano & Pribram, 1982). The effects of damage to the frontal lobes were also examined by Hornak et al. (1996), in which twenty-three individuals who suffered injury to the brain either as a result of stroke or head injury were tested on voice and facial expression identification. Participants were either in-patients or out-patients of a rehabilitation centre. Although the time since event was not recorded, the results indicated that separate domains may exist for the different components of the tasks given, with individuals who had sustained injury to the ventral frontal area of the brain showing impairments in the identification of voice and facial expression, though not necessarily occurring in the same individual. Reduced performance in expression tasks was found to correlate with changes in the degree of subjective emotional experience reported by the individual. Of the 12 individuals with ventral-frontal damage, one showed impairment in identifying vocal expression in others with the other 11 demonstrating severe impairment. Only four of the 11 non-ventral group showed an impaired performance. In the identification of facial expressions condition, nine of the twelve ventral group were severely impaired, whereas in the non-ventral group only one was impaired and one severely impaired. The authors suggest that these difficulties may contribute to the altered behaviour and reduced psychosocial functioning seen following brain lesions.

Age may also influence the identification of facial emotion among individuals who have suffered a stroke or a brain injury but this has not been specifically investigated in the studies outlines above. However, a study examining the perception of facial emotion across the lifespan in 90 normal adult females assigned to three separate groups (30 aged 21-39 years; 30 aged 40-59 years; and 30 aged 60- 81), found no changes in the accuracy of perception as a function of age (Moreno et al., 1993). However, such single-sex studies may not be generalisable as evidence from a number of studies have suggested a reduced ability in the perception of emotion in older adults, particularly in relation to negative emotions (McDowell et al., 1994; Montepare et al., 1999; Brogole & Weisman, 1995).

1.4.3 Social Cognition

The skills involved in social cognition include insight into one's own thoughts and behaviours as well as an awareness of the beliefs and intentions of others. Impaired social cognition and self-regulation skills are common sequelae of brain injury and are associated with poor psychosocial functioning (Morton & Wehman, 1995). These difficulties can lead to decreased social contact, disrupted interpersonal relationships and employment difficulties. As previously outlined above, anxiety and depression are commonly experienced in stroke survivors with concomitant symptoms such as apathy and irritability likely to influence psychosocial behaviours.

A study investigating models of social cognition in a group of 40 adults (32 males, 8 females; mean age 32 years) who had sustained a closed head injury (CHI) included an assessment of interpersonal strategies employed in social problem-solving scenarios in which an element of conflict was evident (Levine, Van Horn & Curtis, 1993). The results showed that compared to a control group of 26 healthy adults (11 males, 15 females; mean age 34 years), the head injury group consistently used a strategy indicating they typically took into account the perspective of only one individual in the given vignettes. The control group, however, utilised a reciprocal strategy by alternating their view of the scenario from the perspective of each individual involved.

The authors concluded that the responses of the CHI group were significantly more concrete and individually less socially mature than those of the controls. The types of injury sustained, however, indicate that 31 of the 40 individuals in the CHI group had been involved in motor vehicle accidents (eight had been pedestrians), five had sustained a previous head injury, and 17 abused alcohol. The findings of this study may, however, reflect some pre-morbid personality characteristics of the participants. There may be other characteristics of this group with which alcohol abuse and predisposition to involvement in accidents are associated that also cause individuals to show social interaction difficulties. But there is insufficient information on which to draw any conclusions. The CHI group also revealed a primary concern regarding changes in their physical, active and social characteristics while their perceptions of their personality had remained unchanged relative to their current perceptions of self prior to their injury. These results of immature levels of social cognition following head injury support previous findings from a related study that showed levels of social cognition in a group of ten brain injured adults (6 males, 4 females; mean age 37 years) which were comparable to those exhibited in a sample of non-clinical adolescents (Van Horn, Levine & Curtis, 1992).

The social interaction deficits outlined above are also seen in the interpersonal difficulties associated with autism. In a review of the research on the social impairments in autism, Travis & Sigman (1998) concluded these deficits might result from the impaired ability to take account of others' perspectives. What had been described as tactless behaviour and the disregard of social norms and conventions can be viewed as impaired social cognition. The case of Phineas Gage (Harlow, 1868) previously discussed, might also be seen as an acquired deficit in social cognition following injury to the brain. There is some evidence to suggest, therefore, that individuals who have sustained injury to the brain following stroke, particularly those who have acquired lesions in the frontal areas of the brain will show impairments in social cognition, thus impacting on social functioning. These issues will be explored in more detail in the following sections.

1.5 Stroke and Social Functioning

1.5.1 Emotion Recognition Following Stroke

Studies have shown that individuals who have sustained a brain injury demonstrate impairment in recognising emotion in others that may not be accounted for by deficits in visuo-perceptual abilities per se (Bowers, Bauer, Coslett & Heilman, 1985). This has been observed with lesions in the right posterior hemisphere and with damage to the frontal lobes (Cicone et al., 1980; Hornak et al., 1996). Individuals who have sustained brain lesions as a consequence of stroke have also shown difficulties in the perception of emotion across facial, prosodic and lexical channels (Borod, 1998). There are a number of studies that suggest mechanisms which may be involved in the comprehension of emotion (e.g. Heilman, Bowers Speedie & Coslett, 1984).

Comprehension of verbal emotional communication depends on at least two factors: the prepositional word message and the emotional prosodic message, which may be either congruent or incongruent. An example of the latter may be sarcasm, where the important component may be how a message is conveyed as opposed to what is being said. Bowers, Coslett, Bauer, Speedie & Heilman (1987) presented emotionally intoned sentences with both congruent and incongruent content to 16 individuals with right hemisphere damage (RHD), 15 left hemisphere damage (LHD) and 14 individuals with no neurological impairments (NNI). The results of this study indicated that RHD individuals were poorer overall on comprehension of the emotional message being conveyed and this was found to be more so when the prepositional word content was incongruent. Additionally, comprehension of the prepositional message was more disrupted for left-hemisphere damaged individuals when the emotional prosody was incongruent. These findings suggest that individuals with RHD have difficulty comprehending information through prosodic communication.

Bowers, Blonder, Feinberg & Heilman, (1991) investigated thirty-six individuals with either unilateral hemispheric lesions involving the right and left hemisphere or who had no neurological damage on two tasks of visual imagery: one involving imagery for facial emotions and the other involving imagery for common objects. The results indicated that individuals who had sustained damage to the right hemisphere were more impaired on the emotional task than the object task, whereas the opposite was found in individuals who had sustained damage to the left hemisphere. Following individual case analyses, the authors suggest some of the right-hemisphere damage individuals displayed a facial affect agnosia and showed impairment on emotional imagery and emotional perceptual tasks. Bowers and colleagues postulate that these findings support the hypothesis that the right hemisphere may contain what they describe as a 'lexicon' of facial emotions.

Borod, Rorie, Pick, Bloom, Andelman, Campbell et al., (2000), among others, investigated the ability to use words to convey emotion in a study of emotional and non-emotional discourse production in individuals with brain damage and in controls. Their findings indicated that left-hemisphere damaged individuals were particularly impaired in the non-emotional condition, whereas right-hemisphere damaged individuals were found to be more impaired in the emotional condition. The findings described above suggest an important role for the right hemisphere in emotion and that damage sustained to the right hemisphere may impair the perception, comprehension and production of emotion-related communication. The role of the right hemisphere in the ability to successfully process emotion-related stimuli will be briefly outlined in the following section.

1.5.2 Emotional Processing and the Right Hemisphere

Two major hypotheses have been put forward to explain the relationship between the right cerebral hemisphere and emotion and have been described as the right-hemisphere hypothesis and the valence hypothesis (Borod, 1992; Liotti & Tucker, 1995). The right-hemisphere hypothesis proposes that for the expression and perception of emotion, regardless of pleasantness (i.e. valence), the right hemisphere is dominant over the left hemisphere. The valence hypothesis, on the other hand, states that the right hemisphere is dominant for negative or unpleasant emotions with the left hemisphere dominant for positive or pleasant emotions. Borod (1998) investigated these hypotheses in a study looking at the perception and discrimination of different emotions across 3 communication channels: facial, prosodic and lexical. Participants in the study included 11 post-stroke individuals with right hemisphere damage and 10 individuals with left hemisphere damage, along with 15 matched controls. The results of this study suggest support for the right-hemisphere hypothesis in the perception of emotional stimuli across all communication channels.

However, on discrimination tasks where pairs of emotion-related stimuli were presented that displayed either the same or different emotions, no differences between the groups were found. Additionally, when group performance was examined on positive and negative items for each communication channel no group difference as a function of valence was found. However, a criticism of the study may stem from the demands of the procedures involved as this necessitated the inclusion of brain-injured participants who showed only relatively mild cognitive and linguistic impairments, which may have influenced the results. Zgaljardic, Borod & Sliwinski, (2002), in a follow-up study looking at recovery of emotional processing using the paradigm outlined above, found evidence of recovery on emotional perception tasks but with individuals who had suffered right hemisphere damage continuing to perform poorer than both controls and individuals who had suffered left hemisphere damage.

1.5.3 Social Functioning and Executive Functioning

Despite making a good physical recovery following a stroke, a number of stroke survivors demonstrate poor psychosocial functioning, which may not be explained by psychological or physical impairments. Clark and Smith (1999) looked at psychological correlates of outcome in a sample of sixty individuals twelve-months post-stroke who had undergone a rehabilitation programme and were subsequently living in a family environment. They found abnormal illness behaviour to be important in determining functional disability, with depression associated with reduced social functioning. Importantly, family functioning was seen as a key feature of social activity. Interpersonal functioning is mediated to some extent by emotion, with reduced interpersonal functioning associated with low mood. As previously discussed (see section 4.3.5), mood disorder has been put forward as a consequence of neurological damage, generally to the right hemisphere with regard to anxiety and to the left hemisphere with regard to depression (Astrom, 1996; Robinson, 1998).

There is, however, continued debate as to specific neurological lesion sites and the consequences for interpersonal functioning. Robinson & Szetela (1981) compared 18 individuals with left hemisphere damage following stroke with 11 individuals who had sustained left hemisphere damage lesions following traumatic brain injury (TBI). Both groups were found to be comparable on a number of measures including neurological symptoms and cognitive impairment. However, only 20% of the TBI group showed clinically significant depression compared with more than 60% of the stroke group. It was noted that although the lesions of both groups were of similar size, the locations of lesion within the hemisphere were different. Further analysis of 7 members of each of the groups matched for location of lesion revealed no significant difference in the frequency of depression, with the stroke group showing similar frequency rates to that of the TBI group. While it is acknowledged that the number of participants in each of the groups was small, these findings suggest that the higher rate of depression found initially was influenced by lesions in the anterior region of the left hemisphere.

However, the frontal lobes of the brain have also been implicated in mood disturbance following lesions in this area. Robinson (1998) proposes a mechanism by which the frontal lobes are involved in both primary and post-stroke depression based on evidence from a number of studies using imaging and bio-chemical techniques (e.g. Bench, Friston, Brown, Scott, Frackowiak & Dolan, 1992). Robinson postulates damage to lateralised bio-chemical pathways contained in the frontal regions of the brain can cause mood disorder, particularly with left frontal lesions. These findings suggest organic changes following brain lesions can result in mood changes, which may have negative consequences for social functioning. There is also some evidence, however, that mood disorder may result from the consequences of neuropsychological impairments experienced following stroke. A number of aspects of psychosocial functioning are mediated by executive function, such as the regulation of one's behaviour and thoughts, motivation and volition (Phillips, 1997; Lezak, 1995), and damage to the frontal areas of the brain may result in deficits in these abilities. Additionally, disinhibited and sexually inappropriate behaviours seen in some individuals with frontal lesions may cause such individuals to be left socially isolated (Lezak & O'Brien, 1990).

These finding suggest poor social functioning concomitant with executive function deficits. However, there is an absence of research of the factors involved in appropriate social interaction that are thought to be mediate by the executive functions, such as the need to take account of the needs and wishes of others, self-awareness and the ability to monitor and alter one's behaviour. Approaches to assessing the different components of social perception will be discussed in the following sections.

1.6 Measuring Emotion Recognition

It has been shown that normal individuals are capable of discriminating between six different types of facial expression that include happy, sad, surprised, angry, afraid and disgusted (though descriptions alter with anxious being used instead of afraid and revolted in place of disgusted, for example) and that this is a cross-cultural ability, which transcends linguistic barriers (Kolb & Wishaw, 1990). The ability to recognise emotions has been measured using a range of different techniques and formats. Often these have involved the capacity to discern a target emotion from a 2-dimensional emotion-related stimulus usually containing a face but varying in form from a photograph or cartoon showing, for example, full face views, profiles or split-half composites (e.g. Stone, Nisenson, Eliassen, Gazzaniga, 1996; Nakamura, Kawashima, Ito, Sugiura, Kato, Nakamura et al., 1999; Critchley, Daly, Phillips, Brammer, Bullmore, Williams et al., 2000). Alternatively, participants have been asked to discriminate between stimuli or to match appropriate emotions from a given range (e.g. Borod, 1998; Kolb & Taylor, 1988).

For example, Kolb & Taylor (1988) conducted a series of studies involving individuals who had sustained brain lesions and their subsequent ability to recognise emotions. In these studies participants were requested to match facial photographs according to the emotion inferred from the facial expression each portrayed. Cicone et al., (1980) studied the ability to perceive emotions in others by asking individuals to match cartoons based on the emotion-related scenes portrayed in each. Both of these studies used visual stimuli in their non-verbal conditions and both showed right hemisphere impairment in the visual form. An example of using verbal stimuli to measure emotion recognition can be seen in the verbal condition of the study by Cicone et al., (1980). In this condition, the emotion-related scenes were either described verbally or provided in a written format. The results pertaining to this aspect of the study showed that right hemisphere-damaged individuals were as equally impaired as left hemisphere-damaged individuals. This was taken as evidence supporting the view that the right hemisphere is dominant in comprehending emotional stimuli and is secondary to language deficits in individuals who sustain lesions to the left hemisphere. However, from measurement perspective, the importance of both visual and verbal aspects of emotional understanding is outlined below.

The verbal and vocal components of emotional communication have been studied by a number of researchers, with the use of auditory stimuli commonly being used in laterality studies. This can be seen in a study by Ley & Bryden (1982) in which the dissociation in hemispheric differences in recognising emotional tone and content of verbally presented stimuli is investigated. In this study, short sentences spoken in happy, sad, neutral and angry voices were presented dichotically-paired with neutral sentences of similar semantic content. The results indicated a strong left-ear advantage for identifying the emotional tone of voice and a right-ear advantage in identifying the content of the sentence. More recent studies have measured emotion recognition and its different components, such as perception, arousal and subjective experience, across different forms of communication (e.g. Borod, 1998). For example, information may be communicated through facial expression, verbal, lexical, gestural and postural means.

A number of assessment batteries have been developed that measure emotional perception across different modes, such as the Perception of Emotion Test (Egan et al., 1990). This is a test of facial, prosodic and verbal perception involving 128 six-second audio-visual tape segments. Four emotions are examined in this battery – anger, happiness, neutrality and sadness – in four conditions: emotion-related scripts verbally presented in a neutral tone of voice without a video element; prosodically-intoned scripts with no emotion-related content verbally presented with no video; facial expressions presented on video with no sound; and combined video clips with sound and emotion-related content. Following viewing of the stimulus, each participant has a short time in which to respond by pointing to one of four drawings, each with a verbal label identifying the emotion the drawing represents. This test was initially administered to 100 healthy adults (mean age = 22.2 years), 11 left hemisphere injured individuals (mean age = 65.9 years) and 10 individuals who had sustained damage to the right hemisphere (mean age = 63.6 years) (Egan et al., 1990). This test combines a number of the different components involved in measuring emotion recognition and the inclusion of real-time video presentation of emotion-related stimuli across different communication channels (facial and vocal expression, verbal content and gestural and postural information) provides a degree of ecological validity (Borod, Andelman, Obler, Tweedy & Welkowitz, 1992).

