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2011-04-08
http://hdl.handle.net/10539/9401

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Emotion Processing, Neuropsychiatric Symptoms and Quality of Life after a Stroke

According to Statistics South Africa (2007) cerebrovascular disease is the leading cause of death among persons aged 50 and above, and accounts for 8 % of male deaths and 11.4 % of female deaths in South Africa. Strokes are extremely prevalent within the culturally diverse context of South Africa, with a prevalence rate of 10.1% for both genders. Differences in presentation, incidence and aetiology do occur, although White, Black, Indian and Coloured patients are affected (Fritz, 1997). The Southern African Stroke Prevention Initiative (SASPI) revealed that although South Africa already suffers the burden of infectious diseases, parasites and HIV/AIDS, vascular disease is fast becoming the new challenge for health systems to adapt to (Fritz, 1997; SASPI, 2004). In fact, vascular diseases are expected to increase substantially in Africa as a result of changing social and economic structures (Wasserman, de Villiers & Bryer, 2009). For each one person dying of stroke, three will survive and of those three, only one will return to independent living (Tipping, 2008). When a stroke does not result in death, it may cause cognitive, motor and neurological disabilities and has been shown to leave about 50% of stroke survivors with some residual physical and cognitive disability (Ashburn, 1997). For example, in the SASPI study, 66 % of stroke survivors needed help with at least one activity of daily living (SASPI, 2004). One of the greatest causes of a stroke is hypertension and a survey revealed high levels of hypertension in the South African community with inadequate treatments for the condition (Steyn, Gaziano, Bradshaw, Laubscher & Fourie, 2001). Plasticity within cortical connections after stroke has also been found to induce a process of neural remapping leading to partial recovery of function after initial injury (Carmichael, 2003). Rehabilitation should begin immediately after the

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diagnosis of a stroke has been established as multidisciplinary stroke care units are guided towards preventing further deaths or complications and encourage independent living after a stroke (Tipping, 2008). The dynamics within the rehabilitation process are complex and multivariate as the onset of a stroke results in enduring changes in the lives of stroke survivors as well as their family members (King, Shade-Zeldow, Carlson, Feldman & Philip, 2002; Prigatano, 1999). Difficulties in social adjustment due to coping or adjustment problems also affect between one-third and two-thirds of patients (Eslinger, Parkinson & Shamay, 2002; Prigatano, 1999).

Functional disabilities after stroke reduce life satisfaction and contribute to depression and psychiatric symptoms although limited research has investigated the outcome of stroke survivors when activities of daily living are not affected (Astrom, Asplund & Astrom, 1992). Even a mild stroke or a stroke that does not affect activities of daily living and motor functioning, can also result in "hidden dysfunctions" such as depression and low life satisfaction and is often not taken into consideration in prognosis (Carlsson, Moller & Blomstrand, 2003). Community services and private rehabilitation facilities need to focus attention on these neuropsychological aspects of stroke survivors as they can damage relationships with family members or caregivers (Anderson, Linto & Stewart-Wynne, 1995).

Moreover, neuropsychiatric disturbances are frequently observed following a cerebrovascular lesion and as documented by numerous studies, the majority have focused on mood disorders (Angelelli et al., 2004; Bourgeois, Hilty, Chang, Wineinger & Servis, 2004; Carota, Staub & Bogousslavsky, 2002; Gainotti, 1983; Grattan et al., 2001; House, Dennis & Molyneux, 1989; Kaplan, 2005; Nelson,

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Cicchotti & Satz, 1993; Robinson, 2006; Staub & Bogousslavsky, 2001; Stone, Townend, Kwan, Haga, Dennis & Sharpe, 2004; Visser-Keizer, 2004). Specifically, Robinson (2006) found that post-stroke depression, can endure from six months to four years and some research has suggested that this can be attributed to quality of life rather than one's ability to walk, perform daily activities or maintain intact cognition (Niemi, Laaksonen, Kotila & Waltimo, 1988; Robinson & Starkstein, 2002). Irritability and aggression, apathy, and obsessive disorders are but a few of the common disorders associated with cerebrovascular accident and create a major stress for the family members of patients (Angelelli et al., 2004; Dennis, O'Rourke, Lewis, Sharpe & Warlow, 1998; Robinson, 2006). The specific effects these disorders have on long term recovery remains unanswered but the potential impact of neuropsychiatric sequelae on rehabilitation efforts is evident (Prigatano, 1999). Prigatano (1999) maintains that dealing with the emotional effects of brain injury is essential to successful therapy. The various neuropsychiatric disturbances found among stroke survivors are of great interest throughout the world and specifically in the South African context characterised by its specific availability of social services and economic profile, as they pose a major obstacle to the rehabilitation process (Wasserman et al., 2009). In South Africa, a dearth of social services intensifies interpersonal dependence amongst members of the family system thus broadening the impact of any combination of the above mentioned stroke related sequelae (Coovadia, Jewkes, Barron, Sanders & McIntyre, 2009). This phenomenon not only influences the caregiver's and/ or partner's mood, activities and eventually life satisfaction; it can obstruct the quality of life of survivors.

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Certain activities impede satisfactory emotion processing and according to Freud, when this occurs, emotions undergo a series of abnormal changes which may find outlet by new paths (Freud, 1940). He asserted that the presence of concurrent stressors can give rise to overload which results in the need to suppress the appropriate emotional expression. Rachman (1980) later noted that emotional experiences reverberate for a considerable length of time and may disrupt one's behaviour for years after the event. Furthermore, Ricciardi and McNally (1995) devoted some attention to investigating the relationship between depression and obsessions to illustrate the importance of mood factors on emotional processing. An example of this would be in the case where an individual suffers a life threatening stroke and in struggling to deal with the process of rehabilitation and life change, he may not adequately express his emotions. Le Doux (1998) provided evidence to suggest that emotion networks have direct anatomical connections to both the cortex and amygdala. The short and long term effects of faulty emotional processing and more specifically, their consequences following a stroke remains an unanswered question. This study was thus directed at investigating emotion processing, neuropsychiatric symptoms and quality of life in stroke survivors, and moreover their interconnectedness.

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While cognitive impairment, behavioural changes, emotion processing, neuropsychiatric disturbances and quality of life after a stroke have independently been studied in considerable depth; their interconnectedness has received virtually no attention (Angelelli et al., 2004; Baker; Holloway, Thomas, Thomas, & Owens, 2004; Carod-Artal, Egido, Gonzalez & de Seijas, 2000; Grattan et al., 2001; Carota et al., 2002; House et al., 1989; Powers, 1990; Robinson & Starkstein, 2002b). Deficits

resulting from a stroke affect the survivor's whole being yet little research has focussed on the interrelated factors that contribute to recovery (Vanhook, 2009). A number of studies focus predominantly on unimpaired individuals (Fellous, Armony & LeDoux, 2002; Phillips, Drevets, Rauch & Lane, 2003a; Wade, Legh-Smith & Hewer, 1987) while others consider the perspective of the relevant caregiver (Dennis et al., 1998; Gainotti, 1983). The present study focused on neuropsychiatric disturbances, quality of life and emotion processing as they are perceived by the neurologically compromised stroke victim and factored in the delicate networks and processes involved. An improved understanding of the psycho-social changes from the stroke survivor's perspective has obvious impact for the therapeutic interventions inherent in stroke rehabilitation and as a result, the return to independent living and thus the personal and economic burden that a stroke exerts on the family system (Dennis et al., 1998; King et al., 2002; Visser-Keizer, 2004). As such, the research contributes towards the fields of neurobiology, physiology, neuropsychology, neuropsychotherapy and the social sciences.

Brain behaviour relationships can be investigated through a multitude of methodologies however each method has particular limitations. A selection of these methodologies is outlined in order to motivate for the neuropsychological orientation of this study. Literature pertinent to relevant structure-function dynamics of the brain are then discussed in order to contextualise the impact of cerebrovascular accident on the individual. Neuroscientific evidence for behaviour following a stroke is presented through an array of experimental and behavioural studies to reveal how the structural and functional processes underpinning emotion have evolved . Pathways involved in the processing of emotion are then presented relative to specific theories of emotion processing. The development of neuropsychiatric conditions following stroke are

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delineated with the purpose of discussing their prevalence and how they relate to emotion processing. A working definition of quality of life is then offered and the cognitive consequences following a stroke are mentioned. Finally, demographic risk factors are identified and the review concludes with the research questions. The particular methodological considerations involved this research including subject characteristics, instruments, procedure and ethical considerations are then outlined. Following the validation of scales and a comparison of this sample to standardised normative data, statistical results are presented. The paper concludes with a discussion of the results, acknowledges the study's limitations and calls attention to directions for future research.

Chapter Two

Literature Review

2.1. Neuroscientific Methodologies

The prevalence of strokes occurring in South Africa has increased over past years and is expected to increase further still (StatsSA, 2007). When an economy is too impoverished to invest in health, it tends to experience a downward spiral of growing disease burden and in turn, deepening poverty (Callow, 2006). While the most obvious stroke sequelae may reflect those of a physical or verbal nature, the professional may identify a broader spectrum of deficits including those related to cognition in the areas of: memory, language, coordination, attention and perception. The individual and their social network have to contend with the lasting effects of behavioural, emotional and personality changes, and often neuropsychiatric symptoms (Angelelli et al., 2004; Dennis et al., 1998; Gainotti, 1993; Ghika-Schmid & Bougosslavsky, 2001; King et al., 2002). This particular research focused on the

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interrelatedness of emotion processing, neuropsychiatric disturbances and quality of life.

Of particular interest, when considering the structural-functional correlates in light of the aetiology of the compromising neurological event, are the multiplicity of neural structures and pathways related independently to automatic temperamental reactions. Integral to the consideration of the connection between cerebrovascular accident, emotion processing, neuropsychiatric symptoms and quality of life are the biological theories underlying personality, emotion processing and how a disruption to this system owing to a stroke may present as neuropsychiatric illness. Relevant to the latter, differences between symptoms and syndromes as well as prevalence of specific disorders have been put forward. As the area affected by the stroke and the consequent neuropsychological deficits that may result are of the utmost importance; the mechanism of stroke (or cerebrovascular accident), theories of emotional processing and in particular, the neurological pathways involved in emotion processing are discussed (Powers, 1990; Whyte & Mulsant, 2002). Finally, quality of life, its particular relevance to the rehabilitation process as well as return to independent living, are conveyed. Ultimately, the research attempts to describe the strength and type of relationships between the aforementioned factors in a stroke survivor population.

Before embarking on a discussion of the brain and how it processes information; a brief expose of the methodologies that have rendered us prive to this knowledge will be addressed. Investigation into the brain encompasses a wide variety of methodologies both within the research and clinical settings with the purpose of

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providing support for our current understanding of the brain and how it functions (Coltheart, 2004; Darby & Walsh 2005; Zillmer, Spiers & Culbertson, 2008). Technology has provided a variety of important tools to be used by neurophysiologists, cognitive psychologists, cognitive neuroscientists, and other researchers interested in brain function. Researchers today can choose from techniques ranging from EEG, MEG, PET, SPECT, MRI, and fMRI amongst others. Each method has its own strengths and weaknesses, and no single method is best suited for all experimental or clinical conditions (Lezak, 2004).

Electroencephalography (EEG), event related potentials (ERP) and magnetophysiological methods (MEG) record the electrical properties of the neurons themselves hence are used in the research context in order to determine when an event is occurring, as well as temporal specificity of neural pathways. The method of electrical stimulation of the brain is now however, rarely carried out (Ward, 2005). In neurophysiology, functional and structural imaging studies make use of computerized tomography (CT) and magnetic resonance imaging (MRI) in the clinical setting to record the soft tissue and its precise location within the skull; the intention is to reconstruct internal structures which can be utilised to look further at behavioural correlates generated by neuroanatomical subsystems. Some drawbacks of this method include the cost and specifically in South Africa, the availability of equipment and the susceptibility to signal distortion as a result of nearby tissues having different magnetic properties (Caramazza & Coltheart, 2006; Coltheart, 2004; Lezak, 2004; Ward, 2005). Positron emission tomography (PET) requires an injection of radio-labelled isotope in order to measure differences in the rate of metabolic activity in the brain. Cognitive tasks, performed simultaneously, are then associated with

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neuroanatomical structures where increased metabolic activity takes place allowing one to map bloodflow of cognitive and psychological functions. This method is however considered an invasive method of investigation. Single photon emission computed tomography (SPECT) and most recently functional magnetic resonance imaging (fMRI) also successfully map cognitive and psychological functions to neuroanatomical structures thus are interpreted in combination with structural research in order to display the spatial specificity of the brain (Caramazza & Coltheart, 2006; Coltheart, 2004; Gur, Gunning-Dixon, Bilker & Gur, 2002, Ward, 2005).

The above mentioned methodologies have certainly contributed towards an understanding of intricate neural pathways, yet; the procedures incur a high cost and are time consuming. Other limitations which need to be acknowledged include the dependence on the technology used as the temporal and spatial resolution is often restricted to some degree. Additionally, the generalisability of data is limited when utilising neurologically compromised subjects and can often be sensitive to extraneous factors for example, the patient's age at time of injury and neuroplasticity (Lezak, 2004).

Although no methodology is perfect; each of the above-mentioned techniques has greatly advanced our knowledge within the field of neuroscience. A more in-depth method of investigating the brain involves movement beyond the structure-function anatomical correlates into more complex behavioural manifestations. The field of neuropsychology employs this technique by identifying patterns of cognitive symptoms and integrates them with underlying neuropathology. Neuropsychology is the applied science that deals with behavioural manifestations of brain dysfunction

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and within this framework, neuropsychological assessments are used to test a range of cognitive abilities including; memory, learning, expressive language and set shifting, as well as executive functions such as emotion processing (Caramazza & Coltheart, 2006). Assessments involve intensive studies of behaviour and make use of standardised scales and questionnaires in both patient populations and healthy subjects to provide sensitive and precise indices of behaviour (Gazzaniga, Ivry & Mangun, 2002; Lezak, 2004). Subject's responses are recorded and can be interpreted as representing specific skills required for particular abilities. Neuropsychological assessments can at times even detect pathologies and the locus of brain damage before structural abnormalities have been acknowledged (Caramazza & Coltheart, 2006; Daw, 2001). The science of neuropsychology is particularly relevant as the present study will employ this methodology.

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2.2. Organic Perspectives

Every single behaviour or action results from a myriad of complex neurophysiological and biochemical interactions involving the whole brain (Darby & Walsh, 2005). Much knowledge of the brain has already been uncovered, yet, it is still always under investigation. When a precise neurological lesion affects a particular function, or produces a neurobehavioral syndrome, it is then possible to make connections between their respective structure and function, resulting in a more in depth discovery of how the brain works (Zillmer et al., 2008). For example; a very rare neuropsychiatric syndrome that results in abnormal reactions to the environment such as loss of fear, aberrant sexual behavior, and 'psychic blindness' is called Kluver-Bucy syndrome and only occurs with bilateral temporal lobe (thalamic and amygdala)

damage (Carota et al., 2002). Another syndrome seen in psychosis, namely Capgra's syndrome, involves a patient's belief that some familiar individual has been replaced by a sosia. This phenomenon results when the cerebral areas (specifically, the fusiform and parahippocampal gyrus which control face and place recognition respectively) are disconnected from the right medial temporal lobe, in which long term memory, retrieval and visual recognition mechanisms are stored. As noted above, the brain is comprised of many complex structures which in turn relate to unique functions; thus, as the research adopts a neuropsychological point of view, the emphasis will now be placed on the structure-function relationships of the brain and in particular those relevant to emotion processing.

Connecting all brain regions is a network of blood vessels that supply oxygen, glucose and nutrients to the brain tissues. The human brain as conceptualised by Luria is split along three divisions; the hindbrain, midbrain and forebrain (Goldberg & McNeil, 2004). Making up the hindbrain is the medulla oblongata, the pons, portions of the reticular formation and the cerebellum. The cerebellum has a strong link to the motor cortex, yet it also connects with both cortical and subcortical areas. Functionally, it has been found to play a role in emotion modulation and planning hence damage to the cerebellum has been found to result in personality changes and psychiatric disorders (Angelelli et al. 2004; Carota et al., 2002; Phillips et al., 2003a; Robinson, 2006; Stone et al. 2004). The midbrain is made up of the reticular formation which plays an essential role in arousal and conscious experience but has also been linked to memory, motor, auditory and visual processing, as lesions have been associated with impaired memory retrieval and movement disabilities. The forebrain, the largest and most anatomically complex structure comprises the

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thalamus, hypothalamus, limbic system, basal ganglia and the four lobes of the cerebrum (Rosenberg, 1991).

Of these structures, specifically those that lie below the cortex; the dorsal thalamus and hypothalamus play an integral role in regulating higher-level brain activity and relay sensory information to appropriate areas of the brain for further processing. The hypothalamus regulates physiological drives such as arousal, fear and rage, thus lesions can diminish drive states and responsivity. The cerebrum is split between the left and right cerebral hemispheres with the basal region at the base and the amygdala, subthalmic nucleus and substantia nigra subcortically. Essentially, the basal region influences all aspects of motor control, however dramatic and disruptive personality changes may occur with degeneration of the basal ganglia which suggests that it plays a role in personality as well (Carota et al, 2002; Lezak, 2004; Zillmer et al., 2008). Obsessive-compulsive disorder, mania and depression are just a few neuropsychiatric conditions associated with alterations in the basal ganglia circuits and damage to the frontal lobe (Phillips, Drevets, Rauch & Lane, 2003b; Robinson, 2006).

The limbic system is not one, but a few structures working together to carry out a variety of functions. When this area is damaged, severe alterations in emotional responses and personality changes have been witnessed (Phillips et al. 2003a; Stone et al. 2004). Structures included are the amygdala, areas of the cortex, the cingulate gyrus and the hippocampus however limbic connections reach as far as the brain stem (Rosenberg, 1991). These structures are responsible for emotion, motivation, and even memory. Damage to critical language areas in the left hemisphere causes loss of the

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amygdala's modulatory effect which then causes catastrophic reactions (Carota et al., 2003). The amygdala also plays a role in emotion processing and fear responses and is necessary for processing facial expressions of fear, as amygdala lesions manifest with a restricted range of both positive and negative emotions (Damasio & Van Hoeson, 1983; Nelson, Chiccetti & Satz, 1993). This is particularly relevant as the scale used in this study measures both emotional awareness and emotional expression, factors that will discussed in more detail later. The cingulate gyrus influences attention and emotional behaviour by detecting errors and is critical for regulating behaviour and intentions. The hippocampus plays the lead role in memory acquisition hence is critical in forming new memories. It has been found to play a role in emotion regulation as well (the third stage of emotion processing) as lesions to the hippocampus and surrounding areas produce not only anterograde amnesia; but also perseveration in neuropsychological assessments such as the Stroop task and oversensitivity towards identification of emotionally relevant stimuli (Lezak, 2004; Zillmer et al., 2008).

Linking the internal states processed by the limbic system to information about the external environment is the frontal lobe, and more specifically, the prefrontal cortex (Damasio & Van Hoeson, 1983). This area makes up the attention, integration, execution and modification station of the human brain, which means that lesions do not actually disrupt cognitive functions but rather affect behavioural programming and reactions to the environment. The medial regions of the prefrontal cortex predominantly affect emotional and social behaviour. Symptoms seen in schizophrenia such as hallucinations and delusions have been linked to abnormalities in the frontal cortex whilst impaired regulation of emotions and behaviour seen in

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bipolar disorder has been attributed to decreased activity in the dorsomedial and dorsolateral prefrontal cortex (Phillips et al., 2003a; Robinson, 2006; Whyte & Mulsant, 2002). Disinhibition (reduced capacity to manage impulsive responses), exaggerated dependency on the environment for cues, and a loss of empathy have also been attributed to the prefrontal cortex networks (Carota et al., 2002).

The subsequent section expands on types of strokes and explores the cognitive and emotional alterations experienced with obstructive or ischemic and haemorrhagic strokes.

2.3. Stroke

A stroke or cerebrovascular accident (CVA) is the most frequently encountered of the cerebrovascular disorders which in fact makes it a privileged disease for human behavioural studies (Carota et al., 2002). In fact it actually consists of a group of vascular disorders that ultimately result in brain injury and thanks to advances in high resolution magnetic resonance imaging techniques; the precise cerebral area and networks affected can be localized (Stern & Silbersweig, 2001). A CVA is in effect a sudden impairment of brain function resulting from the disruption of essential nutrients, glucose and oxygen being carried by the blood to the brain following either occlusion or haemorrhage of an artery (Lezak, 2004; U.S. Department of health and human services centres for disease control and prevention, 2003). It is during this crucial time that the brain is starved of oxygen and glucose that results in initial tissue damage and respective cognitive or emotional deficits. Two mechanisms are responsible for tissue starvation, each with unique symptoms and course yet; in reality,

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these two mechanisms cannot be considered entirely separately as one condition may bring on the other and vice versa (Erlbaum & Benson, 2007).

The ischemic condition occurs when blood vessels are obstructed hence the flow of blood is absent, whilst a haemorrhage occurs when a blood vessel ruptures or bleeds (Lezak, 2004; Rosenberg, 1991). In both cases, it is not only the affected area at risk, but also various pathways leading to and away from the infarction. This can be further complicated by possible secondary damage as a result of intracranial pressure, infection, axonal degeneration or metabolic changes to the neurological pathways involved (Adams et al., 2003).

Relevant to the noted divergence of manifest stroke effect, Sturm et al. (2004) established that there is no significant difference in functional handicap between ischemic stroke and intracerebral haemorrhage two years post stroke while Kelly-Hayes et al. (2003) found that older age at stroke onset had a greater association with disability than stroke subtype. Age, gender and severity of stroke, not stroke subtype, are independent predictors of placement in a nursing home (and thus functional dependence) after stroke (Brown et al., 1999). How does this relate to the present study? Previous studies have indicated that placement in a nursing home (and therefore functional dependence) regardless of the type of stroke; have an impact on depression and quality of life after the stroke (Carod-Artal, 2000). Thus, hemispheric location more so than stroke classification has an effect on neuropsychiatric disturbances and quality of life post stroke.

