

https://dspace.org/

A comparison of mildly head-injured, malingering, and non-head-injured adult South Africans : neuropsychological performance and post-concussion symptoms.

Kuun, Terence Michael

1998

https://hdl.handle.net/10539/26218

Downloaded from a DSpace repository. https://dspace.org/

A COMPARISON OF MILDLY HEAD-INJURED, MALINGERING, AND NON-HEAD-INJURED ADULT SOUTH AFRICANS: NEUROPSYCHOLOGICAL PERFORMANCE AND POST-CONCUSSION SYMPTOMS

Terence Michael Kuun

A dissertation submitted to the Faculty of Arts, University of the Witwatersrand, in partial fulfilment of the requirements of the degree of Master of Arts

Johannesburg, 1998

ABSTRACT

The study reviews the literature concerning mild head injury and postconcussion symptoms. It then investigates the applicability of international findings to South African patients. Three groups of subjects are compared: mildly injured, noninjured, and instructed malingerers. The study establishes base rates of postconcussive symptoms in the noninjured subjects, scores on tests of cognitive ability among the noninjured subjects, expectations regarding postconcussive sequelae among the noninjured subjects, the perceptions of injured subjects of their pre- and postmorbid status, and relationships between subjectively experienced symptoms and cognitive deficits among injured subjects. Injured subgroups are examined to investigate pre-, peri-, and post-injury factors associated with development of postconcussive complaints. No differences in cognitive performance were found between the injured and noninjured groups. Time since injury did not affect cognitive performance, apart from on a copy task. It was found that injured subjects reported lower pre-injury levels of incidence of symptoms than those reported by noninjured subjects. No differences were found between post-injury reporting of postconcussive complaints and those symptoms reported by noninjured controls. Some postconcussive symptoms were nevertheless found to correlate with certain measures of cognitive performance.

Instructed malingerers responded differently noninjured injured and non-injured subjects, reporting fewer pre-injury complaints and more post-injury complaints. They also performed more poorly on several cognitive measures. Test scores that effectively identified malingerers were then re-examined, and cut-off rates suggested for differentiating malingerers from genuinely injured subjects.

DECLARATION

I declare that this dissertation is my own unaided work. It is submitted for the degree of Master of Arts in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any other degree or examination in any other university.

_____

_____ day of _____, 1998

DEDICATION

This dissertation is primarily dedicated to Pearl and Hugo Holl, whose assistance went beyond the call of duty or the limits of sanity, but remained within the bounds of decency (only just). The dissertation is also dedicated to all those who gave me assistance and support while writing it, notwithstanding the significant threat to their sanity. Leon Botes, in particular, endured the saga in intricate detail. Eugene de Grey, Joanne Tuling, Denise and Cyril Percimoney, and my therapist, Marc Goldstein, were also important sources of support.

ACKNOWLEDGEMENTS

Financial support by the University of the Witwatersrand is hereby acknowledged.

A small amount of money was received from the Centre for Science Development. It is a compulsory requirement of this organization that that the following acknowledgement be made:

> "The financial assistance of the Centre for Science Development (HSRC, South Africa) towards this research is hereby acknowledged. Opinions expressed and conclusions arrived at, are those of the author and are not necessarily to be attributed to the Centre for Science Development."

I would like to acknowledge the courteous and efficient assistance I received from the administrative and library staff of the Rand Afrikaans University. They assisted me when others were unwilling or reluctant to do so, and without their help, the preparation of this dissertation would have been extremely difficult, if not impossible.

Grateful acknowledgement is made of the assistance provided by Joan Ziervogel of Maryvale Adult College, and Mr M. Hattingh of ABC Academy, in allowing me access to their

students. I would like to thank Mr Hattingh for providing me with a venue for the assessments.

I would also like to thank Hugo Holl and Terence Murray for making it possible for me to gain access to subjects in Mpumalanga. Many thanks to Hugo Holl for his immense hospitality in providing me with accommodation during that time.

Finally, I would like to express my gratitude to Joseph Phasha, of the Mapodile Resource Centre, for his generous assistance, without which the data collection process would have taken much longer.

My supervisor was Patricia Jansen.

CONTENTS

CHAPTER 1: AIMS AND RATIONALE 1

CHAPTER 2: LITERATURE REVIEW 3

1. History of the Mild Head Injury Debate 3

2. Incidence of Mild Head Injury 6

3. Physical Consequences of Injury 8

4. Sequelae of Physical Damage and the Experience of the Injury 11

4.1. The Problem of Disparate Outcome Measures 11

4.2. Cognitive Sequelae 13

4.2.1. Nature and Incidence of Cognitive Deficits 13

4.2.2. Detection of Cognitive Deficits 17

4.3. Post-concussion Symptoms 25

4.3.1. Introduction 25

4.3.2. Nature and Definition 26

4.3.3. Incidence and Prognosis 29

4.3.4. Factors Influencing Incidence of Sequelae 31

4.3.5. Assessment of Subjective Postconcussive Complaints 49

5. Incomplete effort 50

5.1. Definition 50

5.2. Incidence 51

5.3. Detection of Incomplete Effort 52

6. Management and Minimisation of Sequelae 54

7. Summary 57

CHAPTER 3: RESEARCH QUESTIONS 59

CHAPTER 4: METHODOLOGY 62

1. Sample 62

1.1. Rationale 62

1.2. Ethical Considerations 63

1.3. Recruitment of the Sample 63

1.4. Composition of the Sample 64

1.5. Screening Procedure 76

2. Assessment 77

2.1. Battery 77

2.1.1. Rationale 77

2.1.2. Description of Tests 77

2.2. Procedure 90

2.3. Scoring 92

2.3.1. Initial Biographical Questionnaire 92

2.3.2. Postconcussive Checklist (PCL) 95

2.3.3. Postconcussion Syndrome Checklist (PCSC) 96

2.3.4. Benton Visual Retention Test (BVRT) 99

2.3.5. Paced Auditory Serial Addition Task - Revised (PASAT-R) 100

2.3.6. Stroop Colour Word Task (Stroop) 101

2.3.7. Rey 15-item Test (Rey 15-item) 102

2.3.8. Reliable Digit Span (RDS) 103

CHAPTER 5: RESULTS 104

1. Demcgraphic Comparisons 104

1.1. Procedure 105

1.2. Findings 118

1.2.1. Comparison of the Main Groups (16 Injured, 16 Malingerers, 15 Noninjured) 118

1.2.2. Subgroup Comparisons 119

2. Comparison of Assessment Results 126

2.1. Procedure 126

2.1.1. Descriptive Statistics 127

2.1.2. Comparison of the Test Results of the Main Groups (Injured, Malingering, and Noninjured) 148

2.1.3. Comparison of Subgroups defined in terms of Time Since Injury 177

2.1.4. Examination of Pre-, Peri-, and Post-injury Factors 195

2.1.5. Examination of Relationships between Indices of Injury Severity and Assessment Scores 208

2.1.6. Examination of Relationships between Postconcussive Symptoms and Cognitive Performance 219

2.1.7. Identification of Scores able to Suggest Malingererering, and the Development of Tentative Cutoffs 225

2.2. Findings 242

2.2.1. Cognitive Sequelae 242

2.2.2. Post-concussive Complaints (PCL and PCSC) 248

2.2.3. Incomplete effort 262

CHAPTER 6: DISCUSSION 272

1. Post-injury Sequelae 273

1.1. Cognitive Sequelae 273

1.1.1 Performance on Cognitive Tests 273

1.1.2. Performance on Tests of Malingering (Rey 15-item, RDS, and BVRT) 277

1.2. Factors Affecting Cognitive Sequelae 278

1.2.1. Time Since Injury 278

1.2.2. Injury Severity 280

1.2.3. Other Demographic Characteristics 284

1.2.4. Conclusions 285

1.2. Post-concussive Complaints (PCL and PCSC) 288

1.2.1. Differential Reporting of Complaints, according to Posttraumatic Interval 289

1.2.2. Relationships between Postconcussive Complaints and Test Performance 293

1.2.3. Factors associated with the Development of Postconcussive Complaints 296

2. Malingering 309

2.1. Evidence suggesting the Nature of Malingering 310

2.1.1. Cognitive Performance 310

2.1.2. Subjectively Reported Postconcussive Complaints 313

2.1.3. Specific Tests of Incomplete Effort 315

2.2. Use of Scores in Differentiating Malingerers 316

3. Limitations of the Present Study 319

4. Summary and Conclusions 323

CHAPTER 7: APPENDICES 326

Appendix 1: Subject Information Form 326

Appendix 2: Consent Form 328

Appendix 3: Interview Form/Questionnaire 329

Appendix 4: Assessment Battery 337

Appendix 5: Dataset 346

CHAPTER 8: LIST OF REFERENCES 374

CHAPTER 1: AIMS AND RATIONALE

The literature suggests that postconcussive sequelae are multidetermined, having physical, cognitive, interpretative, emotional, environmental, and motivational causes. It appears that while resolution of symptoms usually occurs fairly rapidly, persistence of symptoms often occurs. Minimisation of sequelae depends on effectively directed intervention, which in turn depends on a theoretical understanding of postconcussion syndrome in general, and an understanding of the specific case in question. There has, however, been little research into the applicability of findings to South African patients. In order to understand the South African client's reaction to and experience of his or her injury, it is important to have knowledge regarding psychological reactions to injury within the population in general, as well as knowledge regarding the use of specific instruments and techniques in assessing and understanding the individual patient in specific. It is therefore important to investigate whether international findings accord with those in the South African context. This applies both to the manifestation of mild head injury and malingering, as well as to the use of imported assessment instruments. From an assessment point of view, the development and standardization of instruments used in researching mild head injury have generally been performed using developed world populations, being tested in their first language. Given educational, cultural, linguistic, and socioeconomic differences in South Africa, it is important to

investigate whether these instruments are able to differentiate effectively between injured, malingering, and noninjured subjects, as well as to establish performance levels for each of these on any instrument. Emerging from this information, it is then important to establish whether the manifestation of the sequelae of mild head injury (in terms of cognitive performance as well as postconcussive complaints) is the same in the local context, particularly in terms of injury severity, time since injury, demographic variables, and correlation (or lack thereof) between postconcussive complaints and cognitive performance. Such differences are quite possible if, for example, personal interpretation of the injury experience differs as a result of different cultural expectations. Differences in the pattern of resolution of difficulties is also possible with, for example, differences in availability of health resources, daily stress levels, and so on. It is also possible that patterns of malingering may differ, with differences between populations such as in terms of general exposure to and understanding of assessment practices. While it is beyond the scope of this report to investigate why differences (if any) exist, it will nevertheless establish the existence or otherwise of such differences.

CHAPTER 2: LITERATURE REVIEW

1. History of the Mild Head Injury Debate

Concussion as a neuropsychological problem gained prominence with the advent of the industrial revolution and the resulting increase in industrially related injuries (Bohnen and Jolles, 1992). The concept of the postconcussion symptom-complex attained importance in the late part of the last century (Benton, 1989; Miller, 1996, Bohnen and Jolles, 1992). It has been claimed that there is a constellation of psychological and affective symptoms that are associated with mild head injury, generally referred to as the Postconcussion Syndrome (Gouvier, Cubic, Jones, Brantley and Cutlip, 1992). Debates have since taken place as to the extent to which the syndrome is of neurotic origin, malingering, or physical damage (Benton, 1989; Gouvier, Cubic, Jones, Brantley and Cutlip, 1992; Miller, 1996).

The post-war decades have tended to confirm the existence of the syndrome as a valid consequence of mild head injury. (Benton, 1989). Initially, however, the majority view tended to see the symptoms as psychogenic, and as a result of stress or malingering, with the reality of organic deficits not recognized (Bohnen and Jolles, 1992).

Objective evidence of damage to the brain has been detected using neuroimaging techniques such as MRI (Brown et al., 1994; Bohnen and Jolles, 1992), but neuropsychological testing has also taken on a central role in the diagnosis of mild head injury, due to the subtlety of physical damage (Millis, 1994). It has been argued that previous psychometric measures were not sufficiently sensitive to the effects of mild head injury, and researchers have found subtle deficits of attention and information processing (Bohnen and Jolles, 1992).

Given evidence of psychological and physiological contributors to postconcussive complaints, many now argue that sequelae are multifactorially determined, with organic, psychological and socioeconomic components interacting (Benton, 1989).

There are, however, inconsistencies in definitions of mild head injury (Jennet, 1989), in addition to which studies are complicated by inconsistency in sampling, intervals post-injury at which patients are assessed, the nature of tests used, and the patient's environment and experience. Different studies are not necessarily directly comparable and it has been argued that inconsistent findings are often a function of this (Bohnen, Twijnstra and Jolles, 1992).

Kibby and Long (1996) criticize much of the literature for not differentiating mild and moderate injury. According to

them, minor head injury has been "typically characterized by individuals with (1) coma of less than 20 minutes, (2) a GCS score on admission of 13 or higher, (3) post-traumatic amnesia (PTA) less than 24 hours, and (4) hospitalization of less than 72 hours, although few studies have included all these criteria when selecting their samples. Mild TBI has typically been defined as that which meets criteria (1)-(4) but with PTA less than 1 hou.....Moderate TBI has been defined as a GCS score of 9-12...with PTA lasting from 1 to 24 hours" (Kibby and Long, 1996, p.160). Mildly head injured subjects with evidence of intracranial mass lesion have also been classified as moderately injured. They suggest seeing head injury as taking place on a continuum (Kibby and Long, 1996).

Bohnen and Jolles (1992) note that patients who do not experience any unconsciousness at all, but are dazed for a short period, may also report symptoms. In addition, it has been argued that mild head injury includes whiplash injuries with and without impact (Miller, 1996; Parker and Rosenblum, 1993).

For the purposes of this study, subjects were selected taking note of the distinction between mild and moderate injury. The criteria that Kibby and Long (1996) derive from their survey of the literature, were therefore used to identify mild head injury, namely:

a) loss of consciousness of less than 20 minutes

b) GCS score on admission of 13 to 15

c) post-traumatic amnesia of less than 1 hour

d) hospitalization of less than 72 hours

Given the disparate measures used by previous researchers, it would be interesting to investigate whether degrees of severity nevertheless exist within this category.

2. Incidence of Mild Head Injury

Mild head injury has been regarded as a major public health problem, constituting the majority of all head trauma (Miller, 1996; Gouvier, Cubic, Jones, Brantley and Cutlip, 1992; Mittenberg, 1993). It has been reported that mild head injuries constitute 75% of all head injuries (Miller, 1996).

Various factors have been associated with risk of sustaining injury. Incidence of adverse life events in the year prior to injury seems to be a significant factor, Jacobson, 1995), as are transient states such as stress (Jacobson, 1995) and fatigue (Jacobson, 1995). Vulnerable personality, psychiatric history, and "genetic liability" have also been found to be significantly related to risk of injury (Jacobson, 1995, p.680). Substance abuse and incidence of previous head injuries also seem to be predisposing factors (Jacobson, 1995). Age is related to risk of head injury (Beers, Goldstein and Katz, 1994), specifically with youth (Jacobson,

1995). Males are especially at risk (Jacobson, 1995; Fenton, McClelland, Montgomery, Macflynn and Rutherford, 1993). However, it has been argued that females may predominate where injury is particularly slight (Cattelani, Gugliotta, Maravita and Mazzucchi, 1996). Kraus and Nourjah (1989) found that young males were especially at risk. Alcohol abuse has also been linked to risk (Kraus and Nourjah, 1989; Beers et al., 1994; Jacobson, 1995), as have certain personality traits (Type A behaviour, antisocial attitudes, and poor thoroughness in making decisions), poor cognitive skills (Jacobson, 1995), and willingness to take risks (Beers et al., 1994). Education level and occupation have been associated with risk of injury (Beers et al., 1994; Jacobson, 1995), with unskilled and semi-skilled workers being especially at risk (Jacobson, 1995).

Kraus and Nourjah (1989) concluded from their epidemiological study that in San Diego County in 1981, the incidence of mild brain injury was 131 per 100 000 of the population. They conclude that the cost implications "cannot be considered trivial" (p.21). Szymanski and Linn (1992) also point to the costs in terms of "lost work days, disruption of family and social life, and cognitive and neurobehavioral sequelae" (p. 358).

It has been argued that estimates of frequency of occurrence are often conservative, as head impact and altered consciousness often remain unreported (Parker and Rosenblum,

1993; Miller, 1996). Many patients are not hospitalized or seen by medical professionals (Bohnen and Jolles, 1992).

According to Tollman (1989) it is difficult to assess the impact that head injuries have on South African society. There is no reason to believe that the situation is any better than that in America, especially as social changes such as industrialisation are placing increasing numbers of people at risk from machinery (Tollman, 1989). Incidence of motor vehicle accidents in South Africa is estimated to be about 5 times that of the United States, while trauma as a result of assault is at least 3 times as common. Black people are estimated to be about 9 times more likely to sustain traumatic brain injury than whites (Tollman and Watts Runge, 1989).

The violent nature of South African society also appears to be a major factor in causing head injury. Jennet (1996) reports that the international range of studies that he surveys "show that the main causes of head injury are road accidents, falls and assaults", but that "the proportion due to assault ranges from 1% of males in France to 45% of males in Johannesburg" (Jennet, 1996, p. 367).

3. Physical Consequences of Injury

Traumatic brain injury can occur with or without impact, requiring only sufficient angular rotation. Rear impact

forces the head back, while front impact forces the head forward (Parker and Rosenblum, 1993).

> "The head moves in a combination of planes (lateral and sagittal) and torsion around the tethering neck, which changes the brain's position and movement relative to the enclosing skull and often causes impact within the confining space" (Parker and Rosenblum, 1993, p.32).

It is difficult to predict which structures will be damaged, with traumatic brain injury being multiply determined by characteristics of the forces operating on the brain, as well as the characteristics of the brain and body (Parker and Rosenblum, 1993). There is evidence that rotational and shearing forces cause neuronal damage (Bohnen and Jolles, 1992). It has been argued that rotational acceleration is more likely to cause concussion and diffuse axonal injury, while linear acceleration is most likely to produce focal lesions. Centripetal forces are more likely to harm subcortical diencephalic structures (Miller, 1996).

Evidence exists that diffuse axonal damage typically occurs, with degenerative changes taking place over several hours. In addition, chemical and molecular changes occur at neuronal level (Miller, 1996). The extent of the diffuse axonal injury and impairment of consciousness are dependent on the magnitude and duration of acceleration, as well as the direction of head motion" (Kibby and Long, 1996, p.160).

Povlishock and C( )urn, 1989, in studies using cats, found that mild axonal damage occurred, followed by some recovery. They conclude that the damage may be amenable to posttraumatic therapeutic intervention.

It has been argued that "subtle dynamic reorganization" may occur, different to that after focal injury (Miller, 1996, p. 18). Diffuse axonal injury and diffuse deafferentiation could account for psychological impairment, whereas compensatory neuroplastic changes may account for recovery typically seen over 3 to 12 months. Persisting or delayed onset of symptoms may be caused by defective reafferentiation, with subtle but significant consequences (Miller, 1996). Miller argues that the cumulative effects noted after repeated head injury may be explained by diffuse axonal injury.

Localized damage has also been noted. Eisenberg and Levin (1989) found MRI evidence of frontal and temporal abnormalities. This appears to be confirmed by the literature. Segalowitz and Lawson (1995) believe that although the areas of damage underlying observed changes vary, there is some consensus that the areas of the brain primarily involved are the various regions of the prefrontal cortex and their connections. Miller (1996) and Szymanski and Linn (1992) also report support for the notion of damage to the temporal and fro[illegible] poles.

Hayes, Lyeth and Jenkins (1989) suggest that brainstem involvement may occur, causing chemical effects which may alter cellular information pathways. They also suggest the possibility of drug interventions. Yet a study by Schoenhuber and Gentilini (1989), using Auditory Brainstem Response recordings, were unable to find clear evidence of brainstem dysfunction in cerebral concussion. Other writers nevertheless also cite evidence that concussion may result in brainstem changes and possibly changes in tonic arousal. (Parasuraman, Mutter and Molloy, 1991; Parker and Rosenbaum, 1993). Dikmen, Temkin and Armsden (1989) cite evidence of "neuropathological and neurophysiological alterations...including neuronal damage, reduced cerebral blood flow, altered brainstem evoked potentials, and reduced speed of information processing" (p.229).

4. Sequelae of Physical Damage and the Experience of the Injury

4.1. The Problem of Disparate Outcome Measures

Research suggests that as lesions resolve, there is generally an improvement in neuropsychological performance and resumption of activities (Gronwall, 1989). However, it has also been argued that in some cases, symptoms persist, despite objective recovery of function (Bohnen, Wijnen, Twijnstra, Van Zutphen and Jolles, 1995).

Studies differ with respect to duration of residual deficits. Kibby and Long (1996) suggest several reasons for these disparities. Studies often do not sufficiently differentiate different severities of injury (that is, mild versus moderate injury). Studies also employ different measures of outcome: recovery or otherwise is variously operationalized return to work, evidence of cognitive deficits, and evidence of postconcussion symptoms. Studies also often do not differentiate between cognitive deficits as a result of neurological factors and changes due to non-neurological factors. More specifically, there is confusion between post-concussion symptoms and cognitive weaknesses (Kibby and Long, 1996). Kibby and Long believe that "since PCS can occur in the absence of TBI, and are inversely related to the severity of injury, they clearly result from substantially different factors" (Kibby and Long, 1996, p.183).

Nevertheless, this is an area of debate, and there are those who argue that postconcussion symptoms may often be a direct or indirect result of cognitive deficits (Bohnen, Twijnstra and Jolles, 1992). Kibby and Long (1996) also acknowledge that postconcussion symptoms may affect performance on cognitive tests.

4.2. Cognitive Sequelae

4.2.1. Nature and Incidence of Cognitive Deficits

There are inconsistencies in definitions, instruments, and methodologies employed (Bohnen and Jolles, 1992) and findings vary according to these. As mentioned previously, discrepant findings may be due to methodological inconsistencies, particularly the failure to differentiate mild and moderate injuries (Kibby and Long, 1996).

It has been claimed that gross deficits in intelligence and memory do not seem to occur, although subtle deficits have been reported (Bohnen and Jolles, 1992). Yet Parker and Rosenblum (1993) found evidence that a subset of patients experienced cognitive loss of nearly one standard deviation of Full Scale IQ on the WAIS, after mild head injury. Deficits were permanent. They claim that their findings are consistent with previous evidence that traumatic brain injury involves greater loss in Performance than Verbal IQ. However, they did not provide details of these deficits. Their conclusions are also weakened by their methodology. Pre-injury levels of functioning of their subjects were not assessed directly, or through the use of a control group, but derived from published norm tables. The researchers do not sufficiently consider the possibility of their sample having unique characteristics.

It has been claimed that while cognitive impairment is common in the first week of injury, persistent deficits are uncommon (Millis, 1994; Millis and Putnam, 1994; Jacobson, 1995). Cognitive deficits in the first few days consist of disturbances of attention, memory and information processing (Jacobson, 1995). An "individual would not be expected to have permanent cognitive impairment or symptoms lasting more than a few months due to mild brain damage alone" (Kibby and Long, 1996, p.165). However, some studies have found deficits that persist longer. There is evidence of symptomatic patients having cognitive deficits for months to years after injury (Bohnen and Jolles, 1992). Often the patient has not returned to previous levels of functioning (Miller, 1996; Gouvier, Cubic, Jones, Brantley and Cutlip, 1992). Hall and Borstein found cognitive abnormalities in subjects tested within 6 months post-injury. Beers, Goldstein and Katz found cognitive deficits in college students who had sustained injury at any stage of their lives (time of injury ranged from before the age of 6 to beyond the age of 18). Likewise, Segalowitz and Brown (1991) found evidence that mild head injury among children was linked to development difficulties in adolescence, and Segalowitz and Lawson (1995) found that childhood injuries were associated with cognitive and psychosocial difficulties in adolescence.

It has been suggested that when recovery does not occur within 3 months, other factors should be considered. Kibby and Long (1996) identify three categories of factors. First, the patient may have sustained a moderate injury, which requires longer recovery time. Second, it is important what criteria are used to measure recovery. Third, "factors not directly resulting from, but interacting with, the trauma" (p. 174) may contribute. These include pre-injury factors, injury-related and post-injury factors (Kibby and Long, 1995). In addition, the internal validity of studies in question should also be considered (Kibby and Long, 1996).

Beers, Goldstein and Katz (1994) also report that according to the literature, "deficits in information processing, including attention and reaction time, are among the most salient effects of MHI (Beers et al., 1994, p.316). They note the argument that mild head injury leads to changes in information processing capacity, which in turn affects attention and memory. Their own study (using college students as subjects) suggested that tests of information processing capacity were most sensitive to mild head injury. Mild head injured were distinguished from controls on tests of memory, problem solving, and visuo-spatial ability. They conclude that "diffuse brain injury, regardless of severity, appears to cause a reduction in the speed, efficiency, and integration of mental processes" (Beers et al., 1994, p.316). This study is particularly interesting, as the majority of the subjects had sustained their injuries during childhood or

adolescence (92 percent). The study therefore suggests that the effects of mild head injury may be very long term.

Miller (1996) reports that memory and concentration deficits are among the most common cognitive postconcussion syndrome complaints. He adds that most persistent deficits are "documented on tests of reasoning, information processing, and verbal learning" (Miller, 1996, p.10), although much postconcussion symptomatology may be as a result of impaired information processing capacity (Miller, 1996).

"Recovery of information processing speed typically occurs within three months, while persisting impairment in attention is still present at three months. Reaction time recovers by about six months. Memory for new information recovers over one to three months, although persisting impairment in visual memory and digit span has been noted beyond that point" (Miller, 1996, p.10).

Szymanski and Linn (1992, p.362) state that "the most common neuropsychological sequelae of MTBI include reduced speed of information processing, attention deficits, and memory problems, but...not all patients...demonstrate significant problems in all of these areas".

4.2.2. Detection of Cognitive Deficits

Deficits are difficult to assess. Symptoms may have an emotional overlay (Arcia and Gualtieri, 1993), and cognitive disturbances may be very subtle and detectable only with suitably sensitive tests. Patients differ, with some recovering quickly with no deficits, while others have deficits. Within this group, there may be subgroups with different degrees of disability (Bohnen, Jolles and Twijnstra, 1992). It has been argued that a wide range of factors needs to be sampled in order not to miss any dysfunctions (Parker and Rosenblum, 1993). It has also been argued that there is a danger in using group norms to assess deficits, as these may mask individual losses - for example, where someone sustains deficits, despite still remaining above average in performance (Lezak, 1995; Ruff et al.,1989).

The detection of cognitive deficits is also vulnerable to malingering and other forms of incomplete effort. Any assessment should therefore incorporate an assessment of effort exerted. This is discussed in a separate section below.

The commonly reported symptoms of memory, attention, and information processing are further discussed below.

1. Memory

Hall and Borstein (1991) maintain that poor verbal memory performance appears to be a lasting feature following minor to mild head injury. Arcia and Gualtieri (1993) found that in their study, the most commonly reported symptom was memory deficit. They also found that reported memory problems were most strongly associated with neurobehavioural performance, but felt that they may have been associated with difficulty in processing information quickly rather than actual recall (Arcia and Gualtieri, 1993). However, Arcia and Gualtieri combined mild and moderately injured subjects, thus limiting the generalizability of the results to mild head injured alone.

Other studies have also suggested that persistence of memory problems may be related more to disturbances in rate of information processing, than to changes in intrinsic memory functions (Bohnen, Twijnstra and Jolles, 1992; Bohnen and Jolles, 1992).

In an investigation of memory recovery following MHI, Ruff et al. (1989) found that "a patient who has sustained a single, uncomplicated mild head injury generally shows compromised memory functioning when tested within one week...specifically, memory for verbal and visual information was found to be significantly below that of regional control subjects. In the period between baseline and one month,

patients...recovered both verbal and visual memory functioning to a level that was no longer significantly below that of the controls" (p.185). However, they also found that there was a lack of correspondence between subjective complaints, which remained almost unchanged at one month, and neuropsychological performance. They suggest that various factors may interact to cause this effect, such as premorbid personality, and psychological reactions to the trauma. Some patients complained of symptoms up to 3 months after injury. Verbal memory was assessed using the Mattis-Kovner Verbal Learning and Memory Test, while visual memory was assessed using the Benton Visual Retention Test.

2. Attention and Information Processing

In an investigation of attention deficits in the weeks and months following MHI, Gronwall (1989) argues that head injury produces a reduction in attention capacity, and hence information processing capacity. Whiplash injuries have also been found to be associated with impaired information processing and cognitive efficiency, specifically divided attention and speed of information processing (Parker and Rosenblum, 1993). Gronwall argues that diffuse damage affects "how much and how rapidly information can be processed, in contrast to the specific and isolated deficits that result from penetrating brain injury" (p.153)

Gronwall (1989) defines information processing capacity as "the number of operations the brain can carry out at the same time" (p. 154). She believes that "after MHI, patients have difficulty in all areas that require them to analyze simultaneously. They present as slow because it takes longer for smaller than normal chunks of information to be processed. They present as distractible because they do not have the spare capacity to monitor irrelevant stimuli at the same time as they are attending to the relevant stimulus. They present as forgetful because while they are concentrating on point A, they do not have the processing space to think about point B simultaneously. They present as inattentive because when the amount of information that they are given exceeds their capacities, they cannot take it all in. These are all aspects of attention" (p.154). Gronwall argues that it is therefore not surprising that concentration difficulties and fatigue are noted. While full functional recovery may occur, fragility to stressors may remain.

In a study by Parasuraman, Mutter and Molloy (1991), it was concluded that sustained attention was unimpaired under normal task conditions, but may "fall short under task conditions that require sustained effortful processing" (Parasuraman et al., 1991, p.789). Thus, while injured subjects may not display deficits under less demanding conditions, as the demands of the situation increase, their performance is more likely to decrease relative to that of controls performing the same tasks. However, the study

applied to subjects in their first month post-injury and the findings may not apply beyond the acute phase. Nevertheless, it has also been claimed by others that difficulties with information processing and attention occur especially with more demanding tasks or tasks performed under pressure (Bohnen, Twijnstra and Jolles, 1992; Bohnen, Jolles, Twijnstra, Mellink and Sulon, 1992; Bohnen and Jolles, 1992) and it has been suggested that reduction in the capacity to process information occurs (Bohnen and Jolles, 1992).

Gronwall (1989) states that information processing capacity has been successfully measured using the Paced Auditory Serial Addition Task and that with weekly testing, PASAT scores improved as the number and severity of PCS symptoms decreased. Gronwall concludes that "reduced information processing capacity is a reliable index of the effects of MHI on cognitive functions, and that some of the clinical symptoms are related to this" (p.161). Lezak (1995) states that PASAT scores generally return to normal within 30 to 60 days, although others continue to "lag behind the performance level of their control group" (Lezak, 1995, p. 373).

Gentilini, Nichelli and Schoenhuber (1989) cite research that "did not find a deficit in PASAT performance with a slower presentation rate" (p. 165). They conclude that "attention deficits following head injury are largely the result of slowing down of information processing. Hence, the head-injured patient will experience more attention deficits...and

will be confronted with ...limited capabilities in situations demanding more global cognitive functions" (p.165). In their study, they found deficits in selective, sustained, divided, and distributed attention. Their subjects were tested within 1 month of trauma. They suggest that deficits may be related to the mechanisms of concussion, which "tend to cause marginal axonal damage or only slight focal dysfunction. The most sensitive tasks for revealing cerebral dysfunction are therefore those that test functions involving the greatest number of cortical and subcortical areas simultaneously. This feature certainly applies to attentional tasks, especially those based on processing speed" (p. 174).

Szymanski and Linn (1992) cite Van Zomeren and Brouwer (1989), who claim that attention can fail for two general reasons: difficulty with divided attention and difficulty with focused attention. Divided attention is "the ability to attend to more than one thing at a time" (p. 361), while focused attention is "the ability to maintain the selectivity of an attentional response despite competing inputs" (p. 361). A focused attention deficit...occurs when a relatively automatic process...intrudes upon a controlled process....A divided attention deficit...occurs as a result of the limited capacity for controlled attentional processes" (p. 361).