Clearly a range of techniques has been developed to assess emotion recognition. These range from single component, uni-modal studies to multi-component, multi-modal studies. The latter approach has been viewed as having greater ecological validity, given that real-life situations generally involve this form of communication between individuals. This advantage, provided by the use of video material over the more static measures previously described is available with The Awareness of Social Inference Test (TASIT) (McDonald, Flanagan & Rollins, 2002), which was used in the present study.

1.7 Measuring Social Awareness

The measurement of social awareness is often part of Theory of Mind (ToM) tasks (Baron-Cohen et al., 1985). In these studies researchers are investigating the ability to ascribe independent mental states to oneself and to others, a deficit commonly found in autism or autistic spectrum disorders (Wing, 1988). As previously outlined in section 4.3.1, these states involve desires, beliefs, intentions and feelings and low scores on such tasks are cited as evidence of deficits in psychosocial functioning. Wing & Gould (1979) proposed a Triad of Impairments in autism: deficits in social communication and imaginative skills, along with inflexibility in thinking and behaviour. A significant degree of the research that has been carried out to investigate this phenomenon has focused on children and adolescents and has tended to use actual materials as visual prompts (e.g. *The Smarties Task*, Perner, Frith, Leslie & Leekham, 1989), social scenarios in which dolls are used to represent people (e.g. *The Sally-Anne Task*, Baron-Cohen, 1989) or printed stories or cartoon scenes containing emotion-related material or a social dilemma (e.g. *Strange Stories*, Happé, 1994).

The strange stories developed by Happé (1994) are used to assess the individual's ability to understand the behaviour of others in various social situations. The stories describe various scenarios in which a character lies for a particular reason, such as to avoid trouble, humour, to avoid hurting another's feelings, persuasion or sarcasm. The participant would be required to say whether what the character had said was factually true and what his or her justification was for saying it. From this information it is possible to gauge whether the participant can comprehend the thoughts, feelings and beliefs of others.

This format has also been used with adults, specifically in studies involving acquired TOM deficits in adults (see section 4.4.1) Happé et al., (1999), investigating acquired deficit in ToM in individuals who had sustained lesions to the right hemisphere following a stroke, used a similar range of social stories adapted from the author's original material. In this particular study, sixteen short passages of two types were developed: ToM stories concerning double-bluff, persuasion, mistakes and white lies; and non-mental state stories. The participants were required to make inferences about the characters' thoughts and feelings and also make an inference about the intentions of the speaker in the story. A second part of the study used 12 single-frame humorous cartoons taken from popular magazines. These made up two conditions: ToM cartoons in which the humour depended on what the character mistakenly thought or did not know; and non-mental state cartoons in which the humour depended on a physical anomaly or violation of a social norm.

The study by Levine et al., (1993), previously discussed in section 1.4.3, investigating models of social cognition included an investigation into the use of interpersonal strategies employed in social problem-solving scenarios in which an element of conflict was incorporated. The social vignettes used in this study were provided verbally, while each participant was given a printed copy of the story to follow. Stories were again used in the study by Happé et al. (2001), which looked at acquired ToM deficits following frontal lobe surgery. In this study each story was given to the participant who was instructed to read it silently until they felt they had understood the content. Similarly, a study by Bach, Happè, Fleminger & Powell (2000) used a comparable method of testing social perception through the use of written stories and printed cartoons. It is evident that little use has been made of other mediums or of other forms communication, although emotion-related vocalisations have been used (e.g. Hobson, Ouston & Lee, 1988).

In this study, the participants were a group of 21 adolescents and young adults (mean age 18.09 years) who had been given a diagnosis of autism and a group of 21 matched controls (mean age = 18.05 years) (Hobson et al., 1988). The participants were asked to listen to a series of six successive 10-second audiotaped sounds, after which they were required to choose a photograph from an array which they felt most corresponded with the sound. They recordings were of emotionally expressive vocalisations: happy humming; sad sighs and groans; gasps and high-pitched tones of fear; angry snorts and growling sounds; light, high-pitched sounds of surprise; and 'ughh' sounds of disgust. The findings suggest that autistic individuals show impairments in recognising emotion-related vocalisations. Speech has significant influence on social perception and communication and a considerable degree of research has been carried out on, for example, the effect of vocal pitch, loudness, enunciation and intonation (Collier, 1985). However, little research exists in the measuring social perception using vocal materials.

Sarcasm has been used as one of the reasons an individual may 'lie' in a social situation (Happé, 1994). Understanding subtle (and sometimes heavy) emotional and social communication in the form of sarcasm has been shown to be impaired in individuals with poor social perceptual abilities. This form of verbal communication depends on what is said and how it is communicated. Comprehension of emotion-related messages has been found to be impaired in brain injured individuals when incongruence exists between the message and intonation (Bowers et al., 1987). Additionally, the study by Montepare et al., (1999), previously described in section 1.2.3, found the ability to use paralinguistic cues such as gestures and body movements to be lower in older adults (mean age = 76.5 years) relative to younger adults (mean age = 18.7 years) in identifying emotion.

The studies outlined above have used a number of methods to measure social perception. However, there is a range of elements involved in accurate perception in social situations. The measure used in this present study (The Awareness of Social Inference Test (TASIT), McDonald, et al., 2002) involves the use of video segments, in both the recognition of emotion component as well as in the social inference component, in which facial expression, vocal intonation, body posture and gestures, among other cues, are available. Additionally, in the social inference component of the TASIT, participants are required to infer from video material the speaker's intention, attitude and meaning. This is in essence what is sought from participants in the ToM tasks outlined above.

1.8 Summary

Stroke is a neurological condition that is relatively common in the general population. For many individuals there are a number of neuropsychological sequelae that affect a range of cognitive and behavioural functions. While cognitive functioning is most influenced by the location and severity of the lesion, other factors influencing the consequences of a stroke include the age and gender of the individual (Sorgato et al., 1990). The frontal lobes of the brain particularly are involved in a wide range of cognitive functions, including attention, concentration, motor sequencing and executive functions (Goldman-Rakic, 1993). Executive function also mediates initiation and response to environmental stimuli, awareness of the self and others, emotional regulation and social interaction. Because of neurological inter-connectedness, damage to cortical and sub-cortical areas distal to the frontal regions may result in deficits in frontal lobe functioning and executive functioning (Grafman et al., 1993).

Perception of emotion-related stimuli, such as facial expression and voice tone, has been found to be impaired in individuals with right hemisphere lesions (Joanette et al., 1990). There is also some evidence that age influences the ability to process emotion-related information, particularly information concerning negative emotions (McDowell et al., 1994; Montepare et al., 1999). There is also evidence that individuals who sustain damage to the frontal regions of the brain show deficits in executive functioning and in the identification of facial and emotional expression (Hornak et al., 1996). Evidence of impaired ability in understanding subtle social and emotional cues has been shown with frontal lobe damage following traumatic brain injury (Cicerone & Tanenbaum, 1997). These areas have also been seen to be active in Theory of Mind (ToM) tasks, as found in individuals with a diagnosis of autism (Baron-Cohen et al., 1994). ToM deficits reflect interpersonal impairments sometimes seen in individuals following lesions in the frontal lobes, such as an apparent disregard for social convention and an ego-centric attitude (Wood, 2001). Happé et al., (1999), investigated the hypothesis of acquired ToM deficits in individuals who had suffered right hemisphere strokes and found stroke survivors to be significantly worse than controls in their attribution of mental states.

Impaired ability in the recognition of emotion has also been reported following, particularly, right hemisphere lesions (Bowers et al., 1991; Borod et al., 2000). Additionally, there is some evidence that the ability to process negative affect declines with age (McDowell et al., 1994; Montepare, et al., 1999). From the literature it can be seen that extensive bodies of research exists on individual aspects included in this study, such as emotion recognition and executive function. However, as discussed, some of these studies may not be generalised to stroke survivors for a number of reasons (e.g. age of participants or methodological flaws). There is also a paucity of research in the area of psychosocial functioning and executive function in post-stroke individuals, as many of these studies have involved individuals who have autistic spectrum disorders. Additionally, the rehabilitation of stroke survivors is dependent on a degree of social communication and the current research available suggests that this may not be being conducted at an optimal level if indeed post stroke patients are susceptible to deficits in psychosocial functioning. It is for these reasons that the present study was carried out.

1.9 Aims

The main aim of this study is to investigate the ability of stroke survivors to recognise emotional states in others, and if there is evidence of differences in the recognition of positive and negative emotions in this group. The influence of location of lesion and age in the recognition of emotion will also be investigated. The study also aims to examine whether such individuals have difficulties in the perception of differing social and behavioural cues. A further aim of the study is to investigate possible links between the abilities outlined above and impairments in executive functioning following stroke.

1.10 Hypotheses

Recognition of Emotion

1. Stroke participants will show a reduced ability in the recognition of emotion compared to controls
2. Stroke participants with right-sided lesions will show a reduced ability in the recognition of negative emotions compared to the recognition of positive emotions
3. Older control participants will show a reduced ability in the recognition of negative emotions compared to younger controls

Social Perception

4. Stroke participants will show a reduced ability in social inference tasks compared to controls
5. Stroke participants will show a reduced ability in social comprehension tasks compared to controls

Executive Function

6. In stroke participants, a positive and significant association will be shown between performance on tasks of executive function and on tasks of emotion recognition
7. Stroke participants with lower scores on measures of executive function will also show lower scores on tasks of social inference
8. Stroke participants with lower scores on measures of executive function will also show lower scores on tasks of social comprehension

Chapter Two: Method

2.0 Method

2.1 Design

The study design involved both within subjects and between subjects comparisons. In analysis, participant's scores were compared to normative data and to a control group. Each participant in the stroke group was seen on two occasions in order to reduce fatigue and both parts of the assessment were administered within 24 hours. Additionally, the administration of tasks to some of the control subjects occurred in groups rather than individually. Many of the controls subjects were recruited from orthopaedic patients and, unfortunately, the closure of hospital theatres for maintenance occurred during the second half of the data collection period. This event was unforeseen prior to arrangements for data collection being made. Care was taken to ensure that this would not influence responses from participants by having responses recorded in writing on a tick-box sheet (see Appendix 1) rather than verbally. A control group was felt necessary as one of the main assessments (The Awareness of Social Inference Test), had obtained normative data from individuals who were either exclusively or predominately younger adults. In Part I of this test 93% of subjects were aged between 14 and 50 years, while in Part II all of the subjects were aged between 14 and 50 years. The majority of participants in this present study were older adults.

The study was granted full approval by Grampian Research Ethics Committee.

2.2 Participants

The experimental group participants comprised 22 individuals who had received a diagnosis of stroke and were in-patients of the Stroke Rehabilitation Centre at Woodend Hospital, Aberdeen or the Acute Stroke Unit, Aberdeen Royal Infirmary, over the duration of the study period. The participants involved in the control group were recruited via consultant's approval from the Departments of Orthopaedic Medicine and Medicine for the Elderly at Woodend Hospital, Aberdeen.

2.2.1 Inclusion Criteria

To be involved in the study, stroke participants had to meet the following criteria:

- diagnosis of stroke (within the past 6 months)
- adults over the age of 18 years

2.2.2 Exclusion Criteria

Participants were excluded from the study if they:

- were currently aphasic
- had a current or previous history of psychosis
- were incapable of informed consent
- had visual or aural impairments which would hinder performance of tasks

2.2.3 Demographic Information

The following information was recorded for both stroke and control subjects:

- age
- gender
- length of formal education (in years)

2.3 Measures

In addition to an estimate of pre-morbid intelligence, the instruments used in this study are believed to measure executive functioning, social perception and recognition of emotion. A number of neuropsychological tests are believed to measure various aspects of executive functioning (Lezak, 1995). Among the most widely used tests are the Wisconsin Card Sorting Test and the test of verbal fluency. Reduced performance on such tests is thought to reflect deficits in the executive control of cognitive processes (e.g. Baddeley & Della Sala, 1996), though the evidence supporting this view has been questioned by others (e.g. Phillips, 1997).

2.3.1 National Adult Reading Test

A measurement of pre-morbid intelligence was obtained using the National Adult Reading Test (NART) (Nelson & Willison, 1991). This is a reading test comprising of 50 common and uncommon words that require irregular pronunciation (see Appendix 2). A score is derived from the number of errors an individual makes as they read the words aloud one at a time. Vocabulary is believed to correlate with overall intellectual ability and residual vocabulary is felt to be the best indicator of pre-morbid mental ability (Lezak, 1995). A factor analytic study combining NART and Wechsler Adult Intelligence Scale (WAIS) found the NART error score to have a high loading on what was identified as Verbal Intelligence (Crawford, Stewart, Cochrane, Parker & Besson, 1989). A series of studies on the NART found significant correlations with education ($r = .51$), inter-rater reliability ($r = .96$ and .98) and test-retest reliability ($r = .98$) (Crawford et al., 1989).

2.3.2 The Awareness of Social Inference Test

The Awareness of Social Inference Test (TASIT) (McDonald et al., 2002) was developed as a valid and reliable instrument with which to assess social perception in order to address such deficits following brain injury in a range of individuals in a multi-modal context. This is achieved through the use of video, which provides visual, auditory and contextual cues. This test consists of three parts (see Appendix 3): Part I measures an individual's ability to recognise a range of seven emotional states in other people from short video sequences (*Happy*, *Surprised*, *Neutral*, *Sad*, *Angry*, *Anxious* and *Revolted*). Parts II and III assess the individual's ability to determine the intention of a character, the message they are trying to communicate, their beliefs and their emotional state (together described as social inference), by discriminating between sincere communication exchanges, simple sarcastic exchanges and paradoxical sarcastic exchanges. Sincere and simple sarcasm dialogue exchanges make literal sense and are distinguished by cues such as the actor's tone of voice or facial expression. For example, the sentence, "*That tie really suits you.*" may be said either sincerely or with sarcasm. However, dialogue in the paradoxical will only make sense if the listener understands the speaker is being sarcastic. For example, an exchange showing an enquirer to be content with the reply, "*No, I tore it up and threw it away.*" to the question, "*Are you sure you have your passport?* ", only makes sense if the response is understood to be sarcastic.

Part II of the TASIT examines an individual's ability to infer intention and meaning based solely on dialogue, emotional expression and related paralinguistic cues and in the absence of additional information to help in this determination. Part III is described as Social Inference *(Enriched)* because of the authors' inclusion of additional evidence describing the true beliefs of the individual portrayed in each of the video sequences. All participants were administered only Parts I and II of the TASIT as it was felt that an administration of Part III would not have added significantly to the examination of the psychological processes under investigation, when considerations such as the additional time commitment and possible participant fatigue were weighed. Additionally, the TASIT is divided into Form A and Form B, which comprise of the same situations but where the emotion or method used to deliver the dialogue is altered (e.g. happy or fearful; sincere or sarcastic). This enables the test to be used in a number of different ways, for example, in a test / re-test manner. Only Form A was used in the current study.

Normative data for the TASIT was obtained from 279 adults and was designed as a criterion referenced test where normal functioning individuals are expected to perform at near ceiling levels on all subtests. In validation studies comparing individuals who had sustained a brain injury with controls, age and education were not significantly associated with performance on Form A (McDonald et al., 2002). An exploration of the effect of crystallised intelligence, as measured by performance on Spot the Word (Baddeley, Emslie & Nimmo-Smith, 1992), indicated that intelligence is not associated with performance on Part I, but was associated with Part II and Part III, with shared variance ranging from 13-24% (McDonald et al., submitted).

Specific details of the psychometric properties associated with the TASIT are not available to date. However, despite this, the decision to use the TASIT as a measure of social perception was taken because of the test's design in assessing various elements of communication across multiple channels. No other assessment was available that measures verbal communication, visual communication and emotion recognition concurrently and in such a comprehensive manner. The opportunity to apply multi-modal measures simultaneously is seen as preferable to the extensive testing that would be required were these elements to be assessed individually by other means.