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Stroke classification accordingly may not affect neuropsychiatric disturbances and quality of life after a stroke, nevertheless, another essential point that does need to be considered is the precise location of the stroke. As every region of the brain has some degree of specialization, damage to a specific area results in alteration of that function (Murdoch, 2010; Powers, 1990). Despite the spectrum of behavioural presentation related to cerebral localisation, general trends have been noted although some discrepancies still exist. Generally, left-sided lesions result in speech and language disorders for example: Broca's or Wernicke's aphasia. Their specific nature however depends on the site and extent of the actual lesion (Carota et al., 2002). Although presentation may vary, both right and left-sided lesions have resulted in manifestation of post stroke depression (Bourgeois et al., 2004; Gainotti, 1983; Murdoch, 1990; Robinson, Kubos, Starr, Rao, & Price, 1984; Robinson, 2006; Singh, Herrmann, & Black, 1998). Individuals with left-sided infarcts tend to exhibit more depressive and catastrophic reactions, whereas individuals with right-sided infarcts have been associated with indifferent reactions, perceptual distortions and visuospatial deficits. In addition, a study on brain damage and personality change after subarachnoid haemorrhage in the early 1970's suggested that an increase in anxiety and irritability was correlated with brain damage at any site (Storey, 1970). More recent studies have consistently found a strong association between development of major depression and left hemisphere damage particularly when damage affects the left frontal cortex and basal region (Bourgeois et al., 2004; Carota et al., 2002; Gainotti & Marra, 2002). Post stroke anxiety disorders are often comorbid with depression and it has been suggested that the combination of anxiety and depression may be more common in left cortical stroke, whereas depression without anxiety may be more common in left subcortical stroke (Bourgeois et al., 2004). Post stroke mania,

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often characterised by irritable and aggressive behaviour, and post stroke psychotic disorder characterised by delusions (with or without hallucinations) have conversely been found to be strongly correlated with right fronto-parietal damage (Robinson & Starkstein, 2002a). Post stroke psychotic disorder can however, often be difficult to distinguish from post stroke cognitive disorders. Finally, less frequently seen symptoms including pathological laughing or crying have also been associated with right-sided stroke. De Haan et al. (1993), in a study measuring quality of life after a stroke recorded that a weak relationship existed between lesion laterality and quality of life. Specifically, it was found that patients with left-sided lesions had more speech pathology and yet, more quality of life deterioration occurred in patients with right-sided lesions. There remain numerous unanswered questions as to why different mood disorders develop with respect to hemisphere damage and the current research seeks consistent results with previous findings.

The consequences of neurological damage and specifically, damage due to a cerebrovascular accident have been discussed; the focus now moves towards personality and the pathways of emotion. Early research on the biological substrates of emotion focused on affect and changes within the autonomic nervous system and subcortical limbic system circuits that mediate emotional behaviours (Heilman, Blonder, Bowers & Valenstein, 1985). Both cortical and subcortical areas are thought to play an important role in emotion (Nelson et al., 1993). Accordingly, prominent neuropsychological theories and functional neuroanatomical systems of emotion, with an emphasis on negative emotional processing, are offered. A preponderance of research has implicated the right cerebrum in the comprehension, reception, expression and even regulation of negative emotions (Heilman et al., 1985). Although

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numerous structures including the anterior cingulate gyrus, hypothalamus, basal ganglia, insular and somatosensory cortex may play a role; the orbitofrontal area and amygdala have emerged as the two brain regions whose primary function is related to emotional processing (Phillips et al., 2003a). Autonomic changes can also co-occur with emotional stimulation and can activate affective memories, thus the heart rate and blood pressure may increase and influence subsequent actions (Gazzaniga et al., 2002; Nelson et al., 1993). Information from a number of brain regions converges in the lateral nucleus and allows for the formation of associations which are essential for conditioning and appraisal of memory. The lateral nucleus then projects to the central nucleus and projections from the central nucleus initiate an emotional response.

Damage to any pathway causes the normal emotion processing pathway to be affected. The cingulate cortex is responsible for interfacing emotion with cognition and consequently, lesions in this area have been associated with apathy, inattention, emotional lability and changes in personality (Grattan et al., 2001). This area is important in evaluative self-monitoring along an affective dimension. The orbitofrontal cortex is comprised of the ventromedial and lateral-orbital prefrontal cortex which serves to regulate social and emotional decision making based on our ability to inhibit, evaluate and act on both social and emotional information. A lesion to this area results in reduced awareness of social appropriateness, impulsive actions and disinhibited behaviour. Thus, the pathway of emotion processing begins with a stimulus that is processed in the amygdala, then projects to the ventromedial prefrontal cortex and the anterior cingulate and finally influences actions through further projection to the prefrontal cortex (Damasio & Van Hoeson, 1983; Nelson et al., 1993; Phillips et al., 2003; Whyte & Mulsant, 2002).

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2.4. Emotion Processing

Various pathways and structures involved in the processing of emotion have been put forward; the next section expands on theories of emotion processing, emotional disturbances following brain injury and their relation to anatomical sites. There is no universally accepted theoretical framework for human emotion although, most emotion processing models have the common understanding that the drive to emotionally express oneself is a natural physiological response to distress and involves mechanisms such as appraisal, subjective experience and expression (Fellous, Armony & LeDoux, 2002; Gazzaniga et al., 2002; Philips et al., 2003a; Nelson et al., 1993). Early neuropsychological theories (Cannon [1929] and James [1884]) emphasized a feedback system however, neglected to differentiate between identification of emotional stimulus and affective responses produced. Appraisalist theories focus specifically on the identification of a salient stimulus and the consequent emotional response. Cummings and Bougosslavsky (2000) however, defined emotion as the experience and expression of feeling states and along that line, Rachman (1980, pp 51) defined emotional processing as the process whereby "emotional disturbances are absorbed, and decline to the extent that other experiences and behaviour can continue without disruption". Emotion processing can thus be understood as comprising of three basic elements:

1) Awareness and identification of emotionally significant information.
2) Labelling the emotion and producing an affective state in response to the stimulus involving autonomic responses, behaviour, and conscious feeling.

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3) Linking the emotional state to causative events, or the regulation mechanism that may involve an inhibition or modulation process dependent on the context.
These processes are clearly interconnected and are supervised by different neural structures (Phillips et al., 2003a).

Emotional awareness is necessary for emotion processing to take place although it is only part of a wider field required for emotional processing. Events that are highly emotional are likely to be registered at both subcortical and cortical levels (Fellous et al., 2001; Lezak, 2004; Nelson et al., 1993). The subcortical route is shorter and rapid whereas the cortical route is longer and slower. In the subcortical route sensory information goes from the thalamus directly to the amygdala. In the cortical route information is sent from the thalamus to both the cortex and hippocampus and is then projected to the amygdala, thus it appears as though there is a qualitative distinction between cortically based and subcortical levels of information processing (Le Doux, 1998). Emotional expression is also seen as an important component of emotional processing as failure to express emotions may be integrally related to failure to properly process an emotional event. A critical review done by Phillips et al. (2003a) used the findings of animals and humans with focal lesions and functional neuroimaging techniques to uncover the neural pathways involved in emotion processing. It was discovered that a ventral system including the amygdala, insula, ventral striatum, anterior cingulate gyrus and prefrontal cortex are primarily involved in the identification of stimulus and creation of affective state processes while a dorsal system including the hippocampus and dorsal regions of the anterior cingulated gyrus and prefrontal cortex are important for regulating the affective states produced in the most appropriate context. This is supported by another study on

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emotion that implicates the anterior cingulate cortex in emotional awareness specifically, the rostral anterior cingulate is considered responsible for phenomenological awareness, whereas the dorsal anterior cingulate is involved in reflective awareness (Lane, Reiman, Axelrod, Yun, Holmes & Schwartz 1998).

The above mentioned model links to items in the emotional processing scale developed by Baker, Thomas, Thomas and Owens (2007) and incorporates labelling, linking and awareness of emotional events under the experience of emotion, signs of unprocessed emotion relates to the actual experience of emotion whilst suppression of emotion, regulation and avoidance of emotions, feelings and bodily sensations, and awareness of negative and positive states relate to control aspects of emotion.

A direct manifestation of emotion is personality. Personality can be understood as the complex encompassment of all the attributes; behavioural, temperamental, emotional and cognitive that characterises a unique individual (Princeton, 2006). The following section expands on personality theories and in particular, the role of personality in neuropsychiatric symptomology.

Personality theories were once thought to only relate to the field of philosophy, sociology and anthropology, however, with the in-depth case study of Phineas Gage and his dramatic personality changes resulting from neurological damage to the medial regions of the prefrontal cortex; came the insight that perception, attention, memory and emotion all interrelate and determine our uniqueness (Carver & Scheier, 2000; Gazzaniga et al., 2002; Stone et al. 2004; Darby & Walsh, 2005). This discovery also allowed for cognitive and psychobiological explanations of personality

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to be sought opening the way for a more sophisticated understanding of the neuropsychological mechanisms underlying personality and ability traits (Gazzaniga et al., 2003; Zillmer et al., 2008). In an empirical study of personality change after stroke using the NEO personality inventory, Grattan et al. (2001) suggested that specific personality trait changes (for example, higher neuroticism and lower extraversion) were identifiable and predicted post stroke depression. Stone et al. (2004) in his study investigating personality change perceived by carers reported that reduced patience, increased frustration and dissatisfaction were among the personality changes that occurred after a stroke.

It is essential at this point to stress that the understanding of personality is dependent on the perspective from which it is explored. Within the neuropsychological context of the present study, a biopsychological perspective has been adopted. As such, personality manifestations are said to be made up of integrated biological process based on a combination of complex genetics, hormones and neurotransmitters (Carver & Scheier, 2000). Personality, or rather, individual differences are said to be controlled by the central nervous system, specifically, the prefrontal cortex and amygdala, thus damage to those areas results in personality change. A limitation of this perspective is that only particular aspects of personality have been investigated not personality as a whole (Gazzaniga et al., 2002). A further limitation that the biopsychological approach to personality has only superficially addressed is the effects of stroke on personality networks.

Evidence of personality change following a brain lesion follows with particular emphasis placed on the mechanism of neuropsychiatric disturbances. First a

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brief distinction between symptoms, signs and syndromes must be made. A symptom or disturbance is any characteristic of a person's actions, thoughts, or feelings that could be a potential indicator of a mental disorder (Bernstein, Penner, Clarke-Stewart, & Roy, 2006). A sign however, is an indication of ill health detected by the medical practitioner. Finally, a syndrome is a constellation of interrelated signs and symptoms manifested by a given individual and often determined by the Diagnostic and Statistical Manual, Fourth Edition, Text Revision (DSM-IV-TR) (American Psychiatric Association, 2000; Bernstein et al. 2007). In the present research only symptoms or disturbances of a neuropsychiatric nature are referred to.

2.5. Neuropsychiatric Symptoms

Distinct patterns of structural and functional abnormalities in the neural systems have repeatedly been shown to be associated with symptoms of certain neuropsychiatric conditions, namely, schizophrenia, generalised anxiety, mood disorder and major depressive disorder (Angelelli et al., 2004; Kaplan, 2005; Stone et al. 2004; Phillips et al., 2003b; Robinson, 2006). Hopelessness, depressed mood, hypersensitivity and social introversion are all symptoms of depression and numerous post stroke depression studies have shown comorbidity with generalised anxiety disorder. Robinson et al. (1984) examined the occurrence of depression after a unilateral cerebrovascular accident in relation to the location of the injury and related depression post injury to dysfunction of the frontal lobe in humans. According to the DSM-IV TR, anxiety is an emotional state involving actual physiological arousal, overt behaviour of avoidance or paranoia and marked interpersonal sensitivities and is manifested in approximately 25-50% of patients in the acute phase of stroke (APA,

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2000; Robinson, 2006). Reduced social awareness, inappropriate familiarity and sexual disinhibition are seen in schizophrenia after a stroke and studies suggest a role of the prefrontal cortex in supervising aspects of empathy and inhibition control as well as being responsible for these unusual affective states (Carota et al., 2002). Mood instability such as emotionalism, inablility to control impulses and excessive anger and aggression are seen when the orbitofrontal cortex is damaged as it is thought to supervise the cognitive aspects of empathy (Carota et al., 2002; Farrow et al., 2001; Ghika-Schmid & Bougousslavsky, 2001; Robinson, 2006; Stone et al. 2004). Psychosis or behavioural symptoms of psychopathic deviate have frequently been reported in acute stroke but the real prevalence is unknown. In these cases, some confusion, changes in mood, behavioural disturbances a lack of concern for social and moral standards is expressed however the mechanisms involved are still unclear (Carota et al., 2002). The incidence of mania in acute stroke is approximately 1% and in most cases is associated with right hemisphere infarcts, usually in the right temporal lobe (Robinson, 2006). Obsessive compulsive disorder or otherwise known as psychasthenia includes a broad range of symptoms such as intrusive thoughts, preoccupations, rituals, self-blame and rigid effects to control impulses although is not often common following a stroke and almost all cases that have been reported occur when the basal ganglia is affected (Angelelli et al., 2004; Kaplan, 2005; Robinson & Starkstein, 2002a). Conversion disorder or hypochondriasis is also not frequently diagnosed after a stroke and a possible explanation presented may be because it usually only occurs in combination with other neuropsychiatric disorders (Chou, Weng, Huang & Chen, 2006). Evidence such as this strengthens the argument that the damage incurred through a stroke leads to severe emotional disabilities and

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ultimately neuropsychiatric disturbances resulting from distortions in emotion processing.

Relative to the discussion on lesion laterality, depression and catastrophic reactions have been associated with left-sided infarcts while indifference reactions and denial have been associated with right hemisphere lesions (Bodini, Lacoboni & Lenzi, 2004; House et al., 2002; Whyte & Mulsant, 2002). Depression has however; been found present regardless of the lesion site; hence studies have further investigated whether different types of depression are experienced by left and right hemisphere stroke patients (Aben et al., 2002; Gainotti, 1993, Lezak, 2004; Lishman, 1987). Studies of the lateralization of emotion in both healthy controls and brain injured subjects, suggest that with respect to depression, there are different characteristics displayed depending on the hemisphere affected. For example, when depression results from a right hemisphere dysfunction, it is characterised by fear, aggression and hostile behaviour, whereas when depression results from a left hemisphere injury, it is characterised more by fear, sadness and perseverative feelings (Armstrong, 1991). Ownsworth and Oei (1998) investigated depression after brain injury and concluded that depression following brain insult results from a complex variety of interacting factors, namely: pre-existing psychiatric disturbance, hemispheric location of injury, insight into deficits and recovery of pre-injury role. Behaviour following any injury is influenced by a host of factors including environmental factors, stage of development, pre-existing medical co-morbidities and personality characteristics prior to the injury (Robinson & Starkstein, 2002a). Following a myocardial infarction (MI) for example, depression, anxiety and mood disorders are a common occurrence with between 10% and 40% of patients reporting

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feeling symptoms of depression after one month (Thombs et al., 2007). Symptoms may relate to adverse long term outcomes for such individuals in view of the fact that where a heart attack does not result in death, a direct relation between severity of depressive symptoms and probability of death has been found (Thombs et al., 2007). After surviving a brain injury such as a stroke that does not result in death but rather in functional deficits, an even greater prevalence exists. Specifically, the worldwide incidence of neuropsychiatric disturbances such as depression within the first five years of stroke is reported to be between 10% and 60% (Angelelli et al., 2004; Bourgeois et al., 2004; Carota et al., 2002; Gainotti & Marra, 2002; Kaplan, 2005; Robinson, 2006). These studies suggest that neuropsychiatric symptoms can occur irrespective of the presence of brain pathology however, it must be noted that a greater proportion of brain injured individuals experience the aforementioned pathologies. As both stroke and heart attack survivors' lives are threatened, and an additional 20% of stroke survivors experience depression, this implies that something in addition to a near death experience is responsible for their symptoms.
Phillips et al. (2003b) considered major depression, bipolar disorder and schizophrenia and demonstrated structural abnormalities and volume reductions within many of the regions implicated in emotion processing. The study further indicated impaired executive and emotion processing that involves a bias towards the identification of emotional information as negative or sad thus suggesting an interaction between functional neuroanatomic abnormalities and impaired regulation of subsequent emotional behaviours resulting in symptoms of psychiatric disorders.

Gainotti, (1993) distinguished three main factors to account for the emotional and psychosocial problems after brain injury. First, there are neuroendocrine

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imbalances and neurological damage brought on by direct brain lesions to some of the important cortical components of the limbic system which results in compromised emotional processing and consequently various neuropsychiatric disturbances. The second factor is a psychological or psychodynamic reaction to the disability subsequent to the stroke as well as awareness of the defect and its implications as to emotion processing and future quality of life. The third factor relates neuropsychiatric sequelae to the consequences of functional impairment on the individual's social network and activities. People who survive a stroke often experience fear, anxiety, frustration, anger and grief for their cognitive and physical losses.

Neuropsychiatric disturbances are a frequent and important consequence of stroke and severity and presentation may differ amongst individuals, but, in spite of the high number of papers aiming for clarification, controversies about the biological and psychological determinants still persist (Gainotti & Marra, 2002). Furthermore, neuropsychiatric disturbances have a negative impact on rehabilitation and functional recovery thus practitioners treating brain injured patients must be aware of these consequences when formulating their treatment plan and incorporate both psychotherapy and pharmacological interventions such as selective serotonin re-uptake inhibitors (SSRIs) to improve depression (Armstrong, 1991; Bourgeois et al., 2004; Paolucci et al, 1999).

It must be acknowledged that any observed behaviours, deficits in emotion processing and neuropsychiatric disturbances are the product of complex interactions involving neurological disabilities, previously established behaviour patterns, current social demands and reactions to all the above (Gainotti, 1993; Gainotti & Marra, 2002;

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Lishman, 1987). The pressing question now moves towards how profound or even subtle neuropsychiatric disturbances and emotion processing relate to quality of life?

2.6. Quality of Life

Measuring quality of life (QOL) is useful if one wants to gain a better understanding of patients' reaction to illness. Furthermore, it can also provide valuable information that can aid the development of therapeutic processes after a stroke. The construct of quality of life has a complex composition, thus it is not surprising that there is no universally accepted definition or standard form of measurement. A multidimensional approach is thus necessary in order to measure QOL. Furthermore, numerous instruments have been designed to measure QOL for highly select groups in the population, for example, individuals undergoing medical treatment. As a result these measures are unsuitable for use with the general population (Cummins, 1997; Felce & Perry, 1995; Williams, 1998). There is a broad consensus that the assessment of QOL should include domains such as subjective experience, life satisfaction, subjective well-being and emotions in addition to physical, functional, psychological and social health (Carod-Artal et al. 2000; de Haan et al, 1993). Quality of life relates closely to the definition of health issued by the WHO as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (World Health Organisation, 1952).

At the patient's level, quality of life can be seen as both objective and subjective: the result of a complex process of interactions between health, productivity, intimacy, safety, community and emotional well-being. The

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comprehensive quality of life scale (discussed in more detail later) is an operationalisation of this definition and is appropriate for use in both the general, or high functioning, and specific, or cognitively impaired, population groups.

Stroke survivors often have significantly lower QOL than control subjects of similar age, even those with only mild consequences of stroke (Carod-Artal et al. 2000). Research has shown the deteriorating effects of depression on the QOL of stroke patients (Carod-Artal et al. 2000; Kauhanen et al., 1999; King et al. 2002). Contrary to these findings, in one study of long-term survivors of stroke, depression was found to be correlated only with leisure time activities (Viitanen et al. 1988). Inconsistent results such as these emphasize the need to determine the effects of not only depression but other neuropsychiatric disturbances as well on quality of life. Furthermore, in terms of caregiving, too much and too little support and protection have been found to lead to an unfavourable quality of life in stroke survivors (Carod-Artal et al. 2000). Research such as this motivates for the necessity to develop individually tailored and multifaceted rehabilitation and support in order to improve QOL in stoke survivors. This in turn motivates for the need to uncover the specific role quality of life plays in emotion processing and neuropsychiatric disturbances after a stroke. The next section explores how cognitive functions and demographic variables in particular may impact the stroke survivor.

2.7. Consequences of a Stroke

2.7.1. Cognitive functions. Cognitive consequences following stroke are not a rare phenomenon affecting only a few survivors; rather, a study by Tatemichi,

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Desmond, Stern, Paik, Sano, and Bagiella (1994) revealed that almost 80% of stroke survivors are left with cognitive problems and between 20-40% of stroke patients have visual, language, memory, orientation, attention and problem-solving difficulties. Cognitive impairment can be a short term problem marked by poor memory and attention however when it persists, it could indicate vascular dementia which according to Censori et al. (1996) is very strongly associated with aphasia. A considerable amount of literature has been devoted towards describing how the loss of motor functions and cognitive abilities in stroke patients can lead to psychological distress and disorders such as anxiety or depression can manifest themselves (Elbaum & Benson, 2007; Gainotti & Marra, 2002; King et al., 2002; Robinson, 2006; Robinson & Starktein, 2002a; Robinson & Starktein, 2002b; Ross & Deverell, 2004; Nelson et al., 1993; Whyte & Mulsant, 2002). Tatemichi et al. (1994) considered the relationship between cognitive impairment after a stroke and functional abilities and concluded that functional impairment (and thus dependent living either at home or in a nursing home was much greater with severe cognitive impairment. Such research indicates that those with a lesser cognitive and functional ability are more likely to have a decreased quality of life.

Memory is comprised of a number of interconnecting systems and subsystems including a long term storage and retrieval system: declarative memory (autobiographical memories, facts and events) and non declarative memory (nonconscious and procedural memories) (Baddeley, 1998). Neuroimaging studies provide support for another memory system, namely short term or working memory which is understood as a temporary store of information (Schacter, Wagner, and Buckner, 2000). Encoding, storage and retrieval are considered the three hypothetical

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stages of memory where the encoding stage registers visual, semantic or acoustic inputs through acquisition and these representations become stronger through consolidation (Baddeley, 1998). The result of this maintenance of information is storage and through the process of retrieval, we access the information by recall or recognition of previously stored information. Following a stroke, memory deficits can occur but the nature of these deficits is largely determined by the lesion site.

Some loss of information occurs continually as normal forgetting. The Freudian view however, hypothesizes that nothing is lost in memory; rather the problem lies in suppression and repression retrieval processes (Lezak, 2004). A study by Anderson et al. (2004) has shown through functional magnetic resonance imaging that specific neural systems are involved in keeping unwanted feelings and memories out of awareness. Controlling unwanted memories was found to be associated with increased dorsolateral prefrontal cortex activation whereas impaired retention of memories was associated with reduced hippocampus activation. There are however, regions in the temporal lobes that are critical for learning and retention as left-sided lesions can disrupt verbal memory, while right-sided lesions can interfere with memory for many nonverbal tasks (Zillmer et al., 2008). Previous studies have shown an association between post stroke depression and severe cognitive impairment, specifically those pertaining to memory (Kauhanen et al., 1999). To rule out these potentially confounding variables and obtain a sample of cognitively unimpaired individuals, patients with severe memory deficits, inattention, and cognitive disabilities will be excluded.