Szymanski and Linn (1992) state that the PASAT has frequently been used to measure divided attention. "Problems with divided attention are thought to primarily reflect decreased

processing capacity secondary to central slowing, but may also result from decreased processing capacity" (p. 361). They state that divided attention is often deficient in individuals who have sustained mild traumatic brain injury. By contrast, focused attention, as measured by the Stroop Interference Task, "is relatively intact following traumatic brain injury, unless there has been involvement of the left frontal region" (p. 361).

However, other research has suggested that deficits in focused attention (alternatively termed selective attention) are detectable with more demanding tasks. A modified version of the Stroop Colour Word Test has been used to demonstrate such deficits (Bohnen, Jolles and Twijnstra, 1992; Batchelor et al., 1995).

Batchelor et al. (1995) found that subjects were slower and more susceptible to interference than controls. They concluded that performance on the modified Stroop colour word test was characterised by both divided attention (indicated by their slowness) and focused attention (indicated by the modified interference condition). In their study, subjects were tested within 14 days of injury. In the study by Bohnen, Jolles and Twijnstra (1992), subjects were also tested in the acute post-injury period (6 to 14 days after injury).

Bohnen, Twi . and Jolles (1992), using the modified Stroop colour word test, compared two groups of subjects at 3 months post-injury: those with complaints of postconcussive symptoms (PCS) and those without PCS. It was found that subjects complaining of symptoms "at 3 months had more difficulties with the Stroop color word interference measure...than patients without PCS but not at 10 days and 5 weeks when both groups consi ed of patients who had persistent symptoms at these times" (Bohnen, Twijnstra and Jolles, 1992). They suggest that the "persistence of PCS following uncomplicated MHI may be related to the persistence of a cognitive deficit as detected in a color word interference task" (p.120). They believe their results to be consistent with findings by Gronwall that "the number and seve_ity of PCS symptoms decreased as the rate of information processing improved. They state that the findings by Ruff et al. (1989), cited above, that recovery from memory deficits following MHI did not paralle' recovery from PCS, were possibly due to the persistence of PCS being related more to disturbances in information processing than to changes in intrinsic memory functions.

4.3. Post-concussion Symptoms

4.3.1. Introduction

While the cognitive sequelae of mild head injury can be understood and investigated tangibly in terms of changes (or otherwise) in specific abilities (or at least in terms of specific performances), it is important to remain aware that subjects do not operate in such abstracted terms. Instead, cognitive status is embedded within a more complex (and, from an assessment point of view, less tangible) experience of the self and the world. Rather than subjects complaining in abstract terms of difficulties with, for example, attention and memory, it is unsurprising that complaints are expressed in terms that reflect the complex emotional, physical, and intellectual constitution of those subjects. It is unsurprising, too, that the more multidimensional and intangible the experience, the more hotly debated is its validity and etiology. It is this multidimensional postconcussive experience that is referred to as "postconcussive symptoms", "postconcussive complaints", or "postconcussive syndrome". What follows is a discussion of the nature of the typical experience that follows concussion.

4.3.2. Nature and Definition

Wong, Regennitter and Barrios (1994) describe the postconcussive syndrome as a constellation of complaints that persist for months, or even just weeks, following mild head injury. Mittenberg, Tremont, Zielinski, Fichera and Rayls (1996) describe the syndrome as "a symptom cluster that includes complaints of poor concentration, memory difficulty, intellectual impairment, irritability, fatigue, headache, depression, anxiety, dizziness, blurred vision, light sensitivity, and sound sensitivity" (Mittenberg et al., 1996, p.139). They state that PCS is often a persistent disorder. Although the syndrome remits spontaneously in many patier others may continue to complain of persistent symptoms (Mittenberg et al., 1996).

Cattelani, Gugliotta, Maravita and Mazzucchi (1996) describe the most common symptoms as "headache, vertigo, dizziness, diminished concentration, impaired memory, proneness to fatigue, insomnia, sexual difficulties, diminished self-assuredness and irritability" (Cattelani et al., 1996, p. 187).

Postconcussion syndrome has been seen as consisting of physical, affective, and cognitive complaints (Bohnen, Wijnen, Twijnstra, Van Zutphen and Jolles, 1995; Wong, Regennitter and Barrios, 1994). Bohnen et al. (1995) report that the relationship is not invariant, however, and patients

may report emotional and vegetative symptoms without differing from asymptomatic patients and healthy controls in terms of neuropsychological performance.

There has been some inconsistency in the extent to which these three factors have been included in the concept of the postconcussion syndrome. There has been a tendency to see reduced cognitive performance as having a purely organic origin, (Bohner and Jolles, 1992), while the subjective nature of many other complaints has resulted in their being treated with circumspection (Gouvier, Cubic, Jones, Brantley and Cutlip, 1992). There is also great variation in time of onset, degree and persistence of symptoms, causing many clinicians to doubt the reality of symptoms (Miller, 1996). Delayed onset and worsening of symptoms over time sometimes occur (Miller, 1996; Mittenberg, Zielinski and Fichera, 1993), particularly without treatment (Mittenberg, 1993). Longer term sequelae are not well understood, but a sizeable proportion of patients have chronic symptoms that appear out of proportion to the injury sustained (Miller, 1996).

It has been suggested that it is only when symptoms persist beyond the normal recovery period that they manifest as the postconcussion syndrome (Bohnen and Jolles, 1992). However, opinions vary as to what constitutes the normal recovery period, as will become evident in the discussion below, concerning incidence of symptoms. Bohnen and Jolles (1992) report that there was for some time consensus that few people

showed symptoms beyond 1 month, but that this view has since been contradicted by evidence of more persistent symptoms. Most researchers appear to use the term postconcussive syndrome more loosely to indicate complaints of postconcussive symptoms.

Two attempts at defining the syndrome more precisely were encountered during the research for this literature review, one that appeared too loose to be of practical value and one that appeared unrealistically stringent. Mureriwa (1995) states that patients who report "two or more concussion symptoms are said to have a concussion syndrome" (Mureriwa, 1995, p. 5). According to the list of typical symptoms that Mureriwa provides, complaints of, for example, anxiety accompanied by depression would therefore constitute a concussion syndrome. This is clearly too loose a definition. Brown, Fann and Grant (1994) propose a more stringent list of criteria for incorporation into the DSM-IV as "postconcussional disorder" (p. 20). However, their definition can be criticised for its underinclusive definition of head injury (at least 2 of the following are required: loss of consciousness of 5 minutes or more, posttraumatic amnesia of 12 hours or more, and onset of posttraumatic amnesia within 6 months). Despite the stringency of the definition, it makes no distinction between acute and chronic symptoms.

This study will therefore use the term postconcussive syndrome synonymously with the term postconcussive complaints. Cognitive components of persistent symptoms have largely been discussed separately from affective and vegetative components, but it is argued that the factors are not independent. It has been argued that cognitive and emotional functions do in fact interact (Parker and Rosenblum, 1993; Bohnen, Twijnstra and Jolles, 1992).

4.3.3. Incidence and Prognosis

Estimations of incidence vary widely, possibly because of the methodological and theoretical inconsistencies noted earlier. Postconcussive symptoms have been reported as having between 20% and 80% incidence after the first months of recovery (Bohnen, Twijnstra and Jolles, 1992). It has also been reported that the prevalence of symptoms at 3 months post-trauma varies from 75% to 80% in epidemiological studies (Mittenberg, Tremont, Zielinski, Fichera and Rayls, 1996). Others suggest that postconcussion symptoms affect 50% or more of the mild head injured population, with duration of symptoms ranging from months to years (Gouvier, Cubic, Jones, Brantley and Cutlip, 1992; Miller, 1996).

According to Jacobson (1995), "a third to a half of patients experience the syndrome over the first few weeks....Whilst most become asymptomatic in the ensuing months, a substantial minority experiences persistent symptoms 6 months to a year

later" (Jacobson, 1995, p.675). "Controversy persists concerning the chronicity of... subjective symptoms....At 3 months the point prevalence varies between 24... and 84%..., at 6 months it is under 30% and at 1 year under 20% (Jacobson, 1995, p.676).

Kibby and Long (1996) report that "When recovery is measured in terms of PCS, 79% of individuals with mild TBI continue to present with deficits 3 months post-injury....At 1 year 10-24%...continue to present with PCS" (Kibby and Long, 1996, p.169).

However, Mittenberg, Tremont, Zielinski, Fichera and Rayls (1996) report that between 35% and 50% of patients who have sustained a mild head injury report PCS symptoms for 1 to 3 years later, with some patients experiencing the syndrome for up to 15 years. Approximately 5% of patients are unable to return to work as a result of symptoms (Mittenberg, Zielinski and Fichera, 1993).

Elsewhere, it has been reported that about 90% of mild TBI and about 80% of moderate TBI return to work within a year (Kibby and Long, 1996). "The majority of mildly head-injured individuals have returned to work by 3 months post-injury. Those who have not resumed employment may have other intervening factors involved such as greater age, lower levels of motivation to work, lower levels of education, poor

social support, or poor coping strategies" (Kibby and Long, 1996, p.172).

4.3.4. Factors Influencing Incidence of Sequelae

An understanding of the aetiology and typical prognosis of postconcussive symptoms is essential if intervention or support is to be effective.

The aetiology of postconcussion symptoms has tended to be seen in terms of a dichotomy between psychogenic or physiogenic causes (Bohnen & Jolles, 1992; Jacobson, 1995). The organic view holds that postconcussion symptoms are closely related to site and severity of injury. This model has been challenged by various factors: PCS may persist after organic deficits have largely resolved; equivalent head injuries may have variable prognoses; symptoms may worsen in the absence of organic deficits; the impact of psychosocial factors are not taken into account; claims of a low correlation between PCS after 3 months and organic indices are not explained (Jacobson, 1995).

The psychogenic perspective argues that the onset of postconcussion symptoms is due to physiological factors, while chronicity of symptoms may be due to psychosocial factors (Jacobson, 1995; Bohnen, Wijnen, Twijnstra, Van Zutphen and Jolles, 1995). Often, medical and

neuropsychological examinations may not validate reported symptoms, and prolonged symptomatology may be "associated with, if not confounded by, considerable social and economic morbidity" (Miller, 1996, p.10).

It also has been argued that post-concussion symptoms occur mainly in patients with a psychological predisposition to neurotic reactions (Gouvier, Cubic, Jones, Brantley and Cutlip, 1992). Psychological factors are especially argued when there is minimal organic damage or the individual displays disproportionate symptoms (Jacobson, 1995).

However, the notion of organic origin, followed by psychosocial maintenance of symptoms has been undermined by evidence that social adversity may contribute to emergence of the symptoms, and their persistence may be contributed to by organic brainstem dysfunction (Jacobson, 1995).

Jacobson concludes that "The sequential organic-psychogenic model is weakened by the observations that psychiatric, social and physical problems may coexist early or late after head injury..., and that organic personality change may occur. Furthermore, the power of organic or psychological or both factors to predict chronic post-concussional symptoms is not high....This implies that not all causes of post-concussional symptoms have been identified" (Jacobson, 1995, p.687). It has also been argued that the frequency and similarity of symptoms suggest that they are too common to be

fabricated (Gouvier, Cubic, Jones, Brantley and Cutlip, 1992).

It has been argued that dichotomous perspectives on etiology are limited. Late development of PCS is difficult to explain on the basis of organic etiology alone, whereas the evidence of organic damage cannot be ignored. It is increasingly accepted that psychological factors interact with neurological damage (Bohnen and Jolles, 1992). Interactive and multifactorial approaches have therefore been proposed (Jacobson, 1995; Benton, 1989; Bohnen and Jolles, 1992). Cattelani, Gugliotta, Maravita and Mazzucchi (1996) state that organic and psychogenic factors probably coexist in most cases, the actual proportion and relevance being different in each case.

Dikmen, Temkin and Armsden (1989) state that "whereas early PCS may be caused by subtle effects of brain damage or disruptions of brain functions, persistent symptoms probably have as their origins multiple factors including pre-existing individual vulnerabilities, head injury-related losses, reactions of others to these losses, litigations, etc." (p. 238). Likewise, Bohnen, Jolles, Twijnstra, Mellink and Sulon (1992) report that adaptive skills have been viewed as the result of an interaction of premorbid adjustment, response to cognitive impairment, the patient's own standards and expectancy, and the levels of subjective stress. These skills are then required to meet the patient's particular

environmental demands.

The coping hypothesis was proposed by Van Zomeren and Van Den Burg in 1985, and relates postconcussion symptoms to environmental demands (Bohnen and Jolles, 1992). The model proposes that PCS may result from chronic effort by patients to compensate for cognitive difficulties. "It is when the patient is confronted with the stresses and strains of life that PCS develop" (Bohnen and Jolles, 1992, p.688). Fatigue and stress result when the individual is faced with demands like rapid resumption of previous activities, thus exacerbating symptoms (Bohnen and Jolles, 1992). Consistent with this, symptoms and cognitive difficulties may therefore not become evident in the initial period when the patient is convalescing, but manifest once the patient is required to resume previous levels of functioning, despite a reduction in coping skills (Gouvier, Cubic, Jones, Brantley and Cutlip, 1992; Bohnen and Jolles, .992; Bohnen, Twijnstra and Jolles, 1992). The chronic effort to compensate for cognitive deficits leads to frustration and a chronic stress reaction (Bohnen, Twijnstra and Jolles, 1992). Anxiety, depression, irritability, aggression, and "enhanced sensitivity to distress" (Jacobson, 1995, p.682) may occur.

Although consistent with this model, Jacobson's cognitive-behavioural perspective focuses more on the interpretations and subjective narrative of the individual. The model "focuses on the patient, rather than on symptoms or

pathophysiology. Emphasis is laid on the patient's beliefs, appraisals and coping responses as direct influences on the severity and disability of post-concussion symptoms'" (Jacobson, 1995, p.685).

This perspective holds that attention to and interpretation of events influences behaviour, emotions, and sometimes physiological factors. Perception of postconcussion symptoms and the distress experienced may be influenced by cognitive interpretation and attentional focus. Behavioural responses may also be affected. Psychosocial stresses, as well as illness-related stresses may exceed personal resources, activating psychobiological stress responses. These responses may affect health through the cognitive-behavioural route or the psychophysiological route. Cognitive-behavioural consequences include appraisal methods and coping strategies. Coping strategies may be directed towards relieving emotional discomfort, or towards confronting the stressful problem. Patients with chronic postconcussion symptoms "may develop negative expectations about their ability to control their symptoms" (Jacobson, 1995, p. 688), and hence passive coping strategies such as avoidance, inactivity and dependency, as opposed to active self-management. Cognitive activity may contribute to the "exacerbation, attenuation, or maintenance of their acute post-concussional symptoms" (Jacobson, 1995, p. 688).

Given that interactive approaches to aetiology appear most comprehensive, it would be useful to examine factors that have been linked to the development of postconcussive complaints. A differentiation has been made in the literature between pre-, peri-, and post-traumatic factors (Jacobson, 1995) and these factors will be discussed below.

1. Pre-injury factors

Substance abuse, previous neuropsychiatric disorders, and neurological history have been found to affect recovery (Kibby and Long, 1995). It has also been argued that alcohol abuse is related to more prolonged recovery (Jacobson, 1995) and that intoxication at the time of the accident is a predisposing factor for the development of postconcussive symptoms (Bohnen, et al., 1994). It has been claimed that some individuals are psychiatrically or psychologically predisposed to responding with postconcussive symptoms (Bohnen and Jolles, 1992; Gouvier, Cubic, Jones, Brantley and Cutlip, 1992). Prior injuries are significant factors, having a cumulative effect and affecting recovery (Jacobson, 1995; Bohnen and Jolles, 1992), predisposing injured individuals to postconcussion symptomatology (Gouvier et al., 1992).

Age is also related to the development of postconcussive complaints (Bohnen et al., 1994), with older people being more at risk (Bohnen and Jolles, 1992; Gouvier, Cubic, Jones, Brantley and Cutlip, 1992). Kibby and Long (1996) state that

greater age is associated with more prolonged recovery, whether measured by cognitive performance, return to work, or postconcussive symptoms. They believe that including subjects of 40 or older in studies significantly affects recovery times observed.

Females are especially at risk for developing postconcussion symptoms (Bohnen, et al., 1994; Bohnen and Jolles, 1992), particularly older females (Fenton, McClelland, Montgomery, Macflynn and Rutherford, 1993). Rucherford (1989) found that late symptoms were associated with female gender and greater age.

The development of PCS has also been linked to lower levels of education (Bohnen and Jolles, 1992; Bohnen et al., 1994) and lower occupational status (Jacobson, 1995). Kibby and Long (1996) suggest that these individuals may have fewer work-related coping abilities. They report that they have the greatest reduction in occupational status after injury. Number of complaints at 1 month post-injury and lower socio-economic status are associated with less chance of successfully returning to work (Kibby and Long, 1996).

Higher occupational levels are also associated with difficulty in returning to work, possibly as these occupations require higher levels of cognitive skills and ability to work under pressure. These abilities may be adversely affected by the injury (Kibby and Long, 1996).

Prior stress has also been associated with the development of postconcussion symptoms (Jacobson, 1995), while chronic social adversity has been linked to chronic postconcussion symptoms (Jacobson, 1995).

It has been suggested that pre-existing characteristics and coping abilities are important in determining how the individual deals with the anxiety caused by the injury (Kibby and Long, 1995). Posttraumatic complaints have been linked to poor cognitive skills (Jacobson, 1995), premorbid personality traits (Jacobson, 1995; Bohnen, Wijnen, Twijnstra, Van Zutphen and Jolles, 1995; Miller, 1996; Bohnen and Jolles, 1992), somatic concern and anxiety (Kibby and Long, 1996). Pre-injury neurotic personality and emotional problems have been found to be significant factors (Bohnen, et al., 1994; Bohnen and Jolles, 1992; Jacobson, 1995).

Gronwall (1989) states that there seem to be 4 groups of patients at risk for "longer than normal periods of incapacity: (1) the older patient, (2) the patient who has a previous head injury, (3) the patient who is a high achiever or is in a demanding occupation, and (4) the patient who has family or social stressors" (Gronwall, 1989, *p.* 160 - 161).

2. Peri- and Post-injury factors

1. Physical Factors

Severity of damage and cognitive deficits have been associated with incidence of PCS. It has been suggested that a reduction in rate of information processing underlies the development of postconcussion symptoms (Bohnen, Twijnstra and Jolles, 1992; Bohnen and Jolles, 1992), although not all researchers agree that there is a relationship between postconcussion symptoms and cognitive performance (Bohnen, Twijnstra and Jolles, 1992). It has been suggested that deficits may be sufficient to disrupt employment and social life, and contribute to depression and illness (Bohnen and Jolles, 1992).

Wrightson (1989) believes that the "basis of the symptoms is that the primary neuronal damage disturbs cognition and emotion and ...results in fatigue and an abnormal sleep pattern. Secondary to this incapacity follow anxiety, depression, and frustration....The third factor is the stress that results from the other two; stress increases the effect of the primary damage ...and creates a spiral of deterioration" (p. 248).

Bohnen, Wijnen, Twijnstra, Van Zutphen and Jolles (1995) report that neuronal damage has been suggested to cause a loss of capacity to deal with stress effectively. They suggest that this may explain why patients with persistent PCS tend to complain more of "rather non-specific emotional and vegetative symptoms with the passage of time" (p.37). Rutherford (1989) suggests an interplay of organic and neurotic factors, with irreversible organic damage remaining.

Lezak (1978), discussing the psychological effects of brain injury in general (and not just mild head injury), states that perplexity, distractibility and fatigue are common and troublesome consequences of "disruption of accustomed pathways" (p. 9) and loss or change of any mental function. "How these problems are perceived by patients and how they can be identified by the observer varies from patient to patient and also varies during the course of his illness" (Lezak, 1978, p. 9).

Lezak describes perplexity as involving a mistrust of one's own ability. It is expressed through "response hesitancy and self-doubt" (Lezak, 1978, p. 9). Previously well-learned responses may occasionally be wrong, with the result that patients constantly feel unsure of themselves. Distractibility is a consequence of the patient having difficulty screening out unwanted stimulation and may have consequences such as discomfort with social gatherings, irritation, and exhaustion. Fatigue results when the patient

"tires more easily as once automatic activities and functions begin to break down and require more and more concentrated effort for their performance" (Lezak, 1978, p. 10).

In her study, Lezak noted irritability, depression and anxiety in her subjects, reflecting the emotional distress experienced. She concludes that while emotional disturbances may sometimes mask subtle sequelae, "they can also result from them" (Lezak, 1978, p. 14).

However, Gouvier, Cubic, Jones, Brantley and Cutlip (1992) did not find support for the claim that postconcussion symptoms are related to reduced cerebral reserve capacity, but suggested that symptoms varied with levels of stress, in head injured and noninjured alike. Gouvier et al. arque that stress is a significant factor in the development, manifestation and maintenance of symptoms. Muscle tension is known to cause headaches, while stress is known to be associated with anxiety disorders (Gouvier et al., 1992). However, as was pointed out in the study, the sample of head injured subjects may have been biased (students having returned to college). Yet the issue is one of debate. Some argue that symptoms are psychological expressions of physical damage, while others argue that as anxiety levels rise, memory and concentration suffer (Gouvier, et al., 1992). Gouvier et al. state that it is not clear if neuronal damage leads directly to symptoms or if injury leads to reduced stress coping mechanisms which in turn cause symptoms.

It has been claimed that neurological complications influence recovery (Bohnen et al., 1994) and that uncomplicated injury is associated with quicker recovery (Kibby and Long 1996). The presence of orthopaedic fractures, comorbidity, and hospitalization also delays recovery (Bohnen, et al., 1994). The measure of recovery is, however, important. Additional injuries do not appear to affect recovery when measured by cognitive tests, but do affect recovery when measured by presence of PCS (Kibby and Long, 1996).

2. Psychosocial Factors

1. Social Pressures and Supports

It has been argued that unemployment, depression, and social isolation increase in patients and their families after injury. Some have reported marital and parenting difficulties, although no pre-injury research has been done (Jacobson, 1995). It has also been claimed that stress affects recovery time and contributes to postconcussion symptoms (Kibby and Long, 1996).

Miller (1996) points out the stresses in dealing with sceptical legal and medical professionals, while Parker and Rosenblum (1993) state that unsympathetic handling of patients by the legal, insurance and compensation systems, as well as discouragement of symptoms, leads to a worse level of

adjustment. In addition, patients themselves may not be able to fully articulate their symptoms, given that they may not understand and interpret them accurately (Lezak, 1978).

Emotional consequences may arise from excessive social demands and inadequate social support, including pressure to return to work prematurely (Parker and Rosenblum, 1993). The effect of the injury on employment and financial stability of the family increases stress, which may worsen postconcussion symptoms and lengthen the recovery process. Family expectations, and rejection or avoidance may lead to emotional reactions to changes in capacity (Kibby and Long, 1995).

The emotional repercussions of the trauma, such as disruptions to education and plans, and worry about the consequences of the experience may contribute to symptoms (Bohnen and Jolles, 1992). The stresses involved in litigation may also be significant (Gouvier, Cubic, Jones, Brantley and Cutlip, 1992). Stress may result from the subjective reaction to physical damage, and traumatic experiences may also cause post-traumatic stress disorder, the symptoms of which overlap with postconcussion syndrome (Jacobson, 1995). Jacobson (1995) suggests that individual physiological hyperreactivity to stress may cause persistence of symptoms, and that this may be a constitutional or learned response.

Post-concussional behaviours may be reinforced positively or negatively and persist in the absence of cognitive deficits. Positive reinforcements include the benefits of attention by others, while negative reinforcements include the benefits of avoidance of certain activities. Initially adaptive behaviours like protection and dependence may persist, resulting in altered family roles enduring (Jacobson, 1995).

2. Expectations

There is evidence that the constellation of postconcussion symptoms is not necessarily unique to mild head injury. There is evidence of typical postconcussion symptoms among noninjured individuals (Gouvier, Cubic, Jones, Brantley and Cutlip, 1992; Wong, Regennitter and Barrios, 1994; Mittenberg, DiGiulio, Perrin and Bass, 1992), and postconcussive symptoms have been found to occur in the noninjured population at a similar rate to that following mild head injury (Mittenberg et al., 1992).

Mittenberg, Tremont, Zielinski, Fichera and Rayls (1996) believe that expectations of sequelae are significant in producing those sequelae. Mittenberg, DiGiulio, Perrin and Bass (1992) found convincing symptom presentation in subjects with no opportunity of previous exposure to postconcussion syndrome. They also argue that expectation is a significant aetiological factor.

Patients often underestimate the frequency and extent of typical post-concussion symptoms pre-injury (Mittenberg, Tremont, Zielinski, Fichera and Rayls, 1996; Mittenberg, DiGiulio, Perrin and Bass, 1992; Jacobson, 1995), therefore overestimating incidence of post-injury symptoms due to cognitive misattribution. This is especially relevant for the issue of assessment of post-concussive symptoms, as these are generally assessed thorough subjective reporting (Wong, Regennitter and Barrios, 1994; Mittenberg, et al., 1992). This will be discussed more fully in a later section.

Mittenberg, DiGiulio, Perrin and Bass (1992) stress expectation rather than underlying personality disorder in the development of postconcussion syndrome. They distinguish 3 stages in this development: 1) Activation of symptom expectancies after injury, in addition to heightened stress and emotions; 2) Selective attention to the patient's internal state; 3) Resulting perceptual bias, contributed to by emotional arousal; 4) Additional emotional responses, which reinforce expectations. They argue that this may explain the frequent observation that symptoms are often inversely related to trauma severity. They state that "the aetiological role of expectations may also explain why persistent PCS is uncommon following mild head injuries sustained by children and in athletic competition" (Mittenberg et al., 1992, p.203).

Nevertheless, not all research supports the lack of uniqueness of postconcussion symptoms. Bohnen et al. (1994) found that while PCS patients displayed distresses similar to a noninjured control population at 1 to 5 years post-injury, displaying a mood factor, a bodily factor and a cognitive factor, these symptoms were of significantly greater severity. They argue for psychogenic and physiogenic etiology of symptoms, with subtle neuropsychological and neurological changes persisting.

Similarly, Bohnen, Wijnen, Twijnstra, Van Zutphen and Jolles (1995) found that postconcussion symptoms manifested in different factor constellations in concussed subjects, versus non-concussed controls. They conclude that "results might indicate that so-called non-specific and vague complaints aggregate in different ways in concussed patients than in non-concussed subjects" (Bohnen et al., 1995, p.35). However, as mentioned above, this study assessed subjects with very chronic symptoms (1 to 5 years after injury) and may not represent typical symptomatology.

3. Motivation and Compensation

Blame has been found to contribute to the development of symptoms (Rutherford, 1989; Jacobson, 1995). It has been suggested that this may be due to feelings of resentment and hence reattribution of pre-injury difficulties. Feelings of personal culpability have been linked to quicker recovery.

(Jacobson, 1995). Prolonged litigation is also associated with symptom chronicity (Jacobson, 1996).

It has also been suggested that symptom formation may be contributed to by inadvertent, or even intentional, suggestion by lawyers and psychologists. For example, the completion of a symptom checklist may be a powerful suggestive factor in interpreting or fabricating symptoms (Wong, Regennitter and Barrios, 1994).

However, it has been suggested that it may be patients with worse symptoms who engage in litigation. As mentioned above, the stresses of litigation, such as the scepticism that the patient has to combat, may also be significant. The patient may also "nurture his suffering" as it is the main weapon in litigation (Jacobson, 1996, p. 684). Gouvier, Cubic, Jones, Brantley and Cutlip (1992) suggest that it is more likely that compensation increases presentation of symptoms by focusing on, rather than producing them. However, Binder and Rohling (1996) found evidence that patients with less severe injuries were more likely to seek monetary compensation. Binder (1993) also found poorer performance among compensation-seekers than those not seeking compensation, although as he acknowledges, his sample may have been biased.

Others have found no relationship between PCS and litigation, resolved or pending (Bohnen and Jolles, 1992). Bohnen and Jolles, (1992) argue that contrary to common belief,

resolution of the legal situation does not cause symptoms to resolve. It has been claimed that post-concussion symptoms are found in nonlitigants and that patients with complaints nevertheless return to employment despite these complaints and during litigation (Gouvier et al., 1992). Jacobson (1995) states that much evidence does not support the notion of compensation neurosis. It has been claimed that symptoms do not necessarily disappear after compensation and that concussion symptoms are not exclusive to mild head injury, but also occur after severe head injury (Mureriwa, 1995). It has been argued that while compensation appears to be a factor in many cases, it is inaccurate to claim that there are no legitimate cases of mild head injury resulting in post-concussion symptoms (Gouvier Cubic, Jones, Brantley and Cutlip, 1992; Miller, 1996).

However, even researchers who reject that malingering is the main mechanism for chronic PCS in general, acknowledge that malingering is more prevalent among litigants (For example, Jacobson, 1995). Millis, Putnam, Adams and Ricker (1995) agree that outright malingerers are a subset of the population of chronically symptomatic, and not representative of the majority of mild head injured. They state that they are nevertheless a significant group, as they are often engaged in litigation and do not respond well to treatment. The issues of malingering and incomplete effort is discussed more fully below.

4.1.5. Assessment of Subjective Postconcussive Complaints

As mentioned above, postconcussive complaints are difficult to evaluate, given their subjective nature and the subjective nature of the tools used to assess them. There is evidence that subjective reporting of symptoms is not necessarily valid or reliable (Gouvier, Cubic, Jones, Brantley and Cutlip, 1992; Wong, Regennitter and Barrios, 1994; Mittenberg, Digiulio, Perrin and Bass, 1992), prompting Kibby and Long (1996) to conclude that the use of a symptom checklist "is not appropriate, in and of itself, for determining the injury's contribution" (Kibby and Long, 1996, p.169).

The study by Wong et al. (1994), cited above, investigated the use of various self-report instruments, including the Postconcussion Checklist and the Postconcussion Syndrome Checklist. They concluded that the instruments were vulnerable to simulation and malingering. The findings of Mittenberg, DiGiulio, Perrin and Bass (1992) regarding expectation as aetiology, also cited above, relate less to intentional malingering and more to cognitive misattribution of symptoms, which is arguably a greater problem in terms of rehabilitation. Using the Postconcussion Checklist, they found that noninjured subjects were able to imagine and present realistic postconcussive profiles, hence suggesting that subjects have a realistic idea of what deficits to

expect. In addition, they found that genuinely injured subjects consistently underestimated the premorbid prevalence of typical PCS symptoms, suggesting that they may have reattributed "benign emotional, physiological, and memory symptoms to their head injury" (Mittenberg et al., 1992, p. 205).

It is proposed from the evidence of the literature that symptom checklists be complemented with other sources, particularly performance on a cognitive battery. An assessment of postconcussion complaints should therefore be linked to a consideration of subjective perceptions and attributions, environmental stressors, cognitive factors, emotional factors and motivational factors.

5. Incomplete effort

5.1. Definition

The term "incomplete effort" is preferred to "malingering", as the former is a more inclusive term that allows for a complex, multifactorial and multidirectional understanding of a phenomenon that may be intentional or unintentional.

Malingering should be differentiated from factitious disorders. "Malingering is ... the intentional production of false or grossly exaggerated physical or psychological symptoms motivated by external incentives....Factitious

disorders involve the intentional production of symptoms or signs to assume the sick role in the absence of external incentives....The distinction...can be difficult" (Jacobson, 1995, p.684). In addition, a distinction should be made between intentional fabrication and poor motivation. There has been a lack of investigation in the literature of this distinction (Greiffenstein, Baker and Gola, 1994).

Trueblood and Schmidt (1993) point out that while malingering consists of reduced ability that results in test data that are not reflective of ability, it should not be assumed that psychological factors lack validity per se. It may happen that psychological factors interfere with examining CNS functioning, but nevertheless reflect real life functioning.

Thus, incomplete effort is not a unitary concept, but involves multiple determining factors and clinical manifestations (Millis, Putnam, Adams and Ricker, 1995). "Incomplete effort or malingering is likely to be a heterogenous set of behaviors that vary across individuals" (Millis and Putnam et al., 1995, p.468).

5.2. Incidence

There is disagreement about the extent to which patients malinger. Bohnen and Jolles (1992) cite studies arguing that malingering has been overestimated. However, other researchers claim that recent data suggests that malingering

has been underestimated (Greiffenstein, Baker and Gola, 1994). Greiffenstein et al. (1994) believe that the base rate for memory deficit manufacture in persistent PCS lies between 33% and 60%. They caution that malingering may be rare in the acute stages of mild head injury.