The scoring of the TASIST (Parts I and II) is derived from a number of sources. Ten scores are obtained from Part I, as follows:

- number of correct items for each of the 7 emotional states
- number of correct positive emotions identified
- number of correct negative emotions identified
- total number of positive and negative emotions identified

Eight scores are obtained in total for Part II, as follows:

- number of sincere exchanges correctly identified
- number of simple sarcasm exchanges correctly identified
- number of paradoxical exchanges correctly identified
- total number of correct social exchange items

Four total scores are also obtained by correctly identifying in each exchange the intention, message, belief and emotional state of the target character.

2.3.3 Modified Card Sort Test

The Wisconsin Card Sort Test (WCST) (Heaton, 1981) is among one of the most widely used tests of executive functioning, examining functions such as shifting set and ability to utilise feedback and modify behaviour accordingly, among others. Specifically, an examinee is asked to place a sorting pack of 64 cards on which is printed symbols that vary in colour, form and number under four stimulus cards. The examinee must sort the cards according to a predetermined set of rules that may be deduced only from responses made by the examiner to the pattern of sorting (colour, form or number). After ten consecutive correct responses, the 'rule' is changed. Reliability studies of the WCST found intraclass correlation coefficients (r_{ICC}) of .93 for perseverative responses, .92 for perseverative errors and .88 for non-perseverative errors. Inter-rater reliability was also found to be high with r_{ICC} of .96, r_{ICC} of .94, and r_{ICC} of .91 for perseverative responses, perseverative errors and non-perseverative errors respectively (Axelrod, Goldman & Woodard, 1992). Research into the validity of the WCST in discriminating between subjects with neuropsychological impairment involving the frontal lobes and executive functions from controls showed significant differences among groups, Λ=.75, F_{MULT}.(24, 2404.84)=8.42, p<.0001 with group identification accounting for 25% of the variance in WCST scores (Heaton, Chelune, Talley, Kay & Curtiss, 1993).

Consideration was given to shortcomings expressed by some researchers regarding the WCST, including lengthy administration, which can be in excess of thirty minutes with impaired individuals, frustration and fatigue. Consequently, a modified version (Nelson, 1976), which simplifies the task was decided upon in order to reduce fatigue, distress and potential non-compliance. Nelson (1976) modified this test by removing all cards from the sorting pack that share more than one attribute with a stimulus card. The modified card sort test (MCST) reduces the number of cards to be sorted to 24 from the original 64. Nelson uses twice the number of cards required, giving the subject 48 cards to sort against four stimulus cards. The number of correct responses prior to changing the sorting rule is reduced from ten to six and the sequence of rules is not predetermined but follows from the first two rules decided upon by the subject. A score based on the number of sets obtained, which would allow for a minimum of zero and a maximum of six (see Nelson, 1976). A termination rule was used to avoid excessive anxiety and/or despondency whereby the task stopped if the participant made twelve errors or more in attempting to obtain a set.

Nelson (1976) used the MCST to examine cognitive abilities in a group of individuals who had sustained brain injuries of varied aetiology and among a control group. The MCST was successful in differentiating between controls and both individuals with frontal lobe lesions (U=908; Z=4.30, p<0.001) and individuals with lesions in other areas of the brain (U=885; Z=2.94, p<0.002) on the number of categories obtained. The frontal lobe functions seen as being most susceptible to impaired performance on the MCST include general cognitive flexibility in problem solving and the ability to utilise feedback. Both of these functions are seen as being key to appropriate executive functioning.

2.3.4 The Controlled Oral Word Association

The Controlled Oral Word Association (COWA) (Benton & Hamsher, 1978) is a test of verbal fluency in which individuals are asked to provide as many words as they can in one minute belonging first to a category (animals), then words beginning with a given letter (C, F and L, respectively), excluding proper nouns, numbers and the same word with a different suffix (see Appendix 4). Reduced verbal fluency is associated with frontal lobe damage (Janowsky, Shimamura, Kritchevsky & Squire, 1989), though studies using positron emission tomography also indicates the involvement of the temporal lobes (Parks, Loewenstein, Dodrill, Barker, Yoshii, Chang et al., (1988). Low verbal production is believed to reflect impaired mental flexibility and difficulty shifting set between letters, which are considered important components of executive functioning (Mitrushina, Boon & D'Elia, 1999). A score based on the total number of responses provided is obtained and adjusted for age and years of education (Gladsjo, Miller & Heaton, 1999). An analysis of internal consistency for the COWA (Ruff, Light, Parker & Levin, 1996) indicated a high co-efficient α (r= .83) for the three letters, thereby indicating high test homogeneity. Additionally, Ruff et al., (1996) reported a test-retest reliability co-efficient of r= .74 using an alternative letter set.

2.3.5 DEX Questionnaire: Behavioural Assmt of the Dysexecutive Syndrome

The Dysexecutive Questionnaire (DEX) (Wilson, Alderman, Burgess, Emslie & Evans, 1996) is a 20-item instrument designed to measure a range of competencies commonly believed to be involved in executive functioning. Each item is measured on a five point (0-4) Likert scale, ranging from *'Never'* to *'Very Often'*. There are two versions of the DEX questionnaire, one that is completed by the individual (see Appendix 5) and the other completed by someone who knows the individual well (e.g. a relative or carer) (see Appendix 6) and who has experience in observing them in social situations. Two scores, one based on self-rated responses and one on the independent rater's responses were obtained, whereby a higher scores indicates poorer executive functioning. The overall profile score of dysexecutive difficulties as found using the BADS was found to highly correlate with carers' / relatives' ratings on the DEX questionnaire of executive functioning in a study of 90 brain-injured individuals (Wilson et al., 1996).

2.4 Medical Data

When permission had been obtained from the stroke group participants, the following data was obtained retrospectively from medical notes:

- location of lesion
- date of admission following stroke

2.5 Procedure

2.5.1 Stroke Group

Potential participants were identified from patients referred to the unit during the time of the study. The Consultant in charge of patient care determined which patients they considered it would be appropriate to assess with regard to the criteria for inclusion, otherwise all individuals who met the criteria for inclusion in the study were approached. A member of staff then approached the individual and briefly explained the study, providing them with an information sheet outlining the rationale and procedure (see Appendix 7). If the individual agreed, the researcher then met with them to fully explain the background of the study and provide an opportunity for questions. Potential participants were given one week in which to peruse the information provided and consider taking part. Discussion with friends and family members was encouraged. It was emphasised that the individual was not obliged to participate and that they could have withdrawn from the project at any time with no consequences. If the individual agreed to take part, they were asked to sign a consent form (see Appendix 8).

As the complete test battery took approximately 90 minutes, testing was split into two sessions to reduce possible effects of fatigue. Session one comprised the video aspect of the TASIT and took approximately 50 minutes. Session two comprised the neuropsychological tests outlined above and took approximately 40 minutes. The DEX questionnaire was given out at this time to both the individual and a significant other who had frequent contact with the participant (in all cases this was a staff member).

2.5.2 Control Group

A control group of 17 individuals matched on gender, age and education was used to establish appropriate comparison data for Parts I and II of the TASIT (Form A). Participants for the control group were recruited from the in-patients of two orthopaedic wards and from two wards for Medicine for the Elderly at Woodend Hospital Aberdeen over the duration of the study. The inclusion criteria were adults with no reported neurological conditions and the exclusion criteria were the same as that described above for stroke sufferers. Control participants were provided with similar information regarding the study as stroke patients but with some alteration regarding what they would be required to do.

2.6 Data Analysis

The patient group's performance on neuropsychological tests was compared to population norms and to controls for the video aspect of the study. Due to the numbers involved in each of the groups and because an initial exploration of the data identified two outliers in the stroke group (one for age and one for years of education), non-parametric tests were run on the data obtained. All statistical analyses were carried out using the Statistical Package for the Social Sciences for Windows (SPSS for Windows: Version 10.0). These involved Mann-Whitney *U* tests, Spearman correlational analyses (one-tailed and two-tailed) and Wilcoxon matched pairs signed rank tests. The size of the correlation coefficients are based upon the definitions provided by Cohen & Holliday (1982):

- .00 to .19 is very low
- .20 to .39 is low
- .40 to .69 is modest
- .70 to .89 is high
- .90 to 1.00 is very high

2.7 Statistical Power

The most important assessment is the TASIT, therefore power has been deduced on this test. Power was also calculated for two important tests of executive functioning - The Modified Card Sorting Test (Nelson, 1976) and the California Oral Word Association (Benton & Hamsher, 1978) – which showed that for each of these tests the number of subjects calculated in the TASIT power calculation was adequate. Evidence from the available literature suggests that an important difference between normal subjects and those post-stroke would be approximately 2 points on the TASIT scale, with a standard deviation 2.1 points on the scale from the published data set. Therefore, to detect a statistically significant difference ($\alpha = 0.05$) with power of 0.8, 22 subjects would be required in both the experimental and the control groups.

Chapter Three: Results

3.0 Results

3.1 Participants

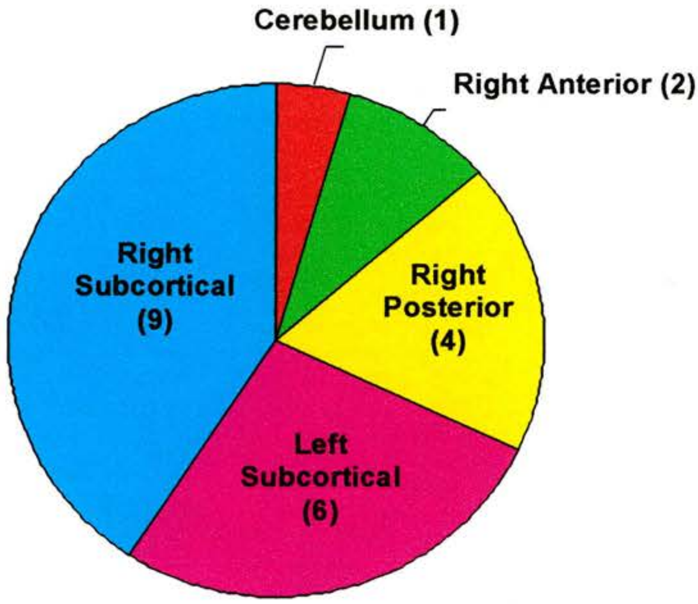
Forty-two individuals were approached to participate in this study: 25 stroke participants and 17 controls. All 17 controls and 23 of the 25 stroke survivors agreed to take part. Another stroke patient agreed but when testing began it became clear that he was having difficulty hearing the audio track of the video aspect of the study. As a consequence of this no further testing was undertaken with this gentleman and his data are not included. In all, 39 participants took part, comprising 22 stroke survivors and 17 controls.

3.1.1 Stroke Group Characteristics

Twenty-two individuals who had suffered a stroke participated in this study.

3.1.2 Location of Lesions

The locations of lesion were obtained from medical records and ordered into seven broad categories following discussion with medical colleagues: right anterior, posterior and subcortical; left anterior, posterior and subcortical; and cerebellum. Nine individuals had suffered stroke in the right sub-cortical region of the brain. The left subcortical region was the second most common area of lesion with six lesions recorded in this region. The remainder were divided between the right posterior, right anterior and cerebellum. Figure 3.1 shows the breakdown of the locations.



3.1.3 Time Since Event

Eighteen participants in the stroke group were between 1 and 2 months post-stroke, three individuals were 2 months and one each at four and five months post-stroke (*Median (Mdn)* = 2.0 months, *Inter Quartile Range (IQR)* = 1.0 month).

3.1.4 National Adult Reading Test (NART)

Error scores on the NART ranged from 1 to 35 (M = 23.5, SD = 6.5), which provided an estimate of pre-morbid IQ. As illustrated in Table 3.1, all members of the group showed estimated pre-morbid IQ scores within the normal range (M = 101.5, SD = 7.8).

TABLE 3.1: Estimated pre-morbid IQ

Estimated Pre-morbid IQ Range (n=22)				
80 – 89	*90 - 99*	*100 - 109*	*110 - 119*	*120 - 129*
1	7	12	1	1

3.2 Demographics of Participants

3.2.1 Gender

Of the twenty-three stroke survivors who agreed to take part, twenty-two met the all the criteria for inclusion in the study (12 males and 10 females) and seventeen control individuals (9 males and 8 females) who met the criteria for inclusion were invited to participate.

3.2.2 Age

The distribution of age of both the stroke and control group are outlined in Table 3.2

TABLE 3.2: Age range of participants

	Minimum (years)	*Maximum (years)*	*M*	*SD*
Stroke	33	82	65.8	11.6
Control	39	82	67.3	12.1

Nineteen (86%) of the 22 participants in the stroke group were aged between 60 and 82 years with two aged between 50 and 59 years and one participant aged 33 years. Sixteen (94%) of the 17 members of the control group were aged between 55 and 82 years with one aged 39 years.

3.2.3 Education

Number of year's education was obtained from each person in both groups. Of the stroke group, seventeen individuals (77%) reported having between 8 and 10 years education with four (18%) having between 11 and 15 years (*M* 10.6 years; *SD* 3.8 years). One individual reported having 27 years education. Eleven individuals (65%) in the control group reported having between 8 and 10 years education with six (35%) having between 11 and 15 years (*M* 10.4 years; *SD* 1.8 years). Table 3.3 shows the breakdown within each group.

TABLE 3.3: Distribution of Years of education in participants

	Years of Education			
	8-10	*11-15*	*16+*	*Total*
Stroke (N=22)	77%	18%	5%	100%
Control (N=17)	65%	35%	0%	100%

3.4 Stroke Group Tests of Executive Function

Tasks of executive function were administered only to members of the stroke group.

3.4.1 California Oral Word Association Test (COWA)

Category Fluency

The scores obtained on the category fluency task are outlined in Table 3.4 (*Mdn* = 13.0, *IQR* = 8.25).

TABLE 3.4: COWA category fluency scores

Median	*IQR*	*Mean*	*SD*	*Min*	*Max*
13.0	8.2	13.7	4.3	7	21

(Stroke Group n=22)
IQR: Inter Quartile Range; SD: Standard Deviation

COWA Letter Fluency

Raw scores obtained on the COWA verbal fluency test by members of the stroke group were converted to standard scores. Table 3.5 shows the median and interquartile range of these scores. A range of standard scores was observed from 3 to 12.

TABLE 3.5: COWA letter fluency scores

Median	*IQR*	*Mean*	*SD*	*Min**	*Max***
7.8	4.6	7.6	2.6	3	12

(Stroke Group n=22)
* Minimum possible standard score = 2; ** Maximum possible standard score = 18
IQR: Inter Quartile Range; SD: Standard Deviation

3.4.2 Modified Card Sort Task (MCST)

Only four individuals obtained the required number of six sets to pass the task. Ten individuals obtained two sets or below and eleven obtained four sets or more. Table 3.6 shows the range of sets obtained among the stroke group.

TABLE 3.6: Range of sets obtained on MCST

No. of Sets obtained (n=22)						
0	1	2	3	4	5	6
2	1	8	0	4	3	4

3.4.3 DEX Questionnaire

Table 3.7 shows the median and interquartile range values for both versions of the questionnaire. It can be seen from the scores that there was a trend for stroke patients to rate themselves as having more executive functioning difficulties than did the independent raters.

TABLE 3.7: DEX Self- and Independent-rated Questionnaire scores

	Median	*IQR*	*Min**	*Max***
DEX Self-rated Q	16.0	14.0	0	48
DEX Independent Q	8.5	13.3	1	53

* Minimum possible score = zero ** Maximum possible score = 80 (n=22)

No significant differences were found between the self-rated and independently-rated questionnaires using Wilcoxon matched pairs signed ranks test ($Z = -1.86, p = 0.063$).