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Language disorders are termed the aphasia's and a number of categorizations exist including expressive aphasia or Broca's aphasia, where verbal fluency is poor but comprehension is intact and Wernicke's apahasia where verbal fluency is good but comprehension, naming and repetition are poor (Carota et al., 2002; Tipping, 2008). Global aphasia is the more severe form of aphasia with almost complete abolition of all linguistic faculties, whilst in anomic aphasia, fluency, comprehension and repetition are good and word naming is poor. Impairment, however of any modality often reflects involvement of other processes, hence agraphia (an inability to write) and alexia (an inability to read) are often found together. Imaging studies of the brain during picture naming, word generation and on patients with brain lesions have led to numerous insights regarding the relationship between language and the brain and assert that any language task relies on a complex set of cognitive processes and representations carried out by an intricate network of neural regions working together (Gazzaniga et al., 2002). Jean- Baptiste Bouillaud collected evidence from brain-injured patients who displayed language problems and concluded that language resides in the frontal lobe. Damage to the inferior frontal lobe of the left hemisphere results in disorders of speech production (Broca's and Global aphasia) while damage to posterior-inferior lateral left parietal and supratemporal areas affect comprehension of language. In line with literature on cerebral localization and neuropsychiatric symptoms, Carota et al. (2002) reported that patients with Broca's aphasia showed intense emotional behaviours, often with a depressive content while patients with Wernicke's aphasia displayed aggressive, irritable and explosive tendencies. This finding is consistent with the notion that left sided injuries tend to result in depressive or catastrophic reactions. The reason for this is thought to be because the damage to critical language areas in the left hemisphere can cause loss of the modulatory

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amygdala effect and therefore catastrophic reaction. Aphasic syndromes however, are not purely correlated with specific functional anatomy. Furthermore, and more obviously, language impairments may affect communicative ability and thus, the reliability of patients' reports. Accordingly, patients with severe forms of aphasia will be excluded from the current study.

Movement disorders following a stroke are a common occurrence and are often observed immediately following a stroke. Alacon, Zijlmans, Duenas and Cevallos (2004) found that 56 patients out of 1500 developed movement disorders up to one year after the stroke. Some physical changes include tremors, spasticity and one of the most common impairments, hemiparesis or paralysis and/ or weakness of one side of the body (Ashburn, 1997; Tipping, 2008; Ward, 2005). Robinson and Starkstein (2002a) suggested an association between personality changes after a stroke, motor impersistence and unilateral neglect, specifically when the right hemisphere is affected. In another study, athymormia, a clinical entity, was defined by Habib as a loss of motivation in the execution of motor actions (even without damage to the motor system). Habib (2000) proposed that the disorder results from damage to the basal ganglia which may indirectly adversely affect the functions of the frontal cortex and consequently the limbic system thereby upsetting the emotional circuitry of the brain. Abulia in a similar light is a condition that occurs with damage to the dorsolateral prefrontal cortex, and individuals with this condition tend to exhibit extreme inertia or an inability to initiate behaviours (Staub & Boguosslavsky, 2001). This apathy or fatigue is often misdiagnosed as depression, however when psychiatric treatment is carried out, it is unsuccessful. The reason for this is because patients with apathy do not necessarily have the sad mood or sense of hopelessness found in

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depression (Carota et al., 2002). Bethoux, Calmels, and Gautheron (1999) considered changes in the quality of life of hemiplegic stroke patients living at home and discovered that quality of life significantly deteriorates with respect to self-care needs, personal relationships and handling life events over time although, interestingly, this was not found to be dependent on the disability level. Motor deficits or functional disabilities clearly affect emotion processing, neuropsychiatric symptoms and quality of life after a stroke, thus patients exhibiting severe movement disorders which could be produce unwanted complications will be excluded from the present study.

2.7.2. Anosognosia. Anosognosia is a well-known symptom after stroke and is manifested through the impaired individual's lack of awareness of their own disability (Lezak, 2004). The condition often occurs when brain injury affects the right hemisphere and specifically, the parietal cortex. Aphasia may confound the rate of anosagnosia after left hemisphere dysfunction, however; the frequency is still greater with right-side dysfunction (Carota et al., 2002). While the condition is often accompanied by amnesia or even neglect towards certain parts of the body; emotional anosognosia may also be present. This poses a possible problem in the current study as the patient may present as cognitively intact whereas aspects of neuropsychiatric disturbances, emotion processing and even quality of life may not be recognised.

The above mentioned potentially hazardous complications including the range of deficits such as the aphasias, anosognosias and athymormias to name a few will be controlled for in the current study. These factors will be addressed by the strict inclusion criteria involving assessments of general cognition, speech and language

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functioning, occupational therapy reports and by making use of reliability scales for the specific measures used.

Risk factors for post stroke psychiatric disorders include female gender, age younger than 60 years, divorce, alcoholism, nonfluent aphasia, major motor and cognitive deficits and nursing home placement (Bourgeois et al., 2004). As the previous discussion considered certain subject characteristics including cognition, language and movement disorders, the next section will build on the role of each demographic variable.

2.8. Demographic Risk Factors

2.8.1. Age and gender. Nakayama et al. (1994) raised the possibility that where the severity of neurological deficits was the same for both genders, women demonstrated more functional problems than men. Confirming this trend, Kelly-Hayes et al. (2003) established that women, more so than men, were more disabled at six months post stroke. He attributed this finding to the fact that women were significantly older (75.1 versus 71.1 years for men) at their first-ever stroke concluding that older age at stroke onset and not gender or stroke subtype were associated with greater disability. Gender therefore may not have implications for functionality post stroke however being female has consistently been found to be significantly associated with lowered health related quality of life and depressed mood following a stroke (Angelelli et al., 2004; King et al., 2002; Nilufer et al, 2005; Robinson & Starkstein, 2002b; Wade et al., 1987). It is thus evident that both age and gender are contributing factors towards stroke recovery and as such need to be

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considered with respect to the demographic description of the sample rather than being accounted for in quantitative analyses.

2.8.2. Education level. Previous studies have indicated that factors such as poor social functioning (for example, below high school education and relationship difficulties) and previous psychiatric history (for example, depression and substance abuse) correlate with depression after a brain injury (Gainotti & Marra 2002; Scicutella, 2007). Stewart, Eales and De Charmoy (2000) found that stroke patients with a higher education status had more knowledge of their medical condition and better quality of life as measured by a decrease in symptoms and better functional capacity. Paulocci et al. (1999) however; found that patients with a higher level of education were more vulnerable to post stroke depression. This was attributed to the fact that they understand their medical condition better and are more likely to have been working prior to the stroke which causes them to become anxious about the possibility of not being able to return to work after. Accordingly, it is necessary to consider education level and its relation to emotion processing, quality of life and neuropsychiatric symptoms.

2.8.3. Marital status. Being married carries a risk for low quality of life in post stroke patients according to Kauhanen et al. (2000). Conversely, single or divorced patients cope well with their impairments. The reason given for this phenomenon was attributed to a spouses' underestimation of the need for support after a mild stroke which ultimately changes the interaction between spouses, and in the family role. Spouses, however, may also react by becoming overprotective and

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overcaring. In a study considering depressed mood after stroke, it was found that living with someone was associated with depression after a stroke (Wade et al., 1987).

In the current research, the relationship between the relevant demographic details alongside the emotion processing, neuropsychiatric disturbances and quality of life variables was considered in order to determine how this multifaceted interaction of behavioural functions is affected by damage through a stroke to any neural structure within the limbic system.

2.9. Research Questions

Is there a relationship between emotion processing, neuropsychiatric symptoms and quality of life after a stroke? What is the underlying structure of correlations between emotion processing, various neuropsychiatric symptoms, objective and subjective quality of life after a stroke?

In order to more fully comprehend these correlations, the stroke survivors' scores will first be compared to normal functioning counterparts. The results of the above will also be explored slightly more qualitatively, taking into account the range of demographic and moderating variables from the patient history. Age, gender, marital status, level of education, and lesion topography will be considered secondary to the chief variables namely, emotion processing, various neuropsychiatric symptoms, objective and subjective quality of life.

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The next section provides insight into some of the issues considered when conducting the research. Specifically, the following section explores how the above mentioned questions were answered. The research design, participants, measures used, data analysis, ethical considerations are discussed in detail.

Chapter Three

Methodology

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3.1. Research Aims

The research primarily aimed to determine the relationship between emotion processing, various neuropsychiatric symptoms, objective and subjective quality of life after a cerebrovascular accident. In order to achieve this, an adult population of high functioning (meaning individuals with intact attention, memory, language, movement and cognitive systems) stroke survivors completed the emotion processing scale (EPS), Minnesota Multiphasic Personality Inventory (MMPI-2) and comprehensive quality of life inventory (ComQOL -A5). Their respective scores were computed and analysed through a factor analysis with the purposes of exploring how each of the variables related to one another. Specifically, the research sought to discover the structure of this proposed relationship between emotion processing, various neuropsychiatric symptoms, objective and subjective quality of life amongst stroke survivors. Subjects were also compared to normal controls in order to place the

stroke survivors in context and determine if any differences between them and a normal population existed.

3.2. Research Design

A variable is the construct under investigation in research and must take on different values (Rosenthal & Rosnow, 1991). Variables in the present study were not influenced in any way but rather measured for the purposes of determining co-variation and their respective degree of association. Correlational research seeks merely to find relationships where they exist rather than to determine causality, thus as the current research did not seek a cause and effect relationship, no strictly independent and dependent variables could be defined. Quantitative research is suited towards theory testing and provides a "general" picture of a situation whereas, to some degree, it neglects the participants' understanding and perceptions that qualitative inquiry does provide (Schultz, 2003). Neither approach succeeds in encompassing human beings in their full capacity; rather a combination of both quantitative and qualitative approaches can provide breadth as well as depth (Mouton & Marais, 1990). The research design of the following study was thus primarily quantitative in nature (although non-experimental) with slight qualitative detail and as such; the three variables were correlated with each other and then trends were explored in a more qualitative fashion.

This research drew on a non-probability purposive sampling technique; therefore, the participants were selected according to certain criteria which served the purposes of the research. Although this resulted in a small sample size; this sampling

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technique was considered to be suitable for the present study as the aim was to merely explore relationships as opposed to attaining strong external validity (Rosenthal & Rosnow, 1991). Research in neuropsychology often does not involve large sample sizes as generalisability is replaced with depth, or rather, quantity is replaced with quality (Caramazza & Coltheart, 2006).

The current study adopted a dominant less-dominant design in that the study was conducted within a single quantitative paradigm; however a small component of the overall study was qualitative (Schultze, 2003). The emphasis was on exploring a relationship between the variables: emotion processing, neuropsychiatric symptoms and quality of life. A secondary focus was on attaining a deeper understanding these relationships by exploring each variable in more detail and comparing stroke survivors with normal functioning individuals. Demographic variables included age, gender and marital status, level of education, stroke classification and lesion topography.

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3.3. Participants

The research was conducted at two private stroke rehabilitation centres in the Johannesburg region where stroke, motor vehicle accident, and traumatic brain injury patients undergo rehabilitation. All subjects volunteered to participate however; only volunteers with specific criteria were included. Age, gender, marital status and level of education were noted in order to consider the role played by demographic variables. Language preference was also noted in order to ensure only subjects fluent in English were tested. The criteria were as follows:

Temporal criteria: Only stroke survivors within the acute stages (up to five years post stroke) and no earlier than two months after the stroke.

Neuropsychological criteria: Only stroke survivors with adequate levels of awareness, attention, perception, communication, memory and higher executive functioning (adequate abstract reasoning, attentional focusing and set shifting) were included. Individuals were thus considered to be high functioning. Patients with severe agnosia (failure to recognise familiar objects), amnesia (disorder affecting memory), alexia (disorder of reading and writing), aphasia, ataxia (disorder of muscle coordination), anosognosia and cognitive decline were excluded. This information was obtained through the collateral information of the neuropsychologist, speech and hearing therapist as well as the occupational therapist.

Neurological criteria: Individuals suffering from the consequences of cerebral ischemic or haemorrhage conditions were considered. Individuals with previous stroke, non-cerebral involvement, those who had undergone surgery or had a history of psychiatric or substance abuse were excluded. Patients taking antihypertensive and psychotropic drugs were not disqualified however the prescribed medications were noted for possible further investigations. This information was obtained through the neurologists report, and in some cases was often accompanied by CT scans.

Twenty one individuals (10 men, 11 women, M_{age} = 53.5 years; S =11 years, age range: 35-70 years) who had survived a cerebrovascular accident met the required criteria (see Table 1 for demographics).

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Table 1

Summary of the Demographic Information of the Stroke Survivors

Demographic results (n = 21)	**No. (%)**
Age distribution	
31 – 40	3 (14)
41 – 50	4 (19)
51 – 60	7 (33)
61 – 70	7 (33)
Gender	
Male	10 (48)
Female	11 (52)
Marital status	
Single	4 (19)
Married	8 (38)
Divorced	6 (29)
Widowed	3 (14)
Level of education	
Below grade 12	1 (5)
Grade 12	11 (52)
University	9 (43)
Stroke classification	
TIA	5 (24)

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Haemorrhage	16 (76)
Lesion topography	
Right Hemisphere	9 (43)
Left Hemisphere	10 (48)
Bilateral	2 (10)

Participants did differ in race and included White, Black, Coloured and Indian individuals although it should be noted that the majority were White. Single, divorced, married and widowed men and women made up the sample. All subjects were within a similar middle to upper class socio-economic status as all were being treated at private rehabilitation centres. The precise location of the stroke was not the same for every individual although, in general areas affected included the prefrontal and frontal cortex of the parietal and temporal lobes. Every participant sustained damage to a specific cortical area within the limbic system and there were two individuals with midline lesions. The range of areas affected is summarized in Figure 1.

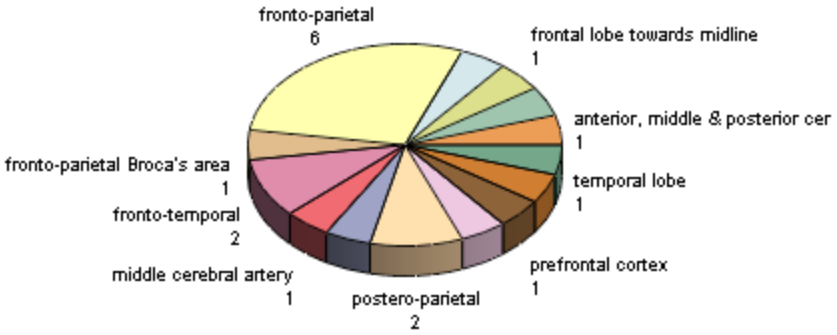


Figure 1. Pie graph showing the cortical areas affected by stroke

3.4. Instruments

3.4.1. Functional mobility. Activities of daily living including: continence, feeding, dressing, self-care, mobility, indoor and outdoor domestic activities as well as social functioning had previously been recorded by the occupational therapist through the Frenchay Activities Index and Barthel Activities of Daily Living Index. These widely used stroke specific measures assess a broad range of activities associated with everyday life as well as functional disability (Holbrook & Skilbeck, 1983; Wade & Collin, 1988). These records were taken to ensure that strictly functionally independent subjects were included. That is to say: only subjects who were continent, mobile and able to participate in household maintenance, domestic chores and social activities were included.

3.4.2. Neuropsychological functioning. Neuropsychological and cognitive functions assessed ranged from orientation, attentional processes, verbal comprehension, mental tracking, long and short term memory, visuospatial perception, planning, information processing speed, higher frontal lobe tasks such as abstract reasoning and response inhibition to error checking. Psychometric measures used included the Rey Auditory-Verbal Learning Test, Stroop Colour Naming, Trail making A and B, Controlled Oral Word Association Test in addition to various subtests of the South African Wechsler Adult Intelligence Scale namely, Digits Forward and Backward, Symbol-Digit Substitution and Block Design test (Groth-Marnat, 2003; Lezak, 2004). The attending psychologist had previously assessed

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majority of the aforementioned measures and subjects had performed within the normal range on these tests. Where not previously included in the assessment, the researcher administered the tests. This was done in order to ensure that each participant fell within a normal cognitive range consequently fulfilling the specific selection criteria although no further investigations were performed on this data.

3.4.3. Emotion processing. The Emotional Processing Scale (EPS) (refer to Appendix A) is a 25 item test with a 10 point response scale designed to identify emotion processing styles and deficits (Baker, Thomas, Thomas, Gower, Santonastaso & Whittlesea, 2010). Five factors make up the scale and these include impoverished emotional experience (poor emotional insight), signs of unprocessed emotion (persistent emotional experiences), avoidance of emotional events, suppression or excessive control of emotional experience and expression and unregulated emotion (inability to control one's emotions). Items measuring avoidance of emotion considered where emotion processing occurs but is detached or avoided because they are felt to be negative (Baker, Thomas, Thomas, & Owens, 2007). The scale has also been used to detect differences between diagnostic groups for example, significantly different patterns were found between mental health patients from healthy individuals ($t_{408} = 12.3$, $p < 0.001$) (Baker et al., 2010). Factor analytical studies on the EPS were conducted using a wide collation of data from a wide variety of populations comprising 690 (201 females; 86 males) individuals half of whom had university degrees and were aged from 25 to 66 and onwards. Participants included normal healthy controls whom had been recruited from the community in addition to a mental health group that had been referred to a general practitioner or clinical psychologist for a range of mental health problems. A pain group was included and were made up

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of outpatients suffering from fibromyalgia, rheumatoid arthritis and chronic lower back pain. Research has supported the internal consistency and temporal stability reliabilities of the EPS. Baker et al. (2007) found split half reliabilities ranged from .88 to .92, test re-test (4 to 6 week intervals) reliabilities ranging between .48 and .84 and internal consistency of the entire scale was found to be .90. This scale has mainly been used in the research context although, as the current research is explorative in nature rather than clinical, it should not impact on the study and caution should be taken as to generalisability. It should also be noted that the psychometric properties of the EPS are still undergoing evaluation but support for the scale thus far has been achieved.

Emotional experience relates to the awareness, labelling, and linkage of events which is measured through the subscale for impoverished emotional expression. Emotional processing relates to the actual experience of emotions and is only measured through the subscale for signs of unprocessed emotion. Finally, the control aspect of emotion relates to the subscale for avoidance, suppression and unregulated emotion. Emotion processing is thus made up of the scores for each of the five separate domains involved in overall emotion processing: suppression, unprocessed emotion, unregulated emotion, avoidance of emotion and impoverished emotional experience, and as per procedure, this score was then averaged into one comprehensive emotion processing score. A high overall score indicates the presence of emotional avoidance as well as unregulated, suppressed, unprocessed and impoverished emotional experience.

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3.4.4. Neuropsychiatric disturbances. The Minnesota Multiphasic Personality Inventory (MMPI-2™) published in 1989 is one of the most widely used and researched instruments to measure psychiatric qualities of personality and is suitable towards assessing personal maladjustment and emotional status such as hysteria, paranoia, depression and social introversion hence will be used to assess neuropsychiatric disturbances or symptoms (Butcher, Atlis & Hahn, 1989; Graham, 2005; Groth-Marnat, 2003; Lezak, 2004). The content of the self-report instrument is obvious and at large deals with psychological, neurological, psychiatric and physical symptoms. Items covered reflect a person's preoccupation with physical problems of a psychological basis, depressed mood, specific physical complaints and inability to deal effectively with life stresses. Antisocial acts or feelings, hostility and/or anger, stereotypic gender roles or interests, feelings of suspiciousness or wariness, feelings of anxiety, concern, obsessive thoughts and also general maladjustment are assessed. Bizarre thoughts and psychotic behavior, feelings of isolation, excessive energy and erratic behavior and finally social shyness and a preference for solitude are among the clinical symptoms assessed. The test contains 567 items although as it has been criticised for its length, this can be countered by using only the first 370 items that cover the ten traditional clinical scales and four validity scales (Cohen & Swerdlik, 2005). The remaining items provide supplementary information.

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The 10 clinical scales are:

0. Social Introversion scale (Si): includes 69 items measuring social shyness, lack of social assertiveness and a preference for solitude.
1. Hypochondriasis scale (Hs): includes 32 items that reflect a person's preoccupation with somatic symptoms and a self-centered orientation.

2. Depression scale (D): includes 57 items designed to assess feelings of hopelessness and melancholy but also serves to indicate certain personality features such as hyper-responsibility and extreme discipline.
3. Conversion Hysteria scale (Hy): includes 60 items concerning reactions to stress that involve the development of physical disorders or discomforts but some denial and lack of social anxiety are also measured.
4. Psychopathic Deviate scale (Pd): includes 50 items reflecting a lack of concern for social and moral standards in addition to hostility and/or anger.
5. Masculine-Feminine Interests scale (Mf): includes 56 items that measure stereotypic gender roles or interests in terms of interests and emotional reactions but is not usually interpreted clinically.
6. Paranoia scale (Pa): includes 40 items that reflect noticeable interpersonal sensitivities as well as a bias to misinterpret the actions of others.
7. Psychasthenia scale (Pt): includes 48 items measuring generalized feelings of anxiety and distress (or negative emotionality) in addition to rigid effort to control impulses or obsessive thoughts and general maladjustment.
8. Schizophrenia scale (Sc): includes 78 items that reflect feelings of isolation, bizarre thoughts, unusual experiences and psychotic behavior.
9. Hypomania scale (Ma): includes 46 items that would indicate excessive energy, extraversion and erratic behavior. Over-ambition and extroversion however can also be determined on this scale.

In practical application of the MMPI-2™, between 60 and 90 minutes are required to complete the test and can be a tedious process even for intact adults thus each patient was given an extended amount of time for completion with breaks and

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where required, verbal assistance was provided. Standardised norms for this measure are based on a number of different population samples including psychiatric patients, peace officers and university students. Raw scores of the MMPI-2™ are converted into T scores (*mean* of 50; *standard deviation* of 10) and T-scores of 65 or higher are indicative of clinical significance. Interpretation of the MMPI-2™ is based on overall scale patterns not on any particular response (Butcher, Atlis et al., 1989). In the present study, these elevated scores signify neuropsychiatric symptoms or disturbances.

A wealth of reliability and validity studies support the continued use of the MMPI-2™ and provide information about the subject's competence to take the test, denial of real problems and even test-taking attitudes (Groth-Marnat, 2003). Unfortunately, strong measures have not been established for severely neurologically impaired subjects. Nevertheless, some pattern tendencies tend to characterize the responses of patients with neurological abnormalities thus; as the current study will include participants without severely compromised cognitive abilities, responses should not be inconsistent and the test will lend understanding to reactions to neurofunctional impairment.

Validity scales for the MMPI-2™ originally developed by Hathaway and McKinley includes cannot say (?), deliberate lies (L), and denial of psychopathology and defensiveness (K). Scale L was designed to detect defensive responding or "faking good" (Lezak, 2004). Finally, infrequent responses or scale (F) was designed to detect exaggerated symptoms or "faking bad". These validity scales have been found effective for their task of detecting inconsistencies that could invalidate the

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clinical scales. For the purposes of this research, an in depth analysis of the validity scales was carried out to rule out individuals either exaggerating or denying symptoms as in the case of anosognosia that may have gone previously undiagnosed.