5.3. Detection of Incomplete Effort

Wong, Regennitter and Barrios (1994) state that the detection of incomplete effort is complicated by disagreement over the likelihood of the nature and persistence of symptoms following concussion. There has also been insufficient research into the public's knowledge of the sequelae of mild head injury, base rates of symptoms in the noninjured and non-head injured population, and the vulnerability of neuropsychological instruments to simulation.

Trueblood and Schmidt (1993) claim that subjects who render incomplete effort are not necessarily readily identifiable in terms of history, symptoms and apparent cooperation. They may not be uncooperative and may in fact have had valid injuries. They may also exaggerate rather than actually fabricate symptoms. Subjects may have had contact with attorneys, other patients, and others and have refined their presentation of symptoms.

Wong, Regennitter and Barrios (1994) also suggests that assessment is complicated by the possibility that incomplete

effort may accompany genuine head injury and genuine sequelae, although Greiffenstein, Baker and Gola (1994) state that to date, "the initial evidence suggests that such coexistence is uncommon" (Greiffenstein et al., 1994, p.223). Binder and Willis (1991) argue that if evidence of incomplete effort is found, no conclusions can be drawn from any other scores that require effort. The only way to then assess severity of damage would be "through the knowledge of the initial trauma and its natural history" (Binder and Willis, 1991. p. 180).

According to Millis, Putnam, Adams and Ricker (1995), there have been 3 primary models for the detection of incomplete effort: tests that appear difficult but are in fact easy, dichotomous forced-choice procedures, and test performance patterns on standard tests.

a) Tests that appear difficult, but tap abilities that remain intact even with head injury.

An example of this is the Rey 15-item Memory Test (Millis, Putnam, Adams and Ricker, 1995).

b) Dichotomous forced-choice procedure

Tests with a forced choice format are regarded as useful tests of malingering, as a predetermined level of performance exists (that is, a score of 50% should be obtained by chance

alone). A below-chance score would suggest incomplete effort (Millis, 1994; Prigitano and Amin, 1992; Greiffenstein, Baker and Gola, 1994; Binder, 1993). This category of tests has been criticised as it may not be sensitive to more sophisticated forms of malingering, which may result in performances that are not significantly below chance (Wong, Regennitter and Barrios, 1994; Millis, Putnam, Adams and Ricker, 1995). An example of the category is the Portland Digit Recognition Test.

c) Test performance patterns on standard tests

This entails the use of "standard neuropsychological measures to determine neuropsychological test performance patterns or derive statistical formulas that differentiate brain-injured patients from known simulators or presumed malingerers" (Millis, Putnam, Adams and Ricker, 1995). Interpretation of the Benton Visual Retention Test incorporates such an approach (see below).

6. Management and Minimisation of Sequelae

Parker and Rosenblum (1993) emphasize inadequate diagnosis and treatment as contributing factors in the production and maintenance of symptoms. Issues such as learned helplessness and the emotional handling of problems should be addressed. They believe that part of the reason of nonreturn to work is the lack of referral for rehabilitation. Nevertheless, Wong

et al. (1994) point out that while accurate diagnosis may bring relief to the patient by explaining difficulties and allowing appropriate interventions, there is the danger that inappropriate assumptions of deficits may cause harm by encouraging the patient's attribution of nonpathological phenomena to the accident and contributing to the perception and experience of post-concussive sequelae. Binder (1993) also argues that patients would in fact benefit from the knowledge that their complaints do not accord with objective measures. Nevertheless, the present study would argue that extreme caution should be exercised before invalidating any patient's experiences.

It has been suggested that intervention in the form of relaxation techniques (Wrightson, 1989) and stress management techniques (Gouvier, Cubic, Jones, Brantley and Cutlip, 1992; Bohnen, Jolles, Twijnstra, Mellink and Sulon, 1992), as well as the gradual resumption by patients of previous activities may reduce or alleviate symptoms (Wrightson, 1989; Bohnen, Twijnstra and Jolles, 1992; Bohnen, Jolles and Twijnstra, 1992; Gouvier et al., 1992). In resuming activities, particular attention should be paid to the risks of overexertion and fatigue (Wrightson, 1989). Szymanski and Linn (1992) also stress the importance of educating the family, as it is from this quarter that pressure to try harder often comes. In addition, patients may benefit from cognitive rehabilitation (Wrightson, 1989), specifically with regard to memory, attention and problem solving (Beers,

Goldstein and Katz, 1994).

Mittenberg, Digiulio, Perrin and Bass (1992) argue that the patient's problem is largely one of lacking an alternative explanation for symptoms and could benefit from support, reassurance regarding prognosis, and cognitive-behavioural therapies. Mittenberg et al. (1996) suggest that expectation and cognitive bias cause a self-reinforcing cycle which accounts for the persistence of the syndrome.

Mittenberg et al. (1996) suggest that the cognitive-behavioural model explains why "early education about the nature and incidence of expected symptoms and cognitive restructuring appear to constitute an effective inoculation against protracted PCS. Informing the patient of the normal base rate of symptoms and reattributing these to benign causes may directly reduce anxiety and provides a basis for challenging negative self-statements. A gradual increase in rewarding activities can provide behavioral evidence of intact abilities and directly reduces depression" (Mittenberg et al., 1996, p. 143-144). Mittenberg, Zielinski and Fichera (1993) designed a treatment manual that they argue could benefit patients in understanding their condition. A later study suggested that early intervention using the manual reduced the incidence of PCS (Mittenberg, Tremont, Zielinski, Fichera and Rayls, 1996).

Lezak agrees that "the problems of perplexity, distractibility and fatigue are most likely to become stressful when the patient misinterprets his new internal experiences and does nothing to limit their effects. Counselling can significantly reduce the emotional distress that these problems generate secondarily" (Lezak, 1978, p. 12). She advises that perplexity be dealt with by reassuring the client, specifically with the information that "since most patients with static or improving conditions get used to their altered mental processes" (Lezak, 1978, p. 13), eventually the problem will lessen. Distractibility can be helped "by a co-operative effort with the family to reduce the amount of extraneous stimulation in his environment" (Lezak, 1978, p. 13). Fatigue she advises, is best dealt with by effective energy management. Denial may establish a vicious cycle between fatigue, inefficiency, and depression.

7. Summary

It has been claimed that postconcussive sequelae are multidetermined, having physical, cognitive, interpretive, emotional, environmental, and motivational causes. While resolution of symptoms usually occurs fairly rapidly, persistence of symptoms often occurs. Minimisation of sequelae depends on effectively directed intervention, which in turn depends on a theoretical understanding of postconcussion syndrome in general, and an understanding of the specific case in question. Accurate assessment of the

individual case would have to be multidimensional in nature, dealing with cognitive and subjective complaints, and include a consideration of motivational factors.

CHAPTER 3: RESEARCH QUESTIONS

This report investigates the sequelae of mild head injury (cognitive deficits and postconcussive complaints) and the ability of the instruments used to detect such sequelae. Performance of the injured group is looked at relative to that of the noninjured group. The report also examines the specific nature of malingering, and the ability of the tests used to detect incomplete effort.

1. What are the sequelae of mild head injury?

    1.1. What are the cognitive sequelae of injury?

        1.1.1. What are the differences between the injured and noninjured groups in performance on tests of cognitive ability?

        1.1.2. What relationships are found between demographic characteristics and cognitive performance, in the injured group?

        1.1.3. What relationships exist between indices of injury severity and cognitive performance in the injured group. More specifically, are different degrees of injury severity found?

        1.1.4. What relationships are observed between time since injury and cognitive performance in the injured group?

1.2. What postconcussive complaints arise from injury?

1.2.1. What differences are found between the injured and noninjured groups, in subjective reporting of postconcussive complaints? More specifically, do injured subjects tend to underestimate their pre-injury experience of typical postconcussive symptoms?

1.2.2. What secondary factors are associated with the incidence and persistence of postconcussive complaints (that is, what pre-, peri-, and post-injury factors)?

1.2.3. What relationships are found between indices of injury severity and postconcussive complaints, within the injured group?

1.2.4. What relationships are found between time since injury and postconcussive symptoms, within the injured group?

1.3. What relationships are found between postconcussive complaints and cognitive performance?

2. What is the nature of the malingering observed?

2.1. How do reported actual postconcussion symptoms (within the injured group) compare with expected postconcussion symptoms (within the malingering group)? It would also be interesting to investigate if this study finds, as have foreign studies, that instructed malingerers produce convincing postconcussive symptom profiles.

2.2. What differences are found between the injured and malingering groups, in terms of performance on tests of cognitive ability, as well as tests of malingering? This would suggest which variables may be most useful in differentiating incomplete effort from actual postconcussive sequelae.

2.3. Tentative cutoff scores will be generated for variables that differentiate malingerers from genuinely injured subjects.

CHAPTER 4: METHODOLOGY

1. Sample

1.1. Rationale

It was decided to assess three groups of subjects: noninjured, instructed malingerers, and mildly head injured. It was initially decided that all subjects should have a minimum education level of Standard 3, although this was later broadened to Standard 7 in order to obtain sufficient numbers of subjects. The rationale for setting a minimum level of education was the expectation that, given the political changes in South Africa, black South Africans as a whole would increasingly attain senior secondary schooling in years to come, whether through initial schooling or later education. It was hoped that the results of the study would therefore provide tentative guidelines with wide social relevance, with the expectation that these could be built on with further research. It was decided to attempt to ensure that the groups were as similar as possible in terms of language, age, and gender composition. As subjects were obtained from two very different regions of South Africa, this was recognized as potentially problematic, and it was decided to introduce region as a variable in the data analysis.

1.2. Ethical Considerations

Payment was offered for participation in the study and confidentiality assured. Subjects were asked to fill in an initial demographic questionnaire (Appendix 3) to assess their suitability for the study, and those selected were then assessed individually. Each subject was briefed as to the purposes of the study (Appendix 1) and his/her written consent to participate obtained (Appendix 2). Where subjects were found during the assessment to be unsuitable for the study (for example, due to injury severity or language difficulties, as discussed later), they were nevertheless paid for participation. Following the assessment, any questions were answered. Where relevant, mildly head injury individuals were given the treatment manual designed by Mittenberg, Zielinski, and Fichera (1993), and the contents of the booklet discussed.

1.3. Recruitment of the sample

All three groups of subjects were volunteers drawn from a population of black South African students. In addition, one injured subject, a nonstudent, was referred by a clinic in Mpumalanga.

Students were approached at an adult education college in Johannesburg, as well as a high school in Johannesburg. Approximately one hundred pamphlets were distributed at the

adult college, and classes spoken to about the research. At the high school, classes were spoken to, and approximately sixty pamphlets distributed. In Mpumalanga, students were approached at a community centre in Mpumalanga, where approximately one hundred pamphlets were distributed. Staff were also approached at a local clinic, and asked to refer members of the community who they knew had suffered concussion.

1.4. Composition of the Sample

A total of 47 suitable subjects was obtained. Breakdown of the recruitment from each centre is as follows:

Mpumalanga:

Since subjects in Mpumalanga were not approached through a school, it was necessary to verify age and educational level. Subjects were therefore requested to bring an identity document and a copy of their latest school results. It was considered undiplomatic and unnecessary to request these from the subjects referred by the clinic, given that they were known socially by the referring staff at the clinic.

Community Centre

None of the volunteers from community centre withdrew. Six volunteers were rejected as poor English proficiency made

assessment impossible. Another was rejected for not meeting the criteria of mild head injury. She had lost consciousness for 2 hours, and been hospitalised for one week.

Twenty-eight volunteers were suitable. Six could be classified as mildly head-injured, while 12 of the noninjured subjects were randomly assigned to the malingering group, and 8 to the noninjured group. Two subjects who were initially assigned to the malingering group were reassigned to the noninjured group, after they indicated that they were not prepared to malinger.

Clinic

Two subjects were referred by the clinic. One was excluded for not meeting the criteria of mild head injury. He had suffered posttraumatic amnesia or loss of consciousness (he was unable to state which) of approximately 6 hours. The other met the criteria for mild head injury, and was included in the dataset.

Gauteng:

Nineteen volunteers from Gauteng were suitable. Breakdown was as follows:

Adult College

After initially volunteering, nine subjects from the adult education college withdrew. Another six subjects were excluded due to having provided inadequate contact details. One volunteer was excluded for not meeting the criteria of mild h injury. He had been hospitalised for approximately one year. A second was excluded for the same reason, having sustained loss of consciousness for approximately 1.5 hours.

The adult college provided 14 suitable subjects, of which 6 could be classified as mildly head-injured. Three of the noninjured were randomly assigned to the malingering group, and 4 were randomly assigned to the noninjured group. The remaining subject misunderstood the instructions and did not malinger on the cognitive tests. She was reassigned to the noninjured group, and the postconcussion symptom questionnaires repeated to obtain her authentic responses.

High School

None of the volunteers withdrew. Three volunteers from the high school were excluded for not meeting the criteria of

mild head injury. One had lost consciousness for a week, and been hospitalised for another week. The second had sustained loss of consciousness of 20 to 30 minutes, and posttraumatic amnesia of about 2 hours. The third had lost consciousness for 24 hours, and been hospitalised for 5 days.

Demographic information for the main groups is set out in Table 1. No information is listed for number of injuries sustained, since only one injured subject had sustained more than one injury (the subject in question had sustained two injuries). Regarding the medians listed, where an even number of scores exists, the median was calculated as the mean of the middle two scores. Hence, for example, a median period of loss of consciousness of half a minute is listed, as the mean of a period of approximately one minute for one subject, and no loss of consciousness for another. As is discussed below, loss of consciousness, post-traumatic amnesia, and time of hospitalisation were all positively skewed, with most subjects reporting no incidence or only short periods of each. Time since injury was positively skewed, with most subjects reporting post-injury periods of two years or less.

Three subjects reported PTA as "about", or "not more than", one hour, whereas the definition criterion employed was PTA of less than one hour. Given the difficulty in finding sufficient numbers of injured subjects, it was decided to include these subjects, recording a PTA of 60 minutes. This was done after establishing that no other deviations from the

criteria existed, particularly as regarded likely GCS scores on admission to hospital (the two subjects who were hospitalised, were fully conscious and responsive on admission, with likely GCS scores of 15, and the remaining subject appeared to have rapidly recovered consciousness and responsiveness to those around him).

Table 1.

Demographic Description of Main Groups (Total Injured, Malingering, and Total Noninjured)

1.1. Frequency of Noncontinuous variables

		Region		Gender		Culpability		Injury Type	
Group	n	Gauteng	Mpumalanga	Male	Female	Blames another	No blame	Sports	Violence
Injured	16	10	6	12	4	6	10	4	4
Malingerers	16	4	12	9	7				
Noninjured	15	5	10	9	6				

1.2. Descriptive Statistics for Continuous Variables

Group	Variable	Mean	Median	SD	Maximum	Minimum
Injured	Education	10.88	11.00	1.26	12.00	9.00
	Age	25.06	23.00	8.84	50.00	16.00
	Loss of consciousness	5.75	0.50	7.04	20.00	0.00
	Posttraumatic amnesia	13.13	1.00	23.47	60.00	0.00
	Hours hospitalised	9.38	0.00	17.06	48.00	0.00
	Time since injury	41.38	17.00	53.30	168.00	1.00
Malingerers	Education	11.38	12.00	0.81	12.00	10.00
	Age	22.06	21.00	5.65	35.00	16.00
Noninjured	Education	11.33	11.00	0.82	12.00	9.00
	Age	22.27	20.00	6.36	40.00	15.00

Various subgroups were also generated, by categorising subjects according to various criteria:

With the present study's injured group, the mean period between injury and assessment was 41.37 months, which is longer than many periods reported in the literature. Thus, in addition to examining the injured group as a whole, this group was also split into three smaller groups, based on time since injury. The "Recently Injured" group had been injured in the previous 12 months, the "Intermediate" group had been injured in the last 24 months, and the "Long Term" group had been injured more than 24 months previously. It would have been preferred to have more groups, with shorter time frames (particularly for the "Acute" subjects), but constitution of the above categories was a compromise, given the limited number of subjects.

In addition, subgroups were generated to investigate claims of relationships between sequelae and gender, blame, and circumstances of injury.

Demographic details for the various subgroups are set out in Table 2.

Table 2.

Demographic Descriptions of Subgroups

2.1. Injured Subgroups

2.1.1. Frequency of Noncontinuous Variables

			Region		Gender		Culpability	
Defining variable	Subgroup	n	Gauteng	Mpumalanga	Male	Female	Blames another	No blame
Time since injury	Recently Injured	4	2	2	4	0	2	2
	Intermediate Injured	8	4	4	6	2	3	5
	Long Term Injured	4	4	0	2	2	1	3
Culpability	Blames Other Party	6	4	2	4	2	6	0
	No Blame	10	6	4	8	2	0	10
Circumstances of Injury	Sports Injury	4	1	3	4	0	0	4
	Violent Injury	4	2	2	2	2	3	1
Gender	Male Injured	12	7	5	12	0	4	8
	Female Injured	4	3	1	0	4	2	2
Region	Gauteng Injured	10	10	0	7	3	4	6
	Mpumalanga Injured	6	0	6	5	1	2	4

2.1.2. Means and Medians of Continuous variables

			Education		Age		Loss of consciousness	
Defining variable	*Subgroup*	n	Mean	Median	Mean	Median	Mean	Median
Time since injury	Recently Injured	4	11.00	11.50	24.25	21.50	9.00	10.50
	Intermediate Injured	8	10.88	11.50	25.38	21.50	3.88	0.00
	Long Term Injured	4	10.75	11.00	25.25	27.50	6.25	5.00
Culpability	Blames Other Party	6	10.50	10.50	26.00	26.50	10.17	10.00
	No Blame	10	11.10	11.50	1.50	21.50	3.10	0.00
Circumstances of injury	Sports Injury	4	12.00	12.00	22.00	21.50	0.25	0.00
	Violent Injury	4	10.50	10.50	34.00	33.00	5.00	5.00
Gender	Male Injured	12	11.08	12.00	23.25	21.50	5.58	0.50
	Female Injured	4	10.25	10.50	30.50	27.50	6.25	5.00
Region	Gauteng Injured	10	10.50	11.00	25.20	23.50	8.10	10.00
	Mpumalanga Injured	6	11.50	12.00	24.83	23.00	1.83	0.00

2.1.2. Means and Medians of Continuous variables - continued

			PTA		Hours hospitalized		Time since injury	
Defining variable	Subgroup	n	Mean	Median	Mean	Median	Mean	Median
Time since injury	Recently Injured	4	31.25	32.50	6.00	0.00	5.75	5.50
	Intermediate Injured	8	1.88	0.00	9.00	0.00	18.38	17.00
	Long Term Injured	4	17.50	5.00	13.50	2.50	123.00	126.00
Culpability	Blames Other Party	6	12.00	1.00	12.50	1.50	40.17	19.00
	No Blame	10	13.80	2.50	7.50	0.00	42.10	17.00
Circumstances of injury	Sports Injury	4	3.25	2.50	0.00	0.00	18.00	17.00
	Violent Injury	4	15.50	1.00	6.00	0.00	13.75	14.00
Gender	Male Injured	12	11.67	1.00	8.25	0.00	30.83	17.00
	Female Injured	4	17.50	5.00	12.75	1.50	73.00	55.50
Region	Gauteng Injured	10	13.20	0.00	15.00	2.50	57.40	23.50
	Mpumalanga Injured	6	13.00	5.00	0.00	0.00	14.67	16.00

2.2. Noninjured Subgroups

			Region (frequency)		Gender (frequency)		Age		Education	
Defining variable	Subgroup	n	Gauteng	Mpumalanga	Male	Female	Mean	Median	Mean	Median
Region	Gauteng Noninjured	5	5	0	1	4	28.40	27.00	11.40	11.00
	Mpumalanga Noninjured	10	0	10	8	2	19.20	16.50	11.30	11.50
Gender	Female Noninjured	6	4	2	0	6	26.33	25.50	11.50	11.50
	Male Noninjured	9	1	8	9	0	19.56	18.00	11.22	11.00

1.5. Screening Procedure

Volunteers were asked to fill in a biographical questionnaire, or were taken through the biographical questionnaire verbally (see Appendix 3). Injury history was established, and those without previous head injuries were randomly assigned to either the group of instructed malingerers or the noninjured group, using a table of random numbers. Subjects reporting previous injuries were asked a series of questions relating to severity of injury. More specifically, duration of loss of consciousness, post-traumatic amnesia, and hospitalization (if any) was established through subjective reporting. The questions had been designed to assess likely GCS on admission, using the criteria listen in the GCS assessment table appearing in Chusid (1985). It is felt that the above procedure ensured that within the limits imposed by subjective reporting, subjects met the requirements for mild head injury as set out in the literature review.

Noninjured volunteers were then randomly assigned to the nonmalingering (that is, the "noninjured"), and instructed malingering groups. Mildly head-injured subjects were obviously not randomly selected.

2. Assessment

2.1. Battery

2.1.1. Rationale

It was decided to examine three areas of interest: subjective reporting of postconcussive symptoms, cognitive performance, and effort exerted.

1. Biographical Questionnaire

The purpose of the biographical questionnaire was to provide information that could be used in assigning the subject to various groups, as well in analyzing group responses. In addition to providing information about experience of a previous head injury (or otherwise), and duration of loss of consciousness, post-traumatic amnesia, and hospitalization (see above), several other variables were recorded.

Information was recorded regarding number of previous head injuries, whether or not the subjects blamed another party for the injury, circumstances of injury, injuries accompanying the head injury, and time since the injury. Region of residence, present age, present level of education, sex, and present occupation, race, and first language were also recorded.

Several factors that were recognized as being of potential importance, had to be omitted. It was considered beyond the practical scope of this study to collect information regarding pre-injury stress, chronic social adversity, and experience of social demands or social support. It was also not practical to collect information concerning pre-injury factors predisposing subjects to injury, given the post-hoc nature of the injured group.

2.3.2. Subjective Postconcussive Complaints

Given the findings in the literature, the following instruments were believed to be useful:

Postconcussion Checklist (PCL)
Postconcussion Syndrome Checklist (PCSC)

Despite the verbal nature of these instruments, it was believed that the use of English was a factor that could be overcome. The questionnaires were administered orally, allowing ample opportunity to verify that questions were understood and for clarification to be given. Some changes were made to the wording of the questionnaires, as the original language used was believed to be potentially confusing to South African subjects. These changes are discussed below.

3. Cognitive Performance

The literature suggests that three areas of cognitive functioning are particularly affected: memory, divided attention, and focused attention.

As it was attempted to avoid the confounding effects of English proficiency as much as possible, verbal memory was not assessed. Given that it has been argued that memory difficulties are in fact secondary to other difficulties, it was concluded that it was probably not essential to investigate all modalities of memory. Visual memory was assessed utilising the Benton Visual Retention Test. As discussed below, this instrument was also useful as a test of incomplete effort.

Divided attention was assessed using the Paced Auditory Serial Addition Task - Revised. The use of the PASAT to investigate divided attention has precedents in the literature (for example, Gronwall, 1989). The shortened form was used for the present research, given time constraints. A fairly broad range of functioning had to be assessed in a limited period.

Focused attention was assessed using the modified Stroop Colour Word Task. Despite its reliance on English reading ability, this test was believed to be useful. This was the

test allows a baseline of reading speed could be established, prior to administration of reading speed to be established, prior to administration of the interference task.

4. Effort Exerted

Greiffenstein, Baker and Gola (1994) found that several tests of simulated amnesia successfully differentiated between subjects with traumatic brain injury, possible malingerers, and subjects with postconcussive symptoms but no malingering signs. Specifically, the following tests were found to be the best discriminators:

Rey 15-item
Portland Digit Recognition Test
Reliable Digit Span from the WAIS-R
Rey Word Recognition List
Rey Auditory Verbal Learning Test - Recognition Trial

However, Nash (1993), in his survey of tests of malingering in South African subjects, suggests omitting certain tests when dealing with subjects who are not English-speaking or Afrikaans-speaking, presumably because their heavy reliance on language ability. He specifically mentions the MMPI and the RAVLT, and this study therefore omitted the RAVLT to avoid the confounding effects of English proficiency. Similarly, it was felt that in the battery of Greiffenstein

et al. (1994), the WRL test may have suffered the same limitations. Nash recommends the use of the Rey 15-item test, which was used in the present study. Cutoff scores were generated by Greiffenstein, Baker and Gola (1994), and their suitability to the present sample was of particular interest. Despite evidence that the PDRT is an effective instrument for detecting incomplete effort (Binder and Willis, 1991; Binder, 1993; Greiffenstein et al., 1994), the length of time that is needed to administer it made it impractical for the present study.

Although Lezak (1983) believes that the score method used for the Reliable Digit Span (combining the forward and backwards scores) obscures the meaning of the final score obtained, and despite her recommendation that the instrument should therefore not be used, it was decided to investigate the use of this instrument. This decision was based on the findings of Greiffenstein et al. (1994), cited above.

Lezak (1983) states that the Benton Visual retention Test has been shown to detect incomplete effort. This test was therefore used as a test to suggest malingering, in addition to testing visual memory. Lezak states that "simulators made more errors of distortion than the [brain damaged] patients, but not as many errors of omission. The patients were more likely to forget the small peripheral figure and also to perseverate than were the simulators

(Lezak, 1983, p. 617).

The following tests were therefore used to assess effort exerted:

Rey 15-item
Reliable Digit Span
BVRT

2. Description of Battery (see Appendix 4)

1. Biographical Questionnaire

The biographical questionnaire consisted of a series of questions that the subject was required to answer, either verbally, or in written form. The questionnaire appears in Appendix 4.

2. Postconcussion Checklist (PCL)

This questionnaire "presents 37 symptoms to which respondents answer each item with 'yes' the symptom did occur, or 'no' the symptom did not occur....A PCL Total Score (total number of items endorsed as occurring) and a Total Postconcussion Syndrome...Score (total number of symptoms classically and specifically associated with PCS endorsed)" (Wong, Regennitter, & Barrios, 1994, p. 414) are calculated. No validity or reliability measures were

available for this instrument.

In order to make the questionnaire more easily understood, some changes were made to the wording used. These changes evolved through finding that subjects consistently had difficulties in understanding the original wording, and finding that ce ain alternatives were consistently understood. It is believed that these changes would not have altered the meaning of the questionnaire, but in fact made the questionnaire more faithful to the meaning of the original.

More specifically, the following changes were made:

1. "Often feel unwell" was changed to "Often feel not well".
2. "Have blackouts (seizures)" was changed to "Faint or have fits".
3. "Find difficulty in becoming interested in anything" was changed to "Find it difficult to become interested in things".
4. "Suffer from dizziness" was kept the same, but it was explained that dizziness was like the feeling one had after spinning around, except that in this case it was not from spinning around.
5. "Have been in trouble with the law" was changed to "Have often been in trouble, such as with the law, your boss, teachers, parents, and so on". This was

done [illegible] question made several subjects uncomfortable and was concluded to be insensitive. It was concluded that since working class black people were especially affected by apartheid legislation such as the pass laws, the original question was probably not all that meaningful, as there was not sufficient emphasis on culpability. The importance of the original form of the question is further diminished by the fact that the answer has no bearing on the Total Postconcussion Syndrome Score.

6. "Sometimes lose way, despite having been there many times before" was changed to "You sometimes get lost, even though you have been in that place many times before".
7. "Occasionally hear voices inside head" was changed to "You sometimes hear voices inside your head".
8. "Refuse to admit difficulties" was changed to "You won't tell people about problems you have".
9. "Have had a nightmare in the last two weeks" was changed to "Have had a bad dream in the last two weeks".
10. "Often feel restless" was changed to "You often feel restless - you don't like to sit still or be in one place".

3. Postconcussion Syndrome Checklist (PCSC)

This checklist "asks respondents to rate the frequency, intensity, and duration of each of 10 symptoms commonly associated with PCS on a Likert-type scale from 1 ('not at all') to 5 ('all the time/crippling/constant'). Four scores...[are] derived for each participant: a Frequency Total, and Intensity Total, a Duration Total, and a Total Score" (Wong, Regennitter, & Barrios, 1994, p. 414). No validity or reliability measures were available for this instrument.

The above two questionnaires were administered in two forms to the injured and malingering groups: present tense (that is, requesting post-injury symptoms), and past tense (that is, requesting pre-injury symptoms). Subjects were asked to provide information regarding the previous two months and the two months prior to the injury, respectively. The noninjured subjects were only given the present tense form.

4. Benton Visual Retention Test (BVRT)

"In the first part of this test, the subject is asked to copy 10 different geometrical designs while looking at them. In the second part, a series of similar geometrical designs is presented for 10 seconds each. Once they have been removed, the subject is asked to

draw the figures from memory" (Ruff, Levin, Mattis, High, Marshall, Eisenberg, & Tabaddor, 1989, p. 181).

Interscorer reliability coefficients have been found to range from .94 to .97 (Sivan, 1992). Kappa coefficients for interrater reliability have been found to range from .881 to .976 (Sivan, 1992).

Product-moment correlation coefficients between the BVRT and various WAIS subtests have been found to range from .46 to .62 (Sivan, 1992).

5. Paced Auditory Serial Additic ask - Revised (PASAT-R)

This test requires that the subject add 26 pairs of randomized digits "so that each is added to the digit immediately preceding it....the digits are presented at four rates of speed" (Lezak, 1995, p. 372). There are therefore a total of 25 answers per trial, with a total of 100 answers over the 4 trials. The revised version differs from the original version in that the latter consists of 4 trials of 61 digits each. Each trial is also presented at a slightly quicker rate than the revised version. Presentation of the digits was by means of a tape recorder.

Reliability and validity measures were not available for this instrument.

6. Stroop Colour Word Task

The test consists of 4 subtasks. Trial 1 requires the subject to requires the subject to read words printed in black ink, while trial 2 requires the subject to name colours printed in the form of a row of Xs in coloured ink. Trial 3 is the colour word interference task, which requires the subject to look at a series of colour names printed in ink of a noncorresponding colour (for example, the word "RED" printed in green ink), and to ignore the typed word, but to name t'e colour of the ink. A modified subtask was added (trial 4), as did Bohnen, et al. (1992), in which the task of reading colours spelling conflicting words was repeated, but with the additional interference of twenty randomly selected items being framed by a black border. For these items, the subject was required to read the printed word and ignore the colour of the ink.

The present study used the Stroop format of Golden (1978), rather than that of Swets and Zeitlinger, Lisse (1971), as used by Bohnen and Twijnstra (1992), and Bohnen, Twijnstra and Jolles (1992).

Trial 4 was generated from a table of random numbers, using the Golden format. The sequence of the words was randomly generated, after which ink colours were randomly generated (corresponding words and colours were rejected). Finally,

20 words were randomly assigned borders. This corresponded to the modifications made by Bohnen and Twijnstra (1992), and Bohnen, Twijnstra and Jolles (1992).

While it is recognised that the change in Stroop format from that used by Bohnen and Twijnstra (1992), and Bohnen, Twijnstra and Jolles (1992), the Golden format was used as it was more easily available. Since the results of this study were not being compared in a direct sense to those of the above studies, it was believed that the use of a slightly different version of the Stroop was not a fundamental problem.

Reliability and validity measures were not available for the modified Stroop task, although Lezak (1995, p.374) states that "the Stroop technique has satisfactory reliability".

7. Rey 15-item

This test requires the memorization of fifteen items. "The principle underlying it is that the patient who consciously or unconsciously wishes to appear impaired will fail at a task that all but the most severely brain damaged or retarded patients perform easily" (Lezak, 1983, p. 618).

No validity measures were available for this instrument. Regarding reliability, Lezak (1995, p.802) states that a

research study by Paul et al. (1992) "found that on two-week retesting with standard instructions, community dwellers achieved a reliability coefficient of .48 which rose to .86 under simulation instructions. (The relatively low correlation under standard conditions reflects the tendency of most normal subjects to get perfect scores so that the statistical effect of slight changes between the two trials is exaggerated.)"

8. Reliable Digit Span

This test consists of two subtests, Digits Forward and Digits Backward. "Both tests consist of...pairs of random number sequences that the examiner reads aloud at the rate of one per second" (Lezak, 1995, p. 357). The subject is required to repeat the numbers, either in the same order or reversed, depending of the subtest.

The digit sequences were taken from Lezak (1995), but in order to make the structure consistent with that of Greiffenstein, Baker and Gola (1994), a nine digit sequence was also generated using tables of random numbers (as suggested by Lezak (1995).