3.4.4 Relationships between Tasks of Executive Function and DEX Q

Table 3.8 shows the results of a Spearman's correlational analysis. This indicates significant correlations between the following executive function tasks: MCST and COWA Letter ($r_s = .64, p < 0.01$); MCST and COWA Category ($r_s = .43, p < 0.05$); and COWA Letter and COWA Category ($r_s = .56, p < 0.01$). However, while the correlational analyses involving the executive function tasks and both the DEX Questionnaires were all in the expected direction (i.e. a negative relationship), no significant correlations were found.

TABLE 3.8: Executive function tasks and DEX-questionnaire

Variables	1	2	3	4
1. MCST	--	--	--	--
2. COWA Letter	0.64**	--	--	--
3. COWA Category	0.43*	0.56**	--	--
4. DEX Self-rated Q	-0.24	-0.36	-0.16	--
5. DEX Independently-rated Q	-0.37	-0.25	-0.05	0.14

* Correlation is significant at the .05 level (2-tailed).
** Correlation is significant at the .01 level (2-tailed).
(n=22)

MCST: Modified Card Sorting Task; **COWA**: Controlled Oral Word Association; **DEX Q**: Dysexecutive syndrome questionnaire.

3.5 Social Cognition Tasks

3.5.1 The Awareness of Social Inference Test (Part I)

Recognition of Emotion

Table 3.9 shows the range of scores obtained by stroke group participants for each of the seven emotional states. This indicates that both *Happy* and *Surprised* were correctly identified on at least two of the four occasions by all 22 stroke participants, with *Anxious* identified on at least two of four occasions by 21 of the 22. In contrast, only 11 of the stroke participants identified *Neutral* on at least two of the four occasions.

As illustrated in Table 3.10, all members of the control group correctly identified *Happy* three times or more out of four trials. However, only 8 individuals managed to achieve this for the *Neutral* condition. Fifteen controls correctly identified *Anxious* three times out of four but only 9 achieved this for the emotion *Revolted*.

Ability in task performance was noted between different emotional states with, for example, 50% of the stroke group failing to identify *Neutral* more than once over four trials compared to 18% of controls. However, only 14% of stroke patients and 18% of controls correctly identified *Sad* on all four occasions. Wilcoxon matched pairs tests were carried out on the above data in order to investigate possible differences of significance within each of the groups. However, the application of multiple comparison procedures raises the issue of increasing the probability of making Type I errors (Howell, 1992). One way to control for these errors is to divide the p value (0.05) by the number of tests undertaken (Dancey & Reidy (1999) p.173). In these analyses 21 Wilcoxon matched pairs signed ranks tests were carried out, thus a p value of (0.002) was indicated. All significant results meeting this more conservative probability value or less have been annotated with an asterisk. Table 3.11 shows the analyses for the stroke group.

TABLE 3.9: Emotional state identification (Stroke Group)

Times correctly identified	Emotional State						
	Happy	Surprised	Neutral	Sad	Angry	Anxious	Revolted
0	0	0	3	1	0	1	0
1	0	0	8	2	3	0	4
2	2	1	4	8	1	3	7
3	11	8	4	8	11	6	4
4	9	13	3	3	7	12	7
Median	3.0	4.0	1.5	2.5	3.0	4.0	2.5

TABLE 3.10: Emotional state identification (Control Group)

Times correctly identified	Emotional State						
	Happy	Surprised	Neutral	Sad	Angry	Anxious	Revolted
0	0	0	0	1	1	0	3
1	0	0	3	2	2	1	2
2	0	1	6	4	4	1	3
3	7	8	7	7	7	3	5
4	10	8	1	3	3	12	4
Median	4.0	3.0	2.0	3.0	3.0	4.0	3.0

Stroke patients were significantly more successful at identifying *Happy* than *Neutral* ($p< 0.01^{*}$); *Happy* than *Sad* ($p< 0.01^{*}$); and *Happy* than *Revolted* ($p< 0.05$). *Surprised* was more successfully identified than *Neutral* ($p< 0.01^{*}$), *Sad* ($p< 0.01^{*}$) or *Revolted* ($p< 0.01$). *Neutral* was less successfully identified than *Sad* ($p< 0.05$), *Angry* ($p< 0.01^{*}$), *Anxious* ($p< 0.01^{*}$), or *Revolted* ($p< 0.01$). *Anxious* was more easily identified than either *Sad* ($p< 0.01$) or *Revolted* ($p< 0.01$).

TABLE 3.11: Wilcoxon tests of differences between emotion recognition scores (stroke)

Variables		1.	2.	3.	4.	5.	6.
1. Happy	Z score	--					
	P value	--					
2. Surprised	Z score	1.18	--				
	P value	.236	--				
3. Neutral	Z score	3.54	3.76	--			
	P value	.000	.000	--			
4. Sad	Z score	2.79	3.45	2.15	--		
	P value	.005	.001	.032	--		
5. Angry	Z score	1.51	1.90	3.19	1.87	--	
	P value	.131	.057	.001	.061	--	
6. Anxious	Z score	0.12	1.39	3.67	2.62	1.12	--
	P value	.904	.163	.000	.009	.261	--
7. Revolted	Z score	2.45	2.91	3.12	0.78	1.53	1.53
	P value	.014	.004	.002	.435	.125	.125

Significant correlations were also found in the control group (Table 3.12). *Happy* was more easily identified than *Neutral* (p< 0.01*), Sad (p< 0.01*), *Angry* (p< 0.01*) or *Revolted* (p< 0.01). *Surprised* was more easily identified than *Neutral* (p< 0.01*), *Sad* (p< 0.05), *Angry* (p< 0.05) or *Revolted* (p< 0.01). *Anxious* was more easily identified than *Neutral* (p< 0.01*), *Sad* (p< 0.05), *Angry* (p< 0.05) or *Revolted* (p< 0.01*).

TABLE 3.12: Wilcoxon tests of differences between emotion recognition scores (controls)

Variables		1.	2.	3.	4.	5.	6.
1. Happy	Z score	--					
	P value	--					
2. Surprised	Z score	-1.134	--				
	P value	0.257	--				
3. Neutral	Z score	-3.109	-3.145	--			
	P value	0.002	0.002	--			
4. Sad	Z score	-3.169	-2.496	-0.548	--		
	P value	0.002	0.013	0.584	--		
5. Angry	Z score	-3.307	-2.508	-0.522	-0.061	--	
	P value	0.001	0.012	0.601	0.952	--	
6. Anxious	Z score	0.000	-0.632	-3.272	-2.445	-2.441	--
	P value	1.000	0.527	0.001	0.014	0.015	--
7. Revolted	Z score	-2.791	-2.687	-0.042	-0.622	-0.725	-3.269
	P value	0.005	0.007	-0.967	0.534	0.469	0.001

Identification of Positive and Negative Emotions

Table 3.13 shows the median and interquartile range of correctly identified positive and negative emotions for each of the two groups. The TASIT categorises *Happy*, *Surprised* and *Neutral* as positive emotions and *Sad*, *Angry*, *Anxious* and *Revolted* as negative emotions. Analyses were carried out using this categorisation.

TABLE 3.13: Positive and negative emotion category scores

		Median	*IQR*	*Min*	*Max*
Positive Emotions*	Stroke	9.0	4.0	5	11
	Control	10.0	2.0	7	12
Negative Emotions**	Stroke	11.0	5.2	7	16
	Control	12.0	4.5	5	15
Total Emotions Score	Stroke	19.0	9.0	14	26
	Control	20.0	5.5	13	27

* Maximum possible score = 12; ** Maximum possible score = 16
stroke (n=22), control (n=17)

Wilcoxon matched pairs signed ranks tests were carried out for within group differences in correctly identifying positive and negative emotions. The results of these analyses indicated no significant difference within the stroke group (Z = -0.558, p = 0.577) but a significant difference was found within the control group (Z = -2.388, p = 0.017). However, the low scores observed on the Neutral state was felt to be confounding the positive emotion scores and post-hoc analyses were conducted using Wilcoxon matched pairs signed ranks tests following an adjustment of the positive category to contain only Happy and Surprised. The results of these analyses indicated highly significant differences in both groups in correctly identifying positive and negative emotional states: Stroke group (Z = -3.173, $p < 0.01$); Control group (Z = -3.254, $p < 0.01$).

3.5.1 The Awareness of Social Inference Test (Part II)

3.5.1(a) Social Inference (Part IIa)

Social Inference scores were obtained for correctly identifying each of the three modes of communication in five video scenarios. In the identification of sincere exchanges almost 60% of the stroke sample obtained a score of 15 or more out of 20. However, this decreased to 50% in the correct identification of simple sarcasm and 54% in the correct identification of paradoxical sarcasm. Ten (45%) of the 22 participants obtained a total Social Inference score of less than 75% correct. Table 3.14 shows the median and interquartile range of scores for each of the three modes of communication.

In the identification of sincere exchanges almost 59% of the control sample obtained a score of 15 or more out of 20. However, this decreased to 35% in the correct identification of simple sarcasm and 41% in the correct identification of paradoxical sarcasm. Thirteen (76%) of the 17 participants obtained a total Social Inference score of less than 75% correct. Table 3.15 shows the median and interquartile range of scores for each of the three modes of communication.

As illustrated in Table 3.16, a highly significant positive association was found using Spearman correlations between Simple Sarcasm and Paradoxical Sarcasm ($r_s = .74$, $p < 0.01$) among the stroke group. A significant positive association was also found between Simple Sarcasm and Paradoxical Sarcasm ($r_s = .51$, $p < 0.05$) among the control group (see Table 3.17).

TABLE 3.14: TASIT scores (Part IIa) Stroke Group

Social Inference Factor	*Mdn*	*IQR*	*M*	*SD*	*Min*	*Max*
Sincere Exchanges*	15.0	5.0	14.5	3.5	5	20
Simple Sarcasm*	15.0	9.8	14.0	5.2	5	20
Paradoxical Sarcasm*	15.0	6.8	13.9	4.8	3	20
Total Social Inference Score**	45.5	12.3	42.4	9.5	24	55

* Min possible score is zero, Max possible score is 20; **Max possible score is 60

TABLE 3.15: TASIT scores (Part IIa) Control Group

Social Inference Factor	*Mdn*	*IQR*	*M*	*SD*	*Min*	*Max*
Sincere Exchanges*	15.0	3.5	14.9	2.6	9	19
Simple Sarcasm*	13.0	10.0	12.5	5.0	5	20
Paradoxical Sarcasm*	13.0	7.0	13.7	3.4	9	19
Total Social Inference Score**	42.0	8.5	41.1	7.5	27	55

* Min possible score is zero, Max possible score is 20; **Max possible score is 60

TABLE 3.16: Social Inference factors (Stroke Group)

Variables	1	2
1. Sincere Exchanges	--	--
2. Simple Sarcasm	-0.16	--
3. Paradoxical Sarcasm	-0.23	0.74**

Spearman Correlations

* Correlation is significant at the .05 level (2-tailed).

** Correlation is significant at the .01 level (2-tailed).

TABLE 3.17: Social Inference factors (Control Group)

Variables	1	2
1. Sincere Exchanges	--	--
2. Simple Sarcasm	-0.27	--
3. Paradoxical Sarcasm	0.13	0.51*

Spearman Correlations

* Correlation is significant at the .05 level (2-tailed).

** Correlation is significant at the .01 level (2-tailed).

3.5.1(b) Social Comprehension (Part IIb)

Nineteen (86%) stroke participants obtained a score of 60% or above in correctly identifying the intention, message, and emotional state of actors. This decreased slightly to 14 (64%) in correctly identifying beliefs. However, only twelve participants (55%) obtained a total score of 75% correct or above in this task. Table 3.18 shows the median and interquartile range of responses for the stroke group. Fifteen control participants (88%) obtained a score of 60% or above in correctly identifying the intention and message being conveyed in this task, and 12 (71%) achieved a score of 60%+. However, only 10 (59%) obtained this level of scoring in correctly identifying beliefs. Additionally, only four controls (24%) obtained a total score of 75% correct or above in this task. Table 3.19 shows the median and interquartile range of scores obtained by the control group.

TABLE 3.18: TASIT scores (Part IIb) Stroke Group

Social Comprehension Factors	*Ability to correctly identify*	*Median*	*IQR*	*Mean*	*SD*	*Min*	*Max*
Doing*	Intentions	11.0	3.0	11.4	2.1	7	14
Saying*	Message	12.0	4.5	10.8	2.7	6	14
Thinking*	Beliefs	10.5	5.0	9.6	3.1	4	13
Feeling*	Emotional state	11.0	2.5	10.9	2.2	5	14
Total SC Score**		45.5	12.3	42.4	9.5	24	55

* Min possible score is zero, Max possible score is 15; **Max possible total score is 60

TABLE 3.19: TASIT scores (Part IIb) Control Group

Social Comprehension Factors	*Ability to correctly identify*	*Median*	*IQR*	*Mean*	*SD*	*Min*	*Max*
Doing*	Intentions	11.0	3.0	10.3	2.2	7	14
Saying*	Message	11.0	4.0	10.9	2.4	6	15
Thinking*	Beliefs	10.0	3.5	9.4	2.6	5	14
Feeling*	Emotional state	11.0	4.5	10.5	2.4	6	14
Total SC Score***		42.0	8.5	41.1	7.5	27	55

* Min possible score is zero, Max possible score is 15; **Max possible total score is 60

Spearman correlational analyses were carried out to explore the relationship between the four factors involved in Social Comprehension (Table 3.20). The results of these analyses for the stroke group indicate significant positive correlations between the factors involved: the ability to identify the intentions of a character in a social scenario was highly correlated with the ability to identify the message being given ($rs = .86$, $p = 0.01$), the beliefs held by the character ($rs = .77$, $p = 0.01$), and his emotional state ($rs = .71$, $p = 0.01$). The ability to understand the message being put across is highly correlated with understanding their beliefs ($rs = .82$, $p = 0.01$) and what they are feeling ($rs = .75$, $p = 0.01$). A very significant relationship was also found between the ability to understand beliefs and identify the emotional state of a character ($rs = .73$, $p = 0.01$).

Table 3.21 shows the results of this analysis for the control group: a significant relationship between control participants' ability to identify the intentions and the emotional state of an actor in a social situation ($rs = .59$, $p = 0.05$). A highly significant correlation was found between the ability to identify the message being put across and the ability to identify the beliefs of an actor ($rs = .59$, $p = 0.05$).

TABLE 3.20: Social Inference factors (Stroke Group)

Variables	1	2	3
1. Do	--	--	--
2. Say	0.86**	--	--
3. Think	0.77**	0.82**	--
4. Feel	0.71**	0.75**	0.73**

Spearman Correlations

* Correlation is significant at the .05 level (2-tailed).

** Correlation is significant at the .01 level (2-tailed).

TABLE 3.21: Social Inference factors (Control Group)

Variables	1	2	3
1. Do	--	--	--
2. Say	0.31	--	--
3. Think	0.52*	0.61**	--
4. Feel	0.59*	0.33	0.46

Spearman Correlations

* Correlation is significant at the .05 level (2-tailed).

** Correlation is significant at the .01 level (2-tailed).

3.5.2 Results in Relation to Specific Hypotheses

1. Stroke patients will show a reduced ability in the recognition of emotion compared to controls.

In order to test this hypothesis Mann-Whitney *U* tests were carried out to compare the two groups (Table 3.22). The results indicate that there were no differences in the ability to correctly identify emotional states between the groups, therefore this hypothesis was not upheld.