Psychometric characteristics of the validity and clinical scales of the MMPI-2™ suggest moderate internal consistency as testified by a meta-analysis of studies over a wide population with sample sizes exceeding 5000. Intercorrelations of the scales are reported as high and this is thought to be because of the way in which the scales were developed. Specifically, items within the scales were selected based on their differentiation of normal from various psychiatric populations rather than on differentiations between psychiatric populations (Groth-Marnat, 2003). Another explanation for item overlap is attributed to the complexity of pathological syndromes. Depression for example, is a common category amongst numerous psychopathologies thus it is theoretically related to hypochondriasis, anxiety and schizophrenia. In sum, moderate to high reliability correlates for both males and females and have been summarised in Table 2 (Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989).

Table 2

Cronbach's Alpha Correlations Highlighting the Psychometric Qualities of the MMPI-2™

Psychometric properties		**Males**	**Females**
Test-retest reliability		.67 – .92	.58 – .91
Internal Consistency	**Validity scales**	.62 – .74	.57 – .72
	Clinical scales	.58 – .85	.39 – .87

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The researcher decided against using the content scales of the MMPI-2 as these scales were designed to explore the clinical symptoms in considerable detail and as such could unnecessarily complicate the investigation. The study sought to explore relationships only around neuropsychiatric symptoms or disturbances, thus only the ten clinical scales were used to represent underlying symptoms of neuropsychiatric disturbances.

3.4.5. Quality of Life. There are seven domains measured by the Comprehensive Quality of Life Inventory (5th edition) (ComQOL –A5) and the construct of quality of life is measured along three axes: objective quality of life (OQOL), as in objective well-being, importance of quality of life (IQOL), as in perceived importance to the individual and finally an index of subjective quality of life (SQOL), that considers the satisfaction of each domain weighted by the perceived importance of that domain (Cummins, 1997). The domains are as follows:

- Material well-being
- Health
- Productivity
- Intimacy
- Safety
- Community
- Emotional well-being

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These 7 domains are measured in 3 sections. Section 1 contains 21 items measuring OQOL on a 5 point likert scale. Section 2 and 3 measure SQOL with section 2 assessing IQOL across all 7 domains and section 3 assessing satisfaction with quality of life, however this measure is along a 7 point likert scale (Cummins, 1997). In terms of the domains, material well-being considers income, possessions and accommodation, health factors include medication, disability and visits to the doctor. Productivity incorporates work, education, spare time and hours spent watching television. Intimacy is measured through conversation, caring and activities, safety includes anxiety levels, home environment and sleep fulfilment. The domain of community considers various activities, responsibilities and advice giving and finally, emotional well-being takes happiness, fulfilled dreams or wishes and independence into account.

The reason for separate axes for objective and subjective quality of life is because research into quality of life generally reports that these components have a poor relationship to one another, for example, in the domain of health: physical health and perceived health are very poorly correlated (Felce & Perry, 1995). Furthermore, importance and satisfaction have been found to be positively correlated with one another hence the subjective aspect of quality of life is weighted by the satisfaction with and importance to the individual. In the present research objective quality of life and subjective quality of life were included as measures of the variable: quality of life.

The scale is ideal for use as both a research instrument and a standardized test thus it suitable for use in the diverse South African context and is supported by normative data. It is psychometrically sound: reliable, stable, valid and also sensitive.

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Internal reliability as measured by Cronbach's alpha for OQOL is reported as $\alpha = .54$, IQOL is reported as $\alpha = .69$ and satisfaction with quality of life is reported as $\alpha = .81$. Test-retest reliability (at a two week re-test) for all three axes falls between .84 and .86. Finally, studies have supported the construct convergent validity (Ferris & Bramston, 1994; Sim, Mahendran & Chong, 2005). According to McAlinden and Oei (2006), the ComQOL –A5 shows consistent, concurrent, discriminant predictive and criterion related validity. The ComQOL - A5 has an alternative test for mentally compromised groups, however as the participants were high functioning and had average to above average intelligence the ComQOL - A5 was considered to be an appropriate measure.

In order to make the scores on the Comprehensive Quality of Life Scale meaningful, each domain score was calculated, totalled, and considered separately. It is however, useful to compare the relative extent of objective, importance and subjective quality of life, in relation to a domain. Along this line, and following standard protocol of the test, raw scores were transformed through a conversion formula and expressed as a standardised comparison statistic or *%SM*. Transforming the data in this way allowed for the interpretation of this group's data in terms of the population standards for *%SM;* specifically, inter-population means for life satisfaction in Western nations have been used as a reference point as Cummins (1996b) established the content validity from the 7 domains combined as 75 ± 2.5*%SM*. Thus, separate scores were obtained for quality of life, each of which comprised a total score that factored in the seven domains measured by the ComQOL. These were objective quality of life (OQOL), subjective quality of life (SQOL) and importance of quality of life (IQOL).

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3.5. Procedure

Permission from the Human Research Ethics Committee (HREC) (medical) was obtained and following that, the heads of the two stroke rehabilitation units in the greater Johannesburg region. An information sheet invited stroke survivors to participate in the research. Those who wished to participate signed a consent form and only volunteers that satisfied the above mentioned criteria were included in the study. The neurologist's report (and where available CT scans as well) was reviewed in order to determine the date of the stroke in addition to the particular stroke classification and location of brain lesion. The occupational therapist's report was considered in order to establish that the subject fulfilled the criteria of functional independence. Both the speech and hearing therapist as well as the neuropsychologist reports were reviewed as they described the cognitive capacity of the volunteer and detailed their psychological assessments (precise measures mentioned above). Only volunteers that fulfilled the specifications for inclusion in the study then completed a demographic questionnaire specifying their age, gender, race, language preference, marital status and education level. The researcher then administered the three scales and responses were recorded. Prior to administration of the tests, the researcher underwent training with a registered psychologist to ensure accuracy of procedure, administration and scoring of the tests. In order to establish optimum standardized test conditions, testing was carried out in a private, comfortable and quiet room. First, the Emotion Processing Scale was administered to ascertain how emotion is processed by the subject that took approximately 20 minutes to complete. The MMPI-2 was then administered and in some cases, where requested, statements were read aloud (in

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order to prevent fatigue) while the subject marked their responses. Administration of the MMPI-2 took between 90 and 120 minutes to complete as breaks were included. Finally, the ComQOL-A5 was administered in order to measure quality of life, and testing took approximately 20 minutes to complete. Cognisant of patient fatigue levels; and the therapeutic programme under which subjects were in rehabilitation, when necessary, the researcher completed the data collection process over an extended amount of time and included breaks. Scores were then computed and interpreted by the researcher according to the guidelines provided by each test manual. Each patient was offered a session in which generalised results of the study could be presented however all participants declined.

3.6. Ethical Considerations

An application was sent to the Committee for research on Human Subjects (Medical) at the University of the Witwatersrand (see Appendix D). Once a clearance certificate was obtained, permission from the rehabilitation centres was confirmed. An information sheet was provided about the study detailing its requirements, the voluntary nature of participation, and withdrawal without penalty, confidentiality, and potential contributions of the research (Appendix B). As an added measure, respective caregivers were also provided with an information sheet detailing the study. Informed consent was then obtained from all participants in the study at the time of data collection and subjects were informed of their right to withdraw at any time and that confidentiality was guaranteed (Appendix C). Anonymity could not be assured as testing only commenced once a rapport had been established with the subject. As the research participants were immersed in a therapeutic programme and testing was

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conducted with cognisance of this process, with the consent and wishes of both stake holders, it was suggested that once completed, the generalised results of the research would be made available in order to enhance understanding, analysis and rehabilitation. Ethical clearance was granted from formal structures within the University of the Witwatersrand (Appendix E).

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Chapter Four

Results

4.1. Introduction

The results section provides an overview of the statistical procedures carried out in order to explore the relationship between emotion processing, neuropsychiatric symptoms and quality of life. All analyses were performed on the combined sample of stroke survivors. Scores from the tests were calculated and produced an overall interval scaled numerical value which was then used as a measure for each quantitative variable. A 95 % confidence interval was selected thus only probabilities less than 0.05 were considered to be significant. Reliabilities of the instruments was assessed through Cronbach's alpha correlations in order to establish sufficient internal consistency, following that, descriptive statistics explored the stroke survivor's dynamics in more detail and placed the stroke survivor group in context with both a normal population and mental health subjects. Cognisant of the large number of

variables to be correlated; specifically emotion processing, objective and subjective quality of life and the ten separate neuropsychiatric symptoms; a factor analysis was considered the most appropriate method of analysis in order to simultaneously reduce the number of variables and determine correlations between variables, thereby addressing research questions one and two (Howell, 2004). Factor analysis does however have certain prerequisite assumptions which prior to carrying out this procedure were tested and satisfied. The statistical programme used to carry out all calculations was SAS Enterprise Guide.

4.2. Instrument Reliability

Although the instrument validity and reliability correlates of the measurements have already been mentioned, Pearson's correlations and Cronbach's coefficient alphas were calculated in order to establish instrument reliability for the present sample (see Table 3).

The total EPS including all five aspects of emotion processing produced a Cronbach's alpha of .68. Pearson's correlations showed significant relationships between unprocessed emotion and unregulated emotion (r = .76; p < .0001) as well as between avoidance and impoverished emotional experience (r = .48; p = .02). Suppression did not correlate with any other measures of emotion processing but had a mild negative relationship with unprocessed emotion (r = -.40; p = .06). When excluded from the overall emotion processing scale and reassessed for internal consistency, an overall Cronbach's alpha of .80 was obtained.

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Table 3

Internal Consistencies as Measured through Cronbach's Alpha for Subscales of Emotion Processing, Neuropsychiatric Symptoms and Quality of Life

	Variable	Cronbach's coefficient Alpha
Level of Emotion Processing	**Suppression of Emotion**	.78
	Unprocessed Emotion	.77
	Unregulated Emotion	.76
	Avoidance of Emotion	.76
	Impoverished Emotional Experience	.70
Neuropsychiatric symptom	**Hypochondriasis**	.78
	Depression	.77
	Conversion hysteria	.77
	Psychopathic deviate	.76
	Masculinity/ femininity	.81
	Paranoia	.76
	Psychasthenia	.77
	Schizophrenia	.74
	Hypomania	.83
	Social introversion	.80
Domain of Quality of life	**Material related quality of life**	.48
	Health related quality of life	.51
	Productivity related quality of life	.45

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Intimacy related quality of life	.42
Safety related quality of life	.54
Community related quality of life	.42
Emotion related quality of life	.54

For the measure of neuropsychiatric symptoms, Cronbach's coefficient alpha for the MMPI-2 comprising all ten clinical subscales was found to be .80. Pearson'*r* correlations between the scales yielded a number of significant relationships most of which were positive. Depression related to hypochondriasis (r = .47; p = .003), conversion hysteria (r = .55; p = .009), psychasthenia (r = .55; p = .009), schizophrenia (r = .58; p = .005), and social introversion (r = .61; p = .003). Hypochondriasis had a remarkably strong relationship with conversion hysteria (r = .87; p <.0001) but only a moderate one with paranoia (r = .51; p = .01). Conversion hysteria had similar moderate relationships to paranoia and psychasthenia (r = .55; p = .01 and r = .53; p = .01). Psychopathic deviate displayed a very strong relationship with schizophrenia (r = .73; p = .0002) but considerably less so with paranoia (r = .57; p = .006). Hypomania was the only scale that did not relate to any other psychiatric disorders. Internal consistencies as measured by Cronbach's alpha values for each separate domain are summarised in Table 3.

Finally, OQol produced a Cronbach's alpha of .79, IQol produced an alpha of .86 and finally, satisfaction with quality of life produced a Cronbach's alpha of .77 across all seven domains. Pearson's correlations between the three subscales of quality of life produced moderately positive relationships between objective and subjective quality of life (r = .44; p = .04) but very weak negative relationships

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between importance, subjective *(r* = -.16; *p* = .48) and objective quality of life (*r* = -.15; *p* = .51).

4.3. Descriptive Statistics

Means (*M*) and standard deviations (*S*) of the stroke survivor's scores were calculated for each of the variables of interest and their respective components (summarised in Table 4). In order to place the stroke survivors into context and hence compare their levels of functioning, their raw scores were converted into standardised scores according to the respective test manuals and compared to a normal population. The EPS is not a standardised measure and as such, the raw scores from this test were compared to a normal population based on UK data in addition to mental health patients (with anxiety, depression and/or personality problems) by means of a *t* test. Each variable is considered separately.

Table 4

Descriptive Statistics: Mean Raw Scores and (Standard Deviations) of the Stroke Survivors

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Variable		Stroke Group N = 21	Normal Population
Level of Emotion Processing	Suppression of Emotion	5.39 (1.91)	3.55 (2.03)
	Unprocessed Emotion	6.02 (1.97)	4.03 (2.18)
	Unregulated Emotion	5.87 (1.94)	3.24 (1.76)
	Avoidance of Emotion	5.89 (1.37)	3.25 (1.85)
	Impoverished Emotional Experience	4.80 (1.95)	2.52 (1.75)
Neuropsychiatric symptom	Hypochondriasis	17.0 (6.06)	4.92 (3.87)
	Depression	25.5 (8.08)	18.3 (4.59)
	Conversion hysteria	25.3 (5.88)	20.9 (4.73)
	Psychopathic deviate	26.9 (5.65)	16.6 (4.60)
	Masculinity/ femininity	23.9 (10.5)	26.0 (5.08)
	Paranoia	13.5 (3.87)	10.1 (2.87)
	Psychasthenia	33.7 (6.91)	11.2 (6.61)
	Schizophrenia	39.2 (8.34)	11.2 (7.12)
	Hypomania	26.1 (4.89)	16.9 (4.51)
	Social introversion	29.6 (10.6)	24.7 (8.84)
Quality of Life	Objective	43.5 (11.2)	75.0 (18.0)
	Subjective	57.7 (14.0)	70.9 (18.0)
	Importance	68.9 (10.8)	70.1 (18.0)

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4.3.1. Emotion processing. No significant differences were found between the stroke survivors and mental health patients as is graphically evident (see Figure 2). Stroke survivors and the normal population did however differ significantly ($t = 10.18$, $p < 0.05$). The size of this difference was large ($d = 2.53$).

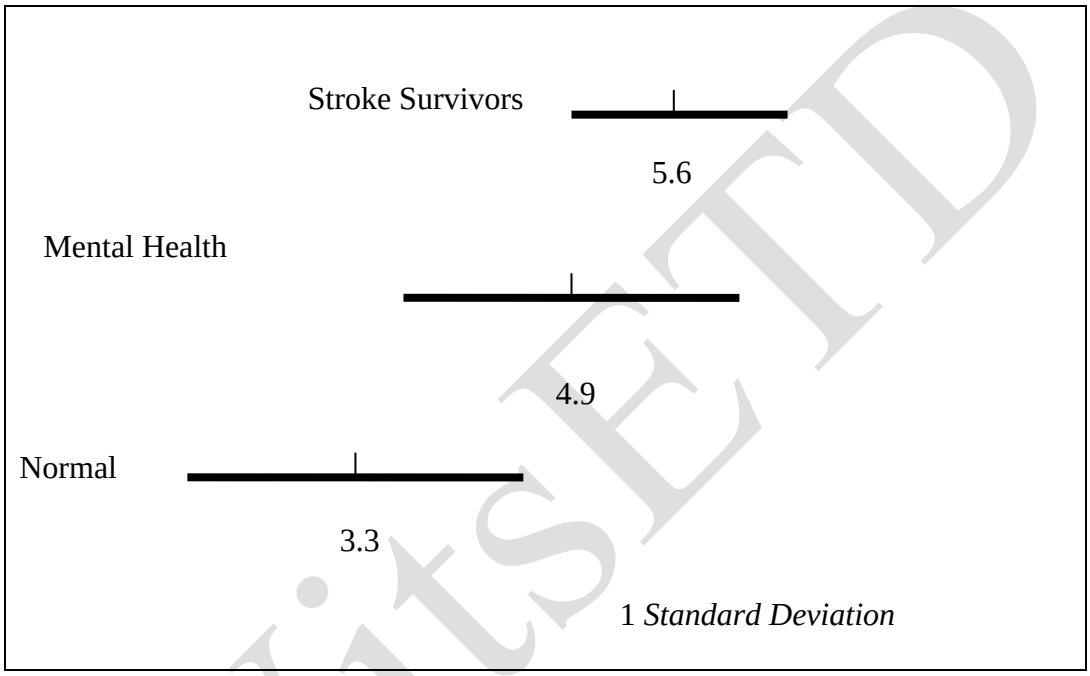


Figure 2. Line diagram comparing the stroke survivors to a normal population and mental health patients.

With respect to emotional experience and hence the labelling or linking of emotional events, the impoverished emotional experience subscale, highlighted that stroke survivors yielded a mean score of 4.8, the mental health patients scored a 4.0 while the normal population controls scored much lower with a mean value of 2.4. In the stage of emotion processing that relates to the actual experience of emotions (the signs of unprocessed emotion subscale), stroke survivors scored 6.02, mental health

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patients scored 6.03 while the normal population scored 4.03. Finally, the control aspect of emotion processing relates to three factors, namely the avoidance, suppression and unregulation of emotions. On these subscales, stroke survivors scored 5.89, 5.39 and 5.87 respectively; while mental health patients achieved a 4.86, 5.07 and 4.37. Finally, the normal population yielded an average avoidance score of 3.24, suppression score of 3.55 and unregulated emotion score of 3.25.

A remarkable finding from this comparison was not strictly limited to the stroke survivors displaying significantly elevated emotion processing than the normal population; it is interesting to note that across all five subscales of the EPS, the mean scores of the stroke patients and those of the mental health patients fell within a similar range. Thus, when compared to a mental health group, the stroke survivors' means were more appropriately matched.

4.3.2. Neuropsychiatric disturbances. Stroke survivors exhibited valid profiles and a range of neuropsychiatric symptoms. Their mean score on the lie scale (M = 58.4) fell within the modal range meaning they approached the test in a comfortable manner and neither over nor under-emphasised various pathologies. Their moderate to high score of 69.8 on the infrequency scale did not invalidate their profiles but intimated that to some degree, unusual feelings or reactions to special circumstances. A result such as this reflects that the sample was experiencing emotional problems of a significant degree, and may have been manifesting clinically severe neurotic or psychotic disorders. In terms of test defensiveness, the sample yielded a mean score of 38.9 indicating that on average, the subjects were experiencing severe distress but that this distress was being openly acknowledged.

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Thus, the stroke survivor's responses appeared to be valid, honest, and indicative of some clinically significant emotional problems. The results of the clinical and validity scales are consistent in that the subjects were experiencing emotional distress and moreover that this distress occurred in the form of neuropsychiatric disturbances, with some symptoms more severe than others.

Response patterns of the stroke survivors on the ten clinical scales are illustrated in Table 5 (both men and women together). Clinically significant *T* scores ($T > 65$) were evident for three scales indicating that the sample was characteristic of poor adjustment levels and likely experienced difficulties carrying out basic responsibilities beyond those related to their degree of impairment consequent to the stroke. The clinically relevant scales were 2 (D), 8 (Sc) and 9 (Ma). This does not necessarily mean that all subjects were depressed, schizophrenic and hypomanic but rather, it implies that stroke survivors' behaviours were most characteristic of depressive symptoms, feeling misunderstood and isolated from social environment with high levels of excitability. Mania is not indicated as a low score on scale 2 combined with a high score on scale 9 was not apparent. It is also worth noting that the stroke survivors scored in the moderate to high range for hypochondriasis, conversion hysteria, psychopathic deviate and paranoia suggesting that they did express some preoccupation with physical symptoms, moderate emotionality, anger and mistrust although not significantly so.

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Table 5

Mean T Scores of Stroke Survivors on the 10 Clinical Scales of the MMPI-2

Scale	Neuropsychiatric symptom	*T* Score			Interpretation	% Sample Symptomatic
		Men & Women	Men	Women		
1 Hs	**Hypochondriasis**	59.3	58.1	60.4	Moderate	28.6
2 D	**Depression**	64.6*	65.5*	61.3	High	33.3
3 Hy	**Conversion hysteria**	58.7	57.4	59.9	Moderate	19.0
4 Pd	**Psychopathic deviate**	60.5	58.7	62.2	Moderate	29.6
5 Mf	**Masc/ femininity**	46.2	33.6	57.6	Modal	19.0
6 Pa	**Paranoia**	61.8	56.2	66.8*	Moderate	19.0
7 Pt	**Psychasthenia**	63.1	60.9	65.2*	Moderate	47.6
8 Sc	**Schizophrenia**	71.1*	66.7*	75.1*	High	57.1
9 Ma	**Hypomania**	67.9*	59.8	75.2*	High	66.6
0 Si	**Social introversion**	54.2	59.9	51.7	Modal	19.0

Note. Significant symptoms indicated by * *(T > 65; p < 0.05)*

From this, behaviours characteristic of bizarre thoughts and schizophrenic disturbances produced the most elevated *T* score with more than half of the sample symptomatic. The most prevalent symptom within the sample was characterised by

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hypomania and women scored far higher than their male counterparts on this scale. As scales 5 (Mf) and 0 (Si) were not elevated, this indicates that characteristics suggested by other elevated scores were not being suppressed. Elevation on scales 2 and 7 signifies subjective distress that is clearly being outwardly displayed. This is emphasised by moderate to elevated Pd and Ma scores which indicate impulsivity, or acting out difficulties. Consistent with this symptom presentation, an externalising coping style was clearly displayed by subjects as combined scores on scales 4, 6 and 9 were greater than those on scales 2, 7 and 0.

Males were mostly symptomatic of feelings of hopelessness, isolation and odd thought patterns as their highest scores belonged to scales 2 and 8. Male stroke survivors appeared to be uncomfortable when dealing with feelings and emotions and possibly in an attempt to compensate for feelings of doubt about their masculinity, presented themselves as extremely masculine by behaving in a crude and vulgar manner. Women on the other hand were less traditionally inclined and expressed interest in a variety of activities. Female stroke survivors experienced high levels of generalised anxiety and sensitivity toward others' opinions. Their marked elevation on scales 8 and 9 further emphasizes their feelings of anxiety and indicates that they did not feel a part of their environment and consequently behaved in an aggressive manner. Females still talkatively acknowledged their difficulty with inhibition control, but became bored, irritable, and aggressive.

4.3.3. Quality of life. Male and female stroke survivors had a strong tendency to score below the normal population indicating that across all domains of quality of life, both their objective quality of life (OQOL) as well as their subjective quality of

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life (SQOL) (Figure 3). No differences were noted across the level of importance placed on various domains of quality of life (IQOL).