No validity measures were available for the Digits Forward test, but Lezak (1995, p.360) reports "test-retest reliability coefficients ranging from .66 to .89 depending on interval length and subjects' age". No reliability and

validity measures were available for the Digits Backwards test.

2.2. Procedure

The battery took approximately forty minutes to an hour to complete, with the subject being given a ten minute coffee break halfway.

Where possible, the biographical was given to the subject to complete prior to the assessment. The questionnaire was then checked for completeness, and any needed clarification obtained during the assessment meeting. Where it was not possible for the questionnaire to be filled in prior to the assessment, the subject was taken through the questionnaire verbally, in the form of an interview, during the assessment meeting. Subjects were assigned to one of the main groups (injured, malingering, or noninjured) once their biographical information was available.

The malingering group was provided with a standard scenario that conforms with the definition of mild head injury above, and asked to imagine the experiences that follow. The scenario was as follows:

"For this assessment, I need you to pretend that you have been injured. Imagine that 4 months ago you were travelling in a car and had an accident. You hit your head and became

unconscious (fainted) for about 10 minutes. Then you woke up and went to the hospital. At the hospital you were fully awake and understood everything that was said to you. You also had no problems following instructions. Now imagine that it is four months later and you are having problems. You are claiming from insurance because of these. I am the psychologist, and it is my job to find out what problems you have. You must imagine what problems a person in such a situation would have, and I need you to pretend that you actually have these problems.

I am going to interview you and give you some tasks to do. In the interview, you must give me the answe - that a previously injured person would give. When you do the tasks, you must do them in such a way that I will see for myself the problems that you have."

The postconcussion symptoms questionnaires were then administered. Prior to the administration of the cognitive tests, the subject's continued malingering status was confirmed as follows:

"Now I'm going to give you some tasks. You have told me about the problems that you have, and now I need to see the problems for myself. You must answer like someone who was injured 4 months ago, as I explained."

2.3. Scoring

What follows is a description of the scores derived from each assessment tool (The dataset appears in Appendix 5).

2.3.1. Initial Biographical Questionnaire

The following measures were derived from the initial questionnaire:

STATUS This refers to injury status, and contained the following classifications:

Injured = 1
Malingerer = 2
Noninjured = 3

While the Malingerers and Noninjured subjects were initially all drawn from volunteers with no history of head injury, for the purposes of this study, the description "noninjured" is only ever used to denote subjects with no history of injury, but who approached the tests with full effort. The description "malingering" is only ever used to denote those subjects who were instructed to malinger. The two groups are therefore entirely separate, and at no point in this study are the malingering subjects referred

to as "noninjured". Similarly, at no point in the study are the malingering and noninjured group referred to collectively as "noninjured".

INJNO Subjectively reported number of previous head injuries.

LOC Subjectively reported period of loss of consciousness (in minutes) sustained in the most recent injury.

PTA Subjectively reported period of posttraumatic amnesia (in minutes) sustained in the most recent injury.

HRSHOSP Subjectively reported period of hospitalisation (in hours) following the most recent injury.

BLAME Opinion regarding the culpability or otherwise of another party. "Yes" denotes feelings that someone else was to blame for the injury, while "No" denotes that another party could not be blamed.

INJTYPE The context of the injury. The following categories exist:

VIOLENCE Injury sustained during a violent attack.

SPORT Injury sustained while playing sport.

NMACC Injury sustained in an accident not involving a motor vehicle.

MVA Injury sustained in a motor vehicle

accident.

REC — Injury sustained during recreation other than sport, such as while playing.

REGION — Region in which the subject was recruited and assessed. Two regions were involved:

M — Mpumalanga

G — Gauteng

INJTIME — Subjectively reported time since the most recent injury (in months).

TIMECLASS — Classification of the injury in terms of chronicity or acuteness. Three categories were defined:

R — Recently injured

I — Intermediate

L — Long term injured

AGE — Age at the time of the assessment.

YRSED — Number of years of schooling at the time of the assessment.

Given the ethnic homogeneity of the sample (all subjects were black South Africans, and none were primarily English-speaking), ethnic information was not scored.

Information regarding return to work, or otherwise, as well as present occupational status, was not scored. This decision was taken, as the majority of the injured subjects were students (either full-time school pupils, or part-time adult students), with those in employment having little occupational diversity (all were in working class occupations). It was decided that meaningful categories could not be derived from the available sample.

It was also not feasible to score information regarding comorbidity, given the absence of additional injuries. The definition of mild head injury used specified hospitalization of not more than 72 hours, with the result that those with additional injuries, requiring longer hospitalization, were systematically screened out.

2.3.2. Postconcussive Checklist (PCL)

Pre- and post-injury scores were obtained for the malingering and injured subjects. For the noninjured subjects, post-injury scores were given the same values as corresponding pre-injury scores. This was done in order to simplify the statistical comparison.

The following scores were derived:

PCL1	Total general pre-injury symptoms.
PCLPCS1	Total pre-injury incidence of typically postconcussive symptoms.
PCL2	Total general post-injury symptoms.
PCLPCS2	Total post-injury incidence of typically postconcussive symptoms.

Difference scores were calculated, subtracting pre-injury scores from post-injury scores. Difference scores for the noninjured group were by definition zero, and disregarded as meaningless. The following difference scores were derived:

PCLDIFF	PCL2 - PCL1
PCLPCDIF	PCLPCS2 - PCLPCS1

2.3.3. Postconcussion Syndrome Checklist (PCSC)

Once again, pre-and post-injury scores were generated, as well as difference scores (post-injury score subtract pre-injury scores). As above, the pre-injury scores for of the noninjured group were re-entered as post-injury scores as well, in order to simplify the statistical comparisons. Again, difference scores within this group were treated as meaningless. The following scores were generated:

PCSC1TOT Total incidence of pre-injury symptoms.

PCSC1FRQ Frequency of pre-injury symptoms.

PCSC1INT Intensity of pre-injury symptoms.

PCSC1DUR Duration of pre-injury symptoms.

PCSC2TOT Total incidence of post-injury symptoms.

PCSC2FRQ Frequency of post-injury symptoms.

PCSC2INT Intensity of post-injury symptoms.

PCSC2DUR Duration of post-injury symptoms.

TOTDIFF PCSC2TOT - PCSC1TOT

FRQDIFF PCSC2FRQ - PCSC1FRQ

INTDIFF PCSC2INT - PCSC1INT

DURDIFF PCSC2DUR - PCSC1DUR

In addition, scores were derived for each of the 10 symptoms about which subjects were questioned. The frequency, intensity, and duration scores for each symptom were added to give the symptom score. This was done for pre- and post-injury scores. In addition, difference scores were calculated. The noninjured subject scores were treated as above. The following scores were generated:

HEADACH1 Pre-injury incidence of headaches.

DIZZINE1 Pre-injury incidence of dizziness.

IRRITAB1 Pre-injury incidence of irritability.

MEMORY1 Pre-injury incidence of memory difficul..es.

CONCENT1 Pre-injury incidence of concentration difficulties.

FATIGUE1 Pre-injury incidence of fatigue.

VISION1 Pre-injury incidence of vision difficulties.

NOISIN1 Pre-injury incidence of difficulties concerning noise intolerance.

JUDGEME1 Pre-injury incidence of judgement difficulties.

ANXIETY1 Pre-injury incidence of anxiety.

HEADACH2 Post-injury incidence of headaches.

DIZZINE2 Post-injury incidence of dizziness.

IRRITAB2 Post-injury incidence of irritability.

MEMORY2 Post-injury incidence of memory difficulties.

CONCENT2 Post-injury incidence of concentration difficulties.

FATIGUE2 Post-injury incidence of fatigue.

VISION2 Post-injury incidence of vision difficulties.

NOISIN2 Post-injury incidence of difficulties concerning noise intolerance.

JUDGEME2 Post-injury incidence of judgement difficulties.

ANXIETY2 Post-injury incidence of anxiety.

HEADADIF HEADACH2 - HEADACH1

DIZZIDIF DIZZINE2 - DIZZINE1

IRRITDIF IRRITAB2 - IRRITAB1

MEMDIF MEMORY2 - MEMORY1

CONCDIF CONCENT2 - CONCENT1

FATIGDIF FATIGUE2 - FATIGUE1

VISIODIF VISION2 - VISION1

NOISEDIF NOISIN2 - NOISIN1

JUDGDIFF JUDGEME2 - JUDGEME1

ANXDIFF ANXIETY2 - ANXIETY1

2.3.4. Benton Visual Retention Test (BVRT)

The following scores were derived:

BVCORR_C Total number of correct figures on the copying task.

BVERR_C Total number of errors on the copying task.

OMIS_C Total number of errors involving omission, on the copying task.

DISTOR_C Total number of errors involving distortion, on the copying task.

PERSEV_C Total number of errors involving perseveration, on the copying task.

ROTAT_C Total number of errors involving, on the copying task.

MISPLA_C Total number of errors involving, on the copying task.

SIZE_C Total number of errors involving size, on the copying task.

LEFT_C Total number of left-sided errors on the copying task.

RIGHT_C Total number of right-sided errors on the copying task.

BVCORR_D Total number of correct figures on the recall task.

BVERR_D Total number of errors on the recall task.

OMIS_D Total number of errors involving omission, on the recall task.

DISTOR_D Total number of errors involving distortion, on the recall task.

PERSEV_D Total number of errors involving perseveration, on the recall task.

ROTAT_D Total number of errors involving, on the recall task.

MISPLA_D Total number of errors involving, on the recall task.

SIZE_D Total number of errors involving size, on the recall task.

LEFT_D Total number of left-sided errors on the recall task.

RIGHT_D Total number of right-sided errors on the recall task.

2.3.5. Paced Auditory Serial Addition Task - Revised (PASAT-R)

Each trial was scored separately, in order to investigate claims that fragility to stressors remain (Gronwall, 1989), and that deficits are less apparent on slower tasks (Gentilini et. al, 1989). The following scores were

derived:

PASAT1	Total correct responses on trial 1.
PASAT2	Total correct responses on trial 2.
PASAT3	Total correct responses on trial 3.
PASAT4	Total correct responses on trial 4.
PASATTOT	Overall total of correct responses.

2.3.6. Stroop Colour Word Task (Stroop)

Speed and accuracy scores were generated. The research by Bohnen and Twijnstra (1992), as well as that by Bohnen, Twijnstra, and Jolles (1992) derived only speed scores. It was nevertheless believed that accuracy scores were also necessary, especially since poor accuracy was often noted during the assessment. Some malingering subjects responded so poorly in terms of accuracy, as to be unscorable. Responses on those trials were judged to lack value in generating information about more subtle malingering styles. Where fewer than 25 percent of responses were correct, the responses for that trial were omitted from the dataset as unscorable. This was only done for the accuracy scores. All speed scores for all subjects were used to examine speed of performance.

The following scores were derived:

STROOP1 Time taken on trial 1.

STROOP2 Time taken on trial 2.

STROOP3 Time taken on trial 3.

STROOP4 Time taken on trial 4.

SUBT32 STROOP3 - STROOP2

SUBT42 STROOP4 - STROOP2

STR1ACC Percentage correct for acceptable responses on trial 1.

STR2ACC Percentage correct for acceptable responses on trial 2.

STR3ACC Percentage correct for acceptable responses on trial 3.

STR4ACC Percentage correct for acceptable responses on trial 4.

2.3.7. Rey 15-item Test (Rey 15-item)

Only one score was derived:

FIFTEEN The total number of figures produced correctly.

2.3.8. Reliable Digit Span (RDS)

The following scores were calculated:

RDSFORW	Digit span on the Forward task.
RDSBACK	Digit span on the Backwards task.
RDSTOT	RDSFORW + RDSBACK
RDS[illegible]	RDSFORW - RDSBACK

CHAPTER 5: RESULTS

1. Demographic Comparisons

This section is divided into two sections: a consideration of the demographic equivalence of the subjects groups, and a comparison of the performance of groups in the assessment.

Setting out of each of these two broad analyses will take place in two steps: description of the statistical procedures employed (the "Procedure" section), followed by description of the actual findings derived (the "Findings" section).

In setting out the procedure, then, the emphasis will be on the statistical logic followed in deriving the results, rather than the specific findings themselves, which are described later. As each statistical method is described, the resulting table of results will be included. These tables will be referred to again when the findings are described.

Throughout the paper, results are regarded significant where $p < 0.05$.

Throughout the Results and Discussion sections, the terms "injured", "noninjured", "malingering", employed without any qualifications, refer to the total group of subjects that were assigned to th. Injured, Noninjured, and Malingering groups respectively. Where any group has been divided into

subgroups, these groups are referred to by their specific features (for example, "recently injured", or "male noninjured").

1.1. Procedure

All main groups and subgroups were compared in terms of demographic factors, in order to investigate their comparability. Summaries of the demographic information pertaining to the main groups and the subgroups are set out in Tables 1 and 2, included previously.

All noncontinuous variables were compared using the chi-square test (see Table 3.1. and Table 3.2.). It was unfortunately not possible to use 2X3 chi-square comparisons, given the statistical package used. Instead, 2X2 chi-squared comparisons were used in a triangular manner, thus achieving the same results that 2X3 comparisons would have achieved. Where any difference was found, the specific direction of this difference was established by inspection of the frequency tables for noncontinuous demographic characteristics (Table 1.1 for the main groups, Table 2.1.1. for the injured subgroups, and Table 2.2. for the noninjured subgroups).

Table 3.

Demographic Comparisons for Noncontinuous Data: Chi Square Test

3.1. Main Groups (Total Injured, Malingering, and Total Noninjured

Comparison	Variable	Chi squared (df = 1)
Injured versus Malingerers	Region	*4.57
	Gender	1.25
Injured versus Noninjured	Region	2.64
	Gender	0.8
Noninjured versus Malingerers	Region	0.26
	Gender	0.04

Note. *$p < .05$

3.2. Demographic Comparisons between Subgroups

Comparison	Variable	Chi squared (df = 1)
Recently Injured versus Intermediate Injured	Region	0.00
	Gender	1.20
	Blame	0.17
Recently Injured versus Long Term Injured	Region	2.67
	Gender	2.67
	Blame	0.53
Intermediate Injured versus Long term Injured	Region	3.00
	Gender	0.75
	Blame	0.19
Recently Injured versus Noninjured	Region	0.38
	Gender	2.34
Intermediate Injured versus Noninjured	Region	7.61
	Gender	0.52
Long Term Injured versus Noninjured	Region	*5.63
	Gender	0.13
Recently Injured versus Malingering	Region	0.95
	Gender	2.69
Intermediate Injured versus Malingering	Region	1.50
	Gender	0.80

3.2. Demographic Comparisons between Subgroups - continued

Comparison	Variable	Chi squared (df = 1)
Long Term Injured versus Malingering	Region	*7.5
	Gender	0.05
Female Injured versus Male Injured	Region	0.36
	Blame	16
Female Injured versus Female Noninjured	Region	0.08
Male Injured versus Male Noninjured	Region	*4.86
Male Noninjured versus Female Noninjured	Region	*5
Gauteng Noninjured versus Mpumalanga Noninjured	Gender	*5
Gauteng Injured versus Mpumalanga Injured	Gender	0.36
	Blame	0.07
Sports Injury versus	Region	0.53
Violent Injury	Gender	2.67
	Blame	
Blames Another Party versus No Blame	Region	0.07
No Blame	Gender	0.36

Note. *p < .05

Continuous variables were compared differently for the main groups and for the smaller subgroups. For the three main groups, parametric tests were used, as their numbers were sufficiently large and the distributions did not appear skewed (see Table 1. the means and medians for Education and Age are approximately equal). Nonparametric tests were used for the subgroups, given the small numbers of subjects involved.

For the three main groups, the Levene test of homogeneity of variance was applied, following which, analysis of variance was performed (see Table 4.1.). Since no significant differences were found, no comparison of means was necessary.

Table 4.

Demographic Comparisons for Continuous Data

4.1. Parametric Comparisons

4.1.1. Homogeneity of Variances: Levene Test

Comparison	Variable	df Effect	MS Effect	F value
All 3 groups	Education	2	0.80	3.04
	Age	2	15.60	0.75

Note. *p < .05

4.1.2. Analysis of variance

Comparison	Variable	df Effect	MS Effect	F Value
All 3 groups	Education	2	1.22	1.25
	Age	2	44.57	0.86

Note. *p < .05

Comparisons of continuous variables that included smaller subgroups were performed using the Mann-Whitney U test (see Table 4.2.). Where differences were found, the nature of the difference was specified by inspecting the medians for each group, listed in Table 1.2. for the main groups, Table 2.1.2. for the injured subgroups, and Table 2.2. for the noninjured subgroups.

4.2. Nonparametric Comparisons: Mann-Whitney U Test

4.2.1. Comparison between Recently Injured, Intermediate Injured, and Long Term Injured Groups

Variable	Comparison	U value for comparison	Significant Differences
Education	Recent vs Long Term	6.50	
	Recent vs Intermediate	15.50	
	Intermediate vs Long Term	14.00	
Age	Recent vs Long Term	5.50	
	Recent vs Intermediate	13.50	
	Intermediate vs Long Term	12.00	
LOC	Recent vs Long Term	6.00	
	Recent vs Intermediate	9.00	
	Intermediate vs Long Term	13.50	
PTA	Recent vs Long Term	6.00	
	Recent vs Intermediate	7.00	
	Intermediate vs Long Term	11.00	
Hours hospitalised	Recent vs Long Term	3.00	
	Recent vs Intermediate	15.50	
	Intermediate vs Long Term	6.50	
Time since injury	Recent vs Long Term	*0	Recent < Long Term
	Recent vs Intermediate	*0	Recent < Intermediate
	Intermediate vs Long Term	*0	Intermediate < Long Term

Note. *$p < 0.05$

4.2.2. Comparison between Recently Injured and Noninjured Groups

Variable	U value for comparison
Education	28.00
Age	29.50

Note. *p < 0.05

4.2.3. Comparison between Intermediate Injured and Noninjured Groups

Variable	U value for comparison
Education	52.5
Age	48

Note. *p < 0.05

4.2.4. Comparison between Long Term Injured and Noninjured Groups

Variable	U value for comparison
Education	21
Age	16

Note. *p < 0.05

4.2.5. Comparison of Female Injured and Male Injured Groups

Variable	U value for comparison
Education	12.50
Age	15.50
LOC	23.50
PTA	21.00
Hours hospitalized	20.50
Time since injury	16.00

Note. *p < 0.05

4.2.6. Comparison between Male Noninjured and Female Noninjured Groups

Variable	U value for comparison	Significant differences
Education	24.00	
Age	*8.5	Female Inj < Male Inj

Note. *p , 0.05

4.2.7. Comparison between Gauteng Noninjured and Mpumalanga Noninjured Groups

Variable	U value for comparison	Significant differences
Education	24.00	
Age	*4	Mpumalanga Non < Gauteng Non

Note. *p < 0.05

4.2.8. Comparison between Gauteng Injured and Mpumalanga Injured Groups

Variable	U value for comparison	Significant differences
Education	16.50	
Age	28.00	
LOC	17.00	
PTA	24.00	
Hours hospitalized		*9 Mpumalanga Inj < Gauteng Inj
Time since injury	20.50	

Note. *p < 0.05

4.2.9. Comparison between Sports Injured and Violently Injured Groups

Variable	U value for comparison
Education	2.00
Age	4.00
LOC	5.00
PTA	8.00
Hours hospitalized	6.00
Time since injury	4.00

Note. *p < 0.05

4.2.10. Comparison between Subjects Blaming Another Party and No Blame Subjects

Variable	U value for comparison
Education	22.50
Age	24.50
LOC	14.50
PTA	29.50
Hours hospitalized	25.00
Time since injury	28.50

Note. *p < 0.05

4.2.11. Comparison between Recently Injured and Malingering Groups

Variabl	U value for comparison
Education	28.00
Age	30.50

Note. *p < 0.05

4.2.12. Comparison between Intermediate Injured and Malingering Groups

Variable	U value for comparison
Education	52.50
Age	52.50

Note. *p < 0.05

4.2.13. Comparison between Long Term Injured and Malingering Groups

Variable	U value for comparison
Education	21.50
Age	.00

Note. *p < 0.05

1.2. Findings

What follows is a summary and discussion of the findings obtained.

1.2.1. Comparison of the Main Groups (16 Injured, 16 Malingerers, 15 Noninjured).

1. Noncontinuous Data

The noninjured group was found not to differ from the injured or malingering groups in terms of region or gender (see Table 3.1.). The injured group did, however, differ from the malingering group in terms of region of origin. The injured group had significantly more Gauteng residents and significantly fewer Mpumalanga residents than the malingering group (see Table 1.).

Thus, where differences are found between the malingering and injured groups, and where these variables are also found to have an association with region, it is not possible to state unequivocally that the differences are associated with injury status, rather than merely being an effect of region. This will be dealt with further in the analysis of the assessment results.

2. Continuous Data

For both education and age, groups were found to have comparable variance. Analyses of variance revealed no differences between the three groups in terms of these two variables (see Table 4.1.).

1.2.2. Subgroup Comparisons

1. Demographic Comparison of the Recently Injured Group, the Intermediate Group, and the Long Term Injured Group.

The 4 recently injured subjects, the 9 intermediate injured subjects, and the 4 long term injured subjects were compared (see Table 3.2. for comparisons of noncontinuous variables, and Table 4.2.1. for comparisons of continuous variables). The only differences between the groups was in terms of time since injury. This was to be expected. All three groups were distinct. Otherwise, the groups were demographically comparable in terms of the information available.

2. Demographic Comparison of the Recently Injured Group and the Noninjured Group.

The 4 recently injured subjects and the 15 noninjured subjects were compared (see Table 3.2. for comparisons of

noncontinuous variables, and Table 4.2.2. for comparisons of continuous variables). No demographic differences were found. The groups were therefore comparable in terms of the demographic data available.

3. Demographic Comparison of the Intermediate Injured Group and the Noninjured Group.

The 8 intermediate injured subjects and the 15 noninjured subjects were compared (see Table 3.2. for comparisons of noncontinuous variables, and Table 4.2.3. for comparisons of continuous variables). No demographic differences were found. The groups were therefore comparable in terms of the demographic data available.

4. Demographic Comparison of the Long Term Injured Group and the Noninjured Group.

The 4 long term injured subjects and the 15 noninjured subjects were compared (see Table 3.2. for comparisons of noncontinuous variables, and Table 4.2.4. for comparisons of continuous variables). Regional differences were found. The long term group was predominantly from Gauteng, while the noninjured group was predominantly from Mpumalanga (see Table 2).

This introduces potential uncertainty in comparing the groups. Where differences are found, and where these differences also have an association with region, it cannot be said whether the differences are associated with injury status or regional differences. This is discussed further below.

5. Demographic Comparison of the Female Injured Group and the Male Injured Group.

The 4 female injured subjects and the 12 male injured subjects were compared (see Table 3.2. for comparisons of noncontinuous variables, and Table 4.2.5. for comparisons of continuous variables). No demographic differences were found. The groups were therefore comparable in terms of the demographic data available.

6. Demographic Comparison of the Male Noninjured Group and the Female Noninjured Group.

The 9 male and the 6 female noninjured subjects were compared (see Table 3.2. for comparisons of noncontinuous variables, and Table 4.2.6. for comparisons of continuous variables). Regional differences and age differences were found. The male noninjured group was predominantly from Mpumalanga, while the female noninjured group was

predominantly from Gauteng (see Table 2). The female group had a higher mean and median age than the male group (see Table 2).

Thus, where group differences are found, and where these differences are also found to have an association with region or age, these differences may be related respectively to the regional or age differences between the groups, rather than the differences in gender. This is discussed further below.

7. Demographic Comparison of the Gauteng Noninjured Group and the Mpumalanga Noninjured Group.

The demographic characteristics of the 5 Gauteng noninjured subjects were compared to those of the 10 Mpumalanga noninjured subjects (see Table 3.2. for comparisons of noncontinuous variables, and Table 4.2.7. for comparisons of continuous variables). Gender and age differences were found. The Gauteng group consisted predominantly of females, while the Mpumalanga group consisted predominantly of males (see Table 2). In addition, the Gauteng group had a higher mean and median age than the Mpumalanga group (see Table 2).

Thus, where group differences are found, and where these differences are also found to have an association with

gender or age, these differences may be related respectively to the gender or age differences between the groups, rather than to the differences in region. This is discussed further below.

8. Demographic Comparison of the Gauteng Injured Group and the Mpumalanga Injured Group.

There were 10 injured subjects from Gauteng and 6 injured subjects from Mpumalanga (see Table 3.2. for comparisons of noncontinuous variables, and Table 4.2.8. for comparisons of continuous variables). Demographic comparisons found differences in hours of hospitalisation following injury. The Gauteng group had longer mean and median hospitalisation periods than the Mpumalanga group (see Table 2). At the same time, it is important to note the small range of hours of hospitalisation (0 to 48 hours). Prolonged hospitalisation, such as for accompanying orthopaedic injuries, was screened out.

Thus, where group differences are found, and where these differences are also found to have an association with hours of hospitalisation, these differences may be related respectively to the difference in hours of hospitalisation between the groups, rather than to the differences in region. This is discussed further below.

9. Demographic Comparison of the Sports Injured Group and the Violently Injured Group.

The 4 sports injury subjects and the 4 violently injured subjects were compared (see Table 3.2. for comparisons of noncontinuous variables, and Table 4.2.9. for comparisons of continuous variables). Differences were found in terms of feelings of personal culpability versus blame. None of the sports injured group believed that another party was to blame for the injury. By contrast, 3 of the 4 violently injured subjects believed that another party was to blame (see Table 2).

Thus, where group differences are found, and where these differences are also found to have an association with blame, these differences may be related the blame status difference between the groups, rather than to the differences in circumstances of injury. This is discussed further below.

10. Demographic Comparison of the No Blame Group and the Blame Group.

Six subjects blamed another party, while 10 did not (see Table 3.2. for comparisons of noncontinuous variables, and Table 4.2.10. for comparisons of continuous variables). No demographic differences were found. The groups were

therefore comparable in terms of the demographic data available.

11. Demographic Comparison of the Recently Injured Group and the Malingering Group.

The 4 recently injured subjects and the 16 malingering subjects were compared (see Table 3.2. for comparisons of noncontinuous variables, and Table 4.2.11. for comparisons of continuous variables). No demographic differences were found. The groups were therefore comparable in terms of the demographic data available.

12. Demographic Comparison of the Intermediate Injured Group and the Malingering Group.

The 8 recently injured subjects and the 16 malingering subjects were compared (see Table 3.2. for comparisons of noncontinuous variables, and Table 4.2.12. for comparisons of continuous variables). No demographic differences were found. The groups were therefore comparable in terms of the demographic data available.

13. Demographic Comparison of the Long Term Injured Group and the Malingering Group.

The 4 long term injured subjects and the 16 malingering subjects were compared (see Table 3.2. for comparisons of noncontinuous variables, and Table 4.2.13. for comparisons of continuous variables). Regional differences were found, with the long term injured subjects all coming from Gauteng, and the malingering subjects mainly coming from umalanga (see Table 1 and Table 2).

Thus, where group differences are found, and where these differences are also found to have an association with region, these differences may be related the regional difference between the groups, rather than to the differences chronicity of injury. This is discussed further below.

2. Comparison of Assessment Results

2.1. Procedure

Groups were then compared in terms of assessment scores. All scores are of a continuous nature, and the steps involved in analyzing the results are described below.

2.1.1. Descriptive Statistics

The dataset is set out in Appendix 5. Descriptive statistics for the scores of the 3 main groups (total injured, malingering, and noninjured) are provided in Table 5, while descriptive statistics for the scores of the subgroups are provided in Table 6.

As can be seen from the definition of the variables listed previously, there are several measures for which pre- and post-injury values were obtained. In order to simplify the statistical analysis, noninjured subjects (for whom only one measure of these values was obtained) were given the same values for pre- and post-injury scores. Those scores which indicate the difference between pre- and post-injury functioning are therefore by definition equal to zero. Comparisons involving these difference scores are therefore meaningless, and were not performed.