TABLE 3.22: Emotional state recognition between stroke patients and controls

Emotion	*Median*	*IQR*	*U*	*Z*	*p*
Happy	3.0	1.0	146.500	-1.293	0.196
Surprised	4.0	1.0	164.500	-0.724	0.469
Neutral	2.0	2.0	135.500	-1.507	0.132
Sad	3.0	1.0	175.000	-0.356	0.722
Angry	3.0	2.0	139.000	-1.448	0.148
Anxious	4.0	1.0	157.500	-0.962	0.336
Revolted	3.0	2.0	165.500	-0.626	0.531
Total Score	20.0	8.0	177.500	-0.270	0.787

The ability of stroke participants and controls to correctly identify emotions as being either positive or negative was examined by looking at the pattern of errors made by each of the two groups. The errors were identified as being Within-Type (e.g. an incorrectly identified positive emotions being identified for another positive emotion) or Outwith-Type (e.g. an incorrectly identified positive emotion being identified for a negative emotion). Mann-Whitney *U* tests were conducted on the number of Within-Type and Outwith-Type errors made for positive and negative emotions (Table 3.23).

TABLE 3.23: Within-Type error differences between stroke patients and controls

Errors Within-Type	*Mdn*	*IQR*	*U*	*Z*	*p*
Positive	2.0	1.0	181.500	-0.164	0.870
Negative	3.0	4.0	167.500	-0.559	0.576

The results of this analysis indicates that there were no significant differences between stroke patients and controls in correctly identifying a particular positive emotion as another positive emotion, or a particular negative emotion as another negative emotion. Table 3.24 also shows the results of a Mann-Whitney *U* test carried out on Outwith-Type errors made. This indicates a trend towards misidentifying a negative emotion as a positive emotion (as opposed to another negative emotion).

TABLE 3.24: Outwith-Type errors between groups

Errors Outwith-Type	*Mdn*	*IQR*	*U*	*Z*	*p*
Positive	1.0	2.0	144.00	-1.264	0.206
Negative	1.0	2.0	126.000	-1.767	0.077

The results of these analyses show that there were no significant differences between stroke patients and controls in making errors Outwith-Type for either positive or negative emotions. That is, there were no significant differences between patients and controls in their likelihood of incorrectly identifying a positive emotion as a negative emotion, or vice versa.

2. Stroke patients with right-sided lesions will show a reduced ability in the recognition of negative emotions compared to positive emotions

An analysis was conducted using a Wilcoxon matched pairs signed ranks test on 15 stroke participants who had sustained right-sided lesions. The results of this analysis indicated there was no significant difference between correctly identified positive and negative emotion emotional states in this group (Z = -0.377, p = 0.706). This hypothesis, therefore, was not upheld.

3. Older control participants will show a reduced ability in the recognition of negative emotions compared to younger controls

An analysis was conducted using Spearman correlations in order to establish whether a relationship existed between age and ability to identify emotional states (Table 3.25). While it can be seen that a significant positive correlation exists between positive and negative emotions identified ($p < 0.01$), no significant relationship was found between age and ability to identify either positive or negative emotions.

TABLE 3.25: Correlations between age and recognition of positive and negative (controls)

Variables	1	2	3
1. Age	--	--	--
2. Positive Emotions	-0.12	--	--
3. Negative Emotions	-0.37	0.63**	--
4. Total Emotions	-0.30	0.85**	0.93**

Spearman Correlations: n=17

* Correlation is significant at the .05 level (1-tailed).

** Correlation is significant at the .01 level (1-tailed).

4. Stroke participants will show a reduced ability in social inference tasks compared to controls.

Mann-Whitney *U* tests were carried out to compare the scores of the two groups on Social Inference tasks (Table 3.26). It can be seen that no significant differences between the groups were found on scores of social inference, therefore, this hypothesis was not upheld.

TABLE 3.26: Social inference between stroke patients and controls

Social Inference	*Mdn*	*IQR*	*U*	*Z*	*p*
Sincere	15.0	4.0	183.000	-0.114	0.909
Simple Sarcasm	13.0	9.0	151.000	-1.025	0.305
Paradoxical Sarcasm	14.0	8.0	170.500	-0.469	0.639
Total Score	43.0	11.0	162.000	-0.709	0.478

5. **Stroke participants will show a reduced ability in social comprehension tasks compared to controls.**

Mann-Whitney *U* tests were carried out to compare the scores between the stroke group and controls on Social Comprehension tasks (Table 3.27). The results of these analyses indicate that no significant differences between the groups were found on scores of social comprehension, therefore, this hypothesis was not upheld.

TABLE 3.27: Social comprehension differences between stroke patients and controls

Social Comprehension	*Mdn*	*IQR*	*U*	*Z*	*p*
Doing	11.0	3.0	144.500	-1.217	0.224
Saying	12.0	4.0	180.500	-0.187	0.852
Thinking	10.0	5.0	173.000	-0.399	0.690
Feeling	11.0	3.0	166.500	-0.587	0.558
Total Score	43.0	11.0	162.000	-0.709	0.478

6. **In stroke participants, a positive and significant association will be shown between performance on tasks of executive function and on tasks of emotion recognition**

In order to test this hypothesis Spearman correlations were carried out. As shown in Table 3.28, the ability to identify positive emotions was significant correlated with performance on all tasks of executive functioning but not with either of the DEX questionnaire scores: MCST ($p < 0.01$), COWA Letter task ($p < 0.01$) and COWA Category task ($p < 0.01$). Ability in identifying negative emotions was also significantly correlated with the following tasks: MCST ($p < 0.01$), and COWA Letter task ($p < 0.01$). Thus, this hypothesis was largely supported.

TABLE 3.28: Correlations between executive function tasks and emotion recognition tasks

Variables	1	2	3	4	5	6
1. MCST	--	--	--	--	--	--
2. COWA Letter	0.64**	--	--	--	--	--
3. COWA Category	0.43**	0.56**	--	--	--	--
4. DEX Self-R Q	-0.24	-0.36	-0.16	--	--	--
5. DEX Ind-R Q	-0.37	-0.25	-0.05	0.14	--	--
6. Positive Emotions	0.70**	0.56**	0.55**	-0.27	-0.36	--
7. Negative Emotions	0.80**	0.55**	0.31	-0.16	-0.47*	0.66**

Spearman Correlations: n=22

* Correlation is significant at the .05 level (1-tailed).

** Correlation is significant at the .01 level (1-tailed).

7. Stroke participants with lower scores on tasks of executive function will also show lower scores in tasks of social inference

In order to test this hypothesis, Spearman correlations were carried out. As can be seen in Table 3.29 performance on the MCST was associated with ability to identify simple sarcasm ($p < 0.01$) and paradoxical sarcasm ($p < 0.01$); performance on the COWA Letter task was also significantly correlated with ability in identifying simple sarcasm ($p < 0.05$); performance of the COWA Category task was significantly correlated with ability to detect simple sarcasm ($p < 0.05$). This hypothesis was therefore supported.

TABLE 3.29: Correlations between executive function tasks and social inference tasks

Variables	1	2	3	4	5	6	7
1. MCST	--	--	--	--	--	--	--
2. COWA Letter	0.64**	--	--	--	--	--	--
3. COWA Category	0.43*	0.56**	--	--	--	--	--
4. DEX Self-R Q	-0.24	-0.36	-0.16	--	--	--	--
5. DEX Ind-R Q	-0.37	-0.25	-0.05	0.14	--	--	--
6. Sincere Exchange	0.07	0.20	-0.17	-0.18	-0.11	--	--
7. Simple Sarcasm	0.76**	0.44*	0.43*	0.00	-0.29	-0.17	--
8. Paradox Sarcasm	0.51**	0.30	0.20	0.23	-0.23	-0.23	0.68**

Spearman Correlations: n=22

* Correlation is significant at the .05 level (1-tailed).

** Correlation is significant at the .01 level (1-tailed).

8. Stroke participants with lower scores on tasks of executive function will also show lower scores in tasks of social comprehension

In order to test this hypothesis, Spearman correlations were carried out. Table 3.30 outlines the results which shows a number of very significant relationships between scores. Performance on the MCST is associated with ability to identify the intention of an actor ($p < 0.01$), the message they were trying to convey ($p < 0.01$), their beliefs ($p < 0.01$) and their emotional state ($p < 0.01$). Performance on the COWA Letter task is significantly correlated with ability in identifying the intention of an actor ($p < 0.05$), their message ($p < 0.05$), their beliefs ($p < 0.05$) and their emotional state ($p < 0.05$). Performance of the COWA Category task is significantly correlated with ability to comprehend the message an actor is trying to convey ($p < 0.05$). This hypothesis was therefore, supported.

TABLE 3.30: Correlations between executive function tasks and social comprehension tasks

	Variables	1	2	3	4	5	6	7	8
1.	MCST	--	--	--	--	--	--	--	--
2.	COWA Letter	0.64**	--	--	--	--	--	--	--
3.	COWA Category	0.43*	0.56**	--	--	--	--	--	--
4.	DEX Self-R Q	-0.24	-0.36	-0.16	--	--	--	--	--
5.	DEX Ind-R Q	-0.37	-0.25	-0.05	0.14	--	--	--	--
6.	Do	0.66**	0.45*	0.19	0.04	-0.34	--	--	--
7.	Say	0.67**	0.46*	0.38*	0.08	-0.38	0.65**	--	--
8.	Think	0.71**	0.40*	0.18	0.09	-0.36	0.68**	0.79**	--
9.	Feel	0.55**	0.39*	0.22	0.22	-0.19	0.67*	0.60**	0.59**

Spearman Correlation: n=22

* Correlation is significant at the .05 level (1-tailed).

** Correlation is significant at the .01 level (1-tailed).

Chapter Four: Discussion

4.0 Discussion

This discussion will begin with a brief summary of the findings and in the following sections the general findings of the study will be outlined with regard to the areas investigated. The specific hypotheses tested will be explored and discussed with consideration given to potential implications for clinical practice. Issues of a methodological and ethical nature will then be discussed with attention to statistical analyses and the participants involved in the study. Consideration of the materials used in this study will also be included and implications for possible future research will be outlined in the conclusion.

4.1 Summary of Findings

The main findings of this study indicated significant differences within both the stroke group and controls group in the ability to correctly identify different emotional states but no significant differences were found between these two groups. Post-hoc analyses also showed significant differences within groups but not between when emotional states were dichotomised into positive and negative conditions. No significant differences were found in the ability of individuals with right-hemisphere lesions to distinguish between positive and negative emotions, nor was a relationship found between this ability and age. No significant differences were found between the stroke group and controls in their ability to identify between sincere and sarcastic messages. Also, the ability to correctly identify the behaviour, the meaning of verbal communication, the beliefs held and emotional state of others was found not be significantly different between these two groups. However, a significant positive correlation was found within the stroke group between performance on tasks of executive function and the ability to recognise emotional states. The ability to make inferences from verbal exchanges and the ability to identify the behaviour, meaning, beliefs and emotional state of others was also found to be significantly and positively correlated with tasks of executive functioning.

4.1.1 General Findings

The above finding will now be discussed in relations to each of the areas investigated in this study: the recognition of emotion; social awareness; and executive functioning.

4.1.2 Recognition of Emotion

Both in the stroke group and the control group, significant differences were found in participants' ability to correctly identify between particular emotional states. The findings showed that the emotional states *Happy*, *Surprised* and *Anxious* were the three most correctly identified emotional states amongst both the stroke group and the controls. The two least correctly identified emotional states were *Neutral* and *Sad* amongst the stroke group and *Neutral* and *Revolted* amongst the control group. However, when the emotional states were categorised into positive and negative, no significant difference was found. Post-hoc analyses carried out following removal of *Neutral* state emotions from the positive category revealed significant differences in both groups in ability to correctly identify positive over negative emotional states.

4.1.3 Social Inference

Differences in the ability to correctly identify communication expressed over three modes (sincere exchanges, simple sarcasm and paradoxical sarcasm) were observed in the stroke group. Stroke participants obtained higher scores in conditions involving sincere exchanges than either simple sarcasm or paradoxical sarcasm. A similar pattern was observed in the control group. Analyses of the data indicated significant correlations between the simple and paradoxical sarcasm scores for both groups. The sincere exchange condition scores were found not to be correlated with either of the sarcasm condition scores in either of the two groups.

4.1.4 Social Comprehension

Similar scores were obtained by both groups in correctly identifying the intention and message being conveyed in social comprehension tasks, with lower scores obtained for correctly identifying beliefs among both the stroke patients and controls. Overall, the stroke group obtained higher scores than controls, but not significantly so. Analyses of the scores obtained by the stroke group in each of the four conditions indicated significant relationships between all of the factor scores involved. This was less pronounced in analyses of the data obtained by the control group, with only three of the six possible correlations showing significance.

4.1.4 Executive Function

Tests of executive function were administered to members of the stroke group only. Correlational analysis of the executive tasks used in this study and the DEX Questionnaires showed significant relationships between all tasks but not with either of the DEX questionnaires. An analysis of the data obtained from the DEX questionnaires revealed no significant differences between the stroke patients' ratings of themselves and the independent ratings made of them by members of the nursing staff. However, compared to staff ratings, there was a trend for patients to rate themselves as having more executive functioning difficulties. Emotion recognition scores and performance on social inference and social comprehension tasks were significantly associated with executive functioning.

4.2 Hypotheses

Each of the above findings will be explored in more detail in relation to the specific hypotheses. The hypotheses are numbered as they are in the introduction.

Hypothesis 1. Stroke participants will show a reduced ability in the recognition of emotion compared to controls

The results indicated that there were no significant differences in the ability to correctly identify emotional states between the stroke group and controls. This finding does not support those found by other studies which suggest that individuals who have suffered injury to the brain following stroke show impairments in the recognition of emotion compared to non brain-injured individuals (e.g. Borod et al., 1998). A number of studies have shown that individuals who have sustained a brain injury demonstrate impairment in recognising emotion in others and these deficits have been observed with lesions in different areas of the brain (Cicone et al., 1980; Hornak et al., 1996). It was hypothesised, therefore, that individuals who had sustained lesions following stroke would be likely to demonstrate deficits in the ability to accurately discriminate between different emotional states using the TASIT. However no such differences between the groups were found.

Analyses of the data to establish differences in obtained correct scores for emotions categorised as either positive or negative indicated no significant differences within the stroke group, though a significant difference was found within the control group. However, following the removal of the *Neutral* state emotion scores from the positive emotion category, significant differences were observed for both groups on the number of correctly identified positive and negative emotions, with both the stroke group and controls achieving a higher number of correctly identified positive emotions. This indicates that the *Neutral* state included in the TASIT was difficult for both groups to identify. This may indicated a difference in the approach to the tasks between the older adults involved in this study and the younger individuals on whom the TASIT was normed. It may be that as the task was introduced and explained as an emotion recognition task to the participants involved in this present study, this had more of a pronounced effect and they were more primed to identify an emotion than not and there was some reluctance to acknowledge that no particular emotion was evident, despite being informed that this would be true in some instances.

The ability of stroke participants and controls to correctly distinguish emotions as being either positive or negative was examined by looking at the pattern of errors made by each of the two groups. Studies have shown there may be separate abilities to identify different types of stimuli. For example, the valence hypothesis (Borod, 1992; Liotti & Tucker, 1995) argues that the right hemisphere is dominant for negative or unpleasant emotions, with the left hemisphere dominant for positive or pleasant emotions. Errors were identified as being within-type (e.g. an incorrectly identified positive emotion being identified for another positive emotion) or outwith-type (e.g. an incorrectly identified positive emotion being identified for a negative emotion).

Post-hoc analyses were conducted in order to assess the ability of stroke participants and controls to correctly identify emotions as being either positive or negative. However, the results of this analysis indicated no significant differences between stroke patients and controls in correctly identifying a particular positive emotion as another positive emotion, or a particular negative emotion as another negative emotion. The TASIT was normed on a much younger age group due to the characteristics of the population used in its development. These were individuals who had been involved in car accidents. At a consequence, the normative sample were a younger cohort than the cohort expected in a stroke survivors population and thus a control group was included in the current study.