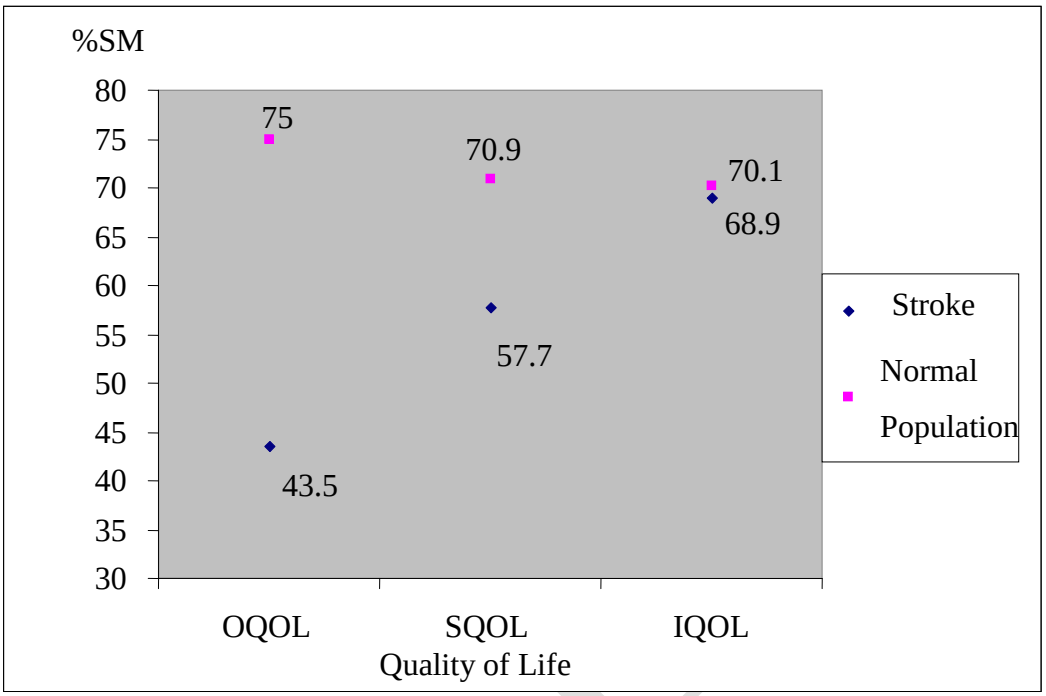


Figure 3. Comparison of stroke survivors and normal population's Quality of Life (OQOL, SQOL and IQOL).

This trend is illustrated below in Figure 4 for only the objective quality of life of stroke survivors. As noted, on this measure, more so than on subjective quality of life, subjects related/ perceived their quality of health (visits to a doctor, disability, medications), productivity (for example, work), intimacy (caring attention), and emotional well-being as lower than a normal population. No formal hypothesis test was performed to determine if these specific areas were significantly below the normal population however, based on the comparison of means, it was apparent that no perceived differences in material possessions (for example, accommodation) safety and community (activities) were acknowledged by stroke survivors.

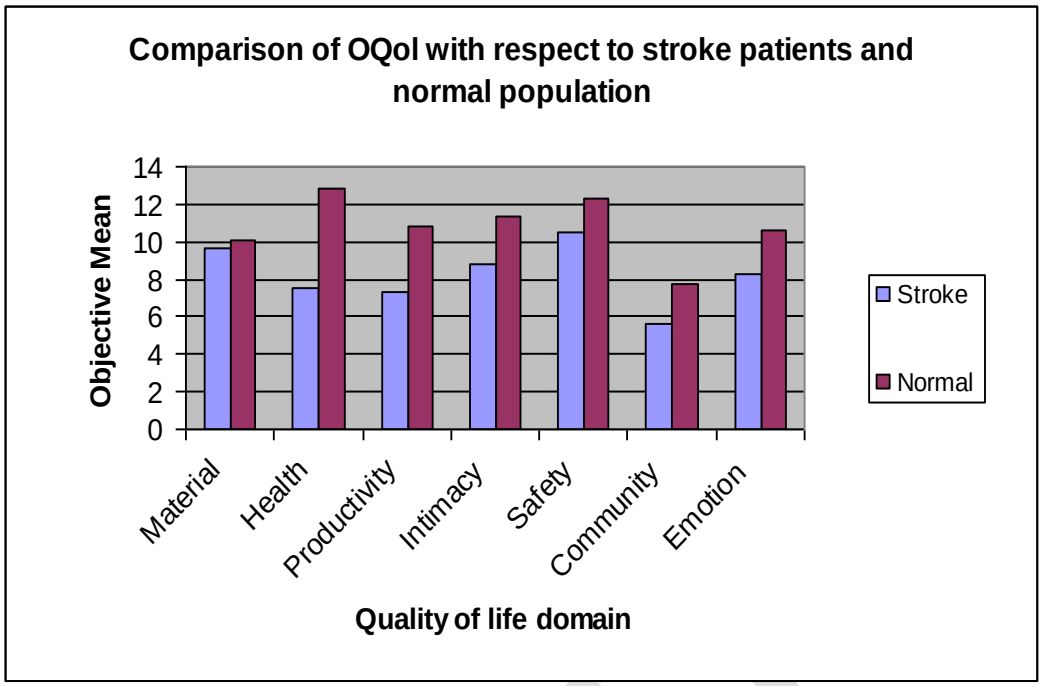


Figure 4. Comparison of stroke survivors and normal population's objective Quality of Life on all domains.

4.4. Assumptions

In order to carry out a factor analysis, certain assumptions needed to be qualified and these assumptions were tested in detail. One of the most important assumptions for a vast majority of statistical tests is adequate sample size, specifically, for a factor analysis, it is a requirement in that at a minimum there are more cases than factors (Kim & Mueller, 1978). In this research, it is acknowledged that although there was a small sample of only 21 individuals, with the equivalent of 13 variables yielding four factors, there were still more cases than factors.

Interval data is another statistical assumption and this was met as both emotion processing and quality of life were measured on a likert scale and each of the ten neuropsychiatric symptoms measured by the MMPI-2 were also interval scaled.

As factor analysis is a linear procedure, the assumption of linearity between variables is obvious (Kim & Mueller, 1978). If this assumption is not met, then relationships disappear and no patterns are evident, however as a distinct pattern was produced, it can be held that this criterion was met.

Multivariate normality of data is not strictly required for a factor analysis yet, owing to the small sample size, the raw data was screened for normality through histogram plots (Appendix G) and Kolmogorov-Smirnov tests (n = 21) (Table 6)

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Table 6

Goodness of fit for Normality of Distribution (N = 21)

Variable	Kolmogorov-Smirnov (*D* Statistic)	*p* Value (Pr > D) Ho: Normally Distributed
Emotion processing	0.141	>.150
Objective quality of life	0.125	>.150
Subjective quality of life	0.181	.073
Hypochondrias	0.172	.103
Depression	0.182	.068
Conversion Hysteria	0.161	>.150
Psychopathic Deviate	0.143	>.150
Masculinity/ Femininity	0.182	.068
Paranoia	0.197	.032*
Psychasthenia	0.125	>.150
Schizophrenia	0.158	>150
Hypomania	0.168	.122
Social Introversion	0.202	.024*

Note. * denotes significance at $p < .05$

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Based on this and histogram plots for each variable, the data for almost all variables followed a normal distribution curve. Paranoia and social introversion fell just short of following a normal distribution however; they were not skewed to any significant degree and as such could be treated as normal.

As the inter item correlation matrix is included in the factor analysis, Kaiser-Meyer-Olkin's measure of sampling adequacy or MSA was included to assess whether the sample of items was adequate or rather (Appendix H) (Hatcher, 1994). This resulted in an overall MSA of .57. This technique requires an MSA greater than .50 for a satisfactory factor analysis thus it can be implied that the correlation matrix was factorable. Orthogonality is also assumed for common factor analysis as the unique factors should be moderately correlated with each other or with the common factors; According to theories cited above and supported by the correlation matrix, many moderate-to-high intercorrelations existed, hence the need for the factor analysis.

4.5. Factor Analysis

Some debate regarding whether differences between principal component analysis and common factor analysis exists (Kim & Mueller, 1978). For the sake of the current research however, they are understood to mean the same thing in that both are ideal methods for representing correlations among a set of measured variables. A principal component analysis approach was thus employed in order to extract a small number of factors to account for the intercorrelations among the variables. Effectively, this method of analysis successfully reduced the large number of variables into key

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factors (Hatcher, 1994). Additionally and more importantly, this method detected structure in the relationships between the variables and in so doing, addressed research questions one and two. The extraction method used was principal component analysis and the principal factors were extracted from the correlation matrix using communality estimates with all priors set to one. Determining the optimal number of factors to extract is not a straightforward task since the decision is ultimately subjective, thus several criteria were used as support (Stevens, 1986). The proportion of variance explained, Kaiser's criteria or minimum eigenvalue (MINEIGEN) criteria, Catell scree plot test, and theoretical reasoning were all used to extract the number of factors. The rotation procedure used was Varimax as this technique ensured that the factors extracted accounted for the maximum amount of variance and simplified the factor pattern produced.

Variables to be correlated were thus: total emotion processing, hypochondriasis, depression, conversion hysteria, psychopathic deviate, masculinity/ femininity, paranoia, psychasthenia, schizophrenia, hypomania and social introversion, objective quality of life and subjective quality of life. Cognisant of the fact that subjective quality of life takes into account the seven domains that relate to importance of and satisfaction with quality of life, the importance of quality of life was eliminated from further analyses.

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Table 7

Correlation Matrix of all Variables Included in the Common Factor Analysis

Variable	1	2	3	4	5	6	7	8	9	10	11	12
(1) EP	1.00											
(2) OQOL	-.04											
(3) SQOL	-.07	.48										
(4) Hs	.13	.18	-.03									
(5) D	.26	-.21	-.32	.46								
(6) Hy	.18	.02	-.24	.86	.51							
(7) Pd	.25	-.51	-.62	.12	.38	.39						
(8) Mf	-.03	-.46	.39	-.04	-.08	.01	.28					
(9) Pa	.13	-.18	-.32	.50	.37	.55	.57	.25				
(10) Pt	.36	-.16	-.22	.36	.55	.52	.35	.09	.30			
(11) Sc	.34	-.60	-.44	.24	.58	.30	.73	.43	.61	.46		
(12) Ma	.08	-.33	.03	-.10	-.34	-.16	.21	.53	.06	-.01	.30	
(13) Si	.25	-.16	-.22	.14	.61	.14	.26	-.01	.12	.28	.43	-.35

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In the correlation matrix (Table 7), a number of moderate interrelationships were evident the most obvious being that virtually no relationship between emotion processing and both objective and subjective quality of life was evident. Amongst the various neuropsychiatric symptom clusters, all clinical categories were moderate to strongly related. Objective quality of life moderately correlated negatively with psychopathic deviate, masculinity/femininity and strongly correlated with schizophrenia. Subjective quality of life conversely correlated moderately with

schizophrenia but had a much stronger relationship with psychopathic deviate. These relationships were also negative. Emotion processing weakly (but positively) correlated with psychasthenia and schizophrenia. Hypochondriasis was moderately related to both depression and paranoia but very strongly related to conversion hysteria. Depression was moderately related to psychasthenia and schizophrenia but best related to social introversion. Conversion hysteria related best with paranoia and psychasthenia; although paranoia related best with schizophrenia. Psychopathic deviate and schizophrenia enjoyed a similarly strong relationship. Hypomania related moderately with masculinity/ femininity. As cited previously, social introversion best related to depression but also moderately related to schizophrenia. In sum, relationships between neuropsychiatric disorders, objective and subjective quality of life were apparent but emotion processing did not share any moderate to strong relationships with the primary variables.

Relative to the aforementioned intercorrelations, with the goal of determining structure between variables, the next step involved extraction of factors. According to the principle underlying factor analysis, the first factor explains majority of the information or accounts for the most amount of variance and all principals thereafter explain slightly less. With 13 variables, around 55% to 65% of the total variance was sought. The actual proportion of variance explained by the 13 variables was 75% when four factors were extracted and 66% when three factors were extracted (see Appendix F for the table listing all eigenvalues and proportion of variance explained). In accordance with the MINEIGEN criterion, the number of factors to be selected was decided by the number of eigenvalues greater than one (Stevens, 1986, as cited in Hatcher, 1994). Consequently, four factors were recommended. The scree plot graphs

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the eigenvalues against the number of variables and again four factors emerged. Theoretical reasoning suggested retaining only three factors, as the relationship between emotion processing, quality of life and neuropsychiatric symptoms was sought however, taking into account the above-mentioned criteria as well as interpretability; four factors were extracted for the orthogonal rotation.

Interpreting this rotated four factor pattern, an item was said to load on a given component if the factor loading exceeded .50 for that factor, and was less than .50 for all others and as such, no significant overlap between the factors occurred. This higher loading criterion was used to counteract the small sample size (Stevens, 1986 as cited in Hatcher, 1994). All variables loaded on at least one of the four factors. Five items loaded robustly on the first principal component, 3 items loaded on the second factor, 3 items on the third factor and only two items loaded on the fourth and final principal component. Factor one accounted for 35% of variance, while factors two, three and four accounted for 19, 12 and 9% of the variance, respectively.

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Table 8

Varimax Rotated Factor Pattern

Variable	Factor1	Factor2	Factor3	Factor4
EPS	-0.00	0.05	-0.02	0.87*
OQOL	-0.81*	0.13	-0.05	-0.09
SQOL	-0.77*	-0.13	0.24	0.13
Hs	-0.10	0.91*	-0.06	0.09
D	0.29	0.45	-0.64*	0.35
Hy	0.07	0.93*	-0.15	0.12
Pd	0.75*	0.29	-0.06	0.22
Mf	0.66*	0.01	0.45	-0.02
Pa	0.43	0.69*	0.05	0.06
Pt	0.19	0.43	-0.17	0.57*
Sc	0.75*	0.27	-0.03	0.47
Ma	0.32	-0.09	0.84*	0.23
Si	0.28	-0.01	-0.72*	0.36

Note. Values greater than .50 have been marked with *

Pertinent to the factor pattern produced, factor one predominantly incorporated both objective and subjective aspects of quality of life as well as traditional masculine/ feminine gender roles, schizophrenic and psychopathic deviate symptoms and as such can be interpreted as the "QOL/ general adjustment" factor. Objective and

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subjective quality of life related strongly and negatively to the disorders of psychopathic deviate and schizophrenia whereas Mf, Pd and Sc were similarly strong but positively related to each other. Factors two and three were independent of quality of life and emotion processing and as such were made up purely of neuropsychiatric disturbances: hypochondriasis, conversion hysteria and paranoia were represented on the second factor which was subsequently labelled the "general anxiety" component. This component only had positive strong correlations with Hs, Hy and Pa. Depression, hypomania and social introversion loaded on the third factor which was subsequently called the "mood modulation" component with both D and Si negatively related to mood (depressed mood) and Ma positively related to mood (elevated mood). Finally, emotion processing and psychasthenia represented the fourth and final factor which was called the "emotion modulation" factor and both emotion processing and Pt related positively to general emotion modulation.

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Chapter Five

Discussion

5.1. Introduction

The increasing prevalence of cerebrovascular diseases in developing countries like South Africa requires the emotional, psychological and neurological consequences of a stroke to be understood (Tipping, 2008). As the dynamics within the rehabilitation process are complex, neurologists, neuropsychologists, occupational therapists and the like need to recognise the unique relationship between emotion

processing, neuropsychiatric symptoms and quality of life in order to develop the appropriate therapeutic interventions guided towards encouraging independent living after a stroke. The present study was directed at exploring whether a relationship between emotion processing, neuropsychiatric symptoms, objective and subjective quality of life exist in a high functioning adult stroke survivor population. It primarily aimed at determining a relationship between these variables and further aims of the research involved exploring in more detail, the structure of these relationships. The results lent support to this theoretical relationship and determined the structure of this relationship as follows. The satisfaction with quality of life after a stroke when not fulfilled, related to neuropsychiatric symptoms of *general maladjustment* in other words schizophrenia and psychopathic deviate. The second factor encompassed symptoms of *general anxiety* both internally and externally directed: Internally directed anxiety included symptoms of hypochondriasis and hysterical conversion, while externally directed anxiety included neuropsychiatric symptoms of paranoia. The third factor was associated with *mood modulation* in that elevated mood connected to neuropsychiatric symptoms of hypomania and depressed mood connected to symptoms of depression and social introversion. Finally, emotion processing and psychasthenia made up the last principal component, namely *emotion modulation*. This meant that avoidance of emotional content, suppression of emotion, unprocessed emotion and so forth related to neuropsychiatric symptoms of obsessions or compulsions.

The analysis began by assessing the reliability estimates of the instruments on the present sample and produced strong Cronbach's alpha correlations suggesting high test reliabilities. By means of a *t* test for the emotion processing variable and a

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comparison across standardised scores for neuropsychiatric symptoms and quality of life, the present sample of stroke survivors significantly differed from a normal population. Subjects' processing of emotion was more reflective of a mental health population and with regards to neuropsychiatric symptoms; the sample was significantly symptomatic of depression and had schizophrenic and hypomanic disturbances. Stroke survivors displayed significantly lower objective and subjective quality of life than a normal population whereas no differences as to the importance of material possessions, physical health, productivity, intimacy, safety, place in community and emotional wellbeing were found. This meant that the subjects, as theoretically expected, placed similar importance on all domains of quality of life to the normal population but consequent to their stroke, their perceived and satisfaction levels were significantly below normal. High functioning stroke survivors' behaviours were thus characterised by general maladjustment, anxiety, and symptoms related to mood and emotion modulation.

5.2. Results and Interpretation

5.2.1. Instrument reliability. It is worth noting the different internal consistencies found on the measures of emotion processing, neuropsychiatric disturbances and quality of life. The emotion processing scale obtained acceptable yet lower internal consistencies. Independently, the subscale for suppression was high, as were all other subscales, yet when considering the full EPS; it reduced the overall reliability of the measure. Excluding the suppression scale, the test revealed an overall alpha of .79 as opposed to .68 when included. It is suggested by the researcher that as inclusion of this scale lowered the internal consistency; perhaps the measure of

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suppression is not as strongly related to all the other aspects of emotion processing as previously thought. This would explain why inclusion of this scale reduced the alpha but simultaneously broadened the areas measured by the emotion processing scale. Boyle (1991) and Cortina (1993) hold that high alphas are not a sign of good intra-scale reliability because the alpha value is affected by item communalities thus when the alpha is low, it suggests that the components of the test are in fact measuring different constructs. This finding highlights the effect that small sample size has on test reliability and could potentially hint towards the idea that suppression or excessive emotional control does not strictly relate to the experience and expression of emotions as thought, but may in fact be a separate construct related to overall emotion processing. This finding raises a question necessitating further exploration into the very definition of emotion processing as defined by Rachman and operationalized by Baker et al. (2007).

In support of several other studies investigating the MMPI-2, the present study found high internal consistencies and significant, strong relationships between the 10 clinical subscales (Butcher, et al., 1989; Graham, 2005). As expected, depression positively related to hypochondriasis, psychasthenia, social introversion and schizophrenia which in turn related to psychopathic deviate. Hypochondriasis related strongly to conversion disorder and paranoia. Contrary to prior research, hypomania was the only scale that did not relate as strongly to all other scales (Groth-Marnat, 2003). This finding and the aforementioned relationships lend support to the theory that pathological syndromes and in this case, neuropsychiatric disturbances are complex and multidimensional in nature; thus need to be interpreted in context (Groth-Marnat, 2003).

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An important limitation of this research and recommendation for future research involves performing additional analyses of patients MMPI-2 records. Incorporating interpretation with the content scales of the MMPI-2 to refine the meanings of the clinical scales could further and more comprehensively provide insight into the neuropsychiatric disturbances experienced after a stroke (Graham, 2005; Groth-Marnat, 2003). For example, a high proportion of the sample (almost half) obtained elevated scores on the psychopathic deviate measure. As this measure relates to symptoms of general maladjustment, this finding may have more to do with family conflict (given the circumstances of involvement in rehabilitation, incomplete emotion processing and low quality of life) than criminal or antisocial behaviour. Furthermore, cognisant of the rehabilitation in which subjects were involved, clarifying the meaning of their clinical scales has implications for the prognosis and return to independent living of the stroke survivors. Scores elevated above 65 namely, depression, schizophrenia and hypomania suggest behaviours that apply to the individual but could additionally represent alternative interpretative dimensions. Further exploration into the content scales could also substantially increase the validity of the clinical scales in addition to strengthening the validity of the study as a whole.

Internal consistency for the ComQOL-A5 was higher than recoded data possibly due to the heterogeneity of the sample and similarly high socioeconomic status of subjects. Relationships between subscales were however, consistent with theory and research on quality of life, thus these discrepancies should not pose a threat as to the reliability of the scale. The weak relationship found between objective

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and subjective quality of life further emphasises for example, how active or productive an individual claims they are, is often dissimilar to how they perceive their achievements in life. This too has therapeutic implications for the attending neurologists, psychologists, neuropsychologists, occupational therapists, speech therapists, family and caregivers as this inconsistency needs to be addressed throughout the rehabilitation process and not just in the acute stages of stroke. For example, survivors' reality of their unfulfilled dreams and their perceived satisfaction with their own emotional wellbeing both need to be recognised independently.

5.2.2. Comparison of stroke survivors to a normal population.

5.2.2.1. Emotion processing. All three stages of stroke survivors' emotion processing were elevated beyond healthy controls. These results are in line with previous literature suggesting deficits in emotion awareness, expression and regulation with frontal and prefrontal lobe damage (Angelelli et al. 2004; Carota et al., 2002; Phillips et al., 2003a; Robinson, 2006). The first stage of emotion processing relates to awareness of emotionally significant information by an event, schema or past memory and corresponds to the avoidance subscale which was significantly more prominent than normal controls (see results). This implies that at the stage of becoming aware of emotional events, stroke survivors are evading emotional triggers more so than a normal population and similar to mental health patients. Additionally, when required to produce an affective state, high functioning stroke survivors displayed poor emotional expression signified by intrusive emotional experiences and an inability to regulate emotions. As this phenomenon occurred amongst all stroke survivors, regardless of lesion cite, and the present sample had both cortical and

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subcortical damage, this finding supports previous research suggesting that highly emotional events are processed both cortically and subcortically (Fellous et al., 2001; Nelson et al., 1993). This further supports studies indicating that damage to areas within the limbic system results in alterations in emotional responses and affects emotion regulation (Carota et al., 2003; Damasio & Van Hoesen, 1983; Nelson et al., 1993; Philips et al., 2003a; Robinson, 2006).

Detached experience of emotions due to poor emotional insight and excessive emotional experience were both evident and although it is seemingly contradictory that these two aspects of emotional experience co-occurred, namely impoverished emotional experience and excessive control over emotional experience this is explained by a common psychological mechanism. Subjects experienced heightened awareness of emotional experience and in order to assert some control over intrusive thoughts, they employed the psychological mechanism of suppression. This is further supported by the emotion modulation factor that relates emotion processing to neuropsychiatric symptoms of psychasthenia. Being a stroke survivor requires one to negotiate new coping behaviours such as defence mechanisms and thus it is plausible that the psychodynamic mechanism of suppression was employed as a way of coping with overwhelming emotions or as a result of specific underlying neural systems. In line with Anderson et al. (2004) it is probable that suppression of emotion is a complex process readily employed by stroke survivors thus future research should consider the implications this mechanism has on relationships with family members, therapists etc.