Table 5.
Test Results: Descriptive Statistics for Main Groups (Total Injured, Malingering, and Noninjured

5.1. Total Injured Group

Test	Variable		Mean	Median	SD	Maximum	Minimum
PCL	PCL1	(pre-injury total symptoms)	11.38	10.50	5.97	23.00	3.00
	PCL2	(post-injury total symptoms)	15.25	14.50	7.95	26.00	3.00
	PCLDIFF	(difference in total symptoms)	3.88	2.00	4.01	13.00	0.00
	PCLPCS1	(pre-injury typical PSC)	4.69	4.50	2.94	10.00	0.00
	PCLPCS2	(post-injury typical PCS)	7.19	6.50	4.40	14.00	0.00
	PCLPCDIF	(difference in typical PCS)	2.50	1.00	2.73	8.00	0.00
PCSC	PCSC1TOT	(pre-injury total symptoms)	51.31	53.00	14.61	75.00	30.00
	PCSC1FRQ	(pre-injury symptom frequency)	16.56	16.00	4.75	24.00	10.00
	PCSC1INT	(pre-injury symptom intensity)	16.25	15.50	4.55	25.00	10.00
	PCSC1DUR	(pre-injury symptom duration)	18.50	19.00	5.94	29.00	10.00
	PCSC2TOT	(post-injury total symptoms)	72.38	67.00	23.62	126.00	44.00
	PSCS2FRQ	(post-injury symptom frequency)	23.25	22.00	8.32	44.00	14.00
	PCSC2INT	(post-injury symptom intensity)	23.38	20.50	8.51	41.00	14.00
	PCSC2DUR	(post-injury symptom duration)	25.75	22.50	8.31	42.00	16.00
	TOTDIFF	(difference in total symptoms)	21.06	11.50	27.06	81.00	0.00
	FRQDIFF	(difference in symptom frequency)	6.6	3.00	9.28	29.00	0.00
	INTDIFF	(difference in symptom intensity)	7.13	2.50	9.86	31.00	0.00
	DURDIFF	(difference in symptom duration)	7.25	4.00	8.43	25.00	0.00
	HEADACH1	(pre-injury headaches)	5.75	5.00	3.02	11.00	3.00
	DIZZINE1	(pre-injury dizziness)	4.06	3.00	1.69	8.00	3.00
	IRRITAB1	(pre-injury irritability)	5.50	4.50	2.83	10.00	3.00
	MEMORY1	(pre-injury memory problems)	4.25	3.00	2.11	10.00	3.00
	CONCENT1	(pre-injury concentration problems)	4.63	3.00	2.33	10.00	3.00
	FATIGUE1	(pre-injury fatigue)	5.31	3.00	3.00	11.00	3.00
	VISION1	(pre-injury vision problems)	4.69	3.00	2.91	13.00	3.00
	NOISIN1	(pre-injury noise intolerance)	5.88	6.00	2.70	11.00	3.00
	JUDGEME1	(pre-injury judgement problems)	5.69	6.00	2.21	9.00	3.00
	ANXIETY1	(pre-injury anxiety)	5.56	6.00	2.53	10.00	3.00
	HEADACH2	(post-injury headaches)	8.31	9.00	3.75	14.00	3.00
	DIZZINE2	(post-injury dizziness)	6.31	6.00	3.34	14.00	3.00
	IRRITAB2	(post-injury irritability)	6.50	7.00	3.33	14.00	3.00
	MEMORY2	(post-injury memory problems)	6.81	4.50	4.51	15.00	3.00
	CONCENT2	(post-injury concentration problems)	6.69	7.00	3.59	15.00	3.00
	FATIGUE2	(post-injury fatigue)	8.25	8.50	3.42	13.00	3.00
	VISION2	(post-injury vision problems)	6.56	5.00	4.37	15.00	3.00
	NOISIN2	(post-injury noise intolerance)	8.19	7.50	3.19	14.00	3.00
	JUDGEME2	(post-injury judgement problems)	7.50	7.00	3.20	15.00	3.00
	ANXIETY2	(post-injury anxiety)	7.25	7.00	3.15	13.00	3.00
	HEADADIF	(difference in headache incidence)	2.56	0.50	3.71	11.00	0.00
	DIZZIDIF	(difference in dizziness incidence)	2.25	0.00	3.38	11.00	0.00
	IRRITDIF	(difference in irritability)	1.00	0.00	2.25	7.00	-1.00
	MEMDIF	(difference in memory problems)	2.56	0.00	4.18	11.00	0.00
	CONCDIF	(difference in concentration problems)	2.06	0.00	3.55	12.00	0.00
	FATIGDIF	(difference in fatigue)	2.94	0.00	4.09	10.00	0.00
	VISIODIF	(difference in vision problems)	1.88	0.00	5.35	12.00	-10.00
	NOISEDIF	(difference in noise intolerance)	2.31	0.00	3.61	11.00	0.00
	JUDGDIFF	(difference in judgement problems)	1.81	0.00	3.47	9.00	-4.00
	ANXDIFF	(difference in anxiety)	1.69	0.00	3.00	9.00	0.00
BVRT	BVCORR_C	(copy task correct)	8.50	9.00	1.86	10.00	3.00
	BVERR_C	(copy task errors)	1.50	1.00	1.86	7.00	0.00
	OMIS_C	(copy task omissions)	0.19	0.00	0.54	2.00	0.00

5.1. Total Injured Group - continued

Test	Variable		Mean	Median	SD	Maximum	Minimum
	DISTOR_C	(copy task distortions)	0.19	0.00	0.40	1.00	0.00
	PERSEV_C	(copy task perseverations)	0.00	0.00	0.00	0.00	0.00
	ROTAT_C	(copy task rotations)	0.06	0.00	0.25	1.00	0.00
	MISPLA_C	(copy task misplacements)	0.94	0.00	1.77	7.00	0.00
	SIZE_C	(copy task size errors)	0.06	0.00	0.25	1.00	0.00
	LEFT_C	(copy task left-sided errors)	0.50	0.00	1.03	3.00	0.00
	RIGHT_C	(copy task right-sided errors)	0.94	0.50	1.29	4.00	0.00
	BVCORR_D	(recall task correct)	5.56	5.00	2.56	10.00	2.00
	BVERR_D	(recall task errors)	6.63	6.50	4.01	13.00	0.00
	OMIS_D	(recall task omissions)	0.31	0.00	0.48	1.00	0.00
	DISTOR_D	(recall task distortions)	2.06	2.00	1.53	5.00	0.00
	PERSEV_D	(recall task perseverations)	1.25	1.00	1.34	4.00	0.00
	ROTAT_D	(recall task rotations)	1.38	1.00	1.20	3.00	0.00
	MISPLA_D	(recall task misplacements)	1.38	1.00	1.54	5.00	0.00
	SIZE_D	(recall task size errors)	0.19	0.00	0.54	2.00	0.00
	LEFT_D	(recall task left-sided errors)	2.19	2.00	1.83	6.00	0.00
	RIGHT_D	(recall task right-sided errors)	3.75	3.00	3.15	12.00	0.00
PASAT	PASAT1	(trial 1)	12.94	12.50	4.45	23.00	7.00
	PASAT2	(trial 2)	12.94	12.50	4.45	23.00	7.00
	PASAT3	(trial 3)	10.88	10.50	4.87	20.00	4.00
	PASAT4	(trial 4)	8.13	8.00	2.58	12.00	4.00
	PASATTOT	(total score)	44.88	44.50	15.17	75.00	26.00
STROOP	STROOP1	(trial 1: speed)	64.25	57.50	21.93	137.00	45.00
	STROOP2	(trial 2: speed)	94.63	86.00	21.32	148.00	67.00
	STROOP3	(trial 3: speed)	148.63	143.00	37.93	240.00	100.00
	STROOP4	(trial 4: speed)	151.81	145.00	39.65	245.00	101.00
	SUBT32	(speed difference: trials 3 and 2)	54.00	54.00	20.70	92.00	15.00
	SUBT42	(speed difference: trials 4 and 2)	57.19	55.00	25.16	107.00	22.00
	STR1ACC	(trial 1: accuracy)	98.81	100.00	1.87	100.00	94.00
	STR2ACC	(trial 2: accuracy)	96.88	97.00	3.76	100.00	85.00
	STR3ACC	(trial 3: accuracy)	96.44	96.00	2.80	100.00	90.00
	STR4ACC	(trial 4: accuracy)	96.19	97.50	3.92	100.00	85.00
REY 15-ITEM	FIFTEEN	(total correct)	13.50	14.50	1.93	15.00	9.00
RDS	RDSFORW	(total score forward)	5.38	5.00	0.89	7.00	4.00
	RDSBACK	(total score backwards)	3.63	4.00	0.81	5.00	2.00
	RDSTOT	(overall total)	9.00	9.00	1.10	11.00	7.00
	RDSDIFF	(forward minus backward score)	1.75	2.00	1.29	5.00	0.00

5.2. Malingering Group

Test	Variable		Mean	Median	SD	Maximum	Minimum
PCL	PCL1	(pre-injury total symptoms)	3.63	3.00	2.42	9.00	1.00
	PCL2	(post-injury total symptoms)	26.88	27.50	6.85	35.00	10.00
	PCLDIFF	(difference in total symptoms)	23.25	23.50	6.51	33.00	9.00
	PCLPCS1	(pre-injury typical PSC)	0.88	1.00	0.81	2.00	0.00
	PCLPCS2	(post-injury typical PCS)	12.81	14.00	2.95	17.00	8.00
	PCLPCDIF	(difference in typical PCS)	11.94	13.00	3.09	17.00	7.00
PCSC	PCSC1TOT	(pre-injury total symptoms)	41.31	41.00	9.14	59.00	30.00
	PCSC1FRQ	(pre-injury symptom frequency)	13.56	13.00	2.61	19.00	10.00
	PCSC1INT	(pre-injury symptom intensity)	13.38	13.00	3.14	20.00	10.00
	PCSC1DUR	(pre-injury symptom duration)	14.38	14.50	4.10	23.00	10.00
	PCSC2TOT	(post-injury total symptoms)	101.00	105.50	16.63	126.00	62.00
	PSCS2FRQ	(post-injury symptom frequency)	34.94	36.00	6.35	45.00	20.00
	PCSC2INT	(post-injury symptom intensity)	34.44	35.00	6.99	48.00	19.00
	PCSC2DUR	(post-injury symptom duration)	31.63	33.00	6.13	38.00	19.00
	TOTDIFF	(difference in total symptoms)	59.69	64.00	12.08	75.00	32.00
	FRQDIFF	(difference in symptom frequency)	21.38	21.50	5.19	29.00	10.00
	INTDIFF	(difference in symptom intensity)	21.06	21.50	5.72	29.00	9.00
	DURDIFF	(difference in symptom duration)	17.25	18.50	4.91	23.00	8.00
	HEADACH1	(pre-injury headaches)	4.69	3.00	2.39	9.00	3.00
	DIZZINE1	(pre-injury dizziness)	3.88	3.00	1.45	7.00	3.00
	IRRITAB1	(pre-injury irritability)	4.13	3.00	1.71	8.00	3.00
	MEMORY1	(pre-injury memory problems)	4.00	3.00	2.16	11.00	3.00
	CONCENT1	(pre-injury concentration problems)	3.56	3.00	1.26	7.00	3.00
	FATIGUE1	(pre-injury fatigue)	4.56	4.00	1.71	7.00	3.00
	VISION1	(pre-injury vision problems)	3.19	3.00	0.75	6.00	3.00
	NOISIN1	(pre-injury noise intolerance)	4.88	3.00	2.53	10.00	3.00
	JUDGEME1	(pre-injury judgement problems)	4.38	3.00	1.71	7.00	3.00
	ANXIETY1	(pre-injury anxiety)	4.25	3.00	2.05	10.00	3.00
	HEADACH2	(post-injury headaches)	11.38	12.00	2.36	15.00	6.00
	DIZZINE2	(post-injury dizziness)	9.13	9.00	2.36	13.00	3.00
	IRRITAB2	(post-injury irritability)	9.56	10.00	3.27	15.00	3.00
	MEMORY2	(post-injury memory problems)	9.88	10.00	3.46	15.00	3.00
	CONCENT2	(post-injury concentration problems)	9.19	10.00	2.61	13.00	3.00
	FATIGUE2	(post-injury fatigue)	10.44	10.00	2.90	14.00	3.00
	VISION2	(post-injury vision problems)	8.69	9.50	3.48	14.00	3.00
	NOISIN2	(post-injury noise intolerance)	11.63	12.00	3.20	15.00	3.00
	JUDGEME2	(post-injury judgement problems)	10.00	12.00	3.81	15.00	3.00
	ANXIETY2	(post-injury anxiety)	11.38	12.00	3.07	15.00	3.00
	HEADADIF	(difference in headache incidence)	6.69	6.00	2.12	11.00	3.00
	DIZZIDIF	(difference in dizziness incidence)	5.25	5.00	1.95	9.00	0.00
	IRRITDIF	(difference in irritability)	5.44	6.00	3.24	12.00	0.00
	MEMDIF	(difference in memory problems)	5.88	6.50	3.67	12.00	0.00
	CONCDIF	(difference in concentration problems)	5.63	6.50	2.78	9.00	0.00
	FATIGDIF	(difference in fatigue)	5.88	6.00	2.45	11.00	0.00
	VISIODIF	(difference in vision problems)	5.50	6.00	3.37	11.00	0.00
	NOISEDIF	(difference in noise intolerance)	6.75	7.00	3.89	12.00	0.00
	JUDGDIFF	(difference in judgement problems)	5.63	6.00	3.48	10.00	0.00
	[illegible]XDIFF	(difference in anxiety)	7.13	8.00	2.78	10.00	0.00
BVRT	BVCORR_C	(copy task correct)	5.31	5.00	3.55	10.00	1.00
	BVERR_C	(copy task errors)	6.94	6.00	5.69	16.00	0.00
	OMIS_C	(copy task omissions)	0.75	0.00	1.98	8.00	0.00
	DIST[illegible]_C	(copy task distortions)	3.50	2.50	3.20	10.00	0.00
	[illegible]RS_V_C	(copy task perseverations)	0.06	0.00	0.25	1.00	0.00

5.2. Malingering Group - continued

Test	Variable		Mean	Median	SD	Maximum	Minimum
	ROTAT_C	(copy task rotations)	1.69	1.00	2.21	9.00	0.00
	MISPLA_C	(copy task misplacements)	0.81	0.50	1.11	4.00	0.00
	SIZE_C	(copy task size errors)	0.19	0.00	0.54	2.00	0.00
	LEFT_C	(copy task left-sided errors)	2.38	2.00	2.16	6.00	0.00
	RIGHT_C	(copy task right-sided errors)	3.25	3.50	2.98	8.00	0.00
	BVCORR_D	(recall task correct)	3.19	3.00	2.59	8.00	0.00
	BVERR_D	(recall task errors)	13.00	13.00	6.41	22.00	3.00
	OMIS_D	(recall task omissions)	1.50	0.00	2.63	9.00	0.00
	DISTOR_D	(recall task distortions)	6.06	6.50	3.59	13.00	1.00
	PERSEV_D	(recall task perseverations)	0.69	1.00	0.79	3.00	0.00
	ROTAT_D	(recall task rotations)	2.75	3.00	2.41	9.00	0.00
	MISPLA_D	(recall task misplacements)	1.81	1.00	1.87	7.00	0.00
	SIZE_D	(recall task size errors)	0.19	0.00	0.40	1.00	0.00
	LEFT_D	(recall task left-sided errors)	6.00	6.00	4.20	18.00	1.00
	RIGHT_D	(recall task right-sided errors)	6.06	5.50	3.34	11.00	0.00
PASAT	PASAT1	(trial 1)	11.50	12.00	5.55	21.00	2.00
	PASAT2	(trial 2)	7.94	7.00	4.78	18.00	0.00
	PASAT3	(trial 3)	6.88	7.00	3.18	12.00	2.00
	PASAT4	(trial 4)	4.63	4.00	3.14	10.00	0.00
	PASATTOT	(total score)	30.94	29.50	14.67	58.00	12.00
STROOP	STROOP1	(trial 1: speed)	104.88	76.00	69.53	264.00	45.00
	STROOP2	(trial 2: speed)	121.44	106.50	49.40	232.00	63.00
	STROOP3	(trial 3: speed)	160.75	156.00	52.92	283.00	75.00
	STROOP4	(trial 4: speed)	165.38	156.00	60.33	300.00	84.00
	SUBT32	(speed difference: trials 3 and 2)	39.31	35.50	32.98	100.00	-17.00
	SUBT42	(speed difference: trials 4 and 2)	43.94	50.50	54.98	158.00	-50.00
	STR1ACC	(trial 1: accuracy)	88.08	97.50	15.15	100.00	59.00
	STR2ACC	(trial 2: accuracy)	83.25	90.00	20.75	99.00	24.00
	STR3ACC	(trial 3: accuracy)	79.27	91.00	26.78	100.00	12.00
	STR4ACC	(trial 4: accuracy)	82.23	90.00	19.14	100.00	29.00
REY 15-ITEM	FIFTEEN	(total correct)	8.00	7.50	3.92	15.00	0.00
RDS	RDSFORW	(total score forward)	3.00	3.00	2.61	6.00	0.00
	RDSBACK	(total score backwards)	2.69	3.00	1.01	4.00	0.00
	RDSTOT	(overall total)	5.69	5.50	2.35	10.00	0.00
	RDSDIFF	(forward minus backward score)	0.31	1.00	2.09	3.00	-3.00

5.3. Total Noninjured Group

Test	Variable		Mean	Median	SD	Maximum	Minimum
PCL	PCL1	(pre-injury total symptoms)	12.07	12.00	6.33	28.00	2.00
	PCL2	(post-injury total symptoms)	12.07	12.00	6.33	28.00	2.00
	PCLDIFF	(difference in total symptoms)	0.00	0.00	0.00	0.00	0.00
	PCLPCS1	(pre-injury typical PCS)	6	6.00	3.31	13.00	2.00
	PCLPCS2	(post-injury typical PCS)	.	6.00	3.31	13.00	2.00
	PCLPCDIF	(difference in typical PCS)	0.00	0.00	0.00	0.00	0.00
PCSC	PCSC1TOT	(pre-injury total symptoms)	65.53	60.00	15.95	102.00	47.00
	PCSC1FRQ	(pre-injury symptom frequency)	19.53	19.00	4.96	32.00	14.00
	PCSC1INT	(pre-injury symptom intensity)	21.80	21.00	5.65	30.00	13.00
	PCSC1DUR	(pre-injury symptom duration)	24.20	22.00	6.76	41.00	16.00
	PCSC2TOT	(post-injury total symptoms)	65.53	60.00	15.95	102.00	47.00
	PSC*2FRQ	(post-injury symptom frequency)	19.53	19.00	4.96	32.00	14.00
	PCSC2INT	(post-injury symptom intensity)	21.80	21.00	5.65	30.00	13.00
	PCSC2DUR	(post-injury symptom duration)	24.20	22.00	6.76	41.00	16.00
	TOTDIFF	(difference in total symptoms)	0.00	0.00	0.00	0.00	0.00
	FRQDIFF	(difference in symptom frequency)	0.00	0.00	0.00	0.00	0.00
	INTDIFF	(difference in symptom intensity)	0.00	0.00	0.00	0.00	0.00
	DURDIFF	(difference in symptom duration)	0.00	0.00	0.00	0.00	0.00
	HEADACH1	(pre-injury headaches)	7.67	8.00	3.24	13.00	3.00
	DIZZINE1	(pre-injury dizziness)	4.73	3.00	2.63	10.00	3.00
	IRRITAB1	(pre-injury irritability)	4.87	3.00	2.97	11.00	3.00
	MEMORY1	(pre-injury memory problems)	6.27	7.00	2.79	12.00	3.00
	CONCENT1	(pre-injury concentration problems)	5.33	3.00	2.94	12.00	3.00
	FATIGUE1	(pre-injury fatigue)	7.93	8.00	3.17	13.00	3.00
	VISION1	(pre-injury vision problems)	5.20	3.00	3.82	13.00	3.00
	NOISIN1	(pre-injury noise intolerance)	8.93	9.00	3.59	14.00	3.00
	JUDGEME1	(pre-injury judgement problems)	5.80	6.00	2.54	9.00	3.00
	ANXIETY1	(pre-injury anxiety)	8.80	9.00	2.68	13.00	3.00
	HEADACH2	(post-injury headaches)	7.67	8.00	3.24	13.00	3.00
	DIZZINE2	(post-injury dizziness)	4.73	3.00	2.63	10.00	3.00
	IRRITAB2	(post-injury irritability)	4.87	3.00	2.97	11.00	3.00
	MEMORY2	(post-injury memory problems)	6.27	7.00	2.79	12.00	3.00
	CONCENT2	(post-injury concentration problems)	5.33	3.00	2.94	12.00	3.00
	FATIGUE2	(post-injury fatigue)	7.93	8.00	3.17	13.00	3.00
	VISION2	(post-injury vision problems)	5.20	3.00	3.82	13.00	3.00
	NOISIN2	(post-injury noise intolerance)	8.93	9.00	3.59	14.00	3.00
	JUDGEME2	(post-injury judgement problems)	5.80	6.00	2.54	9.00	3.00
	ANXIETY2	(post-injury anxiety)	8.80	9.00	2.68	13.00	3.00
	HEADADIF	(difference in headache incidence)	0.00	0.00	0.00	0.00	0.00
	DIZZIDIF	(difference in dizziness incidence)	0.00	0.00	0.00	0.00	0.00
	IRRITDIF	(difference in irritability)	0.00	0.00	0.00	0.00	0.00
	MEMDIF	(difference in memory problems)	0.00	0.00	0.00	0.00	0.00
	CONCDIF	(difference in concentration problems)	0.00	0.00	0.00	0.00	0.00
	FATIGDIF	(difference in fatigue)	0.00	0.00	0.00	0.00	0.00
	VISIODIF	(difference in vision problems)	0.00	0.00	0.00	0.00	0.00
	NOISEDIF	(difference in noise intolerance)	0.00	0.00	0.00	0.00	0.00
	JUDGDIFF	(difference in judgement problems)	0.00	0.00	0.00	0.00	0.00
	ANXDIFF	(difference in anxiety)	0.00	0.00	0.00	0.00	0.00
BVRT	BVCORR_C	(copy task correct)	7.20	8.00	2.70	10.00	0.00
	BVERR_C	(copy task errors)	3.20	2.00	3.32	12.00	0.00
	OMIS_C	(copy task omissions)	0.80	0.00	2.04	8.00	0.00
	DISTOR_C	(copy task distortions)	0.60	0.00	1.12	4.00	0.00
	PERSEV_C	(copy task perseverations)	0.00	0.00	0.00	0.00	0.00
	ROTAT_C	(copy task rotations)	0.33	0.00	0.72	2.00	0.00

5.3. Total Noninjured Group - continued

Test	Variable		Mean	Median	SD	Maximum	Minimum
	MISPLA_C	(copy task misplacements)	1.40	1.00	1.92	6.00	0.00
	SIZE_C	(copy task size errors)	0.07	0.00	0.26	1.00	0.00
	LEFT_C	(copy task left-sided errors)	0.93	0.00	1.28	4.00	0.00
	RIGHT_C	(copy task right-sided errors)	1.93	2.00	2.02	7.00	0.00
	BVCORR_D	(recall task correct)	5.40	5.00	2.59	10.00	1.00
	BVERR_D	(recall task errors)	6.33	6.00	4.22	16.00	0.00
	OMIS_D	(recall task omissions)	0.73	0.00	2.09	8.00	0.00
	DISTOR_D	(recall task distortions)	2.13	1.00	2.56	9.00	0.00
	PERSEV_D	(recall task perseverations)	1.00	1.00	1.41	5.00	0.00
	ROTAT_D	(recall task rotations)	1.13	1.00	1.13	3.00	0.00
	MISPLA_D	(recall task misplacements)	1.27	1.00	1.57	6.00	0.00
	SIZE_D	(recall task size errors)	0.00	0.00	0.00	0.00	0.00
	LEFT_D	(recall task left-sided errors)	2.33	2.00	1.95	7.00	0.00
	RIGHT_D	(recall task right-sided errors)	3.47	3.00	2.33	8.00	0.00
PASAT	PASAT1	(trial 1)	17.27	18.00	5.71	25.00	5.00
	PASAT2	(trial 2)	13.87	14.00	4.53	22.00	7.00
	PASAT3	(trial 3)	11.00	10.00	4.58	21.00	5.00
	PASAT4	(trial 4)	9.20	9.00	3.55	21.00	6.00
	PASATTOT	(total score)	51.33	50.00	16.11	89.00	32.00
STROOP	STROOP1	(trial 1: speed)	52.00	53.00	5.15	61.00	42.00
	STROOP2	(trial 2: speed)	83.00	84.00	9.40	95.00	66.00
	STROOP3	(trial 3: speed)	131.73	136.00	19.12	169.00	97.00
	STROOP4	(trial 4: speed)	136.93	125.00	25.07	197.00	113.00
	SUBT32	(speed difference: trials 3 and 2)	48.73	49.00	14.15	74.00	21.00
	SUBT42	(speed difference: trials 4 and 2)	53.93	45.00	25.86	113.00	28.00
	STR1ACC	(trial 1: accuracy)	99.00	100.00	1.85	100.00	93.00
	STR2ACC	(trial 2: accuracy)	97.33	98.00	2.77	100.00	90.00
	STR3ACC	(trial 3: accuracy)	96.07	98.00	4.04	100.00	87.00
	STR4ACC	(trial 4: accuracy)	96.40	97.00	1.96	100.00	93.00
REY 15-ITEM	FIFTEEN	(total correct)	13.00	13.00	1.31	15.00	10.00
RDS	RDSFORW	(total score forward)	5.40	5.00	0.83	7.00	4.00
	RDSBACK	(total score backwards)	4.00	4.00	1.00	6.00	3.00
	RD_TOT	(overall total)	9.40	9.00	1.35	12.00	8.00
	RDSDIFF	(forward minus backward score)	1.40	1.00	1.24	3.00	0.00

Table 6.
Test Results: Descriptive Statistics for Subgroups

6.1. Descriptive Statistics for Injured Subgroups

6.1.1. Measures of Central Tendency for Groups defined by Time Since Injury

Test	Variable	Recently Injured (n = 4)		Intermediate Inj (n = 8)		Long Term Injured (n = 4)	
		Mean	Median	Mean	Median	Mean	Median
PCL	PCL1	10.00	11.50	12.25	10.50	11.00	11.50
	PCL2	13.00	16.00	16.13	13.50	15.75	15.50
	PCLDIFF	3.00	2.50	3.88	2.00	4.75	4.50
	PCLPCS1	4.25	5.00	5.00	4.50	4.00	4.50
	PCLPCS2	6.25	7.50	7.00	5.50	8.50	9.00
	PCLPCDIF	1.50	1.00	2.00	1.00	4.50	4.50
PCSC	PCSC1TOT	59.50	63.00	49.75	53.00	46.25	46.50
	PCSC1FRQ	19.00	20.50	15.63	15.00	10.00	15.50
	PCSC1INT	18.50	19.50	16.38	15.50	13.75	14.00
	PCSC1DUR	22.00	23.00	17.75	20.00	16.50	17.00
	PCSC2TOT	64.75	67.00	72.25	66.00	80.25	75.00
	PSCS2FRQ	20.75	22.00	22.50	22.50	27.25	25.50
	PCSC2INT	19.25	20.00	24.63	22.50	25.00	23.00
	PCSC2DUR	24.75	24.00	25.13	22.50	28.00	26.50
	TOTDIFF	5.25	3.50	22.50	8.00	34.00	22.00
	FRQDIFF	1.75	1.00	6.88	2.50	11.25	6.50
	INTDIFF	0.75	0.50	8.25	3.00	11.25	8.00
	DURDIFF	2.75	1.50	7.38	2.50	11.50	8.00
	HEADACH1	5.00	5.00	5.63	3.00	6.75	7.50
	DIZZINE1	5.00	4.50	3.75	3.00	3.75	3.00
	IRRITAB1	6.50	6.50	5.25	3.00	5.00	5.00
	MEMORY1	4.75	4.50	4.25	3.00	3.75	3.00
	CONCENT1	6.50	6.50	4.50	3.00	3.00	3.00
	FATIGUE1	7.25	8.00	4.50	3.00	5.00	4.50
	VISION1	6.25	7.00	3.50	3.00	5.50	3.00
	NOISIN1	5.25	6.00	6.88	7.00	4.50	3.00
	JUDGEME1	6.50	6.50	5.75	6.50	4.75	4.50
	ANXIETY1	6.50	6.50	5.75	5.00	4.25	3.00
	HEADACH2	5.50	5.00	9.25	10.50	9.25	8.50
	DIZZINE2	6.00	6.50	6.00	5.00	7.25	6.00
	IRRITAB2	6.50	6.50	5.75	5.00	8.00	7.50
	MEMORY2	4.75	4.50	7.38	6.50	7.75	6.50
	CONCENT2	6.50	6.50	5.88	5.00	8.50	8.00
	FATIGUE2	8.00	8.00	8.00	9.00	9.00	8.50
	VISION2	7.00	7.00	6.63	5.00	6.00	3.00
	NOISIN2	6.75	6.00	8.75	9.00	8.50	8.50
	JUDGEME2	7.00	7.50	6.88	7.00	9.25	7.50
	ANXIETY2	6.75	7.00	7.75	8.50	6.75	5.50
	HEADADIF	0.50	0.00	3.63	0.50	2.50	3.00
	DIZZIDIF	1.00	0.00	2.25	0.50	3.50	1.50
	IRRITDIF	0.00	0.00	0.50	0.00	3.00	2.50
	MEMDIF	0.00	0.00	3.13	0.00	4.00	3.50
	CONCDIF	0.00	0.00	1.38	0.00	5.50	5.00
	FATIGDIF	0.75	0.00	3.50	0.00	4.00	3.50
	VISIODIF	0.75	0.00	3.13	0.00	0.50	0.00
	NOISEDIF	1.50	1.50	1.88	0.00	4.00	2.50
	JUDGDIFF	0.50	0.00	1.13	0.00	4.50	4.00
	ANXDIFF	0.25	0.00	2.00	0.00	2.50	2.50

6.1.1. Time Since Injury - continued

Test	Variable	Recently Injured (n = 4) Mean	Recently Injured (n = 4) Median	Intermediate Inj (n = 8) Mean	Intermediate Inj (n = 8) Median	Long Term Injured (n = 4) Mean	Long Term Injured (n = 4) Median
BVRT	BVCORR_C	7.25	8.00	8.75	9.00	9.25	10.00
	BVERR_C	2.75	2.00	1.25	1.00	0.75	0.00
	OMIS_C	0.50	0.00	0.13	0.00	0.00	0.00
	DISTOR_C	0.25	0.00	0.13	0.00	0.25	0.00
	PERSEV_C	0.00	0.00	0.00	0.00	0.00	0.00
	ROTAT_C	0.00	0.00	0.00	0.00	0.25	0.00
	MISPLA_C	2.00	0.50	0.88	1.00	0.00	0.00
	SIZE_C	0.00	0.00	0.00	0.00	0.25	0.00
	LEFT_C	0.75	0.00	0.25	0.00	0.75	0.00
	RIGHT_C	2.00	2.00	0.88	1.00	0.00	0.00
	BVCORR_D	5.50	4.50	5.00	5.00	6.75	6.50
	BVERR_D	7.25	8.00	7.00	7.50	5.25	4.50
	OMIS_D	0.25	0.00	0.38	0.00	0.25	0.00
	DISTOR_D	2.25	2.00	1.63	1.50	2.75	2.50
	PERSEV_D	1.50	1.00	1.63	1.50	0.25	0.00
	ROTAT_D	1.75	2.00	1.25	1.50	1.25	1.00
	MISPLA_D	1.25	0.00	2.00	2.00	0.25	0.00
	SIZE_D	0.25	0.00	0.00	0.00	0.50	0.00
	LEFT_D	1.25	0.50	2.25	2.00	3.00	2.50
	RIGHT_D	6.00	6.00	3.63	3.50	1.75	1.50
PASAT	PASAT1	14.25	14.00	11.25	9.50	15.00	15.00
	PASAT2	14.25	14.00	11.25	9.50	15.00	15.00
	PASAT3	12.75	13.00	9.88	8.50	11.00	10.50
	PASAT4	7.75	8.00	7.88	6.50	9.00	9.00
	PASATTOT	49.00	47.50	40.25	33.00	50.00	48.00
STROOP	STROOP1	59.00	59.00	68.50	56.00	61.00	61.50
	STROOP2	86.75	86.50	103.88	94.00	84.00	84.00
	STROOP3	141.75	141.00	157.13	146.00	138.50	140.50
	STROOP4	136.00	141.00	168.25	169.50	134.75	133.50
	SUBT32	55.00	54.00	53.25	52.00	54.50	54.00
	SUBT42	49.25	54.50	64.38	62.00	50.75	49.50
	STR1ACC	99.25	99.50	98.25	99.50	99.50	100.00
	STR2ACC	98.50	98.50	95.00	96.00	99.00	99.50
	STR3ACC	96.75	96.50	96.50	96.00	96.00	95.00
	STR4ACC	96.75	96.50	95.25	97.50	97.50	98.00
REY 15-ITEM	FIFTEEN	14.50	15.00	13.38	13.50	12.75	13.50
RDS	RDSFORW	5.75	5.50	5.25	5.00	5.25	5.50
	RDSBACK	3.75	3.50	3.63	4.00	3.50	3.50
	RDSTOT	9.50	9.50	8.88	9.00	8.75	9.00
	RDSDIFF	2.00	2.50	1.63	1.50	1.75	2.00

6.1.2. Measures of Central Tendency for Groups defined by Circumstances of Injury

Test	Variable	Sports injury (n = 4) Mean	Sports injury (n = 4) Median	Violent injury (n = 4) Mean	Violent injury (n = 4) Median
PCL	PCL1	8.50	8.50	16.50	18.50
	PCL2	9.75	9.00	20.50	21.00
	PCLDIFF	1.25	1.50	4.00	3.00
	PCLPCS1	3.25	3.00	7.75	9.50
	PCLPCS2	3.75	3.50	10.00	10.50
	PCLPCDIF	0.50	0.50	2.25	2.00
PCSC	PCSC1TOT	51.25	53.00	55.50	59.00
	PCSC1FRQ	16.00	15.00	18.00	19.00
	PCSC1INT	16.25	15.50	18.75	20.00
	PCSC1DUR	19.00	20.00	18.75	20.00
	PCSC2TOT	56.25	55.50	76.25	74.00
	PCSC2FRQ	17.25	16.00	23.75	24.50
	PCSC2INT	17.75	17.50	26.00	26.00
	PCSC2DUR	20.25	21.00	26.50	23.50
	TOTDIFF	4.00	2.50	20.75	19.50
	FRQDIFF	1.25	1.00	5.75	4.00
	INTDIFF	1.50	0.50	7.25	6.00
	DURDIFF	1.25	1.00	7.75	6.00
	HEADACH1	6.50	6.00	4.75	3.00
	DIZZINE1	3.75	3.00	4.50	4.50
	IRRITAB1	5.75	5.00	5.50	4.50
	MEMORY1	3.00	3.00	6.50	6.50
	CONCENT1	4.00	3.00	5.75	6.00
	FATIGUE1	4.00	3.00	5.75	4.50
	VISION1	3.00	3.00	5.00	5.00
	NOISIN1	8.25	7.50	6.25	6.00
	JUDGEME1	6.25	7.00	6.00	6.00
	ANXIETY1	6.75	7.50	5.50	4.50
	HEADACH2	8.25	9.50	7.50	7.00
	DIZZINE2	4.75	3.00	6.75	6.50
	IRRITAB2	5.75	5.00	6.50	7.00
	MEMORY2	3.00	3.00	10.25	10.00
	CONCENT2	4.00	3.00	7.00	7.00
	FATIGUE2	4.00	3.00	10.50	11.50
	VISION2	4.25	3.00	7.00	7.00
	NOISIN2	8.25	7.50	7.50	8.00
	JUDGEME2	6.25	7.00	6.00	6.00
	ANXIETY2	6.75	7.50	7.25	8.00
	HEADADIF	1.75	0.00	2.75	0.50
	DIZZIDIF	1.00	0.00	2.25	0.50
	IRRITDIF	0.00	0.00	1.00	0.00
	MEMDIF	0.00	0.00	3.75	2.00
	CONCDIF	0.00	0.00	1.25	0.00
	FATIGDIF	0.00	0.00	4.75	4.50
	VISIODIF	1.25	0.00	2.00	0.00
	NOISEDIF	0.00	0.00	1.25	0.00
	JUDGDIFF	0.00	0.00	0.00	0.00
	ANXDIFF	0.00	0.00	1.75	0.00