However, the authors of the TASIT describe this test as one on which normal adults may be expected to 'perform near-ceiling on all subtests' (McDonald et al., 2002, p.9). This was found not to be the case in this present study, with the control group achieving equally low scores as the stroke patients. The total mean score provided by the authors for healthy adults on Part I of the TASIT is 24.9 (89%) (maximum score = 28). The scores obtained in Part I for the stroke group and controls in this present study were 20.0 (71%) and 20.2 (72%), respectively. The data provided for the traumatic brain injured (TBI) group for Part I of the TASIT is 19.8 (71%), which is very similar to the scores obtained by both the stroke patients and controls. This raises questions regarding the participants involved in this present study and methodological concerns, including the materials used. Each of these issues will be discussed in more detail in later sections.

Briefly, however, there may be significant methodological disparities between this present study and previous research. One important consideration is the materials used to test emotion recognition abilities. Bowers et al., (1991), for example, found emotion recognition deficits in individuals who had sustained lesions to the brain using a task for visual imagery for facial emotion. Borod et al., (2000) also found impairments in brain-injured individuals compared to healthy controls using words to convey emotion-laden messages. Both these studies focused on discrete aspects of emotional processing, whereas the emotion recognition task in this present study was multi-component and multi-modal. It is acknowledged that the test used in this present study, the TASIT, is similar to other multi-modal batteries, such as the Perception of Emotion Test (POET) (Egan et al., 1990). A comparison of these two tests may usefully highlight some of the distinctions in the assessment of emotion recognition in this present study.

The POET is a test designed to assess facial, prosodic and verbal perception across four emotions. The TASIT also uses these abilities to assess emotional perception, though on a more expansive scale with the use of seven emotional states. Additionally, the POET alters the conditions of presentation of stimuli (i.e., vision with sound/no sound or sound only) thereby enabling comparisons to be made regarding which aspects of stimuli recognition may be impaired. The TASIT, on the other hand, does not do this in its standard administration and it is difficult to establish whether there are aspects of the TASIT that enable individuals who may show deficits on emotional recognition tasks using one mode, to achieve near normal scores.

2. Stroke participants with right-sided lesions will show a reduced ability in the recognition of negative emotions compared to the recognition of positive emotions

Several studies have examined the role of the right hemisphere in emotional processing. There are a number of studies that suggest mechanisms in the right hemisphere which may be also be involved in the comprehension of emotion (e.g. Heilman et al., 1984; Ross 1981). There is some evidence that the left hemisphere processes the content of communications and the right hemisphere processes the manner in which information is communicated. Also, individuals with right hemisphere damage have been shown to have an impaired ability in identifying the features of emotionally-laden stimuli, in both auditory and visual conditions (Borod & Koff, 1990). It was hypothesised, therefore, that individuals identified as having sustained damage to the right hemisphere would show an impaired ability in emotion recognition relative to individuals who had sustained lesions in others areas of the brain.

The results indicated, however, that no significant differences were found in the ability to identify positive or negative emotions in individuals with right-hemisphere lesions. Findings from this present study would not appear to support the right-hemisphere hypothesis for emotional perception proposed by Borod et al., (1998), who cited evidence from a study investigating emotional perception in stroke patients as supporting the right-hemisphere hypothesis over the valence hypothesis. However, the valence hypothesis was not investigated in this present study.

However, it is acknowledged that only broad categories were used in this present study and the right hemisphere damaged group included individuals who had sustained lesions in the posterior, anterior and subcortical regions. It may be, therefore, that the categorisation of location of lesion as simply being right and left hemisphere was not sensitive enough to discriminate between specific abilities. Previous studies have indicated that differences may be observed in the perception of emotions when lesions are distinguished between posterior and anterior areas within one hemisphere (and within a specific area such as the pre-frontal cortex). Face perception, for example, is found to be impaired in some individuals following a right hemisphere lesion, particularly when the lesion is located in the posterior area of the brain (Hamsher et al., 1979; Benton, 1980).

3. Older control participants will show a reduced ability in the recognition of negative emotions compared to younger controls

There is some evidence which suggests that emotional perception may be influenced by ageing, with a decline occurring over time similar to other cognitive functions, such as speed of processing, mental flexibility and some memory functions. Additionally, evidence from neuroanatomical and behavioural studies have led some researchers to question whether rate of ageing differs between the left and right hemispheres (e.g. Goldstein & Sheeley, 1981). Emotional perception is seen as being chiefly a function of the right hemisphere and may deteriorate if the right hemisphere was found to age more quickly than the left. McDowell et al., (1994) investigated the hemi-ageing hypothesis but found little evidence to support this view in emotion recognition. However, they suggested that elderly subjects had more difficulty processing negative affect, while their ability to process positive affect was equal to that of younger subjects.

On this basis, therefore, it was decided to investigate the relationship between ability to correctly identify emotional states and age within the control group. Analysis of these data revealed no evidence of deterioration in emotion recognition with age amongst older adults, either generally or in relation to either positive or negative emotions. This finding does, however, support the findings from previous studies which have also failed to find differences across the age range (e.g. Moreno et al., 1993). It is acknowledged, however, that the spread of ages within the control group was largely restricted to older adults, with 94% of controls being aged between 55 years and 82 years. However, as outlined in the previous section, the performance of controls was notably worse than the younger-aged norms, suggesting an age effect in emotion recognition.

4. Stroke participants will show a reduced ability in social inference tasks compared to controls

Theory of Mind (ToM) (Baron-Cohen, 1985) may be seen as a necessary component of successful social interactions, which requires the ability to ascribe independent mental states to oneself and to others. As previously outlined in section 1.4.1, these states involve desires, beliefs, intentions and feelings and low scores on tasks assessing these abilities are cited as evidence of deficits in psychosocial functioning. Happé et al., (1999), investigated acquired deficits in ToM in individuals who had sustained lesions to the right hemisphere following a stroke, hypothesising that impairments in emotion-related tasks seen following lesion to the brain may be explained by deficits in ToM abilities. The evidence from such studies would explain some of the psychosocial deficits observed in brain-injured individuals, including some stroke survivors. The above hypothesis (4), therefore, was aimed at investigating social awareness in individuals who had sustained injury to the brain by assessing their ability to infer meaning from differing modes of social communication, similar to that used in investigated ToM functioning.

Part II of the TASIT investigates the ability to make inferences from communicative exchanges between individuals and Part II(a) involves the ability to identify between sincerely meant verbal exchanges and verbal exchanges involving sarcasm. No significant differences were observed between stroke participants and controls on this task, though it would appear that both groups performed at a low level, with 10 (45%) of the stroke group and 13 (76%) of controls obtaining a score of 75% correct or less. The means provided by the authors for healthy adults indicate total mean for Part II(a) to be 54.1 (90%)(maximum possible correct = 60). The total mean scores for the stroke and control groups were 42.4 (71%) and 41.2 (69%) respectively.

A significant positive correlation was found within both groups between the two forms of sarcasm, but not with sincere exchanges. This suggests that there is a common element to the sarcasm conditions that is separate from the sincere exchange condition and would appear to indicate an internal consistency of the authors' data. The fact that in both groups the paradoxical form was slightly easier to identify than simple sarcasm may have to do with the fact that some forms of simple sarcasm were quite subtle, whereas the paradoxical form of the sarcastic exchanges simply didn't make sense unless they were interpreted as being sarcastic.

It would appear, therefore, that there may be some evidence to support previous research which suggests that subtle social and emotional cues are more difficult to identify for some individuals. However, considerably more information is provided in the TASIT tasks to enable participants to assess social inference than is available in tasks used by other studies. In addition to verbal and prosodic information, there are also gestural, postural and (sometimes quite pronounced) facial cues available. It is difficult, therefore, to determine where the difficulties may lie for those participants who found the task problematic.

5. Stroke participants will show a reduced ability in social comprehension tasks compared to controls

Part II(b) of the TASIT assesses an individual's ability to comprehend elements involved in successful social interactions, including the ability to make inferences regarding intent behaviour and verbal information and the ability to ascribe mental states to others. The above hypothesis was tested using this part of the TASIT, whereby both stroke participants and controls were required to make inferences about the message being conveyed by characters, the characters' beliefs, their intentions and make an inference about the emotional state of the character. Eighty-six percent of stroke participants and 88% of controls obtained a score of 60%+ in the identification of the intention of characters and the information they were conveying. This decreased to 64% of stroke patients and 59% of controls in the correct identification of beliefs at the same level. Additionally, 55% of stroke participants but only 24% of controls obtained a total score of 75%+ in this task. Correlational analyses indicated significant relationships between the different elements of this task in respect of the stroke group, suggesting the ability to comprehend one aspect of social communication is related to ability in comprehending the others. However, this was not found to be so clear-cut for the control group. In these analyses, the ability to infer the emotional state of a character was found to be related only to comprehending the character's intentions. Also, comprehension of the characters' intentions was found not be related to comprehension of the message being conveyed. These results were unexpected and raise questions about the performance of the control group.

While no significant differences were found between the control group and the stroke group on tasks of social inference and comprehension, this was due to the fact that controls performed at as low a level and sometimes (though not significantly) lower than stroke patients. From the information provided by the authors of the TASIT, normal adults would be expected to perform at a 'near-ceiling' level. This was not found to be the case. There are a number of possible reasons one may put forward to account for these findings: (1) the stroke patients involved in this study have no psychosocial difficulties and all adults within the age range tested in this study would perform at the level observed in both the stroke group and control group; (2) there are problems with sensitivity and specificity associated with the TASIT; (3) the task performance of controls was influenced by an unknown factor which caused them to score as low as stroke patients. These issues will be further discussed in the following sections.

6. In stroke participants, a positive and significant association will be shown between performance on measures of executive function and tasks of emotion recognition

As discussed in previous chapters, the frontal lobes of the brain mediate aspects of a wide range of cognitive functions and some individuals demonstrate quite pronounced deficits in cognitive functioning and/or changes in their personality following lesions in this area. Changes with lesions in the frontal areas of the brain can present as socially inappropriate or disinhibited behaviours. Importantly, executive function processes are viewed primarily as being mediated by the pre-frontal cortex and include self-monitoring the adequacy and correctness of behaviours (Malloy et al., 1998). Personality changes are often reported by individuals close to those who have sustained injury to this part of the brain. Increased impulsivity and deficits in motivation and the ability to plan, organise and sequence actions are common sequelae with executive function difficulties.

The tasks used to test the above hypothesis (6) involved the California Oral Word Association (COWA) task, the Modified Card Sort Test (MCST) and the DEX Questionnaires taken from the Behavioural Assessment of the Dysexecutive Syndrome (BADS). The scores obtained by stroke patients on tasks of executive function varied quite considerably among individuals. On the category aspect of the COWA, for example, total responses to naming as many animals in one minute as possible ranged from 7 to 21. However, the total responses over three minutes for words beginning with given letters ranged from 8 to 50. On the MCST ability to set-shift, problem-solve and utilise feedback also varied, with some stroke patients failing to obtain any sets at all. Only two individuals successfully completed this task, indicating that almost all stroke patients demonstrated at least some degree of executive function difficulties. The responses obtained from the DEX questionnaires, however, did not reflect this, with only a trend indicated for stroke patients to rate themselves with more executive difficulties than did the staff. This latter issue is discussed in more detail in a later section.

Correlational analyses between the scores obtained on the tasks described above showed significant positive relationships between all of the scores, with the exception of the DEX Questionnaires. Neither the self-rated nor the independently-rated questionnaires showed a significant relationship either to each other or to any of the tasks of executive function. However, the direction of the relationships indicated both to be negatively correlated with executive function tasks and positively correlated with each other, which is what would be expected.

Deficits in executive functioning following damage to the frontal lobes have been reported in cases of neurological pathology, such as cerebrovascular disease, as well as lesions following traumatic brain injury (e.g. Levin et al., 1991). Altered psychosocial and emotional functioning following such an injury includes impairments in emotion-related learning (Rolls et al., 1994), and impairments in identifying facial and emotional expression have been shown in individuals who exhibit socially inappropriate behaviours (Hornak et al., 1996). Against this background of research suggesting reduced ability in emotion-related tasks following injury to areas of the cerebral cortex associated with executive functioning, it was hypothesised that deficits in executive functioning following brain injury would be positively and significantly associated with impaired performance on tasks of emotion recognition in stroke survivors who show poor executive function abilities. The correlational analyses carried out partially supported this hypothesis as almost all executive function tasks were positively associated with the identification of both positive and negative emotional states. These findings suggest a link between the frontal areas of the brain involved in executive functions and abilities required to distinguish emotional states in others.

7. Stroke participants with lower scores on measures of executive function will also show lower scores on tasks of social inference

As previously outlined, the ToM hypothesis postulates that there is a developmental deficit in ToM abilities in autism, but similarities have been noted between the behaviour of autistic children and adults who have suffered damage to the frontal lobes (Damasio & Maurer, 1978). A number of studies have provided some evidence that such a deficit may result following trauma to the brain, including individuals who had suffered a stroke (Happé et al., 1999). Additionally, impaired ToM abilities have also been found following frontal lobe surgery, where pre-morbid ToM functioning was documented (Happé et al., 2001). This evidence suggests that impairment in ToM abilities may be acquired following lesions to the brain, particularly the frontal regions which are involved in mediating executive functions. Additionally, social interaction difficulties seen in individuals with impaired ToM may well be reflected in adults who have suffered a stroke. It was hypothesised, therefore, that performance on tasks assessing executive functioning abilities would be positively associated with the ability to understand the mental states of others, as indicated by tasks measuring the ability to distinguish between different types of communication (sincere exchanges and sarcasm).

Analysis of the data indicated that none of the executive tasks showed a relationship with sincere exchanges but four of the six correlations between the two types of sarcasm exchanges and executive tasks indicated significant positive associations. These findings suggest a positive relationship between executive functioning abilities and abilities to distinguish between subtle and more complex social interactions. This would support previous findings which have found evidence to suggest relationships between the processes involved in ToM tasks and deficits in psychosocial functioning.

8. Stroke participants with lower scores on measures of executive function will also show lower scores on tasks of social comprehension

The background to the above hypothesis (8) is as discussed for the previous hypothesis. Social comprehension abilities were measured by a part of the TASIT that assesses the ability to make inferences about the intention of a character, what they are trying to say, their beliefs and their emotional state. Analysis of the data indicated positive significant relationships between executive functioning and scores on almost all aspects of this task. These findings appear to support previous findings within this present study as well as those from the literature that suggest a relationship between frontal lobe processes and abilities in psychosocial functioning.

4.2.1 Implications of Findings for Clinical Practice

The findings from this present study do not support an overall effect of reduced social perception relative to controls. However, they do suggest an association between social perception and executive functioning following stroke. Executive function has been shown to be associated with various aspects of social functioning including: appreciation and comprehension of more complex forms of social communication; inferring the intentions, beliefs and emotional states of others from social exchanges. If this is the case, the consequences of these findings could have implications for the rehabilitation of post-stroke patients. The rehabilitation of stroke patients involves a considerable amount of interaction with a range of professionals, especially for the more severely affected patient. Such interactions would not only be necessary for assessment and/or physical, language, psychological or medical interventions but would also constitute providing information to the individual.

The findings from this study suggest almost all of the stroke patients assessed showed some degree of executive functioning difficulties. The consequences of impaired executive functioning are multi-faceted and wide-ranging and imply other frontal lobe difficulties. Individuals who demonstrate such difficulties may, for example, experience a degree of social isolation, which may then be exacerbated by poor problem solving, reduced insight and emotional lability (Levin et al., 1982; Prigatano, 1986). Such a situation may have negative consequences for the well-being of the individual. There is considerable literature describing the range of affective disorders often experienced following stroke (e.g. Robinson, 1998). The importance for professionals of recognising alterations in emotional functioning and behaviour post-stroke has been outlined by Bogonsslavsky (2002).