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A final point to note is the finding that stroke survivors and mental health patients produced similar patterns with respect to emotion processing. Therapeutic interventions need to take into account these dynamics in order to correctly formulate strategies to allow for and treat poor control of emotion and their corresponding symptoms. Based on the aforementioned finding, caregivers, family and health care professionals need to adopt an understanding of emotion processing patterns that caters to mental health patients as this technique would also apply to stroke survivors.

5.2.2.2. Neuropsychiatric disturbances. Although the pattern of neuropsychiatric disturbances for post stroke patients has differed across studies, common neuropsychiatric symptoms have still been found (Aben et al., 2002; Angelelli et al., 2004; Astrom, 1996; Bourgeois et al., 2004; Carota et al., 2002; Gainotti, 1993; Gainotti & Marra, 2002; Heilman et al., 2003; Kaplan, 2005; Robinson, 2006; Robinson & Starkstein, 2002b; Wade et al., 1987). According to the literature, subjects with both left and right hemisphere frontal and prefrontal lesions tend to exhibit depressive, anxious, psychotic and hypomanic symptoms. The present study illustrated this trend and as such incidence differed slightly when compared to the Angelelli et al. (2004) sample. For example, the incidence of depression in their population was recorded as 61 %; almost double that of the present sample. Symptoms of generalised anxiety, irritability and agitation also differed when compared to subjects in Carota's sample as prevalence was higher in the present sample. Conversely, the range of abnormal behaviours reported after stroke such as withdrawal and bizarre ideas and behaviours was consistent with findings of Bourgeois et al. (2004) and Stone et al. (2004). Timing after stroke and method of assessment used may play a role in differences across symptom prevalence as

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measurement of neuropsychiatric disturbances in neurological patients understandably presents numerous challenges (Angelelli et al., 2004). As Robinson and Starkstein (2003a) pointed out, behaviour following any injury is influenced by a host of factors. The deficits created by a stroke have an impact on the survivor's self image, relationships and whole being (Vanhook, 2009). Gainotti (1993) attributed neuropsychiatric sequalae to neurological damage, psychological reactions to disability and functional impairment. This study is unique however as similar neuropsychiatric sequelae were found amongst subjects who survived a mild stroke, or rather, did not suffer from functional disability.

Less than 10 % of Angelelli's sample demonstrated aberrant behaviour, disinhibition and euphoria and yet a far greater proportion of the present sample displayed similar symptoms of maladjustment. As cited in the discussion relevant to interpretation of the MMPI-2, the high incidence of psychopathic deviance could possibly be better attributed to family conflict (given the circumstances of involvement in rehabilitation, incomplete emotion processing and low quality of life) rather than antisocial behaviours (although they are common with right hemisphere lesions). Angelelli's work however, regardless of his findings, illustrated the developmental trends of neuropsychiatric symptoms in post stroke patients. In the subacute phase (or two months post stroke), depression, anxiety, irritability and aberrant behaviours were observed. Following that, at six months post stroke, aberrant behaviours remitted but depression increased and finally, at one year post stroke, irritability was found to increase. In the present study, the temporal criterion for inclusion was between two months and five years post stroke and the mean time between stroke and data collection was 2.04 years. As such, results are consistent with

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longitudinal studies investigating the duration of neuropsychiatric disturbances (Angelelli et al., 2004; Astrom, 1996; Robinson & Starkstein, 2002b). Post stroke neuropsychiatric disturbances are treatable but early diagnosis is of supreme importance to prevent symptoms from progressing into chronic disorders that negatively affect rehabilitation.

5.2.2.3. Quality of life. The finding that the importance placed on various domains of quality of life by stroke survivors and the normal population were equivalent was expected based on the very definition of quality of life (Cummins, 1997). Significantly lowered objective and subjective quality of life were also not surprising findings given that previous research has shown stroke survivors' QOL as to be significantly lower even after a mild stroke (Carod-Artal, 2000). Domains in which the largest differences occurred included health related quality of life, productivity, intimacy, place in community, and emotional wellbeing. This finding is in line with others suggesting that failure to return to work (as measured through productivity and place in community) is a major source for low quality of life amongst individuals in this age group (Carod-Artal et al., 2000). Leisure time activities are another facet related to place in community and as observed in this sample, these too were below normal. This finding lends partial support to Viitanen et al. (1988) who proposed that depression was correlated with leisure time activities. Finally, relative to the aforementioned neuropsychiatric symptom presentation of stroke survivors, results are consistent with studies showing the deteriorating effects of depression on quality of life (Bethoux et al., 1999; Carod-Artal et al., 2000; Kauhanen et al., 1999; Williams, 1998).

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Subjects' cognitive and functional abilities were still within normal range, nevertheless, they were involved in rehabilitation to return to previous levels of functioning. Accordingly, these findings assist other studies indicating the relationship between cognitive or functional ability and decreased quality of life (Baker et al., 2004; King et al., 2002; Phillips et al., 2003a). Results such as this motivate for the recommendation to develop individually tailored and multifaceted rehabilitation and support in order to improve the quality of life of stoke survivors.

5.2.3. Demographic variables. Men, more so than women experienced symptoms of a depressive nature however women presented with a greater range of neuropsychiatric disturbances. An interesting finding related to the general maladjustment factor. Both women and men had low quality of life and equally expressed their compromised traditional gender roles with symptoms of schizophrenic and hypomanic disturbances. Women did however show higher susceptibility to symptoms relating to mood modulation while men expressed symptoms relating best to symptoms of generalised anxiety. This study is consistent with research suggesting that this age group is more susceptible to stroke and furthermore, that women are more prone to neuropsychiatric disturbances, specifically depression (Angelelli et al., 2004; Bourgeois et al., 2004; King et al., 2002; Robinson & Starkstein, 2002b). Ninety five percent of the sample had a high level of education (at least grade 12) which according to Gokkaya et al. (2005) has been positively related to quality of life and yet, against expectations this did not result in high or even average quality of life. Perhaps the high socioeconomic status of stroke survivors meant that quality of life was not as severely affected as it would have been had subjects had lower socioeconomic status? This question remains unknown but does raise further

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questions as to the implications of level of education of quality of life. Similarly, according to Stewart et al. (2000), education level has been negatively related to neuropsychiatric symptoms and was attributed to having more knowledge of one's medical condition (thus better quality of life) but again, this proved to not be reflected in the current sample despite the fact that subjects were high functioning and receiving private medical care. The question begs why such inconsistencies exist, is level of education in South Africa not on a par with other countries? Additional research is needed to address such questions. Consistent with a substantial amount of studies on lesion laterality, individuals with right and left hemisphere damage displayed symptoms of a depressive nature and post stroke mania and psychotic disorder was more common amongst those with right-sided infarcts (Gainotti, 1983; Gainotti & Marra, 2002; Robinson, 2006). Almost half the sample had right hemispheric damage and low quality of life supporting De Haan's (1993) study; nonetheless as the inclusion criteria did not allow language deficits, further exploration would be required to verify his findings. At least 62% of subjects were single, divorced or widowed and it is possible to infer that majority did not receive fulltime care. This lends support to studies around too little caregiving resulting in unfavourable quality of life (Tatemichi et al., 1994). Subjects that lived alone did point out that they were (at the time of research) living with family members thus additional detail would be needed in order to achieve true consistency with Tatemichi's findings. With regards to demographic differences and emotion processing, no differences across level of education between men and women were noted; both genders and age groups had similarly high levels of suppression, avoidance etc. Individuals with right sided infarcts more elevated emotion processing than those with left sided lesions although this difference was slight. The greatest

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difference that stood out was between singles and the divorced, married and widowed. All had elevated levels of emotion processing but the singles in particular displayed the most notable avoidance of emotional input, signs of unprocessed emotion, suppressed and impoverished emotional experience, and unregulated emotion. Could this be related to behavioural tendencies that are altered after marriage? Or is this purely a post stroke phenomenon? Additional research is needed to support these hypotheses. Cognisant of these factors, therapeutic interventions need to acknowledge the role that demographic variables play in the context of stroke rehabilitation and additional research needs to consider what other factors may be at play when considering emotion processing, quality of life and neuropsychiatric disorder after a stroke.

5.2.4. Factor analysis. The factor analysis results supported the fundamental goal of the research and highlighted the unique way in which emotion processing, neuropsychiatric disturbances and quality of life relate. Male and female stroke survivors with traditional gender roles who perceived their objective and subjective quality of life to be low related these feelings of general maladjustment by expressing symptoms related to social isolation, social deviance, conflict driven behaviour and bizarre thoughts or sensations. This category of individuals with low quality of life was thus more likely to express neuropsychiatric disturbances after a stroke in a psychopathic and/ or psychotic manner.

The second and third factors revealed that certain neuropsychiatric symptoms did not relate to perceived quality of life and emotion processing after a stroke, specifically, the factor analysis revealed two distinct patterns of neuropsychiatric

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disturbances that individuals with right or left hemisphere stroke damage displayed. The first category related to symptoms of general anxiety/ worry that were either directed internally as in the case of hypochondriasis and conversion hysteria or externally as in the case of paranoia and suspicion. The third category pertained to modulation of mood in that neuropsychiatric symptoms were expressed by depressed mood with symptoms of irritability, restlessness and depression characterised by hopelessness and social introversion. Alternatively, neuropsychiatric symptoms were expressed as mood elevations in the form of hyper excitability or hypopmanic tendencies.

Finally, the last factor revealed that neuropsychiatric symptoms characterised by obsessions and compulsions (in other words psychasthenic symptoms) relate best to emotion processing after a stroke. Hence, the avoidance of emotional content, suppression of emotion, unprocessed emotion and so forth are readily expressed as symptoms of obsessions or compulsions. This made up the emotion modulation component but was unconnected to perceived quality of life.

As no particular study has investigated this unique relationship, the results cannot be found to be consistent with previous research although, findings do support other factor analytical studies involving the MMPI-2 that suggest correlations between symptom presentation clusters (Quereshi & Rosemary, 1996; Butcher, Atlis et al., 1989; Butcher, Dahlstrom et al., 1989). Findings such as this lend support to the agreement amongst academics suggesting that pathological syndromes are highly complex and many psychopathologies overlap. General maladjustment, general anxiety, mood modulation and emotion modulation could not be further explored in

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this study nonetheless; the relationship found between emotion processing, neuropsychiatric symptoms and quality of life emphasizes the need to broaden research in neuropsychology, neuropsychiatry and even abnormal psychology. Qualitative examination of each individual's preferred pattern of neuropsychiatric behaviour could present additional insight into stroke survivors' reactions to a stroke.

Empathy refers to the cognitive process whereby an individual identifies the mental state of others and projects their own intellectual or emotional feelings towards it. Studies suggest that the left prefrontal cortex is responsible for supervising the cognitive aspects of empathy (Farrow et al., 2001). Sociopathic traits such as the lack of concern for social or moral standards of conduct, sexual disinhibition and poverty of emotional expressions as witnessed amongst stroke survivors with poor general adjustment could then be understood to have empathy loss caused by frontal lesions. This finding supports studies suggesting a role of the prefrontal cortex in supervising aspects of empathy and inhibition control as well as being responsible for these unusual affective states (Carota et al., 2002).

A positive consequence of rehabilitation evident from this study is acknowledged due to the fractionally small amount of patients that displayed symptoms of social introversion. Both men and women comprising the sample were well balanced in their traditional gender roles and social activities. As the study took place at a rehabilitation centre and most of the activities involved some interaction with other head injured patients, therapists and the like, the research provides partial support for the positive social aspects of the process of out-patient rehabilitation (Prigatano, 1999).

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5.3. Limitations and Directions for Future Research

5.3.1. Statistical limitations. Many statistical methods are used to study the relation between independent and dependent variables. Factor analysis is different; it is used to study the patterns of relationship among many dependent variables, with the goal of discovering something about the nature of the independent variables that affect them, even when those independent variables were not measured directly. Accordingly, the relationship found between emotion processing, neuropsychiatric disturbances and quality of life that was better described by the concepts "QOL/ general adjustment", "general anxiety", "mood modulation" and "emotion modulation" is necessarily more hypothetical and tentative than is true when independent variables are manipulated.

Inter-factor correlations were within a moderate range thus the 4 factors could be submitted to new factor analysis that may obtain a single second-order factor which potentially could delineate relationships even further (Cohen 1988). Future research could explore this possible outcome in more detail in order to enhance the understanding of the structure between emotion processing, quality of life and neuropsychiatric symptoms.

5.3.2. Measures and norms. A non-standardised measure, namely the emotional processing scale was used, although the reason for its use was justified and the measure itself does provide some reliability and validity data. Still, it must be noted that the norms used to compare the groups were based on a large sample

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obtained from both the UK and Italy. This does not mean that the interpretation is invalid as emotion processing is not dependent on the context wherein it occurs but rather on the neural systems that are involved. However caution must still be taken as the language and its specific connotations may differ across contexts. Further research needs to look more in depth and possibly even qualitatively at each stage of emotion processing and how emotion can be utilised to assist the process of rehabilitation.

A fundamental problem, common to all studies using psychometric tests, is the definition of normality compared with abnormality or impairment; a discrimination that depends in part on the reference group or standard selected. The approach used in this study involved comparisons with a non-clinical sample and a clinical sample with known psychiatric disorders. Comparison involved a predetermined cut off criteria based on externally derived standards thus it must be acknowledged that this approach is susceptible to biases related to race, education and gender. Pertinent to this, the sample obtained was small, the stroke condition highly specific and the rehabilitation centre a private facility all of which compromise the generalisability of results as centres of contrasting orientation such as private rehabilitation centres and general wards versus stroke units have wide variability in treatment regimens, patient outlook and even exercise technique of therapists involved. Data was also self-report therefore only deficits the patients chose to acknowledge could be identified and may have implications as to the prevalence of neuropsychiatric symptoms found in the study. Although research in neuropsychology uses relatively small sample sizes, a larger sample with a greater range of damage in a variety of rehabilitation settings would allow for more confidence in results and generalisations.

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The (even non severe) neurobehavioral consequences of stroke such as aphasia, indifference, denial, and cognitive impairment may compromise patient's responses even if language and attention are not significantly involved (Lezak, 2004). The stroke survivors as per selection criteria were not significantly cognitively impaired as they performed within the range of normal subjects on similar standardised neuropsychological tests; however a limitation related to the cognitive functioning of subjects must be acknowledged in that as they were enrolled in a rehabilitation setting and furthermore, as the definition of cognitive impairment was based on average performance on standardised measures; subjects identified as cognitively intact may just have been less severely affected within the spectrum of intellectual decline after a stroke.

The effects of a stroke they tend to be localised to a specific hemisphere of the brain, and these infarcts in turn affect the opposite side of the body antagonistically (Erlbaum & Benson, 2007). There is a range of deviation according to the depth, extent and site of damaged tissue according to Adams et al. (2003). Swelling in the acute stages of stroke can result in diffuse damage which is considered among the additional symptoms of brain pathology. As swelling decreases, so too some of the symptoms improve. The present study only considered subjects with damage to the limbic system in general and did not go into such detail as primary and secondary areas affected thus future research could examine whether variations with regards to primary and secondary damage affect emotion processing and neuropsychiatric disturbances after a stroke and how this would impact on quality of life.

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Relative to the discussion on timing and symptomatology post stroke, it is acknowledged that although it would be difficult to conduct a longitudinal study on emotion processing, quality of life and the development of various neuropsychiatric disturbances experienced by stroke survivors; such research would guide the course of rehabilitation at numerous time intervals following a stroke.

5.3.3. Socioeconomic status. The sample did not have large variability with regards to race and this is attributed to the fact that White and Black people reflect different patterns of disease (Norman et al., 2006). Studies on socioeconomic status and stroke have revealed that lower social class is independently related to cognitive impairment after a stroke and is associated with poor long-term outcomes (Cox, McKevitt, Rudd & Wolfe, 2006). In the present research, it should not be considered an extraneous variable as all stroke survivors within the sample fell within the same socio-economic status as all were undergoing rehabilitation at a private rehabilitation facility which implies middle to upper class socioeconomic viability. Future research could however investigate if the relationships between emotion processing, neuropsychiatric symptoms and quality of life differ among the low, middle and upper class after a stroke.

5.3.4. Methodological contribution of the research. Although findings in this study may not have been novel or unexpected, the results serve as indirect validation of the methodologies undertaken and emphasize the potential value of neuropsychological assessments of patients with stroke. In particular, the emotion processing scale has been validated for use on a South African stroke survivor sample.

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The MMPI-2 and the ComQOL -A5 were also shown to be reliable for use in this context.

5.4. Conclusion

Emotional effects of brain injury range from reduced quality of life to various neuropsychiatric disturbances and are of great interest in the South African context and throughout the world as they pose a major obstacle to the rehabilitation process. This study illustrated that subjects with neurological disturbances to areas within the limbic system, who either regained or maintained high cognitive and behavioural functioning, displayed emotion processing deficits, neuropsychiatric disturbances and low quality of life. The findings of this study lent support to the theoretical relationship between emotion processing, neuropsychiatric symptoms and quality of life and determined the particular structure of this relationship. The satisfaction with quality of life after a stroke when not fulfilled, was associated with neuropsychiatric symptoms of *general maladjustment* i.e. schizophrenia and psychopathic deviate. The second factor encompassed symptoms of *general anxiety* that were either directed internally or externally. Internally directed anxiety included symptoms of hypochondriasis and hysterical conversion, while externally directed anxiety included neuropsychiatric symptoms of paranoia. The third factor was associated with *mood modulation* in that elevated mood connected to neuropsychiatric symptoms of hypomania and depressed mood connected to symptoms of depression and social introversion. Finally, emotion processing and psychasthenia made up the last principal component, namely *emotion modulation*. This meant that avoidance of emotional content, suppression of emotion, unprocessed emotion and so forth best related to

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neuropsychiatric symptoms of obsessions or compulsions. High functioning stroke survivors' behaviours were thus characterised by general maladjustment, anxiety, and problems with mood and emotion modulation.

Subjects displayed emotion processing patterns similar to those of mental health patients and significantly different to normal controls. Various neuropsychiatric disturbances were evident most notably depressive, schizophrenic and hypomanic symptoms. Results also indicated that across all domains of quality of life, male and female stroke survivors' objective and subjective quality of life was significantly below the normal population. At the stage of becoming aware of emotional events, stroke survivors evaded emotional triggers more so than a normal population and behaved similar to mental health patients. When required to control and experience an affective state, high functioning stroke survivors struggled and displayed poor emotional expression signified by intrusive emotional experiences: the results of poor emotion processing. Through this, numerous studies indicating that damage to areas within the limbic system result in alterations in emotional responses and affect emotion regulation were supported (Carota et al., 2003; Damasio & Van Hoesen, 1983; Nelson et al., 1993; Philips et al., 2003a; Robinson, 2006). Caregivers, family and health care professionals need to adopt an understanding of these emotion processing patterns in order to develop individually tailored post stroke rehabilitation programmes.

Depressive symptoms manifested as feelings of uselessness, being a burden to family members, hopelessness and feelings of unworthiness. Stroke survivors expressed bizarre thoughts and behaviours, felt misunderstood and showed signs of hypomanic disturbances. These results were consistent with a number of studies

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showing that a number of neuropsychiatric disturbances occur following a stroke, the most common being depression (Angelelli et al., 2004; Bourgeois et al., 2004; Carota et al., 2002; Gainotti, 1983; House et al., 1989; Robinson, 2006; Stone et al., 2004; Tipping, 2008). This study provided evidence strengthening the argument that damage incurred through a stroke leads to severe emotional disabilities and ultimately neuropsychiatric disturbances resulting from distortions in emotion processing. Post stroke neuropsychiatric disturbances are treatable but early diagnosis is of supreme importance to prevent symptoms from progressing into chronic disorders that negatively affect rehabilitation (Bourgeois et al., 2004).

Significantly low objective and subjective quality of life amongst stroke survivors was not a surprising finding given that previous research has consistently found stroke survivors' quality of life significantly reduced (Carod-Artal, 2000). Health related quality of life, productivity, intimacy and emotional well-being were among the areas affected. Improved understanding of quality of life from the stroke survivor's perspective has obvious impact for the therapeutic interventions inherent in stroke rehabilitation (Dennis et al., 1998; King et al., 2002; Kauhanen et al., 2000).

The results presented in this study cannot offer any definitive answers as to how post stroke rehabilitation should proceed. New ways of coping need to be explored if individuals are expected to return to (or achieve) improved emotion processing, higher quality of life and less, if any, neuropsychiatric disturbances. If the goal of rehabilitation is to return to independent living and regain previous functioning, therapeutic interventions need to take these relationships into account and in so doing, acknowledge deficits in emotion processing, treat neuropsychiatric

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disturbances and improve domains of quality of life that can be improved. These results should encourage and stimulate enquiry into these areas worldwide and particularly in the diverse South African context.

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Appendix A

The Emotion Processing Scale

As the EPS has not yet been released commercially, and as a collaborator of the measure, the researcher is required to respect issues of copy-write and therefore, not reproduce the test. It was thus not possible to include the actual scale as an appendix however, permission has been received from the research publications officer (Anna Whittlesea) working with the test developer (Professor Roger Baker and colleagues). The initial psychometric properties of the test are as follows:

A total of 460 participants (175 males, 284 females, 1 missing) were recruited from a variety of settings to respond to the 45-item version of the questionnaire. Participants included colorectal cancer patients (*n* =124) and non-patient older adult controls (*n* = 73), individuals referred to a clinical psychologist or a counsellor for a range of mental health problems (*n* = 147), university undergraduate students (*n* = 100), individuals with a diagnosis of chronic back pain (*n* = 11) and individuals with a diagnosis of ankylosing spondylitis (*n* = 5). Participants ranged in age from 17 to 89 years (mean = 47, S.D. = 21). The 460 participants rated themselves on each of the 45 items using the 10-point response scale. In addition, a number of participants completed several established scales assessing constructs theoretically related to emotional processing.

Five items were removed prior to the principal components factor analysis: conceptually weak and/or low item-total correlations and/or failed to show any between group differences on independent samples t-tests Exploratory principal components factor analysis was therefore undertaken on 40 items. Eight factors

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emerged (see Table 1). The cumulative variance accounted for by the 5 factor solution was 58.1%

Table 1: Factor structure of the EPS

Factor name	Description	No of items	Cronbach's Alpha
Suppression	Excessive control of emotional experience and expression	5	.84
Unregulated emotion	Inability to control one's emotions	5	.76
Impoverished emotional experience	Detachment from emotions due to poor insight	5	.74
Signs unprocessed emotion	Intrusive and persistent emotional experiences	5	.85
Avoidance	Avoidance of negative emotions	5	.74

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Appendix B

School of Human and Community Development

Private Bag 3, Wits 2050,

Johannesburg, South Africa

Tel: (011) 717-4500

Fax: (011) 717-4559

My name is JEANINE BLUMENAU, and I am conducting research for the purposes of obtaining a Master's degree at the University of the Witwatersrand. My focus is on emotion processing, personality and quality of life and how they are affected by a stroke. We live in South Africa where, among other things, the onset of a stroke can affect life in many ways. Aspects of life that can be affected range from cognitive and motor abilities to social adjustment, interpersonal relationships, and independent living. Part of the research aims to explore which dimensions of personality are affected by a stroke. In addition to this, I will be exploring how emotion processing is influenced by the onset of a stroke as well as what role quality of life plays after the stroke. I would like to invite you to participate in this study.