6.1.2. Circumstances of Injury - continued

Test	Variable	Sports injury (n = 4) Mean	Sports injury (n = 4) Median	Violent injury (n = 4) Mean	Violent injury (n = 4) Median
BVRT	BVCORR_C	9.25	9.50	8.75	9.00
	BVERR_C	0.75	0.50	1.25	1.00
	OMIS_C	0.00	0.00	0.25	0.00
	DISTOR_C	0.00	0.00	0.00	0.00
	PERSEV_C	0.00	0.00	0.00	0.00
	ROTAT_C	0.00	0.00	0.00	0.00
	MISPLA_C	0.75	0.50	0.75	0.50
	SIZE_C	0.00	0.00	0.00	0.00
	LEFT_C	0.25	0.00	0.25	0.00
	RIGHT_C	0.50	0.50	1.00	0.50
	BVCORR_D	6.25	5.50	4.00	3.00
	BVERR_D	5.50	6.00	8.25	9.50
	OMIS_D	0.00	0.00	0.75	1.00
	DISTOR_D	1.50	1.50	2.50	2.50
	PERSEV_D	1.00	0.50	2.00	2.00
	ROTAT_D	1.25	1.00	1.50	1.50
	MISPLA_D	1.75	2.00	1.25	1.00
	SIZE_D	0.00	0.00	0.25	0.00
	LEFT_D	1.75	2.00	3.00	3.00
	RIGHT_D	3.00	2.50	4.25	4.50
PASAT	PASAT1	13.50	11.50	11.00	10.50
	PASAT2	13.50	11.50	11.00	10.50
	PASAT3	12.50	13.00	10.00	9.50
	PASAT4	8.50	8.50	7.75	7.50
	PASATTOT	48.00	44.50	39.75	38.50
STROOP	STROOP1	54.00	54.00	61.75	55.50
	STROOP2	92.50	89.50	100.50	92.00
	STROOP3	138.75	137.00	150.50	142.00
	STROOP4	147.50	143.00	173.50	166.00
	SUBT32	46.25	47.50	50.00	50.00
	SUBT42	55.00	53.50	73.00	81.50
	STR1ACC	99.75	100.00	98.25	99.00
	STR2ACC	97.00	97.50	94.00	95.50
	STR3ACC	97.50	97.50	95.75	96.50
	STR4ACC	93.00	94.00	97.50	97.50
REY 15-ITEM	FIFTEEN	14.00	14.00	13.50	13.50
RDS	RDSFORW	5.25	5.00	5.00	5.00
	RDSBACK	3.75	4.00	3.25	3.00
	RDSTOT	9.00	9.00	8.25	8.00
	RDSDIFF	1.50	0.50	1.75	2.00

6.1.3. Measures of Central Tendency for Groups defined by Gender

Test	Variable	Male injured (n = 12) Mean	Male injured (n = 12) Median	Female injured (n = 4) Mean	Female injured (n = 4) Median
PCL	PCL1	10.08	10.00	15.25	16.00
	PCL2	12.83	11.50	22.50	25.00
	PCLDIFF	2.75	2.00	7.25	8.00
	PCLPCS1	4.42	4.00	5.50	5.00
	PCLPCS2	5.83	5.50	11.25	13.00
	PCLPCDIF	1.42	1.00	5.75	6.00
PCSC	PCSC1TOT	52.25	53.00	48.50	52.50
	PCSC1FRQ	16.75	16.00	16.00	16.00
	PCSC1INT	16.58	15.50	15.25	15.00
	PCSC1DUR	18.92	19.00	17.25	19.00
	PCSC2TOT	64.17	58.50	97.00	94.00
	PSCS2FRQ	20.58	20.50	31.25	28.00
	PCSC2INT	20.50	19.00	32.00	30.50
	PCSC2DUR	23.08	21.50	33.75	35.50
	TOTDIFF	11.92	6.00	48.50	41.50
	FRQDIFF	3.83	2.00	15.25	12.00
	INTDIFF	3.92	1.00	16.75	14.50
	DURDIFF	4.17	2.50	16.50	15.50
	HEADACH1	5.25	3.00	7.25	8.00
	DIZZINE1	3.92	3.00	4.50	4.50
	IRRITAB1	5.42	4.50	5.75	5.00
	MEMORY1	4.17	3.00	4.50	4.50
	CONCENT1	4.92	3.00	3.75	3.00
	FATIGUE1	6.08	6.00	3.00	3.00
	VISION1	4.42	3.00	5.50	3.00
	NOISIN1	6.08	6.00	5.25	4.50
	JUDGEME1	6.00	6.50	4.75	4.50
	ANXIETY1	6.00	6.50	4.25	3.00
	HEADACH2	7.25	7.50	11.50	12.00
	DIZZINE2	5.25	4.50	9.50	9.00
	IRRITAB2	5.50	4.50	9.50	8.50
	MEMORY2	5.00	3.00	12.25	12.00
	CONCENT2	5.92	6.50	9.00	9.00
	FATIGUE2	7.17	7.00	11.50	12.00
	VISION2	6.08	5.00	8.00	7.00
	NOISIN2	7.75	7.00	9.50	10.50
	JUDGEME2	7.42	7.50	7.75	6.50
	ANXIETY2	6.83	7.00	8.50	9.00
	HEADADIF	2.00	0.00	4.25	3.00
	DIZZIDIF	1.33	0.00	5.00	4.50
	IRRITDIF	0.08	0.00	3.75	4.50
	MEMDIF	0.83	0.00	7.75	8.00
	CONCDIF	1.00	0.00	5.25	4.50
	FATIGDIF	1.08	0.00	8.50	9.00
	VISIODIF	1.67	0.00	2.50	4.00
	NOISEDIF	1.67	0.00	4.25	3.00
	JUDGDIFF	1.42	0.00	3.00	2.00
	ANXDIFF	0.83	0.00	4.25	5.00

6.1.3. Gender - continued

Test	Variable	Male injured (n = 12) Mean	Median	Female injured (n = 4) Mean	Median
BVRT	BVCORR_C	8.33	9.00	9.00	9.50
	BVERR_C	1.67	1.00	1.00	0.50
	OMIS_C	0.17	0.00	0.25	0.00
	DISTOR_C	0.25	0.00	0.00	0.00
	PERSEV_C	0.00	0.00	0.00	0.00
	ROTAT_C	0.08	0.00	0.00	0.00
	MISPLA_C	1.08	0.50	0.50	0.00
	SIZE_C	0.08	0.00	0.00	0.00
	LEFT_C	0.58	0.00	0.25	0.00
	RIGHT_C	1.00	1.00	0.75	0.00
	BVCORR_D	5.83	5.00	4.75	4.00
	BVERR_D	6.58	6.00	6.75	7.00
	OMIS_D	0.17	0.00	0.75	1.00
	DISTOR_D	1.92	2.00	2.50	2.50
	PERSEV_D	1.08	1.00	1.75	2.00
	ROTAT_D	1.58	1.50	0.75	0.50
	MISPLA_D	1.50	1.00	1.00	0.50
	SIZE_D	0.25	0.00	0.00	0.00
	LEFT_D	1.92	1.50	3.00	3.00
	RIGHT_D	4.08	3.00	2.75	2.50
PASAT	PASAT1	13.00	12.00	12.75	13.50
	PASAT2	13.00	12.00	12.75	13.50
	PASAT3	10.50	9.00	12.00	12.50
	PASAT4	7.83	7.00	9.00	10.00
	PASATTOT	44.33	41.00	46.50	49.50
STROOP	STROOP1	65.83	58.50	59.50	53.50
	STROOP2	96.42	91.00	89.25	76.00
	STROOP3	152.33	146.00	137.50	118.00
	STROOP4	148.92	145.00	160.50	148.00
	SUBT32	55.92	55.00	48.25	46.50
	SUBT42	52.50	55.00	71.25	74.50
	STR1ACC	98.83	99.50	98.75	100.00
	STR2ACC	97.83	98.00	94.00	95.50
	STR3ACC	96.58	96.00	96.00	97.00
	STR4ACC	95.92	97.00	97.00	98.00
REY 15-ITEM	FIFTEEN	13.75	14.50	12.75	13.50
RDS	RDSFORW	5.33	5.00	5.50	5.50
	RDSBACK	3.58	3.50	3.75	4.00
	RDSTOT	8.92	9.00	9.25	9.50
	RDSDIFF	1.75	2.00	1.75	2.00

6.1.4. Measures of Central Tendency for Groups defined by Region

Test	Variable	Gauteng injured (n = 10) Mean	Gauteng injured (n = 10) Median	Mpumalanga inj (n = 6) Mean	Mpumalanga inj (n = 6) Median
PCL	PCL1	12.50	12.50	9.50	10.00
	PCL2	16.50	19.50	13.17	13.50
	PCLDIFF	4.00	2.00	3.67	2.50
	PCLPCS1	5.10	5.00	4.00	3.00
	PCLPCS2	8.20	9.00	5.50	5.50
	PCLPCDIF	3.10	1.00	1.50	1.00
PCSC	PCSC1TOT	51.80	52.50	50.50	53.00
	PCSC1FRQ	16.60	16.00	16.50	17.00
	PCSC1INT	16.50	15.00	15.83	15.50
	PCSC1DUR	18.70	19.00	18.17	19.00
	PCSC2TOT	78.10	74.50	62.83	58.50
	PSCS2FRQ	24.80	23.50	20.67	21.00
	PCSC2INT	25.50	24.00	19.83	19.50
	PCSC2DUR	27.80	27.00	22.33	21.00
	TOTDIFF	26.30	12.50	12.33	8.00
	FRQDIFF	8.20	3.50	4.17	2.50
	INTDIFF	9.00	3.50	4.00	1.00
	DURDIFF	9.10	5.50	4.17	2.50
	HEADACH1	6.40	7.00	4.67	3.00
	DIZZINE1	3.60	3.00	4.83	4.50
	IRRITAB1	5.60	5.00	5.33	4.50
	MEMORY1	4.60	3.00	3.67	3.00
	CONCENT1	4.90	3.00	4.17	3.00
	FATIGUE1	5.30	3.00	5.33	4.50
	VISION1	4.60	3.00	4.50	3.00
	NOISIN1	5.30	4.50	6.83	6.50
	JUDGEME1	6.00	6.50	5.17	5.00
	ANXIETY1	5.30	4.50	6.00	6.50
	HEADACH2	8.60	8.50	7.83	9.00
	DIZZINE2	6.00	6.00	6.83	7.00
	IRRITAB2	6.70	7.00	6.17	6.50
	MEMORY2	7.60	8.00	5.50	3.00
	CONCENT2	8.20	8.50	4.17	3.00
	FATIGUE2	9.00	9.50	7.00	6.50
	VISION2	7.00	5.00	5.83	5.00
	NOISIN2	8.70	8.50	7.33	7.50
	JUDGEME2	8.30	7.50	6.17	6.50
	ANXIETY2	8.00	7.50	6.00	6.50
	HEADADIF	2.20	0.50	3.17	1.00
	DIZZIDIF	2.40	0.50	2.00	0.00
	IRRITDIF	1.10	0.00	0.83	0.00
	MEMDIF	3.00	0.00	1.83	0.00
	CONCDIF	3.30	2.00	0.00	0.00
	FATIGDIF	3.70	2.00	1.67	0.00
	VISIODIF	2.20	0.00	1.33	0.00
	NOISEDIF	3.40	2.00	0.50	0.00
	JUDGDIFF	2.30	1.00	1.00	0.00
	ANXDIFF	2.70	0.50	0.00	0.00

6.1.4. Region - continued

Test	Variable	Gauteng injured (n = 10) Mean	Gauteng injured (n = 10) Median	Mpumalanga inj (n = 6) Mean	Mpumalanga inj (n = 6) Median
BVRT	BVCORR_C	8.10	8.50	9.17	9.50
	BVERR_C	1.90	1.50	0.83	0.50
	OMIS_C	0.10	0.00	0.33	0.00
	DISTOR_C	0.20	0.00	0.17	0.00
	PERSEV_C	0.00	0.00	0.00	0.00
	ROTAT_C	0.10	0.00	0.00	0.00
	MISPLA_C	1.40	1.00	0.17	0.00
	SIZE_C	0.10	0.00	0.00	0.00
	LEFT_C	0.70	0.00	0.17	0.00
	RIGHT_C	1.10	1.00	0.67	0.00
	BVCORR_D	5.40	5.00	5.83	5.00
	BVERR_D	7.00	5.50	6.00	7.50
	OMIS_D	0.30	0.00	0.33	0.00
	DISTOR_D	2.40	2.50	1.50	1.00
	PERSEV_D	1.20	1.00	1.33	1.00
	ROTAT_D	1.40	1.00	1.33	1.00
	MISPLA_D	1.40	1.00	1.33	1.50
	SIZE_D	0.20	0.00	0.17	0.00
	LEFT_D	2.50	2.00	1.67	2.00
	RIGHT_D	3.80	2.50	3.67	3.50
PASAT	PASAT1	13.20	13.00	12.50	10.50
	PASAT2	13.20	13.00	12.50	10.50
	PASAT3	11.30	11.50	10.17	8.50
	PASAT4	8.60	9.00	7.33	6.50
	PASATTOT	46.30	47.50	42.50	35.00
STROOP	STROOP1	66.30	58.50	60.83	55.00
	STROOP2	91.60	86.00	99.67	91.00
	STROOP3	143.10	134.00	157.83	159.50
	STROOP4	143.70	136.50	165.33	151.50
	SUBT32	51.50	51.00	58.17	62.00
	SUBT42	52.10	49.50	65.67	60.50
	STR1ACC	98.90	100.00	98.67	99.50
	STR2ACC	97.90	98.00	95.17	96.50
	STR3ACC	97.10	96.00	95.33	95.50
	STR4ACC	97.50	98.00	94.00	96.50
REY 15-ITEM	FIFTEEN	13.50	15.00	13.50	13.00
RDS	RDSFORW	5.30	5.00	5.50	5.00
	RDSBACK	3.80	4.00	3.33	3.00
	RDSTOT	9.10	9.50	8.83	9.00
	RDSDIFF	1.50	2.00	2.17	2.00

6.1.4. Measures of Central Tendency for Groups defined by Blame for another Party, or Lack of Blame

Test	Variable	Blame another (n = 6) Mean	Blame another (n = 6) Median	No blame (n = 10) Mean	No blame (n = 10) Median
PCL	PCL1	12.33	13.00	10.80	10.00
	PCL2	18.33	21.00	13.40	11.50
	PCLDIFF	6.00	5.50	2.60	2.00
	PCLPCS1	5.17	5.00	4.40	4.00
	PCLPCS2	8.33	10.50	6.50	5.50
	PCLPCDIF	3.17	2.00	2.10	1.00
PCSC	PCSC1TOT	48.17	48.00	53.20	53.00
	PCSC1FRQ	16.50	16.50	16.60	16.00
	PCSC1INT	15.33	14.00	16.80	15.50
	PCSC1DUR	16.33	16.00	19.80	20.00
	PCSC2TOT	75.33	74.00	70.60	59.00
	PCSC2FRQ	25.33	24.50	22.00	20.50
	PCSC2INT	25.67	26.00	22.00	19.50
	PCSC2DUR	24.33	23.50	26.60	22.50
	TOTDIFF	27.17	19.00	17.40	11.50
	FRQDIFF	8.83	5.50	5.40	3.00
	INTDIFF	10.33	7.00	5.20	2.00
	DURDIFF	8.00	6.50	6.80	4.00
	HEADACH1	4.00	3.00	6.80	7.00
	DIZZINE1	4.00	3.00	4.10	3.00
	IRRITAB1	4.17	3.00	6.30	7.00
	MEMORY1	4.83	3.00	3.90	3.00
	CONCENT1	4.33	3.00	4.80	3.00
	FATIGUE1	4.83	3.00	5.60	4.50
	VISION1	6.00	5.00	3.90	3.00
	NOISEIN1	5.67	4.50	6.00	6.00
	JUDGEME1	5.17	4.50	6.00	6.50
	ANXIETY1	5.17	4.50	5.80	7.00
	HEADACH2	8.17	8.00	8.40	9.00
	DIZZINE2	6.83	6.50	6.00	4.50
	IRRITAB2	6.17	4.50	6.70	7.00
	MEMORY2	9.50	10.00	5.20	3.00
	CONCENT2	6.00	6.50	7.10	7.00
	FATIGUE2	10.00	11.50	7.20	7.50
	VISION2	6.33	5.00	6.70	5.00
	NOISIN2	8.00	8.00	8.30	7.50
	JUDGEME2	6.67	6.50	8.00	7.50
	ANXIETY2	7.67	7.50	7.00	7.00
	HEADADIF	4.17	2.00	1.60	0.50
	DIZZDIF	2.83	2.00	1.90	0.00
	IRRITDIF	2.00	0.00	0.40	0.00
	MEMDIF	4.67	3.50	1.30	0.00
	CONCDIF	1.67	0.00	2.30	0.00
	FATIGDIF	5.17	6.00	1.50	0.00
	VISIODIF	0.33	0.00	2.80	0.00
	NOISEDIF	2.33	0.50	2.30	0.00
	JUDGDIFF	1.50	0.00	2.00	0.00
	ANXDIFF	2.50	0.50	1.20	0.00

6.1.4. Blame - continued

Test	Variable	Blame another (n = 6) Mean	Blame another (n = 6) Median	No blame (n = 10) Mean	No blame (n = 10) Median
BVRT	BVRCOR_C	9.17	9.00	8.10	8.50
	BVRERR_C	0.83	1.00	1.90	1.50
	OMIS_C	0.00	0.00	0.30	0.00
	DISTOR_C	0.17	0.00	0.20	0.00
	PERSEV_C	0.00	0.00	0.00	0.00
	ROTAT_C	0.00	0.00	0.10	0.00
	MISPL	0.50	0.50	1.20	0.00
	SIZE_	0.00	0.00	0.10	0.00
	LEFT_C	0.17	0.00	0.70	0.00
	RIGHT_C	0.50	0.50	1.20	0.50
	BVRCOR_D	5.00	4.00	5.90	5.00
	BVRERR_D	6.83	6.50	6.50	6.50
	OMIS_D	0.50	0.50	0.20	0.00
	DISTOR_D	1.83	1.50	2.20	2.50
	PERSEV_D	1.33	1.00	1.20	0.50
	ROTAT_D	1.50	1.50	1.30	1.00
	MISPLA_D	1.33	0.50	1.40	1.00
	SIZE_D	0.17	0.00	0.20	0.00
	LEFT_D	1.83	1.50	2.40	2.00
	RIGHT_D	4.17	4.50	3.50	2.50
PASAT	PASAT1	12.50	12.00	13.20	12.50
	PASAT2	12.50	12.00	13.20	12.50
	PASAT3	11.33	11.00	10.60	10.50
	PASAT4	8.17	8.00	8.10	8.00
	PASATTOT	44.50	42.00	45.10	44.50
STROOP	STROOP1	75.17	59.50	57.70	56.00
	STROOP2	103.83	92.00	89.10	86.50
	STROOP3	158.67	142.00	142.60	145.00
	STROOP4	162.33	145.00	145.50	147.50
	SUBT32	54.83	50.00	53.50	55.00
	SUBT42	58.50	57.50	56.40	53.50
	STR1ACC	97.67	98.50	99.50	100.00
	STR2ACC	96.33	98.50	97.20	97.00
	STR3ACC	96.50	96.50	96.40	95.50
	STR4ACC	97.50	97.50	95.40	97.00
REY 15-ITEM	FIFTEEN	13.17	13.50	13.70	15.00
RDS	RDSFORW	5.33	5.00	5.40	5.00
	RDSBACK	3.67	3.50	3.60	4.00
	RDSTOT	9.00	9.00	9.00	9.00
	RDSDIFF	1.67	2.00	1.80	1.50

6.2. Descriptive Statistics for Noninjured Subgroups

6.2.1. Measures of Central Tendency for Groups defined by Region

Test	Variable	Gauteng non (n = 3) Mean	Gauteng non (n = 3) Median	Mpumalanga non (n = 10) Mean	Mpumalanga non (n = 10) Median
PCL	PCL1	9.80	10.00	13.20	12.00
	PCL2	9.80	10.00	13.20	12.00
	PCLDIFF	0.00	0.00	0.00	0.00
	PCLPCS1	5.00	6.00	6.70	6.00
	PCLPCS2	5.00	6.00	6.70	6.00
	PCLPCDIF	0.00	0.00	0.00	0.00
PCSC	PCSC1TOT	63.80	60.00	66.40	60.00
	PCSC1FRQ	17.00	16.00	20.80	19.50
	PCSC1INT	22.40	22.00	21.50	18.50
	PCSC1DUR	24.40	22.00	24.10	22.00
	PCSC2TOT	63.80	60.00	66.40	60.00
	PCSC2FRQ	17.00	16.00	20.80	19.50
	PCSC2INT	22.40	22.00	21.50	18.50
	PCSC2DUR	24.40	22.00	24.10	22.00
	TOTDIFF	0.00	0.00	0.00	0.00
	FRQDIFF	0.00	0.00	0.00	0.00
	INTDIFF	0.00	0.00	0.00	0.00
	DURDIFF	0.00	0.00	0.00	0.00
	HEADACH1	7.80	8.00	7.50	8.50
	DIZZINE1	4.80	3.00	4.70	3.00
	IRRITAB1	4.60	3.00	5.00	3.00
	MEMORY1	3.60	3.00	7.60	7.50
	CONCENT1	6.40	7.00	4.80	3.00
	FATIGUE1	6.80	7.00	8.50	9.00
	VISION1	6.60	3.00	4.50	3.00
	NOISEIN1	8.00	10.00	9.40	9.00
	JUDGEME1	5.60	6.00	5.90	6.50
	ANXIETY1	9.60	10.00	8.40	9.00
	HEADACH2	.0	8.00	7.60	8.50
	DIZZINE2	4.80	3.00	4.70	3.00
	IRRITAB2	4.60	3.00	5.00	3.00
	MEMORY2	3.60	3.00	7.60	7.50
	CONCENT2	6.40	7.00	4.80	3.00
	FATIGUE2	6.80	7.00	8.50	9.00
	VISION2	6.60	3.00	4.50	3.00
	NOISIN2	8.00	10.00	9.40	9.00
	JUDGEME2	5.60	6.00	5.90	6.50
	ANXIETY2	9.60	10.00	8.40	9.00
	HEADADIF	0.00	0.00	0.00	0.00
	DIZZDIF	0.00	0.00	0.00	0.00
	IRRITDIF	0.00	0.00	0.00	0.00
	MEMDIF	0.00	0.00	0.00	0.00
	CONCDIF	0.00	0.00	0.00	0.00
	FATIGDIF	0.00	0.00	0.00	0.00
	VISIODIF	0.00	0.00	0.00	0.00
	NOISEDIF	0.00	0.00	0.00	0.00
	JUDGDIFF	0.00	0.00	0.00	0.00
	ANXDIFF	0.00	0.00	0.00	0.00

6.2.1 Region - continued

Test	Variable	Gauteng non (n = 5) Mean	Gauteng non (n = 5) Median	Mpumalanga non (n = 10) Mean	Mpumalanga non (n = 10) Median
BVRT	BVRCOR_C	7.60	8.00	7.00	8.00
	BVRERR_C	2.40	2.00	3.60	2.00
	OMIS_C	0.40	0.00	1.00	0.00
	DISTOR_C	0.60	1.00	0.60	0.00
	PERSEV_C	0.00	0.00	0.00	0.00
	ROTAT_C	0.00	0.00	0.50	0.00
	MISPLA_C	1.40	0.00	1.40	1.00
	SIZE_C	0.00	0.00	0.10	0.00
	LEFT_C	0.80	0.00	1.00	0.50
	RIGHT_C	1.00	1.00	2.40	2.00
	BVRCOR_D	4.80	5.00	5.70	6.00
	BVRERR_D	6.80	7.00	6.10	5.00
	OMIS_D	0.00	0.00	1.10	0.00
	DISTOR_D	2.80	2.00	1.80	1.00
	PERSEV_D	0.20	0.00	1.40	1.00
	ROTAT_D	1.4[illegible]	1.00	1.00	1.00
	MISPLA_D	2[illegible]	2.00	0.70	0.50
	SIZE_D	[illegible]	0.00	0.00	0.00
	LEFT_D	2.4[illegible]	2.00	2.30	2.00
	RIGHT_D	3.4[illegible]	3.00	3.50	3.00
PASAT	PASAT1	18.20	22.00	16.80	17.50
	PASAT2	15.80	17.00	12.90	13.50
	PASAT3	14.[illegible]0	16.00	9.20	8.50
	PASAT4	10.60	9.00	8.50	9.00
	PASATTOT	59.20	65.00	47.40	48.50
STROOP	STROOP1	53.80	54.00	51.10	49.50
	STROOP2	77.80	76.00	85.60	84.50
	STROOP3	124.40	125.00	135.40	137.50
	STROOP4	140.00	132.00	135.40	124.00
	SUBT32	46.60	49.00	49.80	52.00
	SUBT42	62.20	47.00	49.80	44.50
	STR1ACC	97.60	98.00	99.70	100.00
	STR2ACC	96.40	97.00	97.80	98.00
	STR3ACC	96.60	99.00	95.80	97.00
	STR4ACC	97.00	97.00	96.10	96.00
REY 15-ITEM	FIFTEEN	12.60	13.00	13.20	13.00
RDS	RDSFORW	6.00	6.00	5.10	5.00
	RDSBACK	3.60	3.00	4.20	4.00
	RDSTOT	9.60	9.00	9.30	9.00
	RDSDIFF	2.40	3.00	0.90	0.50

6.2.1. Measures of Central Tendency for Groups defined by Gender

Test	Variable	Male noninjured (n = 9) Mean	Male noninjured (n = 9) Median	Female noninjured (n = 6) Mean	Female noninjured (n = 6) Median
PCL	PCL1	12.89	12.00	10.83	11.00
	PCL2	12.89	12.00	10.83	11.00
	PCLDIFF	0.00	0.00	0.00	0.00
	PCLPCS1	6.78	6.00	5.17	6.00
	PCLPCS2	6.78	6.00	5.17	6.00
	PCLPCDIF	0.00	0.00	0.00	0.00
PCSC	PCSC1TOT	63.11	59.00	69.17	72.00
	PCSC1FRQ	19.44	17.00	19.67	20.00
	PCSC1INT	20.11	17.00	24.33	26.00
	PCSC1DUR	23.56	22.00	25.17	24.50
	PCSC2TOT	63.11	59.00	69.17	72.00
	PCSC2FRQ	19.44	17.00	19.67	20.00
	PCSC2INT	20.11	17.00	24.33	26.00
	PCSC2DUR	23.56	22.00	25.17	24.50
	TOTDIFF	0.00	0.00	0.00	0.00
	FRQDIFF	0.00	0.00	0.00	0.00
	INTDIFF	0.00	0.00	0.00	0.00
	DURDIFF	0.00	0.00	0.00	0.00
	HEADACH1	7.44	8.00	8.00	8.50
	DIZZINE1	4.44	3.00	5.17	5.00
	IRRITAB1	4.78	3.00	5.00	3.00
	MEMORY1	6.67	7.00	5.67	4.50
	CONCENT1	5.11	3.00	5.67	7.00
	FATIGUE1	7.56	9.00	8.50	7.50
	VISION1	4.67	3.00	6.00	3.00
	NOISEIN1	9.22	9.00	8.50	9.50
	JUDGEME1	5.22	3.00	6.67	7.00
	ANXIETY1	8.00	9.00	10.00	10.00
	HEADACH2	7.44	8.00	8.00	8.50
	DIZZINE2	4.44	3.00	5.17	5.00
	IRRITAB2	4.78	3.00	5.00	3.00
	MEMORY2	6.67	7.00	5.67	4.50
	CONCENT2	5.11	3.00	5.67	7.00
	FATIGUE2	7.56	9.00	8.50	7.50
	VISION2	4.67	3.00	6.00	3.00
	NOISIN2	9.22	9.00	8.50	9.50
	JUDGEME2	5.22	3.00	6.67	7.00
	ANXIETY2	8.00	9.00	10.00	10.00
	HEADADIF	0.00	0.00	0.00	0.00
	DIZZDIF	0.00	0.00	0.00	0.00
	IRRITDIF	0.00	0.00	0.00	0.00
	MEMDIF	0.00	0.00	0.00	0.00
	CONCDIF	0.00	0.00	0.00	0.00
	FATIGDIF	0.00	0.00	0.00	0.00
	VISIODIF	0.00	0.00	0.00	0.00
	NOISEDIF	0.00	0.00	0.00	0.00
	JUDGDIFF	0.00	0.00	0.00	0.00
	ANXDIFF	0.00	0.00	0.00	0.00

6.2.1. *Gender - continued*

Test	Variable	Male noninjured (n = 9) Mean	Median	Female noninjured (n = 6) Mean	Median
BVRT	BVRCOR_C	7.78	8.00	6.33	7.00
	BVRERR_C	2.67	2.00	4.00	3.00
	OMIS_C	0.33	0.00	1.50	0.00
	DISTOR_C	0.33	0.00	1.00	0.50
	PERSEV_C	0.00	0.00	0.00	0.00
	ROTAT_C	0.56	0.00	0.00	0.00
	MISPLA_C	1.33	1.00	1.50	1.00
	SIZE_C	0.11	0.00	0.00	0.00
	LEFT_C	0.67	0.00	1.33	0.50
	RIGHT_C	1.89	1.00	2.00	2.00
	BVRCOR_D	5.78	5.00	4.83	5.00
	BVRERR_D	6.56	6.00	6.00	6.50
	OMIS_D	0.22	0.00	1.50	0.00
	DISTOR_D	2.44	1.00	1.67	1.50
	PERSEV_D	1.44	1.00	0.33	0.00
	ROTAT_D	1.22	1.00	1.00	1.00
	MISPLA_D	1.11	1.00	1.50	0.50
	SIZE_D	.00	0.00	0.00	0.00
	LEFT_D	2.44	2.00	2.17	2.00
	RIGHT_D	3.44	3.00	3.50	3.00
PASAT	PASAT1	16.44	17.00	18.50	21.00
	PASAT2	12.78	13.00	15.50	17.00
	PASAT3	8.89	8.00	14.17	14.00
	PASAT4	8.33	9.00	10.50	9.00
	PASATTOT	46.44	47.00	58.67	62.50
STROOP	STROOP1	52.67	52.00	51.00	53.50
	STROOP2	85.67	85.00	79.00	78.50
	STROOP3	133.89	137.00	128.50	130.50
	STROOP4	138.44	128.00	134.67	121.50
	SUBT32	48.22	48.00	49.50	56.00
	SUBT42	52.78	45.00	55.67	46.00
	STR1ACC	99.56	100.00	98.17	99.00
	STR2ACC	98.00	99.00	96.33	97.50
	STR3ACC	96.67	98.00	95.17	97.00
	STR4ACC	96.56	97.00	96.17	96.00
REY 15-ITEM	FIFTEEN	13.00	13.00	13.00	13.00
RDS	RDSFORW	5.22	5.00	5.67	6.00
	RDSBACK	4.11	4.00	3.83	3.50
	RDSTOT	9.33	9.00	9.50	9.00
	RDSDIFF	1.11	1.00	1.83	2.50

2.1.2. Comparison of the Test Results of the Main Groups (Injured, Malingering, and Noninjured)

The Levene test of homogeneity of variances was performed on all the test scores, except the Stroop Accuracy scores. The latter scores were omitted because the scoring method employed eliminated several scores (this method is described above). These scores were therefore examined nonparametrically (see below).

Comparisons of homogeneity of variances that involved all 3 groups are listed in Table 7.1. Those scores that were not relevant to the noninjured group (that is, the difference scores) were compared for only the malingering and injured groups. These are listed in Table 7.2..

In both tables, those scores for which variances were significantly different are highlighted. These variables were omitted from further parametric analysis and later analyzed nonparametrically (see below).