4.2.2 Ethical Considerations

There are a number of ethical considerations that must be taken into account when undertaking psychological research as outlined in the Code of Conduct published by the British Psychological Society (2000). The issues in question involve consideration of the costs and benefits of the research and the obligations of the researcher to all participants. Clark-Carter (1997) suggests the planning of research, the conduct of the researcher and the subsequent reporting of data obtained to be the key areas in which ethical considerations are vital. Section 2.5 outlines the specific details of the procedures used in this present study.

It is acknowledged that the participants involved in this present study may be seen as being from a vulnerable group within society. Individuals who have suffered a stroke may be less able than otherwise healthy individuals to fully appreciate research in which they have been requested to participate due to the psychological and neuropsychological difficulties such individuals may experience. However, given the nature of the research in question it was felt that the possible benefits resulting from the study in the form of an increased understanding of social perception following stroke outweighed any potentially negative effects, such as psychological distress or fatigue, which was considered by the Grampian Ethics Committee to be minimal. Had an individual expressed a wish to end their participation or either indicated distress or appeared to be distressed in any way, testing would have ceased immediately. However, this did not occur. It is important to stress that no individual who agreed to participate was considered to be incapable of giving their consent in the judgement of either the medical or nursing staff or in the opinion of the author.

4.3 Methodological Issues

There are a number of methodological issues related to this present study which will be discussed in the sections below.

4.3.1 Statistical Issues

The decision to use non-parametric instead of parametric analyses was made for the following reasons:

- because two outliers were found within the stroke group - one for age and one for education- and as two of the important tasks of executive function are significant influenced by both these factors, a conservative approach was adopted

- the relatively lower number of controls (17) suggested that parametric tests may not be the best approach for data analyses in this group.

It is acknowledged that the application of multiple comparison procedures used in this study may raise the issue of increasing the probability of making Type I errors (Howell, 1992). It was decided to try and control for these errors by dividing the *p* value (0.05) by the number of tests undertaken (Dancey & Reidy (1999) p.173). Thus, an analysis using 21 Wilcoxon matched pairs signed ranks tests was carried out using a *p* value of (0.002) for significance.

There are differing opinions as to whether experimental hypotheses should be uni-directional (one-tailed) or bi-directional (two-tailed). Green & D'Oliviera (1982) argue that it is preferable to attempt an explanation of human behaviour in terms of predicting behaviour in one direction where possible. This was the approach adopted in this present study, that where possible hypotheses were based upon predications from the literature and therefore theory-driven, rather than exploratory.

4.3.2 Stroke Participants

There may be issues regarding the inclusion of a larger number of post-stroke survivors who have remained as in-patients over a long period. Clearly such individuals are more severely disabled by their stroke than the larger number of individuals who suffer a stroke but are relatively unimpaired. While it could be argued that this study investigated strokes of greater severity implicitly by including individuals from a rehabilitation in-patient unit, no precise measure of stroke severity was used. There are also issues around medication use by stroke patients. It was acknowledged that such individuals would be on a considerable medication regimen but it was beyond the scope of this study to comment on the effects of the large array of medication involved (as well as potential polypharmacy effects). However, each participant was briefly assessed prior to both assessment sessions to ensure that they could respond in an appropriate manner and that their behaviour did not raise doubts regarding their performance on tasks.

It is also acknowledged that some of the literature cited reporting studies which suggested difficulties in the perception of emotion following brain lesions were carried out on individuals who had sustained brain lesions following mild or traumatic brain injury and these cases may have confounding implications. Individuals who sustain traumatic brain injury, for example, often have tearing or shearing damage which does not normally occur in stroke.

4.3.4 Controls

The controls used in this study appeared to perform on all tasks at a level very similar to the stroke patients and at a lower level than would be expected from the information provided by the authors of the TASIT. However, the controls (and stroke patients) may actually have performed at a normal level for their age, as the TASIT had been normed on a much younger age group. An attempt to establish whether age affected emotion recognition scores in this study using controls indicted no relationship between these factors. However, there are a number of issues that may be pertinent to the task performance of this control group. These were individuals recruited from Orthopaedic and Medicine for the Elderly wards at

Woodend Hospital and may not have fully engaged with the tasks for a number of reasons. As with the stroke patients, these individuals may have been on a number of medications which may have influenced their ability to perform at an optimal level. Additionally, pain may also have been a factor. While none of the controls indicated that they were in any discomfort, pain levels were not recorded or monitored, except in an informal manner.

4.3.5 Mood

Robinson (1998) postulates that mental health issues, particularly anxiety and depression, are commonly experienced by stroke survivors. Symptoms associated with these conditions and also features of adjustment, such as irritability, apathy and withdrawal may influence psychosocial behaviours. The low scores obtained by the stroke patients on emotion recognition tasks may therefore be influenced by mood factors (though this would not explain the scores obtained by the controls). Robinson (1998) describes depression as being one of the most frequent emotional disorders experienced by stroke survivors that also has a significant impact on rehabilitation and recovery. A study looking at the prevalence of depression in post-stroke survivors found the prevalence of depression in hospitalised stroke patients to be similar to that of stroke survivors in community samples, with 27% of 103 individuals meeting the criteria outlined in the Diagnostic and Statistical Manual of Mental Disorders (3rd edition) for major depression (Robinson et al., 1983). A measure of mood, such as the Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983), might have been a useful tool to have included in this study.

4.3.6 Materials

Much of the research which has shown deficits in the perception of emotion following brain lesions has focused on specific aspects such as facial expression; for example, matching emotion-related stimuli with pictures of facial expression (e.g. Stone et al., 1996) or discriminating between emotionally-intoned recordings (e.g. Brosgole & Weisman, 1995). However, the TASIT used in the present study assessed social perception abilities across a range of communication channels, including: facial, prosodic, gestural and postural. This offers an extensive amount of information to the individual from which to infer the emotion being expressed or the message being communicated. Differences were found in the use of gestures as cues to decoding emotion by younger and older adults in video sequences, with older adults making more overall errors (Montepare et al., 1999). However, the video sequences used were silent and the faces blurred. But in a study by Brosgole & Weisman (1983), senile elderly adults was found to be able to recognise emotion expressed posturally, despite showing pronounced impairments in recognising facial affect. Evidence from these studies indicates that a wide range of information is used, either consciously or unconsciously, in the perception of emotion.

The TASIT, therefore, may actually be more akin to real-life situations. Individuals may show impairments in emotion-related tasks under laboratory conditions but show no such deficits in their performance on the TASIT or reflect few difficulties in their day-to-day lives. For the majority or individuals few social interactions involve only one communication channel, therefore there is an abundance of information usually available to an individual. A stroke patient, for example, may show impairments in the ability to identify the emotion *Angry* from a 2-dimensional stimulus array but such individuals have a wealth of other information that they may use consciously or unconsciously to aid their understanding in the real world. It has been shown that individuals who demonstrate impairments in particular cognitive domains under testing conditions do not always show similar difficulties in their everyday lives (Lezak, 1995).

However, the TASIT was developed with TBI patients who often show significantly more deficits or severity of damage following brain injury than stroke patients. Trauma to the brain often involves contra-coup injuries, oedema, shearing, tearing and the consequences of open-head and/or high velocity injury such as infection or damage from bone fragmentation. It might have been anticipated, therefore, that brain-trauma individuals would show more pronounced difficulties on this task than stroke survivors but this was not shown to the case. As outlined in section 4.2, both stroke participants and controls obtained scores very similar to that obtained by younger TBI patients.

The decision to have the DEX Q completed by nursing staff was based upon the fact that the majority of stroke participants had been inpatients since their stroke and relatives had little opportunity to observe then closely in social circumstances other than a generally one-to-one basis. Hospital staff, on the other hand, were provided the opportunity to engage and observe their patients in a variety of situations. Staff were requested to have the questionnaires completed by the members of staff who best knew a particular patient, whether that was a qualified named nurse or auxiliary carer. However, the responses obtained from staff members reflected similar ratings as each of the patients had given themselves. In validation studies, relatives generally rated individuals with executive difficulties significantly higher on the DEX questionnaire than did individuals themselves, indicated reduced insight by patients (Wilson et al., 1996). Given that the majority of stroke patients in this study had some degree of executive functioning difficulties, one would have expected the independently-rated questionnaire scores to be higher, even if not to a significant degree. This may reflect the staff members' approach to completing the questionnaire, in that they may have compared the named individual with other (more impaired) stroke patients. Thus, low executive impairments were observed relative to other stroke survivors.

4.4 Considerations for Future Research

There are a number of aspects of this present study that raise issues that might be addressed in future research. These include:

- further investigation of the TASIT in normal older adults
- investigation of associations between executive function and social perception in other populations, such as Huntington's Disease or Multiple Sclerosis
- the relationship between a more accurate identification of lesion location and emotion recognition in stroke patients
- an investigation of mood and social perception in stroke patients

4.5 Conclusion

Although individuals who have sustained a brain lesion following stroke have been shown to be impaired in emotion recognition tasks relative to controls, this finding was not replicated using the measures employed in this study. The findings of this present study indicated no significant differences in the recognition of emotion between individuals who have sustained lesions to the brain following stroke and age-matched controls. Also, no significant differences were found on tasks of social perception relative to controls. However, there is some evidence to suggest that rather than the stroke group performing tasks of social perception at a normal level, the control group may have performed at an unexpectedly low level. Additionally, the findings would not appear to support the right-hemisphere hypothesis for emotional perception (e.g. Borod et al., 1998). Also, no association was found between age and emotion recognition, though this may reflect methodological issues within the control group on whom this part of the study was focused. Significant and positive associations were observed between executive function and both emotion recognition tasks and tasks of social perception.

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List of Appendices

Appendix 1

Response Form (Controls)

P	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
1	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
2	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
3	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
4	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
5	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
6	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
7	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
8	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
9	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
10	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
11	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
12	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
13	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
14	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
15	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
16	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
17	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
18	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
19	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
20	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
21	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
22	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	
23	Happy		Surprised		Neutral		Sad		Angry		Anxious		Revolted	

24	Happy	☐	Surprised	☐	Neutral	☐	Sad	☐	Angry	☐	Anxious	☐	Revolted	☐
25	Happy	☐	Surprised	☐	Neutral	☐	Sad	☐	Angry	☐	Anxious	☐	Revolted	☐
26	Happy	☐	Surprised	☐	Neutral	☐	Sad	☐	Angry	☐	Anxious	☐	Revolted	☐
27	Happy	☐	Surprised	☐	Neutral	☐	Sad	☐	Angry	☐	Anxious	☐	Revolted	☐
28	Happy	☐	Surprised	☐	Neutral	☐	Sad	☐	Angry	☐	Anxious	☐	Revolted	☐

PRACTICE ITEM

A.	Is Ruth trying to pressure Gary into helping her?	Y	N	DK
B.	Is she trying to say it's OK if he doesn't help her?	Y	N	DK
C.	Does she think he should stop what he is doing and help her?	Y	N	DK
D.	Is she annoyed with him?	Y	N	DK

1. WEEKEND AWAY

A.	Is he seriously suggesting they invite other family members?	Y	N	DK
B.	Is he trying to say he doesn't want her relatives to come?	Y	N	DK
C.	Does she think he wants her relatives to come?	Y	N	DK
D.	Is he annoyed with her?	Y	N	DK

2. DATE

A.	Is Gary criticising Michael for dating Anne?	Y	N	DK
B.	Is he trying to say it's a mistake to date Anne?	Y	N	DK
C.	Does Gary think Anne is a good date?	Y	N	DK
D.	Is he openly impressed that Michael is dating Anne?	Y	N	DK

3. REPORT

A.	Is Ruth denying the report took a lot of work?	Y	N	DK
B.	Is she trying to say she had a lazy, relaxing weekend?	Y	N	DK
C.	Does Michael think she took it easy on the weekend?	Y	N	DK
D.	Does Ruth seem happy about working all weekend?	Y	N	DK

4. LUNCH

A.	Is Ruth reluctantly agreeing to go to the lunch?	Y	N	DK
B.	Is she trying to say she's happy to help out with a salad?	Y	N	DK
C.	Does she think the lunch will be fun?	Y	N	DK
D.	Does she seem pleased about going to the lunch?	Y	N	DK

5. TIE

A.	Is Ruth encouraging Michael to wear the tie?	Y	N	DK
B.	Is she trying to say the tie is unsuitable for a business meeting?	Y	N	DK
C.	Does she think the tie is suitable for a business meeting?	Y	N	DK
D.	Does she seem to be impressed by his choice?	Y	N	DK

6. CLASS

A.	Is Ruth trying to make Michael feel OK?	Y	N	DK
B.	Is she trying to say that he's causing a big problem?	Y	N	DK
C.	Does she believe he's too busy to take the class?	Y	N	DK
D.	Is she annoyed with him?	Y	N	DK

A.	Is Gary trying to make Ruth feel bad?	Y	N	DK
B.	Is he trying to say that she looks OK?	Y	N	DK
C.	Does she think he's joking with her?	Y	N	DK
D.	Is he angry with her?	Y	N	DK

8. PASSPORT

A.	Is Keith seriously trying to make Gary think he's lost his ticket?	Y	N	DK
B.	Is Keith trying to say that his ticket and passport are safe?	Y	N	DK
C.	*By the end of the scene:* Does Gary believe Keith has his ticket?	Y	N	DK
D.	Is Keith openly pleased about Gary's concern?	Y	N	DK

9. HARD DAY

A.	Is Ruth trying to make Michael feel appreciated?	Y	N	DK
B.	Is she trying to say he's been a big help?	Y	N	DK
C.	Does she think he has worked hard?	Y	N	DK
D.	Is she annoyed with him?	Y	N	DK

10. MOVIES

A.	Is Michael agreeing with Ruth about the movie?	Y	N	DK
B.	Is he trying to say he thought the actors were good?	Y	N	DK
C.	Did he think the movie was bad?	Y	N	DK
D.	Is he openly pleased that he saw the movie?	Y	N	DK

11. TICKETS

A.	Is Michael trying to show he appreciates Gary getting the tickets?	Y	N	DK
B.	Is he trying to say he's pleased about the tickets?	Y	N	DK
C.	*By the end of the scene,* does Gary think Michael wants to go?	Y	N	DK
D.	Is Michael annoyed Gary got him the tickets?	Y	N	DK

12. BOXES

A.	Is Gary trying to make Michael feel guilty?	Y	N	DK
B.	Is he trying to say Michael should take it easy?	Y	N	DK
C.	Does he think Michael is being lazy?	Y	N	DK
D.	Is he annoyed with Michael?	Y	N	DK

13. PROMOTION

A.	Is Ruth sending Michael up about his chances of a promotion?	Y	N	DK
B.	Is she trying to say he's worked really well?	Y	N	DK
C.	Does she think he deserves a promotion?	Y	N	DK
D.	Would she like him to get the promotion?	Y	N	DK

14. SHIRT

A.	Is Ruth reassuring Gary that the shirt is nice?	Y	N	DK
B.	Is she trying to say the shirt is awful?	Y	N	DK
C.	Does she think the shirt's OK?	Y	N	DK
D.	Is she happy for him to wear the shirt?	Y	N	DK

15. DRESS

A.	Is Michael being complimentary about the dress?	Y	N	DK
B.	Is he trying to say the dress looks cheap?	Y	N	DK
C.	Does he like the dress?	Y	N	DK
D.	Does he think Ruth's sister paid a lot for the dress?	Y	N	DK

Appendix 2

NART Response Form

National Adult Reading Test (NART)

SECOND EDITION

Answer/Record Sheet

Name:.. Date of test:..