If you agree to take part in this study, you will be required to complete some psychological tests that will require you to answer questions about yourself as truthfully as possible. I must stress that aim is not to test you as an individual but rather to explore which dimensions of personality, what aspects of emotion processing and how your quality of life is affected by the stroke. The assessments will take up approximately 2 hours of you time and will be done at a time convenient to you. Your participation is strictly voluntary, and you will not be penalized in any way if you choose to not participate. If you do chose to participate, you may still withdraw at any time without penalty. No

WiSERD

identifiable information, such as your name or I.D. number, will be asked for. Your demographic information will be transferred to your corresponding test immediately and the original questionnaire will be destroyed. A corresponding number will appear on the test so you cannot possibly be identified. Anonymity cannot be guaranteed as I, the researcher will be in direct contact with each participant however confidentiality can and will be guaranteed. The test will not be seen by any person in this institution at any time, and will only be processed by myself.

If you have any questions, please do not hesitate to ask me. If you would like to contact me for further information about this study, feel free to do so on 0725946204. I will make the generalized results of the study available to you on its completion.

If you choose to participate in the study please detach and sign the consent form which confirms that you understand the study. I will be conducting the tests in a nearby private room individually, at a time suitable to you. This will guarantee privacy and comfort for maximum concentration.

Your participation in this study would be greatly appreciated. This research will contribute to our understanding of emotion, as well as towards the very important process of rehabilitation. Finally, a greater understanding of quality of life can have an effect on both yourself and your loved ones.

Kind Regards,

Jeanine Blumenau

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Appendix C

School of Human and Community Development

Private Bag 3, Wits 2050,

Johannesburg, South Africa

Tel: (011) 717-4500

Fax: (011)717-4559

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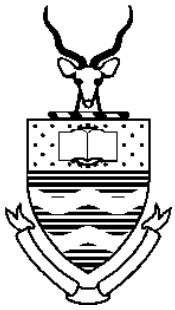
I _____ consent to being assessed by JEANINE BLUMENAU for her study on factors affecting personality after a stroke

I understand that:

- Participation in this study is completely voluntary.
- Withdrawal from the study is allowed at any time.
- No identifiable information will be included in the research report, and results will remain confidential.
- The tests will not be seen by any person other than the researcher and her supervisor.

Signed _____

Appendix D



FORM HREC (2007 - MEDICAL)

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

APPLICATION TO THE HUMAN RESEARCH ETHICS COMMITTEE: (MEDICAL) FOR CLEARANCE OF RESEARCH

SECTION 1

PRINCIPAL INVESTIGATOR PER SITE: **Master's student**

NAME: Miss Jeanine Blumenau

PROFESSIONAL STATUS OR STUDENT YEAR OF STUDY AND DEGREE:

The researcher is currently in the 2nd year of a Master's degree by dissertation. The researcher has the qualifications of a BSc degree with honours, cum laude. Previous years of study: 5. Student no. 0308138H

UNIVERSITY DEPARTMENT: Psychology: School of Human and Community Development

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DETAILS WHERE STUDY WILL BE DONE: The study will be conducted at private rehabilitation facilities in the greater Johannesburg region. Provisional acceptance has been obtained by the relevant sites.

HOSPITAL/INSTITUTION WHERE EMPLOYED: The researcher is employed by the University of the Witwatersrand and by the private Monash University as a sessional lecturer.

FULL-TIME OR PART-TIME EMPLOYEE: Part-time.

HPCSA NO: 607-2007

SECTION 2

CONTACT PERSON'S DETAILS FOR ALL CORRESPONDENCE:

NAME: Jeanine Blumenau

TELEPHONE NO: +27 (011) 640 2853 **FAX NO:** N/A

CELL: 0725946204 **EMAIL:** jeanineblumenau@gmail.com

CO-INVESTIGATORS' NAME: (Supervisor)

Enid Schutte, Staff no. 00400089

SECTION 3

TITLE OF RESEARCH PROJECT: *(Use no abbreviations*)

Emotion processing, neuropsychiatric symptoms and quality of life after a stroke.

WHERE WILL THE RESEARCH BE CARRIED OUT?

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The research will be conducted in 2 private stroke rehabilitation centres in the Johannesburg region where stroke, motor vehicle accident, and traumatic brain injury patients are undergoing rehabilitation. The assessments will be conducted in a private, quiet and standardised setting. Provisional acceptance has been granted from the Stroke Aid Rehabilitation centre, Patterson Park, Norwood as well as from Headway, Hyde Park, Gauteng.

All the following sections must be completed [3]. **Please tick all relevant boxes.**

3.1 PURPOSE OF THE RESEARCH:

Postgraduate: degree/diploma (state which) ☒

Undergraduate: degree/diploma (state which) ☐

Not for degree purposes ☐

3.2 OBJECTIVES OF THE RESEARCH (please list):

The research primarily aims to seek associations between emotion processing, neuropsychiatric disturbances and quality of life after a cerebrovascular accident. The research will focus on an adult population of stroke survivors and aims at investigating the elements of emotion processing, through the emotion processing scale (EPS), their correlates with neuropsychiatric symptoms according to the Minnesota Multiphasic Personality Inventory (MMPI-2) and quality of life, which will be assessed through the comprehensive quality of life inventory (ComQol-A5).

Further aims of the research involve describing the strength, type and directions of correlations that may exist between emotion processing, neuropsychiatric disturbances and quality of life in stroke survivors.

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The research also aims to determine if the ischemic and haemorrhage conditions affect emotion processing, neuropsychiatric disturbances in different ways.

A secondary aim of the research seeks to determine if results in this study are consistent with previous research of a similar nature. Consequently, it seeks to determine if demographic variables such as gender and education level have an effect on levels of emotion processing, neuropsychiatric disturbances and quality of life after stroke.

3.3 BRIEF SUMMARY OF THE RESEARCH:

Emotion and mood disorder, cognitive impairment, quality of life and neuropsychiatric disturbances after a stroke have independently been studied in considerable depth yet their interconnectedness has received virtually no attention (Johnson, 1991; House, Dennis, & Molyneux, 1989; Kim, Choi, & Kwon, 2002; Brooks & McKinlay, 1983; Carota, Staub, & Bogousslavsky, 2002; Carod-Artal, Egido, Gonzalez, & de Seijas, 2000). Investigation into these phenomena from the patient's perspective will enhance the understanding of personality, emotion processing and quality of life after a stroke. Furthermore, results of the study have obvious impact for the therapeutic interventions inherent in stroke rehabilitation and as a result, the return to independent living and thus the personal and economic burden that a stroke exerts on the family system (Dennis et al., 1998; King et al., 2002; Visser-Keizer, 2004). As such, the research will contribute towards the fields of neurobiology, physiology, neuropsychology, neuropsychotherapy and the social sciences.

WiSER

The research primarily aims to seek associations between emotion processing, neuropsychiatric disturbances and quality of life after a cerebrovascular accident. The research will focus on an adult population of 20 ischemic and haemorrhage stroke survivors and investigate the levels of emotion processing, through the emotion processing scale (EPS), their correlates with neuropsychiatric symptoms according to the Minnesota Multiphasic Personality Inventory (MMPI-2) and quality of life, which will be assessed through the comprehensive quality of life inventory (ComQol-A5). The strength, type and directions of correlations will be characterised.

As note will be taken of the particular stroke classification, the two independent groups will be compared on all measures, namely, their differences in emotion processing, neuropsychiatric symptoms and quality of life. Finally, in order to maintain consistency in the scientific research field, the research will explore the effect that demographic variables such as gender and education level have an effect on levels of emotion processing, neuropsychiatric disturbances and quality of life after cerebrovascular accident.

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SECTION 4

4. REQUIREMENTS

4.1 If this project involves studies with drugs at a teaching hospital associated with this University, approval must first be obtained from the Hospital's relevant Committee.

Has application been made? ***If not, this application cannot be considered.***

Yes ☐ No ☒

The study does not involve any medication.

4.2 If radiation or isotopes are to be used, written approval must be obtained from the Nuclear Medicine Department, Diagnostic Radiology Department, Radiation Therapy Department or NUCOR representative.

Is this attached? ***If not, the application cannot be considered.***

Yes ☐ No ☒

The study will not be using radiation or isotopes.

4.3 Is a Participant Information Sheet attached?

Yes ☒ No ☐

See Appendix B

Is Informed Consent Form attached? (Written consent)

Yes ☒ No ☐

(If informed consent will be verbal – explain why)

See Appendix C

If informed consent is not considered necessary – explain why not.

N/A

4.4 If a questionnaire or interview is to be used in the research, it must be attached.

Is it attached? ***If not, the application cannot be considered.***

Yes ☒ No ☐

SECTION 5

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5. STUDY PARTICIPANTS

5.1 If patients are being studied, state where and how they are selected:

The proposed size of the sample is 20 stroke survivors. The patients themselves will be approached and supplied with an information sheet regarding the study and level of involvement and only the volunteers with the required criteria will be included. The information sheet will address: details about the researcher, the purposes of the study (i.e. Masters degree at the university of the Witwatersrand), the aims and purpose of the research (investigation into emotion processing, personality and quality of life), the voluntary nature of participation and that no benefits or drawbacks are associated with participation, the level of involvement in the study (two hours of testing at a convenient time). Patients will be guaranteed confidentiality and the ability to withdraw, at any time, without prejudice. The researchers contact details will also be provided for any further queries from the subject and their respective families.

The following criteria will have to be met in order to participate in the study:

Temporal criteria: Only patients within the acute stages of stroke and no earlier than 2 months after the stroke.

Neuropsychological criteria: Only patients with adequate levels of awareness, linguistic ability and abstract reasoning will be considered. Age (the range may be as large as between the ages of 40 and 65), gender (both males and females are eligible to volunteer), level of education and language preference will be noted. Patients with severe comprehension deficits and cognitive decline (previously assessed by the neurologist or speech and hearing therapist) will be excluded.

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Neurological criteria: Patients suffering from the consequences of cerebral ischemic or haemorrhage conditions. Patients with previous stroke, non-cerebral involvement, those who have undergone surgery or have a history of psychiatric or substance abuse will be excluded. Patients taking psychotropic drugs will not be excluded but the prescribed medications will be noted.

Research in neuropsychology often does not involve large sample sizes as generalisability is replaced with depth, or rather, quantity is replaced with quality (Caramazza & Coltheart, 2006). This sampling technique is suitable to the nature of the present study as its aim is to attain rich, in-depth data as opposed to attaining strong external validity (Caramazza & Coltheart, 2006).

5.2. Where the participants are not patients,

Will they be invited to volunteer? ☒

Will they be selected? ☒

State who is invited to volunteer or how the participants are selected:

Family members or caregivers of the stroke survivors will also be provided with the information sheet and consent form.

Are the participants subordinate to the person doing the recruiting?

Yes☐ No ☒

If yes, justify the selection of subordinate participants

5.3 Will control participants be used?

Yes☐ No☒

If yes, explain who they are and how they will be recruited

5.4 Participant records: state what records will be used, how they will be selected and whether the study is retrospective or prospective:

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Records of the date of injury, type of injury and details of injury will be noted as a means of determining the stroke classification and location of lesion. Participants' functional mobility as assessed by the relevant occupational therapist and physiotherapist will need to be consulted in order to determine the patient's level of mobility and general functioning. Cognitive abilities, as assessed by the speech and hearing therapist will also need to be considered in order to establish that the participant fulfils the criteria specified for inclusion in the study. Subjects fulfilling the above-mentioned criteria will complete the three tests with the aid of the researcher at a time convenient to both the Stroke centres and the patients themselves. Although participant records will be used, the study is considered a prospective study as the sample and instruments were selected before the data collection process.

5.5 What is the age range of participants in the study?

The age range may be as large as between the ages of 40 to 65 years.

If participants are minors (< 18 years), from whom will consent be obtained?

If participants are minors, is an Assent Document provided?

Yes☐ No☒

The participants are not minors.

5.6 Sex: Male ☒ Female ☒

Number of patients: 20

5.8 Will the research benefit the participants in any direct way?

Yes ☐No ☒

5.9 Will participants receive any remuneration?

Yes☐ No☒

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5.10 Will participation, non-participation or withdrawal from the study disadvantage persons in any way?

Yes ☐ No ☒

SECTION 6

6. PROCEDURES

6.1 Mark research procedure(s) that will be used:

☒ **Record review**

☐ **Interview form / questionnaire (must be attached)**

☐ **Self-administered questionnaire (must be attached)**

☐ **Examination (state below nature and frequency of examination)**

☐ **Drug or other substance administration (name, dose, and frequency of administration)**

☐ **X-rays**

☐ **Isotope administration (state below name, dose, and frequency)**

☐ **Blood sampling; ☐venous; ☐arterial (amount and frequency of sampling)**

☐ **Biopsy**

☒ **Other procedures (explain)**

Use this space to elaborate procedures marked above:

Three psychological tests will be administered to volunteers. The tests will be administered individually by the researcher in a small private room in the facility and both written and verbal instructions will be given.

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The 25 item Emotion Processing Scale (EPS) will be administered to ascertain how emotion is processed by the subject as the test measures factors ranging from the extent that emotions are in control, whether they are intrusive and finally the extent to which they have been processed, thereby measuring numerous aspects of emotion processing through a simple 10 point response scale. The EPS has as yet, only been used in the research context although, as the current research is explorative in nature rather than clinical, it should not impact on the generalisability of the study. Furthermore, the EPS has been presented at two conferences and been submitted for psychometric evaluation. The researcher has been given permission to use the test. Completion of the scale should take 10 minutes.

The Minnesota Multiphasic Personality Inventory (MMPI-2) is one of the most widely used and researched instruments to measure personality, and is suitable towards assessing personal maladjustment and emotional status such as hysteria, paranoia, depression and social introversion hence will be used to assess neuropsychiatric symptoms (Lezak, 2004). The 567 items cover ten clinical scales and seven validity scales which provide information about the subject's competence to take the test, denial of real problems and even test-taking attitudes (Cohen & Swerdlik, 2005). The scale should take approximately 60 to 90 minutes to complete however, if fatigue sets in, the patient will be given a break.

Finally, the Comprehensive Quality of Life Inventory (ComQol-A5) will be administered and responses will be recorded. QOL is decribed in both objective (O) and subjective (S) terms. 7 broad domains are covered, these are:

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1. Material well-being
2. Health
3. Productivity
4. Intimacy
5. Safety
6. Place in community
7. Emotional well-being

ComQol-A5 should take approximately 15 to 20 minutes to complete. The data will then be analysed through the appropriate statistical measures. As the testing will be arranged by the staff in the facility, it will be done at a time that is convenient to the staff and patients and does not interfere with their rehabilitation.

6.2 Is/are procedure/(s) routine for: Diagnosis/management?

☐

Specific to this research?

☒

6.3 Who will carry out the procedure(s)?

Miss Jeanine Blumenau will be collecting the data and this will be supervised by Mrs Enid Schutte.

6.4 When will the research commence, and over what approximate time period will the research be done?

RECRUITMENT START: March 2008

DATA COLLECTION: July 2008 – September 2008

END DATE: December 2008

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6.5 For studies being done outside the Gauteng Academic Hospitals, please list the number of studies currently being done by the Principal Investigator, the number of patients per study and where they are being done.

Not applicable, only the current study is being performed.

6.6 For applications outside the Gauteng Academic Hospitals: Is the investigator involved in a clinical Part-Time / Full-Time capacity at the study site?

No.

SECTION 7

7. RISKS OF THE STUDY PROCEDURE(S):

- ☒ **No risk**
- ☐ **Physical discomfort**
- ☐ **Pain**
- ☐ **Possible complications**
- ☐ **Side effects from agents used**
- ☐ **Breach of confidentiality**
- ☐ **Possible stigmatisation**
- ☐ **Psychological stress**

If you have checked any of the above except "No risk" please provide details:

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There are no legal, financial or physical risks involved as the instruments to be used are non-invasive and are thus unlikely to evoke any psychological disturbance among participants. As subjects will be accessed through a rehabilitation centre, therapists, counsellors and psychologists at the institution will be equipped to deal with any potentially vulnerable information.

SECTION 8

8. GENERAL

8.1. Has permission of relevant authority been obtained to do the study?

Yes☒ No☐ N/A☐

State name of authority:

Jackie Fabian and Michelle Cahi, senior therapists at Headway have approved of the research, and Sandra Colombick from Stroke Aid has given the research provisional acceptance.

8.2 Has this study been submitted to other Ethics Committees?

Yes☐ No☒ N/A☐

8.3 How will confidentiality be maintained so that participants are not identifiable to persons not involved in the research? Please answer the questions below:

Will data be anonymous?

Anonymity cannot be guaranteed as the researcher will be in direct contact with each participant however confidentiality can and will be guaranteed as only trends within the variables will be focussed on.

Will identifiable data be coded and the 'links' kept separate?

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Each test will only be identifiable through a number and the demographic information will be transferred to the corresponding test immediately hence no participant will be identified. The original questionnaire will be destroyed. Should the rehabilitation facility however, request the results of the specific tests for each volunteer to be kept on record, consent will first have to be given by the patient.

Who will have access to data?

The researcher and only her supervisor will have access to the research material but only for the duration of the study; thereafter, all raw materials will be destroyed.

8.4 To whom will results be made available?

The end results will be reported in the final write up of the study for the Masters by Dissertation degree of the University of the Witwatersrand. It may also be submitted as a journal article or presented at a conference however no particular individual will be identifiable.

8.5 Will there be financial costs to:

Participants	**Yes☐ No☒**
Hospital/Institution	**Yes☐ No☒**
Other	**Yes☐ No☒**

Explain any box marked "Yes":

8.6 How will the research be funded?

The research is funded by the researcher herself.

8.7 Any other information, which may be of value to the Committee, should be provided here:

In South Africa, a dearth of social services intensifies interpersonal dependence amongst members of the family system thus broadening the impact of any combination of the above mentioned stroke related sequelae (Turnbull & Turnball,

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1986b; cited in Wade, Taylor, Drotar, Stancin & Yeates, 1997). This phenomenon not only influences the caregivers' or partners' mood, activities and eventually life satisfaction; it obstructs the quality of life of survivors. An improved understanding of the psycho-social changes from the patient's perspective has obvious impact for the therapeutic interventions inherent in stroke rehabilitation and as a result, the personal and economic burden that a stroke exerts on the family system. As such, the research contributes towards the fields of neurobiology, physiology, neuropsychology and the social sciences.

Date: _____ Applicant's

Signature:_____

WHO WILL SUPERVISE THE PROJECT? (WHERE APPLICABLE)

Name: Enid Schutte

Department: Psychology

Staff no. 00400089

Telephone No: 0829206731

Date: _____ Signature: _____

HEAD / RESEARCH COORDINATOR OF DEPARTMENT / ENTITY IN WHICH STUDY WILL BE CONDUCTED (where applicable)

Name: _____

Date: _____ Signature: _____

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Appendix E

Ethical Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Blumenau

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER M080235**
PROJECT	Factors affecting personality change after stroke
INVESTIGATORS	Miss J Blumenau
DEPARTMENT	Psychology
DATE CONSIDERED	08.02.29
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 08.06.11 **CHAIRPERSON** .....
(Professor P E Cleaton Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : E Schutte

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix F

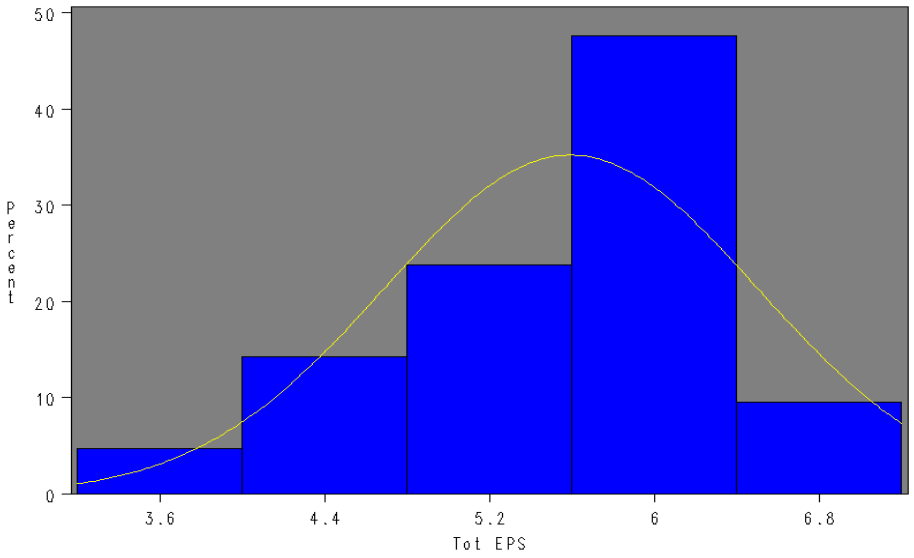
Eigenvalues of the Correlation Matrix and Proportion of Variance

	Eigenvalue	Difference	Proportion	Cumulative
1	4.60979547	2.09848938	0.3546	0.3546
2	2.51130609	0.99603333	0.1932	0.5478
3	1.51527276	0.39862020	0.1166	0.6643
4	1.11665256	0.39126630	0.0859	0.7502
5	0.72538626	0.06152127	0.0558	0.8060
6	0.66386499	0.10926919	0.0511	0.8571
7	0.55459580	0.09516654	0.0427	0.8998
8	0.45942926	0.12511857	0.0353	0.9351
9	0.33431069	0.09130806	0.0257	0.9608
10	0.24300263	0.06714911	0.0187	0.9795
11	0.17585352	0.11837017	0.0135	0.9930
12	0.05748334	0.02443672	0.0044	0.9975
13	0.03304662		0.0025	1.0000