TABLE 7.
Test Results: Comparisons between Main Group (Total Injured, Malingering, and Noninjured)

7.1. Test for Homogeneity of Variance in Comparisons of all three Main Groups: Levene Test

Test	Variable	df Effect	MS Effect	F Value
PCL	PCL1	2.00	31.74	2.60
	PCL2	2.00	28.06	1.54
	PCLPCS1	2.00	12.44	*3.98
	PCLPCS2	2.00	10.17	2.44
PCSC	PCSC1TOT	2.00	157.86	*3.36
	PCSC1FRQ	2.00	19.54	*3.56
	PCSC1INT	2.00	22.03	*4.09
	PCSC1DUR	2.00	15.78	1.55
	PCSC2TOT	2.00	221.13	1.68
	PSCS2FRQ	2.00	19.96	1.01
	PCSC2INT	2.00	17.40	0.96
	PCSC2DUR	2.00	22.29	1.39
	HEADACH1	2.00	1.75	0.99
	DIZZINE1	2.00	5.16	*6.64
	IRRITAB1	2.00	6.07	*4.29
	MEMORY1	2.00	2.28	1.16
	CONCENT1	2.00	10.27	*8.25
	FATIGUE1	2.00	4.68	2.28
	VISION1	2.00	33.76	*15.47
	NOISIN1	2.00	1.28	0.41
	JUDGEME1	2.00	1.86	2.22
	ANXIETY1	2.00	1.81	0.87
	HEADACH2	2.00	5.83	1.79
	DIZZINE2	2.00	3.74	1.42
	IRRITAB2	2.00	0.61	0.17
	MEMORY2	2.00	12.49	*3.24
	CONCENT2	2.00	2.65	0.91
	FATIGUE2	2.00	2.41	0.68
	VISION2	2.00	2.02	0.49
	NOISIN2	2.00	0.29	0.07
	JUDGEME2	2.00	2.78	0.77
	ANXIETY2	2.00	1.75	0.45
BVRT	BVCORR_C	2.00	13.54	*6.54
	BVERR_C	2.00	57.55	*15.26
	OMIS_C	2.00	2.74	1.40
	DISTOR_C	2.00	25.19	*23.38
	PERSEV_C	2.00	0.07	*4.44
	ROTAT_C	2.00	6.82	*6.53
	MISPLA_C	2.00	1.69	1.32
	SIZE_C	2.00	0.23	2.42
	LEFT_C	2.00	6.08	*10.40
	RIGHT_C	2.00	12.72	*8.43
	BVCORR_D	2.00	0.00	0.00
	BVERR_D	2.00	26.45	*3.99
	OMIS_D	2.00	8.36	*3.51
	DISTOR_D	2.00	12.13	*5.20
	PERSEV_D	2.00	1.01	1.67
	ROTAT_D	2.00	3.71	*3.47
	MISPLA_D	2.00	0.18	0.16
	SIZE_D	2.00	0.51	*6.16
	LEFT_D	2.00	12.26	*3.45
	RIGHT_D	2.00	2.67	0.95

7.1. Test for Homogeneity of Variance in Comparisons of all three Main Groups: Levene Test - continued

Test	Variable	df Effect	MS Effect	F Value
PASAT	PASAT1	2.00	6.58	0.75
	PASAT2	2.00	0.25	0.03
	PASAT3	2.00	11.23	2.26
	PASAT4	2.00	1.68	0.41
	PASATTOT	2.00	2.67	0.04
STROOP	STROOP1	2.00	12385.36	*21.65
	STROOP2	2.00	4005.59	*10.32
	STROOP3	2.00	2696.04	*5.00
	STROOP4	2.00	2590.18	*3.54
	SUBT32	2.00	897.92	*4.18
	SUBT42	2.00	3103.44	*5.58
REY 15-ITEM	FIFTEEN	2.00	19.47	*7.30
RDS	RDSFORW	2.00	12.57	*20.58
	RDSBACK	2.00	0.07	0.23
	RDSTOT	2.00	19.96	*20.42
	RDSDIFF	2.00	3.15	*4.65

Note. *p < .05

7.2. Test for Homogeneity of Variance in Comparisons of Total Injured and Malingering Groups Only: Levene Test

Test	Variable	df Effect	MS Effect	F Value
PCL	PCLDIFF	1.00	25.83	2.77
	PCLPCDIF	1.00	0.86	0.38
PCSC	TOTDIFF	1.00	1173.10	*7.57
	FRQDIFF	1.00	63.63	2.75
	INTDIFF	1.00	83.69	3.90
	DURDIFF	1.00	56.45	3.76
	HEADADIF	1.00	12.50	3.93
	DIZZDIF	1.00	15.82	5.51
	IRRITDIF	1.00	7.27	2.55
	MEMDIF	1.00	4.41	0.94
	CONCDIF	1.00	3.05	0.94
	FATIGDIF	1.00	25.38	*8.50
	VISIODIF	1.00	10.41	1.25
	NOISEDIF	1.00	1.22	0.26
	JUDGDIFF	1.00	0.05	0.01
	ANXDIFF	1.00	0.71	0.24

Note. *$p < .05$

Those scores for which comparable variances were displayed, were then compared by analysis of variance. Table 7.3. contains comparisons involving all 3 groups, while Table 7.4. contains comparisons involving only 2 groups.

7.3. Analysis of Variance for Comparisons of all three Main Groups

Test	Variable	df Effect	MS Effect	F Value
PCL	PCL1	2.00	346.74	*12.90
	PCL2	2.00	953.80	*18.97
	PCLPCS2	2.00	202.91	*15.53
PCSC	PCSC1DUR	2.00	375.75	*11.62
	PCSC2TOT	2.00	5562.66	*15.08
	PSCS2FRQ	2.00	1013.12	*22.42
	PCSC2INT	2.00	747.38	*14.52
	PCSC2DUR	2.00	240.89	*4.72
	HEADACH1	2.00	35.11	*4.17
	MEMORY1	2.00	23.67	*4.23
	FATIGUE1	2.00	48.08	*6.60
	NOISIN1	2.00	68.66	*7.81
	JUDGEME1	2.00	9.91	2.10
	ANXIETY1	2.00	84.31	*14.30
	HEADACH2	2.00	61.72	*6.13
	DIZZINE2	2.00	77.15	*9.75
	IRRITAB2	2.00	88.65	*8.67
	CONCENT2	2.00	59.63	*6.28
	FATIGUE2	2.00	29.30	*2.91
	VISION2	2.00	48.09	*3.14
	NOISIN2	2.00	52.10	*4.70
	JUDGEME2	2.00	69.44	*6.60
	ANXIETY2	2.00	69.40	*7.80
BVRT	OMIS_C	2.00	1.83	0.66
	MISPLA_C	2.00	1.47	0.55
	SIZE_C	2.00	0.98	0.56
	BVCORR_D	2.00	27.93	*4.20

7.3. Analysis of Variance for Comparisons of all three Main Groups - continued

Test	Variable	df Effect	MS Effect	F Value
	PERSEV_D	2.00	1.27	0.87
	MISPLA_D	2.00	1.31	0
	RIGHT_D	2.00	31.97	*3.59
PASAT	PASAT1	2.00	138.38	*5.00
	PASAT2	2.00	160.05	*7.59
	PASAT3	2.00	87.01	*4.77
	PASAT4	2.00	89.75	*9.31
	PASATTOT	2.00	1697.63	*7.24
RDS	RDSBACK	2.00	7.15	*8.02

Note. *p < .05

7.4. Analysis of Variance for Comparisons of Malingering and Total Injured Groups Only

Test	Variable	df Effect	MS Effect	F Value
PCL	PCLDIFF	1.00	3003.13	*102.75
	PCLPCDIF	1.00	712.53	*83.84
PCSC	FRQDIFF	1.00	1725.78	*30.54
	INTDIFF	1.00	1554.03	*23.92
	DURDIFF	1.00	800.00	*16.83
	HEADADIF	1.00	136.13	*14.93
	DIZZDIF	1.00	72.00	*9.47
	IRRITDIF	1.00	157.53	*20.20
	MEMDIF	1.00	87.78	*5.67
	CONCDIF	1.00	101.53	*9.99
	VISIODIF	1.00	105.13	*5.25
	NOISEDIF	1.00	157.53	*11.18
	JUDGDIFF	1.00	116.28	*9.63
	ANXDIFF	1.00	236.53	*28.24

Note. *$p < .05$

For those scores that differed significant :heffe post-hoc comparison of means were performed. These are listed in Table 7.5.2.. The entries in the "Significant Differences" column were derived by inspection of group means, as listed in Table 7.5.1..

7.5. Comparison of Means

7.5.1. Summary Table of Means: Main Groups Only

Test	Variable		Injured	Malingering	Noninjured
PCS	PCL1	(pre-injury total symptoms)	11.38	3.63	12.07
	PCL2	(post-injury total symptoms)	15.25	26.88	12.07
	PCLDIFF	(difference in total symptoms)	3.88	23.25	0.00
	PCLPCS1	(pre-injury typical PSC)	4.69	0.88	6.13
	PCLPCS2	(post-injury typical PCS)	7.19	12.81	6.13
	PCLPCDIF	(difference in typical PCS)	2.50	11.94	0.00
PCSC	PCSC1TOT	(pre-injury total symptoms)	51.31	41.31	65.53
	PCSC1FRQ	(pre-injury symptom frequency)	16.56	13.56	19.53
	PCSC1INT	(pre-injury symptom intensity)	16.25	13.38	21.80
	PCSC1DUR	(pre-injury symptom duration)	18.50	14.38	24.20
	PCSC2TOT	(post-injury total symptoms)	72.38	101.00	65.53
	PSCS2FRQ	(post-injury symptom frequency)	23.25	34.94	19.53
	PCSC2INT	(post-injury symptom intensity)	23.38	34.44	21.80
	PCSC2DUR	(post-injury symptom duration)	25.75	31.63	24.20
	TOTDIFF	(difference in total symptoms)	21.06	59.69	0.00
	FRQDIFF	(difference in symptom frequency)	6.69	21.38	0.00
	INTDIFF	(difference in symptom intensity)	7.13	21.06	0.00
	DURDIFF	(difference in symptom duration)	7.25	17.25	0.00
	HEADACH1	(pre-injury headaches)	5.75	4.69	7.67
	DIZZINE1	(pre-injury dizziness)	4.06	3.88	4.73
	IRRITAB1	(pre-injury irritability)	5.50	4.13	4.87
	MEMORY1	(pre-injury memory problems)	4.25	4.00	6.27
	CONCENT1	(pre-injury concentration problems)	4.63	3.56	5.33
	FATIGUE1	(pre-injury fatigue)	5.31	4.56	7.93

7.5.1. Summary Table of Means: Main Groups Only - continued

Test	Variable		Injured	Malingering	Noninjured
	VISION1	(pre-injury vision problems)	4.69	3.19	5.20
	NOISE1	(pre-injury noise intolerance)	5.88	4.88	8.93
	JUDGEME1	(pre-injury judgement problems)	5.69	4.38	5.80
	ANXIETY1	(pre-injury anxiety)	5.56	4.25	8.80
	HEADACH2	(post-injury headaches)	8.31	11.38	7.67
	DIZZINE2	(post-injury dizziness)	6.31	9.13	4.73
	IRRITAB2	(post-injury irritability)	6.50	9.56	4.87
	MEMORY2	(post-injury memory problems)	6.81	9.88	6.27
	CONCENT2	(post-injury concentration problems)	6.69	9.19	5.33
	FATIGUE2	(post-injury fatigue)	8.25	10.44	7.93
	VISION2	(post-injury vision problems)	5.56	8.69	5.20
	NOISIN2	(post-injury noise intolerance)	8.19	11.63	8.93
	JUDGEME2	(post-injury judgement problems)	7.50	10.00	5.80
	ANXIETY2	(post-injury anxiety)	7.25	11.38	8.80
	HEADADIF	(difference in headache incidence)	2.56	6.69	0.00
	DIZZIDIF	(difference in dizziness incidence)	2.25	5.25	0.00
	IRRITDIF	(difference in irritability)	1.00	5.44	0.00
	MEMDIF	(difference in memory problems)	2.56	5.88	0.00
	CONCDIF	(difference in concentration problems)	2.06	5.63	0.00
	FATIGDIF	(difference in fatigue)	2.94	5.88	0.00
	VISIODIF	(difference in vision problems)	1.88	5.50	0.00
	NOISEDIF	(difference in noise intolerance)	2.31	6.75	0.00
	JUDGDIFF	(difference in judgement problems)	1.81	5.63	0.00
	ANXDIFF	(difference in anxiety)	1.69	7.13	0.00
BVRT	BVCORR_C	(copy task correct)	8.50	5.31	7.20
	BVERR_C	(copy task errors)	1.50	6.94	3.20

7.5.1. Summary Table of Means: *Main Groups Only* - continued

Test	Variable		Injured	Malingering	Noninjured
	OMIS_C	(copy task omissions)	0.19	0.75	0.80
	DISTOR_C	(copy task distortions)	0.19	3.50	0.60
	PERSEV_C	(copy task perseverations)	0.00	0.06	0.00
	ROTAT_C	(copy task rotations)	0.06	1.69	0.33
	MISPLA_C	(copy task misplacements)	0.94	0.81	1.40
	SIZE_C	(copy task size errors)	0.06	0.19	0.07
	LEFT_C	(copy task left-sided errors)	0.50	2.38	0.93
	RIGHT_C	(copy task right-sided errors)	0.94	3.25	1.93
	BVCORR_D	(recall task correct)	5.56	3.19	5.40
	BVERR_D	(recall task errors)	6.63	13.00	6.33
	OMIS_D	(recall task omissions)	0.31	1.50	0.73
	DISTOR_D	(recall task distortions)	2.06	6.06	2.13
	PERSEV_D	(recall task perseverations)	1.25	0.69	1.00
	ROTAT_D	(recall task rotations)	1.38	2.75	1.13
	MISPLA_D	(recall task misplacements)	1.38	1.81	1.27
	SIZE_D	(recall task size errors)	0.19	0.19	0.00
	LEFT_D	(recall task left-sided errors)	2.19	6.00	2.33
	RIGHT_D	(recall task right-sided errors)	3.75	6.06	3.47
PASAT	PASAT1	(trial 1)	12.94	11.50	17.27
	PASAT2	(trial 2)	12.94	7.94	13.87
	PASAT3	(trial 3)	10.88	6.88	11.00
	PASAT4	(trial 4)	8.13	4.63	9.20
	PASATTOT	(total score)	44.88	30.94	51.33
STROOP	STROOP1	(trial 1: speed)	64.25	104.88	52.00

7.5.1. Summary Table of Means: Main Groups Only - continued

Test	Variable		Injured	Malingering	Noninjured
	STROOP2	(trial 2: speed)	94.63	121.44	83.00
	STROOP3	(trial 3: speed)	148.63	160.75	131.73
	STROOP4	(trial 4: speed)	151.81	165.38	136.93
	SUBT32	(speed difference: trials 3 and 2)	54.00	39.31	48.73
	SUBT42	(speed difference: trials 4 and 2)	57.19	43.94	53.93
	STR1ACC	(trial 1: accuracy)	98.81	88.08	99.00
	STR2ACC	(trial 2: accuracy)	96.88	83.25	97.33
	STR3ACC	(trial 3: accuracy)	96.44	79.27	96.07
	STR4ACC	(trial 4: accuracy)	96.19	82.23	96.40
REY 15	FIFTEEN	(total correct)	13.50	8.00	13.00
RDS	RDSFORW	(total score forward)	5.38	3.00	5.40
	RDSBACK	(total score backwards)	3.63	2.69	4.00
	RDSTOT	(overall total)	9.00	5.69	9.40
	RDSDIFF	(forward minus backward score)	1.75	0.31	1.40

7.5.2. Scheffe Post Hoc Comparisons of Means: Comparison of All Main Groups (Injured, Malingering, and Noninjured)

Test	Variable	Comparison	p Value	Significant differences
PCL	PCL1	INJ VS NON	0.93	
		INJ VS MAL	*0.00	MAL < INJ
		MAL VS NON	*0.00	MAL < NON
	PCL2	INJ VS NON	0.46	
		INJ VS MAL	*.00	INJ < MAL
		MAL VS NON		NON < MAL
	PCLPCS2	INJ VS NON	0.72	
		INJ VS MAL	*0.00	INJ < MAL
		MAL VS NON	*0.00	NON < MAL
PCSC	PCSC1DUR	INJ VS NON	*0.03	INJ < NON
		INJ VS MAL	0.13	
		MAL VS NON	*0.00	MAL < NON
	PCSC2TOT	INJ VS NON	0.62	
		INJ VS MAL	*0.00	INJ < MAL
		MAL VS NON	*0.00	NON < MAL
	PCSC2FRQ	INJ VS NON	0.32	
		INJ VS MAL	*0.00	INJ < MAL
		MAL VS NON	*0.00	NON < MAL
	PCSC2INT	INJ VS NON	0.83	
		INJ VS MAL	*0.00	INJ < MAL
		MAL VS NON	*0.00	NON < MAL
	PCSC2DUR	INJ VS NON	0.83	
		INJ VS MAL	0.08	
		MAL VS NON	*0.02	NON < MAL
	HEADACH1	INJ VS NON	0.20	
		INJ VS MAL	0.59	
		MAL VS NON	*0.02	MAL < NON
	MEMORY1	INJ VS NON	0.07	
		INJ VS MAL	0.96	

Scheffe Post Hoc Comparisons of Means: Comparison of All Main Groups - continued

Test	Variable	Comparison	p Value	Significant differences
		MAL VS NON	*0.04	MAL < NON
	FATIGUE1	INJ VS NON	*0.03	INJ < NON
		INJ VS MAL	0.74	
		MAL VS NON	*0.00	MAL < NON
	NOISIN1	INJ VS NON	*0.02	INJ < NON
		INJ VS MAL	0.64	
		MAL VS NON	*0.00	MAL < NON
	JUDGEME1	INJ VS NON	0.99	
		INJ VS MAL	0.24	
		MAL VS NON	0.20	
	ANXIETY1	INJ VS NON	*0.00	INJ < NON
		INJ VS MAL	0.32	
		MAL VS NON	*0.00	MAL < NON
	HEADACH2	INJ VS NON	0.85	
		INJ VS MAL	*0.03	INJ < MAL
		MAL VS NON	0.01	NON < MAL
	DIZZINE2	INJ VS NON	*0.01	
		INJ VS MAL	*0.03	INJ < MAL
		MAL VS NON	*0.00	NON < MAL
	IRRITAB2	INJ VS NON	0.37	
		INJ VS MAL	*0.03	INJ < MAL
		MAL VS NON	*0.00	NON < MAL
	CONCENT2	INJ VS NON	0.48	
		INJ VS MAL	0.08	
		MAL VS NON	*0.00	NON < MAL
	FATIGUE2	INJ VS NON	0.96	
		INJ VS MAL	0.16	
		MAL VS NON	0.10	

7.5.2. Scheffe Post Hoc Comparisons of Means: Comparison of All Main Groups - ontinued

Test	Variable	Comparison	p Value	Significant differences
	VISION2	INJ VS NON	0.63	
		INJ VS MAL	0.32	
		MAL VS NON	0.06	
	NOISIN2	INJ VS NON	0.82	
		INJ VS MAL	*0.02	INJ < MAL
		MAL VS NON	0.09	
	JUDGEME2	INJ VS NON	0.35	
		INJ VS MAL	0.10	
		MAL VS NON	*0.00	NON < MAL
	ANXIETY2	INJ VS NON	0.36	
		INJ VS MAL	*0.00	INJ < MAL
		MAL VS NON	0.07	
BVRT	OMIS_C	INJ VS NON	0.60	
		INJ VS MAL	0.64	
		MAL VS NON	1.00	
	MISPLA_C	INJ VS NON	0.73	
		INJ VS MAL	0.98	
		MAL VS NON	0.61	
	SIZE_C	INJ VS NON	1.00	
		INJ VS MAL	0.65	
		MAL VS NON	0.68	
	BVCOR_D	INJ VS NON	0.98	
		INJ VS MAL	*0.04	MAL < INJ
		MAL VS NON	0.07	
	PERSEV_D	INJ VS NON	0.85	
		INJ VS MAL	0.43	
		MAL VS NON	0.77	

7.5.2. Scheffe Post Hoc Comparisons of Means: Comparison of All Main Groups - continued

Test	Variable	Comparison	p Value	Significant differences
	MISPLA_D	INJ VS NON	0.98	
		INJ VS MAL	0.77	
		MAL VS NON	0.67	
	RIGHT_D	INJ VS NON	0.97	
		INJ VS MAL	0.10	
		MAL VS NON	0.06	
PASAT	PASAT1	INJ VS NON	0.08	
		INJ VS MAL	0.74	
		MAL VS NON	*0.01	MAL < NON
	PASAT2	INJ VS NON	0.85	
		INJ VS MAL	*0.01	MAL < INJ
		MAL VS NON	*0.00	MAL < NON
	PASAT3	INJ VS NON	1.00	
		INJ VS MAL	*0.04	MAL < INJ
		MAL VS NON	*0.04	MAL < NON
	PASAT4	INJ VS NON	0.63	
		INJ VS MAL	*0.01	MAL < INJ
		MAL VS NON	*0.00	MAL < NON
	PASATTOT	INJ VS NON	0.51	
		INJ VS MAL	*0.05	MAL < INJ
		MAL VS NON	*0.00	MAL < NON
RDS	RDSBACK	INJ VS NON	0.55	
		INJ VS MAL	*0.03	MAL < INJ
		MAL VS NON	*0.00	MAL < NON

Note. *p < .05

7.5.3. Scheffe Post Hoc Comparison of Means: Total Injured and Malingering Groups Only

Test	Variable	Comparison	p Value	Significant differences
PCL	PCLDIFF	INJ VS MAL	*0.00	INJ < MAL
	PCLPCDIF	INJ VS MAL	*0.00	INJ < MAL
PCSC	FRQDIFF	INJ VS MAL	*0.00	INJ < MAL
	INTDIFF	INJ VS MAL	*0.00	INJ < MAL
	DURDIFF	INJ VS MAL	*0.00	INJ < MAL
	HEADADIF	INJ VS MAL	*0.00	INJ < MAL
	DIZZDIFF	INJ VS MAL	*0.00	INJ < MAL
	IRRITDIF	INJ VS MAL	*0.00	INJ < MAL
	MEMDIF	INJ VS MAL	*0.02	INJ < MAL
	CONCDIF	INJ VS MAL	*0.00	INJ < MAL
	VISIODIF	INJ VS MAL	*0.03	INJ < MAL
	NOISEDIF	INJ VS MAL	*0.00	INJ < MAL
	JUDGDIFF	INJ VS MAL	*0.00	INJ < MAL
	ANXDIFF	INJ VS MAL	*0.00	INJ < MAL

Note. *$p < .05$

Those variables that were identified for nonparametric treatment were then compared, using the Mann-Whitney U test. Results are listed in Table 7.6.. Entries in the "Difference" column were derived by inspection of the medians for the groups, as listed in Table 8.1. (see later).

Nonparametric Comparison of Main Group Test Scores: Mann Whitney-U Test

Test	Variable	Comparison	U value	Difference
PCL	PCLPCS1	Injured versus Noninjured	80.50	
		Injured versus Malingering	*21	MAL < INJ
		Malingering versus Noninjured	*6	MAL < NON
PCSC	PCSC1TOT	Injured versus Noninjured	*64	INJ < NON
		Injured versus Malingering	*75.5	MAL < INJ
		Malingering versus Noninjured	*15.5	MAL < NON
	PCSC1FRQ	Injured versus Noninjured	82.50	
		Injured versus Malingering	81.00	
		Malingering versus Noninjured	*26.5	MAL < NON
	PCSC1INT	Injured versus Noninjured	*52	INJ < NON
		Injured versus Malingering	78.50	
		Malingering versus Noninjured	*19	MAL < NON
	TOTDIFF	Injured versus Malingering	*36	INJ < MAL
	DIZZINE1	Injured versus Noninjured	107.50	
		Injured versus Malingering	125.50	
		Malingering versus Noninjured	106.00	
	IRRITAB1	Injured versus Noninjured	105.00	
		Injured versus Malingering	97.00	
		Malingering versus Noninjured	114.50	
	CONCENT1	Injured versus Noninjured	105.50	
		Injured versus Malingering	99.00	
		Malingering versus Noninjured	79.50	
	VISION1	Injured versus Noninjured	119.00	
		Injured versus Malingering	93.50	
		Malingering versus Noninjured	93.50	
	MEMORY2	Injured versus Noninjured	118.50	
		Injured versus Malingering	77.00	
		Malingering versus Noninjured	*45	NON < MAL
	FATIGDIF	Injured versus Malingering	*73	INJ < MAL

7.6. Nonparametric Comparison of Main Group Test Scores - continued

Test	Variable	Comparison	U value	Difference
BVRT	BVRCOR_C	Injured versus Noninjured	78.00	
		Injured versus Malingering	*63	MAL < INJ
		Malingering versus Noninjured	99.00	
	BVRERR_C	Injured versus Noninjured	73.50	
		Injured versus Malingering	*59	INJ < MAL
		Malingering versus Noninjured	81.00	
	DISTOR_C	Injured versus Noninjured	99.50	
		Injured versus Malingering	*39.5	INJ < MAL
		Malingering versus Noninjured	*49	NON < MAL
	PERSEV_C	Injured versus Noninjured	120.00	
		Injured versus Malingering	120.00	
		Malingering versus Noninjured	112.50	
	ROTAT_C	Injured versus Noninjured	102.50	
		Injured versus Malingering	*44.5	INJ < MAL
		Malingering versus Noninjured	*59	NON < MAL
	MISPLA_C	Injured versus Noninjured	102.50	
		Injured versus Malingering	[illegible]00	
		Malingering versus Noninjured	105.50	
	LEFT_C	Injured versus Noninjured	94.00	
		Injured versus Malingering	*60	INJ < MAL
		Malingering versus Noninjured	74.00	
	RIGHT_C	Injured versus Noninjured	76.00	
		Injured versus Malingering	*73.5	INJ < MAL
		Malingering versus Noninjured	100.50	
	BVRERR_D	Injured versus Noninjured	112.50	
		Injured versus Malingering	*54.5	INJ < MAL
		Malingering versus Noninjured	*47.5	NON < MAL
	OMIS_D	Injured versus Noninjured	111.50	
		Injured versus Malingering	102.00	
		Malingering versus Noninjured	92.00	

7.5. Nonparametric Comparison of Main Group Test Scores - continued

Test	Variable	Comparison	U value	Difference
	DISTOR_D	Injured versus Noninjured	105.50	
		Injured versus Malingering	*43.5	INJ < MAL
		Malingering versus Noninjured	*42	NON < MAL
	ROTAT_D	Injured versus Noninjured	107.00	
		Injured versus Malingering	81.00	
		Malingering versus Noninjured	*68	NON < MAL
	SIZE_D	Injured versus Noninjured	105.00	
		Injured versus Malingering	121.50	
		Malingering versus Noninjured	97.50	
	LEFT_D	Injured versus Noninjured	115.00	
		Injured versus Malingering	*45	INJ < MAL
		Malingering versus Noninjured	*45	NON < MAL
STROOP	STROOP1	Injured versus Noninjured	*0.5	NON < INJ
		Injured versus Malingering	89.00	
		Malingering versus Noninjured	*47	NON < MAL
	STROOP2	Injured versus Noninjured	75.50	
		Injured versus Malingering	85.00	
		Malingering versus Noninjured	*56	NON < MAL
	STROOP3	Injured versus Noninjured	89.00	
		Injured versus Malingering	108.00	
		Malingering versus Noninjured	80.50	
	STROOP4	Injured versus Noninjured	99.00	
		Injured versus Malingering	114.00	
		Malingering versus Noninjured	88.50	
	SUBT32	Injured versus Noninjured	103.50	
		Injured versus Malingering	90.50	
		Malingering versus Noninjured	92.00	
	SUBT42	Injured versus Noninjured	103.00	
		Injured versus Malingering	110.00	
		Malingering versus Noninjured	116.00	

7.6. Nonparametric Comparison of Main Group Test Scores - continued

Test	Variable	Comparison	n valid Malingering scores	U value	Difference
	STR1ACC	Injured versus Noninjured		114.00	
		Injured versus Malingering	12	65.50	
		Malingering versus Noninjured	15	58.50	
	STR2ACC	Injured versus Noninjured		115.00	
		Injured versus Malingering	12	*33.5	MAL < INJ
		Malingering versus Noninjured	15	*29.5	MAL < NON
	STR3ACC	Injured versus Noninjured		115.00	
		Injured versus Malingering	11	*43.5	MAL < INJ
		Malingering versus Noninjured	15	46.00	
	STR4ACC	Injured versus Noninjured		97.50	
		Injured versus Malingering	13	*34.5	MAL < INJ
		Malingering versus Noninjured	15	*32	MAL < NON

7.6. Nonparametric Comparison of Main Group Test Scores - continued

Test	Variable	Comparison	U value	Difference
REY 15-ITEM	FIFTEEN	Injured versus Noninjured	90.50	
		Injured versus Malingering	*27.5	MAL < INJ
		Malingering versus Noninjured	*32	MAL < NON
RDS	R[illegible]FORW	Injured versus Noninjured	115.00	
		Injured versus [illegible]lingering	*66	MAL < INJ
		Malingering versus Noninjured	*59	MAL < NON
	RDSTOT	Injured versus Noninjured	103.00	
		Injured versus Malingering	*56	MAL < INJ
		Malingering versus Noninjured	*46	MAL < NON
	RDSDIFF	Injured versus Noninjured	105.50	
		Injured versus Malingering	82.50	
		Malingering versus Noninjured	88.50	

Note. Variables were selected because of previously established heterogeneity of variance, or, with the Stroop accuracy scores, because of the small number of valid scores.

*$p < .05$

In order to provide a concise summary of the group differences for use in the discussion, the results of the parametric and nonparametric comparisons were then combined into a summary table. Table 7.7. is a summary of the comparisons between the main groups.