Word	Errors	Word	Errors
CHORD		SUPERFLUOUS	
ACHE		SIMILE	
DEPOT		BANAL	
AISLE		QUADRUPED	
BOUQUET		CELLIST	
PSALM		FACADE	
CAPON		ZEALOT	
DENY		DRACHM	
NAUSEA		AEON	
DEBT		PLACEBO	
COURTEOUS		ABSTEMIOUS	
RAREFY		DETENTE	
EQUIVOCAL		IDYLL	
NAIVE		PUERPERAL	
CATACOMB		AVER	
GAOLED		GAUCHE	
THYME		TOPIARY	
HEIR		LEVIATHAN	
RADIX		BEATIFY	
ASSIGNATE		PRELATE	
HIATUS		SIDEREAL	
SUBTLE		DEMESNE	
PROCREATE		SYNCOPE	
GIST		LABILE	
GOUGE		CAMPANILE	

Appendix 3

TASIT Response Form (A)

Thames Valley Test Company

TASIT A:
PART I ~
EMOTION EVALUATION TEST
SUMMARY SHEET

Name: M/F: D.O.B.: Date:

Item no.	Two-person Scene prompt *"Focus on the..."*	**ACTORS*** Target actor in **bold**	Happy (i)	Surprised (ii)	Neutral (iii)	Sad (iv)	Angry (v)	Anxious (vi)	Revolted (vii)
Practice		**Ruth**							
1 (ang)	Man	**Mick**, Olivia							
2 (sur)		**Gary**							
3 (hap)		**Olivia**							
4 (rev)		**Olivia**							
5 (sad)	Woman	**Ruth**, Mick							
6 (neu)		**Michael**							
7 (anx)		**Mick**							
8 (hap)		**Olivia**							
9 (rev)	Younger Man	**Mick**, Michael							
10(sad)		**Mick**							
11(sur)		**Olivia**							
12(ang)		**Ruth**							
13(neu)	Man	**Mick**, Zika							
14(anx)		**Mick**							
15(rev)		**Olivia**							
16(sad)		**Ruth**							
17(hap)	Woman	**Olivia, Mick**							
18(ang)		**Michael**							
19(neu)		**Ruth**							
20(anx)		**Zika**							
21(sur)	Man	**Michael**, Zika							
22(rev)		**Michael**							
23(ang)		**Tanya**							
24(sur)		**Zika**							
25(anx)	Man of Asian origin (on left)	**Keith**, Mick							
26(hap)		**Mick**							
27(sad)		Michael							
28(neu)		**Olivia**							

No. items correct for each emotion:		
No. of positive vs negative emotion items correct:	Positive emotions : (i) + (ii) + (iii) =	Negative emotions: (iv) + (v) + (vi) + (vii) =
TOTAL No. OF ITEMS CORRECT:	Positive + Negative emotions =	

TC
Valley
npany

TASIT A:
PART 2 ~
SOCIAL INFERENCE (Minimal) - RESPONSE FORM

TICE ITEM

Ruth trying to pressure Gary into helping her?	Y	N	DK
he trying to say it's OK if he doesn't help her?	Y	N	DK
es she think he should stop what he is doing and help her?	Y	N	DK
he annoyed with him?	Y	N	DK

EEKEND AWAY

e seriously suggesting they invite other family members?	Y	N	DK
e trying to say he doesn't want her relatives to come?	Y	N	DK
es she think he wants her relatives to come?	Y	N	DK
e annoyed with her?	Y	N	DK

TE

Gary criticising Michael for dating Anne?	Y	N	DK
e trying to say it's a mistake to date Anne?	Y	N	DK
es Gary think Anne is a good date?	Y	N	DK
e openly impressed that Michael is dating Anne?	Y	N	DK

PORT

Ruth denying the report took a lot of work?	Y	N	DK
he trying to say she had a lazy, relaxing weekend?	Y	N	DK
es Michael think she took it easy on the weekend?	Y	N	DK
es Ruth seem happy about working all weekend?	Y	N	DK

NCH

Ruth reluctantly agreeing to go to the lunch?	Y	N	DK
he trying to say she's happy to help out with a salad?	Y	N	DK
es she think the lunch will be fun?	Y	N	DK
es she seem pleased about going to the lunch?	Y	N	DK

E

Ruth encouraging Michael to wear the tie?	Y	N	DK
she trying to say the tie is unsuitable for a business meeting?	Y	N	DK
es she think the tie is suitable for a business meeting?	Y	N	DK
es she seem to be impressed by his choice?	Y	N	DK

ASS

Ruth trying to make Michael feel OK?	Y	N	DK
he trying to say that he's causing a big problem?	Y	N	DK
es she believe he's too busy to take the class?	Y	N	DK
he annoyed with him?	Y	N	DK

7. GOING OUT

A. Is Gary trying to make Ruth feel bad?	Y	N	DK
B. Is he trying to say that she looks OK?	Y	N	DK
C. Does she think he's joking with her?	Y	N	DK
D. Is he angry with her?	Y	N	DK

8. PASSPORT

A. Is Keith seriously trying to make Gary think he's lost his ticket?	Y	N	DK
B. Is Keith trying to say that his ticket and passport are safe?	Y	N	DK
C. *By the end of the scene:* Does Gary believe Keith has his ticket?	Y	N	DK
D. Is Keith openly pleased about Gary's concern?	Y	N	DK

9. HARD DAY

A. Is Ruth trying to make Michael feel appreciated?	Y	N	DK
B. Is she trying to say he's been a big help?	Y	N	DK
C. Does she think he has worked hard?	Y	N	DK
D. Is she annoyed with him?	Y	N	DK

10. MOVIES

A. Is Michael agreeing with Ruth about the movie?	Y	N	DK
B. Is he trying to say he thought the actors were good?	Y	N	DK
C. Did he think the movie was bad?	Y	N	DK
D. Is he openly pleased that he saw the movie?	Y	N	DK

11. TICKETS

A. Is Michael trying to show he appreciates Gary getting the tickets?	Y	N	DK
B. Is he trying to say he's pleased about the tickets?	Y	N	DK
C. *By the end of the scene,* does Gary think Michael wants to go?	Y	N	DK
D. Is Michael annoyed Gary got him the tickets?	Y	N	DK

12. BOXES

A. Is Gary trying to make Michael feel guilty?	Y	N	DK
B. Is he trying to say Michael should take it easy?	Y	N	DK
C. Does he think Michael is being lazy?	Y	N	DK
D. Is he annoyed with Michael?	Y	N	DK

13. PROMOTION

A. Is Ruth sending Michael up about his chances of a promotion?	Y	N	DK
B. Is she trying to say he's worked really well?	Y	N	DK
C. Does she think he deserves a promotion?	Y	N	DK
D. Would she like him to get the promotion?	Y	N	DK

14. SHIRT

A. Is Ruth reassuring Gary that the shirt is nice?	Y	N	DK
B. Is she trying to say the shirt is awful?	Y	N	DK
C. Does she think the shirt's OK?	Y	N	DK
D. Is she happy for him to wear the shirt?	Y	N	DK

15. DRESS

A. Is Michael being complimentary about the dress?	Y	N	DK
B. Is he trying to say the dress looks cheap?	Y	N	DK
C. Does he like the dress?	Y	N	DK
D. Does he think Ruth's sister paid a lot for the dress?	Y	N	DK

Appendix 4

COWA Response Form

CONTROLLED ORAL WORD ASSOCIATION TEST

____

. Give me the names of as many animals/occupations as you can think of.

. I am going to give you a letter and I would like you to tell me as many words as you can think of that begin with that letter excluding proper nouns (i.e. names), numbers and the same word with a different suffix (i.e. all, always, altogether, e.t.c.). The first letter is C/P. The second letter is F/R. The third letter is L/W.

ime (Secs)	Animals/ Occupations	C/P	F/R	L/W
– 15				
5 – 30				
0 – 45				
5 – 60				
otals				

otal:
djusted Score:
ercentile Range:
lassification:

Appendix 5

DEX Questionnaire: Self-rated

BADS

TVTC
Thames Valley
Test Company

Dex Questionnaire
Self-rating

Subject's name ______________________

Date

This questionnaire looks at some of the difficulties that people sometimes experience. We would like you to read the following statements, and rate them on a five-point scale according to your own experience:

1 I have problems understanding what other people mean unless they keep things simple and straightforward

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

2 I act without thinking, doing the first thing that comes to mind

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

3 I sometimes talk about events or details that never actually happened, but I believe did happen

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

4 I have difficulty thinking ahead or planning for the future

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

5 I sometimes get over-excited about things and can be a bit 'over the top' at these times

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

6 I get events mixed up with each other, and get confused about the correct order of events

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

7 I have difficulty realizing the extent of my problems and am unrealistic about the future

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

8 I am lethargic, or unenthusiastic about things

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

9 I do or say embarrassing things when in the company of others

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

10 I really want to do something one minute, but couldn't care less about it the next

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

11 I have difficulty showing emotion

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

12 I lose my temper at the slightest thing

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

13 I am unconcerned about how I should behave in certain situations

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

14 I find it hard to stop repeating saying or doing things once I've started

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

15 I tend to be very restless, and 'can't sit still' for any length of time

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

16 I find it difficult to stop myself from doing something even if I know I shouldn't

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

17 I will say one thing, but will do something different

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

18 I find it difficult to keep my mind on something, and am easily distracted

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

19 I have trouble making decisions, or deciding what I want to do

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

20 I am unaware of, or unconcerned about, how others feel about my behaviour

☐ 0 Never ☐ 1 Occasionally ☐ 2 Sometimes ☐ 3 Fairly often ☐ 4 Very often

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Thames Valley Test Company, 7–9 The Green, Flempton, Bury St Edmunds, Suffolk, IP28 6EL, England.

Appendix 6

DEX Questionnaire: Independently-rated

TVTC
Thames Valley Test Company

BADS

Dex Questionnaire
Independent rater

Subject's name ______________________

Date of rating ______________________

Rater's name ______________________

Relationship to subject ______________________

This questionnaire looks at some of the difficulties that people sometimes experience. We would like you to read the following statements, and rate them on a five-point scale according to your experience of ______________________ [the subject]:

1 Has problems understanding what other people mean unless they keep things simple and straightforward

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

2 Acts without thinking, doing the first thing that comes to mind

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

3 Sometimes talks about events or details that never actually happened, but s/he believes did happen

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

4 Has difficulty thinking ahead or planning for the future

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

5 Sometimes gets over-excited about things and can be a bit 'over the top' at these times

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

6 Gets events mixed up with each other, and gets confused about the correct order of events

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

7 Has difficulty realizing the extent of his/her problems and is unrealistic about the future

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

8 Seems lethargic, or unenthusiastic about things

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

9 Does or says embarrassing things when in the company of others

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

10 Really wants to do something one minute, but couldn't care less about it the next

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

11 Has difficulty showing emotion

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

12 Loses his/her temper at the slightest thing

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

13 Seems unconcerned about how s/he should behave in certain situations

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

14 Finds it hard to stop repeating saying or doing things once started

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

15 Tends to be very restless, and 'can't sit still' for any length of time

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

16 Finds it difficult to stop doing something even if s/he knows s/he shouldn't

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

17 Will say one thing, but will do something different

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

18 Finds it difficult to keep his/her mind on something, and is easily distracted

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

19 Has trouble making decisions, or deciding what s/he wants to do

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

20 Is unaware of, or unconcerned about, how others feel about his/her behaviour

☐0 Never ☐1 Occasionally ☐2 Sometimes ☐3 Fairly often ☐4 Very often

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Appendix 7

Information sheet for Patients

Information Sheet

Project: **<u>An Exploration of Social Perception and Executive Function Following Stroke</u>**

Introduction

I would like to invite you to take part in a research project to enable us learn more about people's experiences following a stroke and how to help them more effectively.

Background

Sometimes after having a stroke a number of individuals have been reported experiencing some difficulties in tasks requiring, for example, problem-solving and initiation. This is sometimes referred to as Executive Functioning. They also sometimes experience problems interacting with other people, such as recognising emotions in others, even though they did not have these difficulties before their illness. This combination of psychological difficulties and social perception problems can make recovery from stroke more difficult and may take longer as a result.

The purpose of this study is to examine in more detail what social perception difficulties people do experience after having a stroke (if any), and to see whether this has any effect on they way they behave.

What will I have to do?

This project involves watching a video of actors in different situations and answering questions about their behaviour. The video is in two parts and will take about 45 minutes altogether. You will also be asked to do a few short tasks and complete a questionnaire, which will take about another 45 minutes to do. The researcher, Angus Lorimer, would explain the questionnaire and the tasks to you and will answer any questions you may have regarding the project.

Patient Notes

I would also like to request permission to review your file / notes for information, e.g. about the type of stroke you experienced. This information will be kept in the strictest confidence.

Do I have to take part?

No, taking part in this study is voluntary. If you decide not to take part, you do not have to give a reason. Any treatment or support you receive will not be affected as a result of your decision.

Confidentiality

Each participant in the study will be assigned a code and all information gathered during this study regarding individuals will be coded and known only to the researcher and will be kept strictly confidential.

What to do now?

If you would like to take part in the study or would like to know more about it, tell your nurse and he or she will contact me. If you wish, you may contact me directly yourself at the address or telephone number below and I would be happy to talk to you.

Thank you very much for considering taking part in this study. Please discuss this matter with you family, friends or a member of staff if you wish.

Angus Lorimer
Psychologist in Clinical Training
Dept of Clinical Neuropsychology
Ward 40, ARI
Aberdeen

Tel: (01224) 554350 / 553453

Appendix 8

Consent Form

Consent Form

An Exploration of Social Perception and Executive Function Following Stroke

Name: ____________________________________

I have read the information on this study and have had the opportunity to talk it over with Angus Lorimer. I have also had the opportunity to ask any questions. I have been told what the study is for and understand what will happen. I know that I do not have to take part and that I can withdraw from the study at any time. If I do not want to take part, or if I decide to withdraw, I have been assured that my treatment and support will not be affected in any way.

I also understand that my name will not be known to anyone apart from the person who interviews me and that all information will be treated in the strictest confidence.

I hereby fully and freely consent to take part in this study, which has been explained to me satisfactorily.

Signature of Participant: ____________________________________

Date: ____________________ Tick for verbal response *

I confirm that I have explained to the participant the nature and purpose of this study and I have answered all queries posed by the participant as honestly, fully and truthfully I can.

Signature of Investigator: ____________________________________

Date: ____________________

* Signature of Witness: ____________________________________

Date: ____________________

This form be held in Section A of the patient's notes.

Appendix 9

Information Sheet for Controls

Information Sheet For Individuals Who Have Not Had a Stroke

Project: **An Exploration of Social Perception and Executive Function Following Stroke**

Introduction

As someone who has not had a stroke, I would like to invite you to take part in a research project to enable us learn more about people's experiences following a stroke and how to help them more effectively. In order to do this I need to compare individuals who have had a stroke with individuals who have not.

Background

Sometimes after having a stroke a number of individuals have been reported experiencing some difficulties in tasks requiring, for example, problem-solving and initiation. This is sometimes referred to as Executive Functioning. They also sometimes experience problems interacting with other people, such as recognising emotions in others, even though they did not have these difficulties before their illness. This combination of psychological difficulties and social perception problems can make recovery from stroke more difficult and may take longer as a result.

The purpose of this study is to examine in more detail what social perception difficulties people do experience after having a stroke (if any), and to see whether this has any effect on they way they behave.

What will I have to do?

The part of the project I would like you to participate in involves watching a video of actors in different situations and answering questions about their behaviour. The video is in two parts and will take about 45 minutes altogether. The researcher, Angus Lorimer, will be happy to answer any questions you may have regarding the project.

Do I have to take part?

No, taking part in this study is voluntary. If you decide not to take part, you do not have to give a reason. Any treatment or support you receive will not be affected as a result of your decision.

Confidentiality

Each participant in the study will be assigned a code and all information gathered during this study regarding individuals will be coded and known only to the researcher and will be kept strictly confidential.

What to do now?

If you would like to take part in the study or would like to know more about it, tell your nurse and he or she will contact me. If you wish, you may contact me directly yourself at the address or telephone number below and I would be happy to talk to you.

Thank you very much for considering taking part in this study. Please discuss this matter with you family, friends or a member of staff if you wish.

Angus Lorimer
Psychologist in Clinical Training
Dept of Clinical Neuropsychology
Woodend Hospital
Aberdeen

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