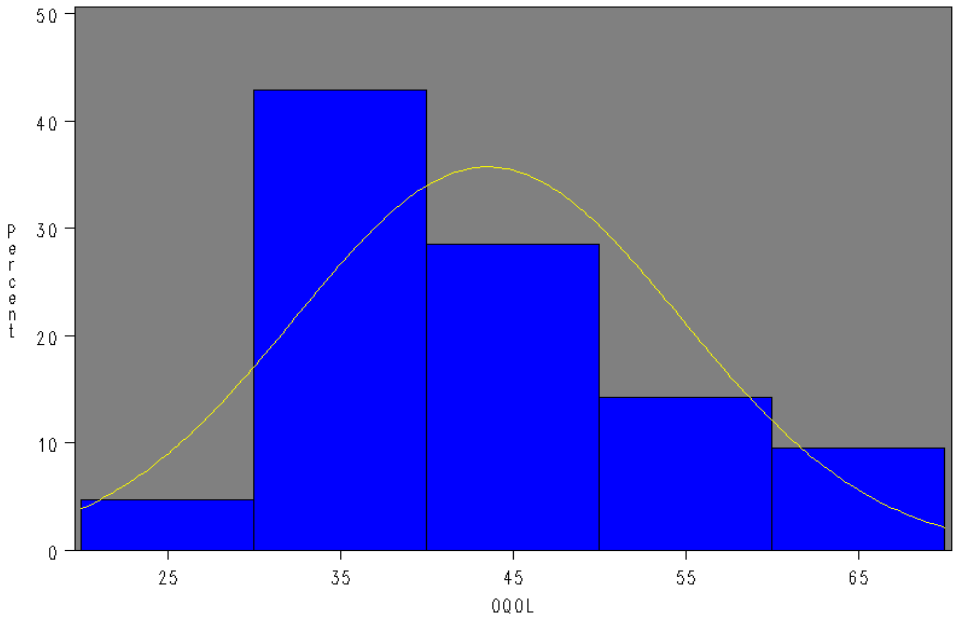
Wiley

Appendix G

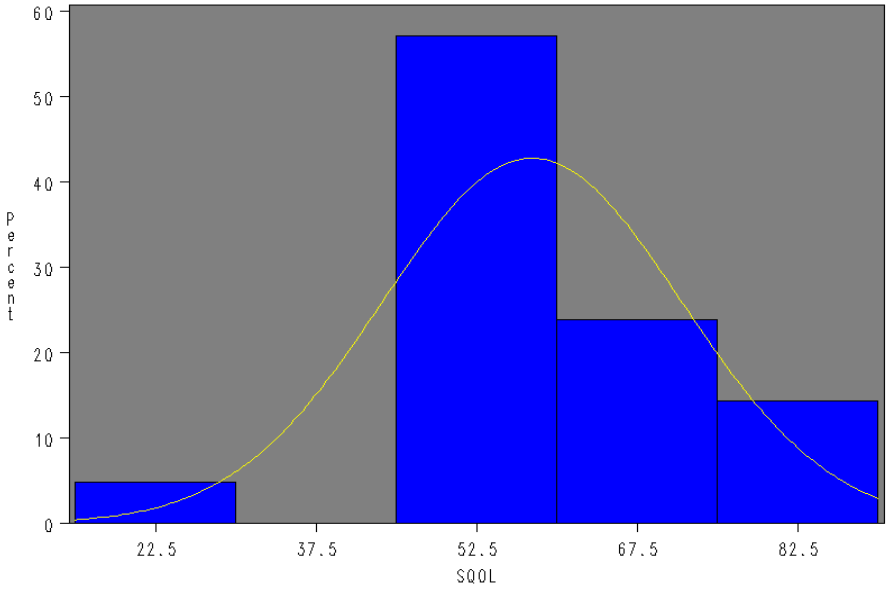
Distribution of Residuals for all Variables Measured



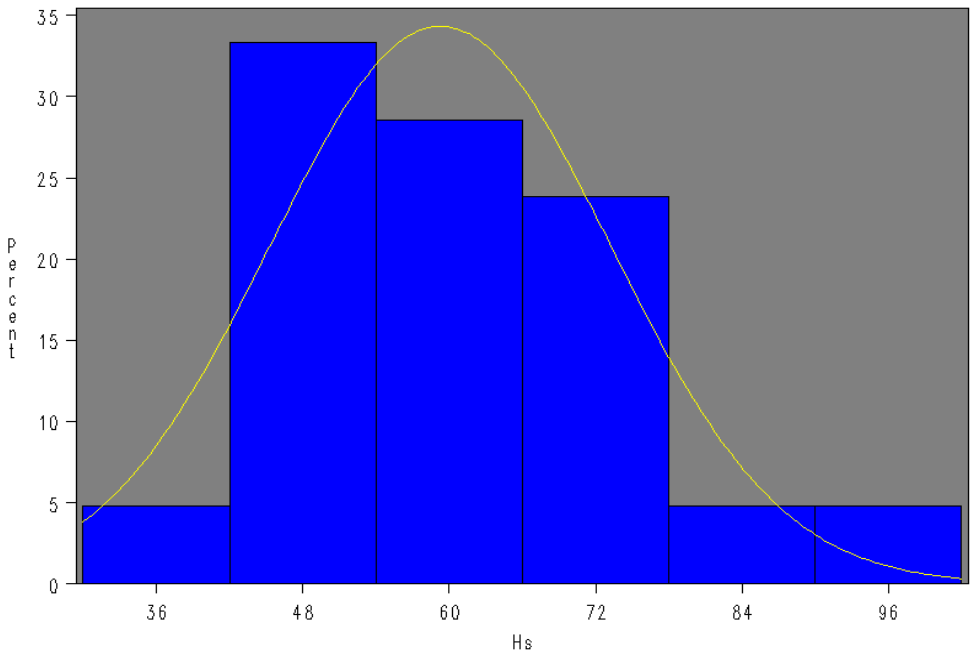
A histogram showing the distribution of the residual values for the variable emotion processing



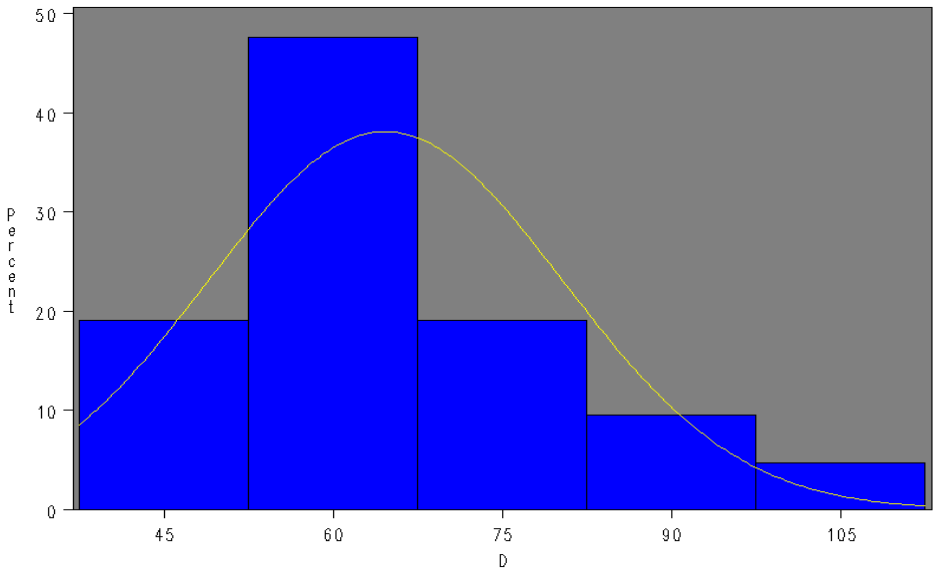
A histogram showing the distribution of the residual values for the variable objective quality of life



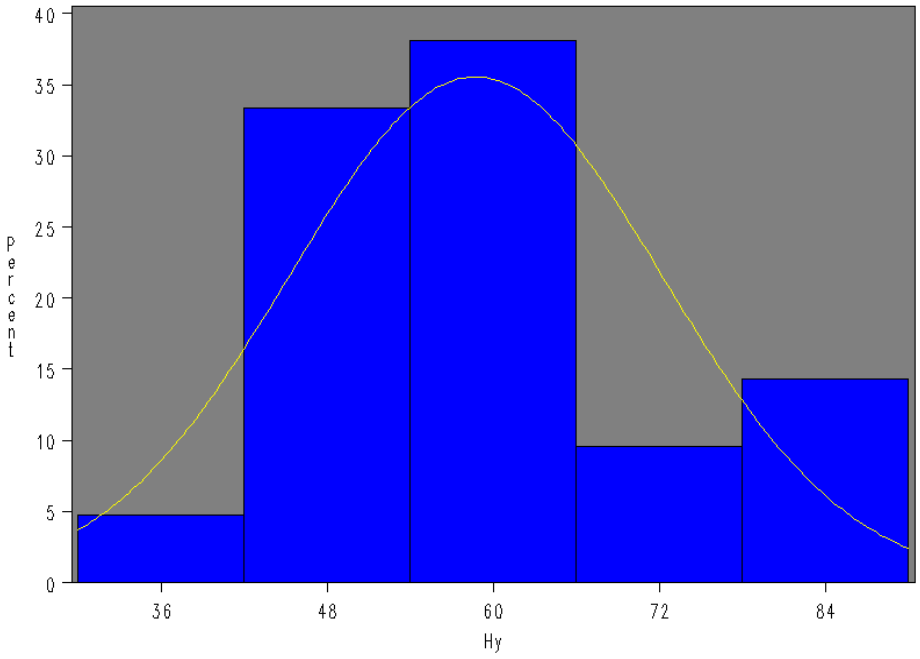
A histogram showing the distribution of the residual values for the variable subjective quality of life



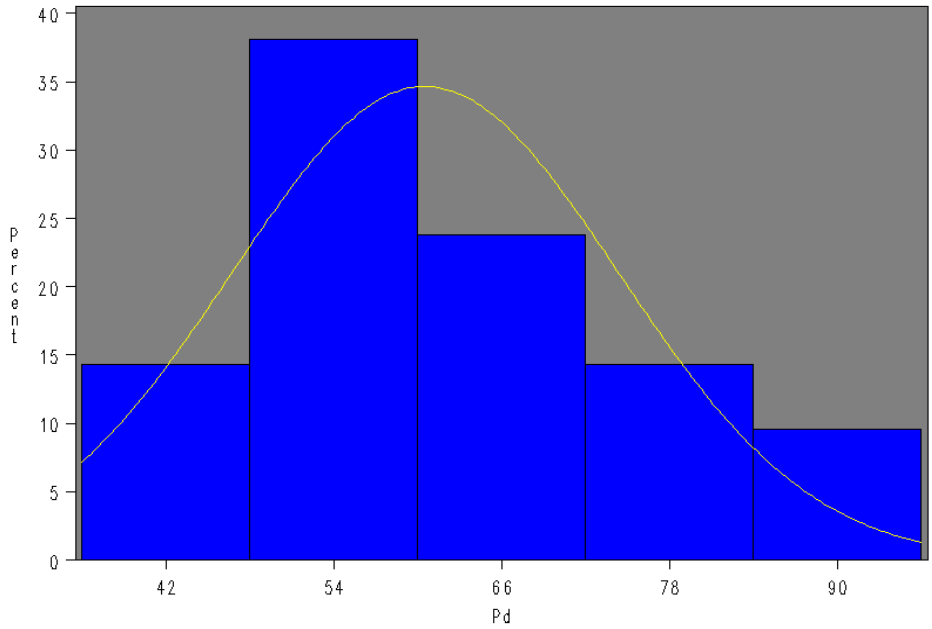
A histogram showing the distribution of the residual values for the variable hypochondriasis



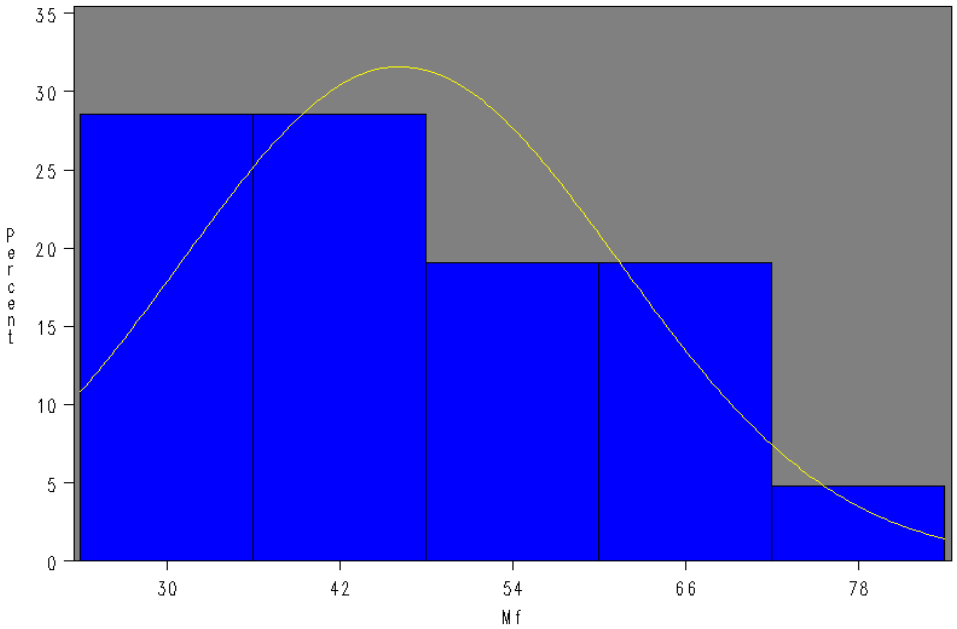
A histogram showing the distribution of the residual values for the variable depression



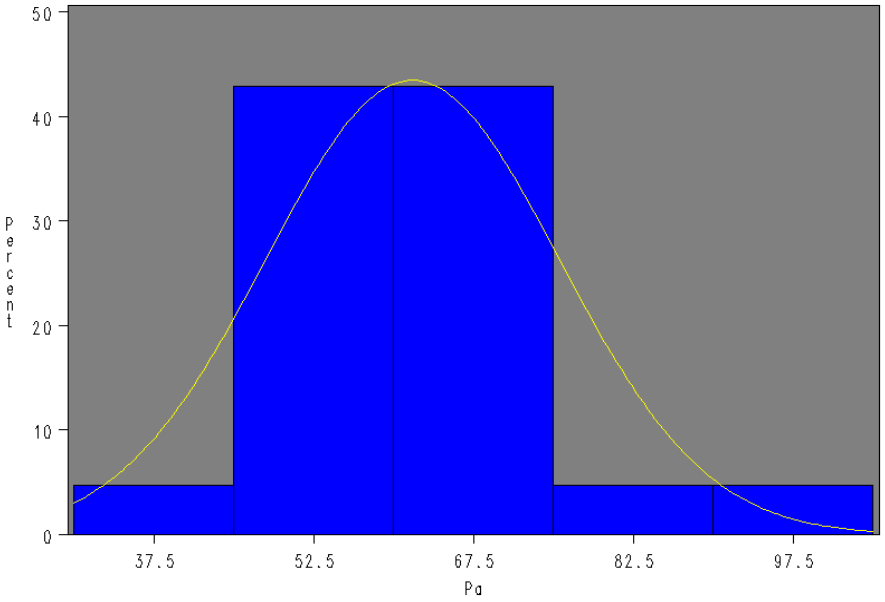
A histogram showing the distribution of the residual values for the variable conversion hysteria



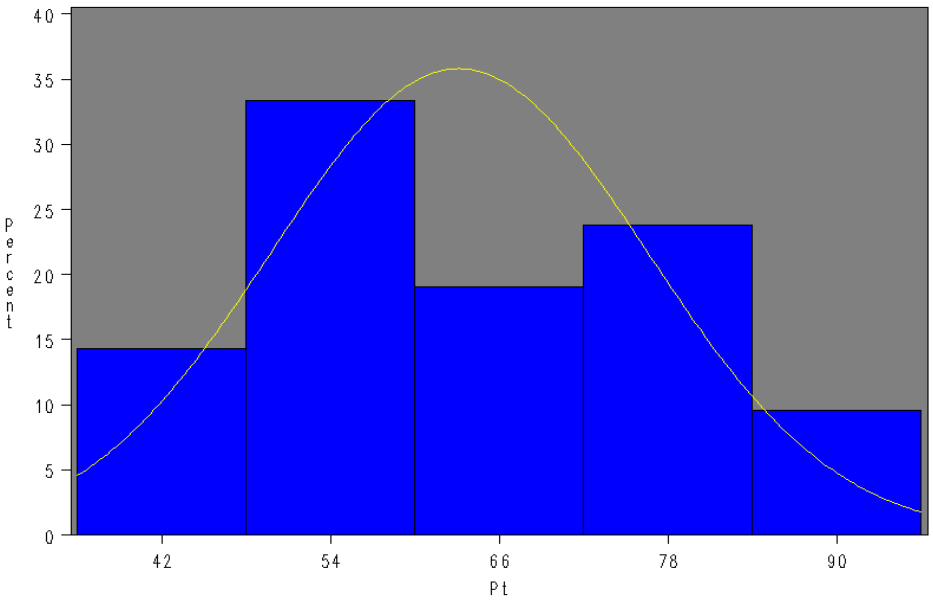
A histogram showing the distribution of the residual values for the variable psychopathic deviate



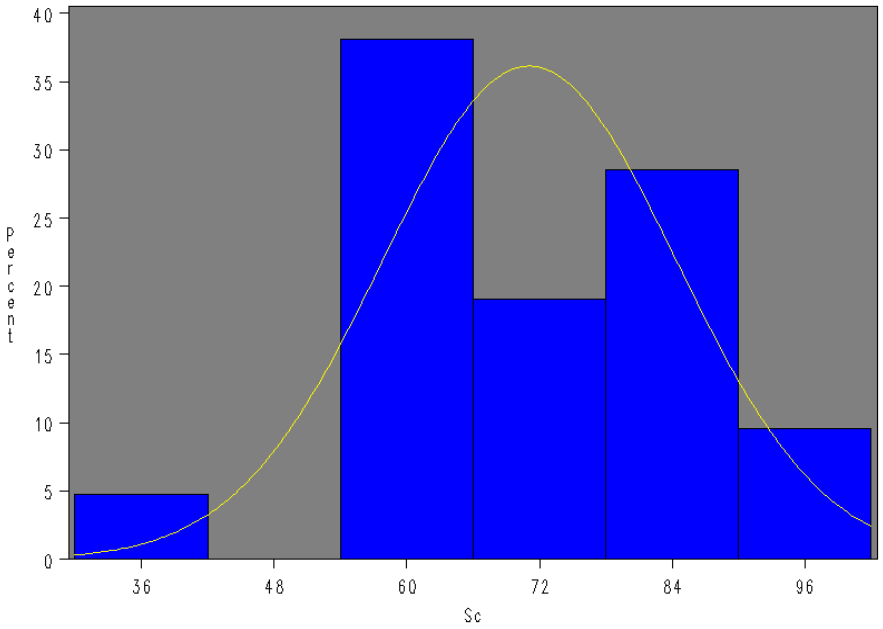
A histogram showing the distribution of the residual values for the variable masculinity/ femininity



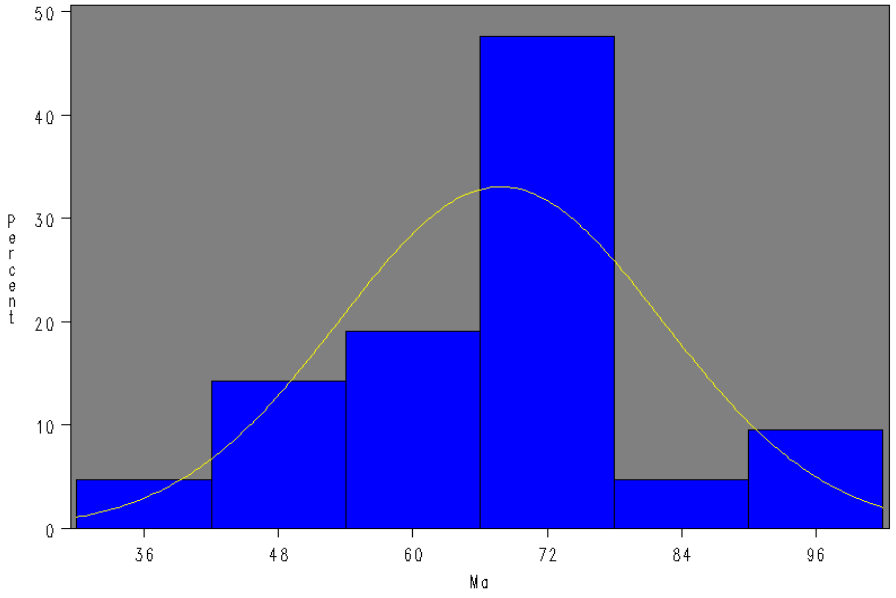
A histogram showing the distribution of the residual values for the variable paranoia



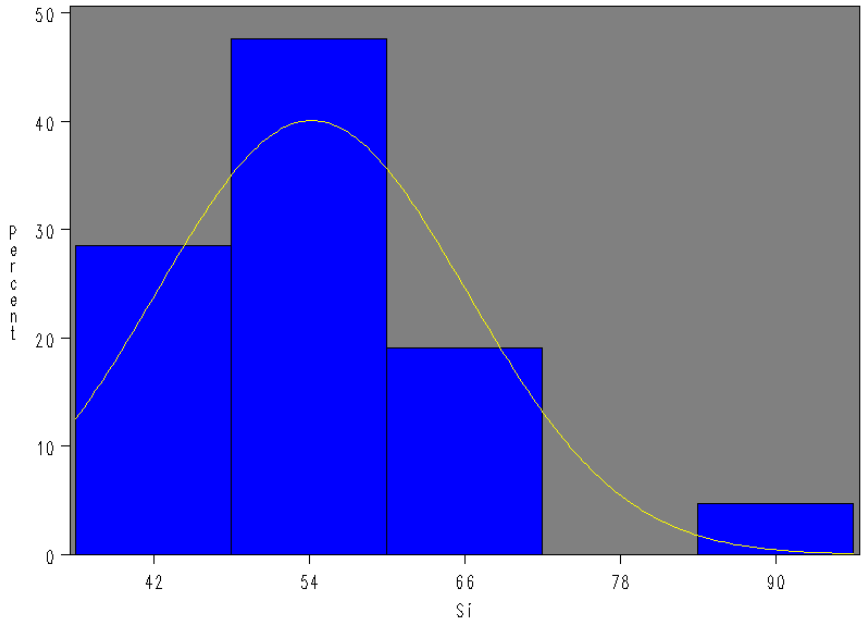
A histogram showing the distribution of the residual values for the variable psychasthenia



A histogram showing the distribution of the residual values for the variable schizophrenia



A histogram showing the distribution of the residual values for the variable hypomania



A histogram showing the distribution of the residual values for the variable social introversion

WitsE

Appendix H

Kaiser-Meyer-Olkin's Measure of Sampling Adequacy

Kaiser's Measure of Sampling Adequacy: Overall MSA = 0.57103794												
EP	**OQOL**	**SQOL**	**Hs**	**D**	**Hy**	**Pd**	**Mf**	**Pa**	**Pt**	**Sc**	**Ma**	**Si**
0.75	0.81	0.66	0.44	0.69	0.50	0.53	0.46	0.62	0.73	0.64	0.35	0.49

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