7.7. Summary of Comparisons between Main Groups (Total injured, Malingering, and Noninjured)

Test	Variable		Significant Differences
PCL	PCL1	(pre-injury total symptoms)	MAL < INJ, NON
	PCL2	(post-injury total symptoms)	INJ, NON < MAL
	PCLDIFF	(difference in total symptoms)	INJ < MAL
	PCLPCS1	(pre-injury typical PSC)	MAL < INJ, NON
	PCLPCS2	(post-injury typical PCS)	INJ, NON < MAL
	PCLPCDIF	(difference in typical PCS)	INJ < MAL
PCSC	PCSC1TOT	(pre-injury total symptoms)	MAL < INJ < NON
	PCSC1FRQ	(pre-injury symptom frequency)	MAL < NON
	PCSC1INT	(pre-injury symptom intensity)	INJ, MAL < NON
	PCSC1DUR	(pre-injury symptom duration)	INJ, MAL < NON
	PCSC2TOT	(post-injury total symptoms)	INJ, NON < MAL
	PSCS2FRQ	(post-injury symptom frequency)	INJ, NON < MAL
	PCSC2INT	(post-injury symptom intensity)	INJ, NON < MAL
	PCSC2DUR	(post-injury symptom duration)	NON < MAL
	TOTDIFF	(difference in total symptoms)	INJ < MAL
	FRQDIFF	(difference in symptom frequency)	INJ < MAL
	INTDIFF	(difference in symptom intensity)	INJ < MAL
	DURDIFF	(difference in symptom duration)	INJ < MAL
	HEADACH1	(pre-injury headaches)	MAL < NON
	DIZZINE1	(pre-injury dizziness)	No significant differences
	IRRITAB1	(pre-injury irritability)	No significant differences
	MEMORY1	(pre-injury memory problems)	MAL < NON
	CONCENT1	(pre-injury concentration problems)	No significant differences
	FATIGUE1	(pre-injury fatigue)	INJ, MAL < NON
	VISION1	(pre-injury vision problems)	No significant differences
	NOISIN1	(pre-injury noise intolerance)	INJ, MAL < NON
	JUDGEME1	(pre-injury judgement problems)	No significant differences
	ANXIETY1	(pre-injury anxiety)	INJ, MAL < NON

7.7. Summary of Comparisons between Main Groups - continued

Test	Variable		Significant Differences
	HEADACH2	(post-injury headaches)	INJ, NON < MAL
	DIZZINE2	(post-injury dizziness)	INJ, NON < MAL
	IRRITAB2	(post-injury irritability)	INJ, NON < MAL
	MEMORY2	(post-injury memory problems)	NON < MAL
	CONCENT2	(post-injury concentration problems)	NON < MAL
	FATIGUE2	(post-injury fatigue)	No significant differences
	VISION2	(post-injury vision problems)	No significant differences
	NOISIN2	(post-injury noise intolerance)	INJ < MAL
	JUDGEME2	(post-injury judgement problems)	NON < MAL
	ANXIETY2	(post-injury anxiety)	INJ < MAL
	HEADADIF	(difference in headache incidence)	INJ < MAL
	DIZZIDIF	(difference in dizziness incidence)	INJ < MAL
	IRRITDIF	(difference in irritability)	INJ < MAL
	MEMDIF	(difference in memory problems)	INJ < MAL
	CONCDIF	(difference in concentration problems)	INJ < MAL
	FATIGDIF	(difference in fatigue)	INJ < MAL
	VISIODIF	(difference in vision problems)	INJ < MAL
	NOISEDIF	(difference in noise intolerance)	INJ < MAL
	JUDGDIFF	(difference in judgement problems)	INJ < MAL
	ANXDIFF	(difference in anxiety)	INJ < MAL
BVRT	BVCORR_C	(copy task correct)	MAL < INJ
	BVERR_C	(copy task errors)	INJ < MAL
	OMIS_C	(copy task omissions)	No significant differences
	DISTOR_C	(copy task distortions)	INJ, NON < MAL
	PERSEV_C	(copy task perseverations)	No significant differences
	ROTAT_C	(copy task rotations)	INJ, NON < MAL
	MISPLA_C	(copy task misplacements)	No significant differences

7.7. Summary of Comparisons between Main Groups - continued

Test	Variable		Significant Differences
	SIZE_C	(copy task size errors)	No significant differences
	LEFT_C	(copy task left-sided errors)	INJ < MAL
	RIGHT_C	(copy task right-sided errors)	INJ < MAL
	BVCORR_D	(recall task correct)	MAL < INJ
	BVERR_D	(recall task errors)	INJ , NON < MAL
	OMIS_D	(recall task omissions)	No significant differences
	DISTOR_D	(recall task distortions)	INJ, NON < MAL
	PERSEV_D	(recall task perseverations)	No significant differences
	ROTAT_D	(recall task rotations)	NON < MAL
	MISPLA_D	(recall task misplacements)	No significant differences
	SIZE_D	(recall task size errors)	No significant differences
	LEFT_D	(recall task left-sided errors)	INJ, NON < MAL
	RIGHT_D	(recall task right-sided errors)	No significant differences
PASAT	PASAT1	(trial 1)	MAL < NON
	PASAT2	(trial 2)	MAL < INJ, NON
	PASAT3	(trial 3)	MAL < INJ, NON
	PASAT4	(trial 4)	MAL < INJ, NON
	PASATTOT	(total score)	MAL < INJ, NON
STROOP	STROOP1	(trial 1: speed)	NON < INJ, MAL
	STROOP2	(trial 2: speed)	NON < MAL
	STROOP3	(trial 3: speed)	No significant differences
	STROOP4	(trial 4: speed)	No significant differences
	SUBT32	(speed difference: trials 3 and 2)	No significant differences
	SUBT42	(speed difference: trials 4 and 2)	No significant differences
	STR1ACC	(trial 1: accuracy)	No significant differences
	STR2ACC	(trial 2: accuracy)	MAL < INJ, NON

7.7. Summary of Comparisons between Main Groups - continued

Test	Variable		Significant Differences
	STR3ACC	(trial 3: accuracy)	MAL < INJ
	STR4ACC	(trial 4: accuracy)	MAL < INJ, NON
REY 15	FIFTEEN	(total correct)	MAL < INJ, NON
RDS	RDSFORW	(total score forward)	MAL < INJ, NON
	RDSBACK	(total score backwards)	MAL < INJ, NON
	RDSTOT	(overall total)	MAL < INJ, NON
	RDSDIFF	(forward minus backward score)	No significant differences

2.1.3. Comparison of Subgroups defined in terms of Time Since Injury

The 3 injured subgroups defined in terms of time since injury (recently injured, intermediate injured, and long term injured) were compared with each other, as well as with the noninjured and malingering groups, using the Mann-Whitney U test. Results are shown in Table 8.2.1., with the "Difference" column being derived from a comparison of medians as listed in Table 8...

Table 8.
Test Results: Comparisons between Subgroups

8.1. Summary Table of Medians for All Groups

Variable	Recent Injury	Inter Injury	Long Term Injury	Sports Injury	Violent Injury	Male Injured	Female Injured	Gauteng Injured	Mpum Inj	Blames Another	No Blame	Gauteng Non	Mpum Non	Male Non	Female Non	Total Inj	Total Non	Total Mal
PCL1	11.50	10.50	11.50	8.50	18.50	10.00	16.00	12.50	10.00	13.00	10.00	10.00	12.00	12.00	11.00	10.50	12.00	3.00
PCL2	16.00	13.50	15.50	9.00	21.00	11.50	25.00	19.50	13.50	21.00	11.50	10.00	12.00	12.00	11.00	14.50	12.00	27.50
PCLDIFF	2.50	2.00	4.50	1.50	3.00	2.00	8.00	2.00	2.50	5.50	2.00	0.00	0.00	0.00	0.00	2.00	0.00	23.50
PCLPCS1	5.00	4.50	4.50	3.00	9.50	4.00	5.00	5.00	3.00	5.00	4.00	6.00	6.00	6.00	6.00	4.50	6.00	1.00
PCLPCS2	7.50	5.50	9.00	3.50	10.50	5.50	13.00	9.00	5.50	10.50	5.50	6.00	6.00	6.00	6.00	6.50	6.00	14.00
PCLPCDIF	1.00	1.00	4.50	0.50	2.00	1.00	6.00	1.00	1.00	2.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	13.00
PCSC1TOT	63.00	53.00	46.50	53.00	59.00	53.00	52.50	52.50	53.00	48.00	53.00	60.00	60.00	59.00	72.00	53.00	60.00	41.00
PCSC1FRQ	20.50	15.00	15.50	15.00	19.00	16.00	16.00	16.00	17.00	16.50	16.00	16.00	19.50	17.00	20.00	16.00	19.00	13.00
PCSC1INT	19.50	15.50	14.00	15.50	20.00	15.50	15.00	15.00	15.50	14.00	15.50	22.00	18.50	17.00	26.00	15.50	21.00	13.00
PCSC1DUR	23.00	20.00	17.00	20.00	20.00	19.00	19.00	19.00	19.00	16.00	20.00	22.00	22.00	22.00	24.50	19.00	22.00	14.50
PCSC2TOT	67.00	66.00	75.00	55.50	74.00	58.50	94.00	74.50	58.50	74.00	59.00	60.00	60.00	59.00	72.00	67.00	60.00	105.50
PSCS2FRQ	22.00	22.50	25.50	16.00	24.50	20.50	28.00	23.50	21.00	24.50	20.50	16.00	19.50	17.00	20.00	22.00	19.00	36.00
PCSC2INT	20.00	22.50	23.00	17.50	26.00	19.00	30.50	24.00	19.50	26.00	19.50	22.00	18.50	17.00	26.00	20.50	21.00	35.00
PCSC2DUR	24.00	22.50	26.50	21.00	23.50	21.50	35.50	27.00	21.00	23.50	22.50	22.00	22.00	22.00	24.50	22.50	22.00	33.00
TOTDIFF	3.50	8.00	22.00	2.50	19.50	6.00	41.50	12.50	8.00	19.00	11.50	0.00	0.00	0.00	0.00	11.50	0.00	64.00
FRQDIFF	1.00	2.50	6.50	1.00	4.00	2.00	12.00	3.50	2.50	5.50	3.00	0.00	0.00	0.00	0.00	3.00	0.00	21.50
INTDIFF	0.50	3.00	8.00	0.50	6.00	1.00	14.50	3.50	1.00	7.00	2.00	0.00	0.00	0.00	0.00	2.50	0.00	21.50
DURDIFF	1.50	2.50	8.00	1.00	6.00	2.50	15.50	5.50	2.50	6.50	4.00	0.00	0.00	0.00	0.00	4.00	0.00	18.50
HEADACH1	5.00	3.00	7.50	6.00	3.00	3.00	8.00	7.00	3.00	3.00	7.00	8.00	8.50	8.00	8.50	5.00	8.00	2.00
DIZZINE1	4.50	3.00	3.00	3.00	4.50	3.00	4.50	3.00	4.50	3.00	3.00	3.00	3.00	3.00	5.00	3.00	3.00	3.00
IRRITAB1	6.50	3.00	5.00	5.00	4.50	4.50	5.00	5.00	4.50	3.00	7.00	3.00	3.00	3.00	3.00	4.50	3.00	3.00
MEMORY1	4.50	3.00	3.00	3.00	6.50	3.00	4.50	3.00	3.00	3.00	3.00	3.00	7.50	7.00	4.50	3.00	7.00	3.00
CONCENT1	6.50	3.00	3.00	3.00	6.00	3.00	3.00	3.00	3.00	3.00	3.00	7.00	3.00	3.00	7.00	3.00	3.00	3.00
FATIGUE1	8.00	3.00	4.50	3.00	4.50	6.00	3.00	3.00	4.50	3.00	4.50	7.00	9.00	9.00	7.50	3.00	8.00	4.00
VISION1	7.00	3.00	3.00	3.00	5.00	3.00	3.00	3.00	3.00	5.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
NOISIN1	6.00	7.00	3.00	7.50	6.00	6.00	4.50	4.50	6.50	4.50	6.00	10.00	9.00	9.00	9.50	6.00	9.00	3.00
JUDGEME1	6.50	6.50	4.50	7.00	6.00	6.50	4.50	6.50	5.00	4.50	6.50	6.00	6.50	3.00	7.00	6.00	6.00	3.00
ANXIETY1	6.50	5.00	3.00	7.50	4.50	6.50	3.00	50	6.50	4.50	7.00	10.00	9.00	9.00	10.00	6.00	9.00	3.00
HEADACH2	5.00	10.50	8.50	9.50	7.00	7.50	12.00	8.50	9.00	8.00	9.00	8.00	8.50	8.00	8.50	9.00	8.00	12.00
DIZZINE2	6.50	5.00	6.00	3.00	6.50	4.50	9.00	6.00	7.00	6.50	4.50	3.00	3.00	3.00	5.00	6.00	3.00	9.00

8.1. Medians for All Groups - continued

Variable	Recent Injury	Inter Injury	Long Term Injury	Sports Injury	Violent Injury	Male Injured	Female Injured	Gauteng Injured	Mpum Inj	Blames Another	No Blame	Gauteng Non	Mpum Non	Male Non	Female Non	Total Inj	Total Non	Total Mal
IRRITAB2	6.50	5.00	7.50	5.00	7.00	4.50	8.50	7.00	6.50	4.50	7.00	3.00	3.00	3.00	3.00	7.00	3.00	10.00
MEMORY2	4.50	6.50	6.50	3.00	10.00	3.00	12.00	8.00	3.00	10.00	3.00	3.00	7.50	.00	4.50	4.50	7.00	10.00
CONCENT2	6.50	5.00	8.00	3.00	7.00	6.50	9.00	8.50	3.00	6.50	7.00	7.00	3.00	3.00	7.00	7.00	3.00	10.00
FATIGUE2	8.00	9.00	3.50	3.00	11.50	7.00	12.00	9.50	6.50	11.50	7.50	7.00	9.00	9.00	7.50	8.50	8.00	10.00
VISION2	7.00	5.00	3.00	3.00	7.00	5.00	7.00	5.00	5.00	5.00	5.00	3.00	3.00	3.00	3.00	5.00	3.00	9.50
NOISIN2	6.00	9.00	8.50	7.50	8.00	7.00	10.50	8.50	7.50	8.00	7.50	10.00	9.00	9.00	9.50	7.50	9.00	12.00
JUDGEME2	7.50	7.00	7.50	7.00	6.00	7.50	6.50	7.50	6.50	6.50	7.50	6.00	6.50	3.00	7.00	7.00	6.00	12.00
ANXIETY2	7.00	8.50	5.50	7.50	8.00	7.00	9.00	7.50	6.50	7.50	7.00	10.00	9.00	9.00	10.00	7.00	9.00	12.00
HEADADIF	0.00	0.50	3.00	0.00	0.50	0.00	3.00	0.50	1.00	2.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	6.00
DIZZIDIF	0.00	0.50	1.50	0.00	0.50	0.00	4.50	0.50	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
IRRITDIF	0.00	0.00	2.50	0.00	0.00	0.00	4.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00
MEMDIF	0.00	0.00	3.50	0.00	2.00	0.00	8.00	0.00	0.00	3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.50
CONCDIF	0.00	0.00	5.00	0.00	0.00	0.00	4.50	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.50
FATIGDIF	0.00	0.00	3.50	0.00	4.50	0.00	9.00	2.00	0.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00
VISIODIF	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00
NOISEDIF	1.50	0.00	2.50	0.00	0.00	0.00	3.00	2.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00
JUDGDIFF	0.00	0.00	4.00	0.00	0.00	0.00	2.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00
ANXDIFF	0.00	0.00	2.50	0.00	0.00	0.00	5.00	0.50	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00
BVCORR_C	8.00	9.00	10.00	9.50	9.00	9.00	9.50	8.50	9.50	9.00	8.50	8.00	8.00	8.00	7.00	9.00	8.00	5.00
BVERR_C	2.00	1.00	0.00	0.50	1.00	1.00	0.50	1.50	0.50	1.00	1.50	2.00	2.00	2.00	3.00	1.00	2.00	6.00
OMIS_C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DISTOR_C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.50	0.00	0.00	2.50
PERSEV_C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROTAT_C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
MISPLA_C	0.50	1.00	0.00	0.50	0.50	0.50	0.00	1.00	0.00	0.50	0.00	0.00	1.00	1.00	1.00	0.00	1.00	0.50
SIZE_C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LEFT_C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
RIGHT_C	2.00	1.00	0.00	0.50	0.50	1.00	0.00	1.00	0.00	0.50	0.50	1.00	2.00	1.00	2.00	0.50	2.00	3.50
BVCORR_D	4.50	5.00	6.50	5.50	3.00	5.00	4.00	5.00	5.00	4.00	5.00	5.00	6.00	5.00	5.00	5.00	5.00	3.00
BVERR_D	8.00	7.50	4.50	6.00	9.50	6.00	7.00	5.50	7.50	6.50	6.50	7.00	5.00	6.00	6.50	6.50	6.00	13.00
OMIS_D	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

8.1. Medians for All Groups - continued

Variable	Recent Injury	Inter Injury	Long Term Injury	Sports Injury	Violent Injury	Male Injured	Female Injured	Gauteng Injured	Mpum Inj	Blames Another	No Blame	Gauteng Non	Mpum Non	Male Non	Female Non	Total Inj	Total Non	Total Mal
DISTOR_D	2.00	1.50	2.50	1.50	2.50	2.00	2.50	2.50	1.00	1.50	2.50	2.00	1.00	1.00	1.50	2.00	1.00	6.50
PERSEV_D	1.00	1.50	0.00	0.50	2.00	1.00	2.00	1.00	1.00	1.00	0.50	0.00	1.00	1.00	0.00	1.00	1.00	1.00
ROTAT_D	2.00	1.50	1.00	1.00	1.50	1.50	0.50	1.00	1.00	1.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.00
MISPLA_D	0.00	2.00	0.00	2.00	1.00	1.00	0.50	1.00	1.50	0.50	1.00	2.00	0.50	1.00	0.50	1.00	1.00	1.00
SIZE_D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LEFT_D	0.50	2.00	2.50	2.00	3.00	1.50	3.00	2.00	2.00	1.50	2.00	2.00	2.00	2.00	2.00	2.00	2.00	6.00
RIGHT_D	6.00	3.50	1.50	2.50	4.50	3.00	2.50	2.50	3.50	4.50	2.50	3.00	3.00	3.00	3.00	3.00	3.00	5.50
PASAT1	14.00	9.50	15.00	11.50	10.50	12.00	13.50	13.00	10.50	12.00	12.50	22.00	17.50	17.00	21.00	12.50	18.00	12.00
PASAT2	14.00	9.50	15.00	11.50	10.50	12.00	13.50	13.00	10.50	12.00	12.50	17.00	13.50	13.00	17.00	12.50	14.00	7.00
PASAT3	13.00	8.50	10.50	13.00	9.50	9.00	12.50	11.50	8.50	11.00	10.50	16.00	8.50	8.00	14.00	10.50	10.00	7.00
PASAT4	8.00	6.50	9.00	8.50	7.50	7.00	10.00	9.00	6.50	8.00	8.00	9.00	9.00	9.00	9.00	8.00	9.00	4.00
PASATTOT	47.50	33.00	48.00	44.50	38.50	41.00	49.50	47.50	35.00	42.00	44.50	65.00	48.50	47.00	62.50	44.50	50.00	29.50
STROOP1	59.00	56.00	61.50	54.00	55.50	58.50	53.50	58.50	55.00	59.50	56.00	54.00	49.50	52.00	53.50	57.50	53.00	76.00
STROOP2	86.50	94.00	84.00	89.50	92.00	91.00	76.00	86.00	91.00	92.00	86.50	76.00	84.50	85.00	78.50	88.00	84.00	106.50
STROOP3	141.00	146.00	140.50	137.00	142.00	146.00	116.00	134.00	159.50	142.00	145.00	125.00	137.50	137.00	130.50	143.00	136.00	158.00
STROOP4	141.00	169.50	133.50	143.00	166.00	145.00	149.00	136.50	151.50	145.00	147.50	132.00	124.00	128.00	121.50	145.00	125.00	156.00
SUBT32	54.00	52.00	54.00	47.50	50.00	55.00	46.50	51.00	62.00	50.00	55.00	49.00	52.00	49.00	56.00	54.00	49.00	35 50
SUBT42	54.50	62.00	49.50	53.50	81.50	55.00	74.50	49 50	60.50	57.50	53.50	47.00	44.50	45.00	46.00	55.00	45.00	50.50
STR1ACC	99.50	99.50	100.00	100.00	99.00	99.50	100.00	100 00	99.50	98.50	100.00	98.00	100.00	100.00	99.00	100.00	100.00	97.50
STR2ACC	98.50	96.00	99.50	97.50	95.50	98.00	95.50	98.00	96.50	98.50	97.00	97.00	98.00	99.00	97.50	97.00	98.00	90.00
STR3ACC	96.50	96.00	95.00	97.50	96.50	96.00	97.00	96.00	95.50	96.50	95.50	99.00	97.00	98.00	97.00	96.00	98.00	91.00
STR4ACC	96.50	97.50	98.00	94.00	97.50	97.00	98.00	98.00	96.50	97.50	97.00	97.00	96.00	97.00	96.00	97.50	97.00	90.00
FIFTEEN	15.00	13.50	13.50	14.00	13.50	14.50	13.50	15.00	13.00	13.50	15.00	13.00	13.00	13.00	13.00	14.50	13.00	7.50
RDSFORW	5.50	5.00	5.50	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	6.00	5.00	5.00	6.00	5.00	5.00	3.00
RDSBACK	3.50	4.00	3.50	4.00	3.00	3.50	4.00	4.00	3.00	3.50	4.00	3.00	4.00	4.00	3 50	4.00	4.00	3.00
RDSTOT	9.50	9.00	9.00	9.00	8.00	9.00	9.50	9.50	9.00	9.00	9.00	9.00	9.00	9.00	9 00	9.00	9.00	5.50
RDSDIFF	2.50	1.50	2.00	0.50	2.00	2.00	2.00	2.00	2.00	2.50	1.50	3.00	0 50	1.00	2.50	2.00	1.00	1.00

8.2. Nonparametric Groups comparisons: Mann-Whitney U Test

8.2.1. Time Since Injury

8.2.1.1. Comparison between Recently Injured, Intermediate Injured, and Long Term Injured

Test	Variable		Comparison	U value	Difference
PCL	PCL1	(pre-injury total symptoms)	Recent vs Long Term	6.00	
			Recent vs Intermediate	15.50	
			Intermediate vs Long Term	14.50	
	PCL2	(post-injury total symptoms)	Recent vs Long Term	6.00	
			Recent vs Intermediate	15.00	
			Intermediate vs Long Term	12.50	
	PCLDIFF	(difference in total symptoms)	Recent vs Long Term	6.50	
			Recent vs Intermediate	15.50	
			Intermediate vs Long Term	15.50	
	PCLPCS1	(pre-injury typical PSC)	Recent vs Long Term	6.50	
			Recent vs Intermediate	16.50	
			Intermediate vs Long Term	15.00	
	PCLPCS2	(post-injury typical PCS)	Recent vs Long Term	6.00	
			Recent vs Intermediate	15.00	
			Intermediate vs Long Term	13.00	
	PCLPCDIF	(difference in typical PCS)	Recent vs Long Term	4.00	
			Recent vs Intermediate	14.50	
			Intermediate vs Long Term	9.00	
PCSC	PCSC1TOT	(pre-injury total symptoms)	Recent vs Long Term	3.50	
			Recent vs Intermediate	8.50	
			Intermediate vs Long Term	14.50	
	PCSC1FRQ	(pre-injury symptom frequency)	Recent vs Long Term	5.00	
			Recent vs Intermediate	10.50	
			Intermediate vs Long Term	14.50	
	PCSC1INT	(pre-injury symptom intensity)	Recent vs Long Term	3.00	
			Recent vs Intermediate	11.50	
			Intermediate vs Long Term	10.50	
	PCSC1DUR	(pre-injury symptom duration)	Recent vs Long Term	4.00	
			Recent vs Intermediate	10.00	
			Intermediate vs Long Term	13.00	
	PCSC2TOT	(post-injury total symptoms)	Recent vs Long Term	5.00	
			Recent vs Intermediate	16.00	
			Intermediate vs Long Term	14.00	
	PCSC2FRQ	(post-injury symptom frequency)	Recent vs Long Term	6.50	
			Recent vs Intermediate	13.50	
			Intermediate vs Long Term	14.00	
	PCSC2INT	(post-injury symptom intensity)	Recent vs Long Term	6.50	
			Recent vs Intermediate	10.50	
			Intermediate vs Long Term	15.00	
	PCSC2DUR	(post-injury symptom duration)	Recent vs Long Term	6.00	
			Recent vs Intermediate	14.50	
			Intermediate vs Long Term	13.50	
	TOTDIFF	(difference in total symptoms)	Recent vs Long Term	2.00	
			Recent vs Intermediate	12.00	
			Intermediate vs Long Term	10.00	
	FRQDIFF	(difference in symptom frequency)	Recent vs Long Term	2.00	
			Recent vs Intermediate	11.50	
			Intermediate vs Long Term	8.50	
	INTDIFF	(difference in symptom intensity)	Recent vs Long Term	*0.00	Recent < Long Term
			Recent vs Intermediate	10.50	
			Intermediate vs Long Term	11.50	

8.2.1.1. Recently Injured, Intermediate Injured, and Long Term Injured - continued

Test	Variable		Comparison	U value	Difference
	DURDIFF	(difference in symptom duration)	Recent vs Long Term	2.00	
			Recent vs Intermediate	12.50	
			Intermediate vs Long Term	9.00	
	HEADACH1	(pre-injury headaches)	Recent vs Long Term	4.00	
			Recent vs Intermediate	15.00	
			Intermediate vs Long Term	14.00	
	DIZZINE1	(pre-injury dizziness)	Recent vs Long Term	5.50	
			Recent vs Intermediate	11.00	
			Intermediate vs Long Term	16.00	
	IRRITAB1	(pre-injury irritability)	Recent vs Long Term	6.00	
			Recent vs Intermediate	12.00	
			Intermediate vs Long Term	16.00	
	MEMORY1	(pre-injury memory problems)	Recent vs Long Term	5.50	
			Recent vs Intermediate	12.50	
			Intermediate vs Long Term	15.50	
	CONCENT1	(pre-injury concentration problems)	Recent vs Long Term	2.00	
			Recent vs Intermediate	9.50	
			Intermediate vs Long Term	10.00	
	FATIGUE1	(pre-injury fatigue)	Recent vs Long Term	4.50	
			Recent vs Intermediate	9.00	
			Intermediate vs Long Term	13.00	
	VISION1	(pre-injury vision problems)	Recent vs Long Term	5.50	
			Recent vs Intermediate	5.50	
			Intermediate vs Long Term	13.50	
	NOISIN1	(pre-injury noise intolerance)	Recent vs Long Term	5.50	
			Recent vs Intermediate	8.50	
			Intermediate vs Long Term	9.00	
	JUDGEME1	(pre-injury judgement problems)	Recent vs Long Term	4.00	
			Recent vs Intermediate	13.00	
			Intermediate vs Long Term	11.50	
	ANXIETY1	(pre-injury anxiety)	Recent vs Long Term	4.00	
			Recent vs Intermediate	15.00	
			Intermediate vs Long Term	11.50	
	HEADACH2	(post-injury headaches)	Recent vs Long Term	3.00	
			Recent vs Intermediate	6.50	
			Intermediate vs Long Term	13.00	
	DIZZINE2	(post-injury dizziness)	Recent vs Long Term	7.50	
			Recent vs Intermediate	16.00	
			Intermediate vs Long Term	14.00	
	IRRITAB2	(post-injury irritability)	Recent vs Long Term	6.00	
			Recent vs Intermediate	14.00	
			Intermediate vs Long Term	12.00	
	MEMORY2	(post-injury memory problems)	Recent vs Long Term	6.00	
			Recent vs Intermediate	12.00	
			Intermediate vs Long Term	15.00	
	CONCENT2	(post-injury concentration problems)	Recent vs Long Term	6.00	
			Recent vs Intermediate	14.50	
			Intermediate vs Long Term	11.00	
	FATIGUE2	(post-injury fatigue)	Recent vs Long Term	6.00	
			Recent vs Intermediate	14.00	
			Intermediate vs Long Term	14.50	
	VISION2	(post-injury vision problems)	Recent vs Long Term	5.50	
			Recent vs Intermediate	14.50	
			Intermediate vs Long Term	13.50	

8.2.1.1. Recently Injured, Intermediate Injured, and Long Term Injured - continued

Test	Variable		Comparison	U value	Difference
	NOISIN2	(post-injury noise intolerance)	Recent vs Long Term	5.00	
			Recent vs Intermediate	7.00	
			Intermediate vs Long Term	15.00	
	JUDGEME2	(post-injury judgement problems)	Recent vs Long Term	6.00	
			Recent vs Intermediate	15.00	
			Intermediate vs Long Term	10.50	
	ANXIETY2	(post-injury anxiety)	Recent vs Long Term	8.00	
			Recent vs Intermediate	9.50	
			Intermediate vs Long Term	13.50	
	HEADADIF	(difference in headache incidence)	Recent vs Long Term	3.00	
			Recent vs Intermediate	11.00	
			Intermediate vs Long Term	15.00	
	DIZZIDIF	(difference in dizziness incidence)	Recent vs Long Term	6.00	
			Recent vs Intermediate	11.50	
			Intermediate vs Long Term	15.00	
	IRRITDIF	(difference in irritability)	Recent vs Long Term	2.00	
			Recent vs Intermediate	16.00	
			Intermediate vs Long Term	6.00	
	MEMDIF	(difference in memory problems)	Recent vs Long Term	4.00	
			Recent vs Intermediate	10.00	
			Intermediate vs Long Term	15.00	
	CONCDIF	(difference in concentration problems)	Recent vs Long Term	2.00	
			Recent vs Intermediate	12.00	
			Intermediate vs Long Term	7.50	
	FATIGDIF	(difference in fatigue)	Recent vs Long Term	3.50	
			Recent vs Intermediate	*12.50	
			Intermediate vs Long Term	13.50	
	VISIODIF	(difference in vision problems)	Recent vs Long Term	7.00	
			Recent vs Intermediate	12.50	
			Intermediate vs Long Term	12.50	
	NOISEDIF	(difference in noise intolerance)	Recent vs Long Term	5.00	
			Recent vs Intermediate	14.00	
			Intermediate vs Long Term	9.00	
	JUDGDIFF	(difference in judgement problems)	Recent vs Long Term	3.00	
			Recent vs Intermediate	14.00	
			Intermediate vs Long Term	*4.00	Inter < Long Term
	ANXDIFF	(difference in anxiety)	Recent vs Long Term	5.00	
			Recent vs Intermediate	15.00	
			Intermediate vs Long Term	14.00	
BVRT	BVCORR_C	(copy task correct)	Recent vs Long Term	4.00	
			Recent vs Intermediate	12.00	
			Intermediate vs Long Term	10.50	
	BVERR_C	(copy task errors)	Recent vs Long Term	4.00	
			Recent vs Intermediate	12.00	
			Intermediate vs Long Term	10.50	
	OMIS_C	(copy task omissions)	Recent vs Long Term	6.00	
			Recent vs Intermediate	13.50	
			Intermediate vs Long Term	14.00	
	DISTOR_C	(copy task *distortions*)	Recent vs Long Term	8.00	
			Recent vs Intermediate	14.00	
			Intermediate vs Long Term	14.00	
	PERSEV_C	(copy task perseverations)	Recent vs Long Term	8.00	
			Recent vs Intermediate	16.00	
			Intermediate vs Long Term	16.00	

8.2.1.1. Recently Injured, Intermediate Injured, and Long Term Injured - continued

Test	Variable		Comparison	U value	Difference
	ROTAT_C	(copy task rotations)	Recent vs Long Term	6.00	
			Recent vs Intermediate	16.00	
			Intermediate vs Long Term	12.00	
	MISPLA_C	(copy task misplacements)	Recent vs Long Term	4.00	
			Recent vs Intermediate	15.50	
			Intermediate vs Long Term	6.00	
	SIZE_C	(copy task size errors)	Recent vs Long Term	6.00	
			Recent vs Intermediate	16.00	
			Intermediate vs Long Term	12.00	
	LEFT_C	(copy task left-sided errors)	Recent vs Long Term	8.00	
			Recent vs Intermediate	15.00	
			Intermediate vs Long Term	15.00	
	RIGHT_C	(copy task right-sided errors)	Recent vs Long Term	2.00	
			Recent vs Intermediate	10.00	
			Intermediate vs Long Term	6.00	
	BVCORR_D	(recall task correct)	Recent vs Long Term	5.00	
			Recent vs Intermediate	14.50	
			Intermediate vs Long Term	10.00	
	BVERR_D	(recall task errors)	Recent vs Long Term	6.00	
			Recent vs Intermediate	15.00	
			Intermediate vs Long Term	11.00	
	OMIS_D	(recall task omissions)	Recent vs Long Term	8.00	
			Recent vs Intermediate	14.00	
			Intermediate vs Long Term	14.00	
	DISTOR_D	(recall task distortions)	Recent vs Long Term	6.50	
			Recent vs Intermediate	13.50	
			Intermediate vs Long Term	8.00	
	PERSEV_D	(recall task perseverations)	Recent vs Long Term	3.50	
			Recent vs Intermediate	15.00	
			Intermediate vs Long Term	6.00	
	ROTAT_D	(recall task rotations)	Recent vs Long Term	6.50	
			Recent vs Intermediate	12.00	
			Intermediate vs Long Term	16.00	
	MISPLA_D	(recall task misplacements)	Recent vs Long Term	7.50	
			Recent vs Intermediate	8.00	
			Intermediate vs Long Term	*1.50	Long Term < Inter
	SIZE_D	(recall task size errors)	Recent vs Long Term	7.50	
			Recent vs Intermediate	12.00	
			Intermediate vs Long Term	12.00	
	LEFT_D	(recall task left-sided errors)	Recent vs Long Term	3.50	
			Recent vs Intermediate	9.50	
			Intermediate vs Long Term	14.00	
	RIGHT_D	(recall task right-sided errors)	Recent vs Long Term	4.00	
			Recent vs Intermediate	11.00	
			Intermediate vs Long Term	8.00	
PASAT	PASAT1	(trial 1)	Recent vs Long Term	8.50	
			Recent vs Intermediate	8.50	
			Intermediate vs Long Term	*4.50	Inter < Long Term
	PASAT2	(trial 2)	Recent vs Long Term	6.50	
			Recent vs Intermediate	8.50	
			Intermediate vs Long Term	*4.50	Inter < Long Term
	PASAT3	(trial 3)	Recent vs Long Term	7.00	
			Recent vs Intermediate	12.00	
			Intermediate vs Long Term	12.50	

8.2.1.1. Recently Injured, Intermediate Injured, and Long Term Injured - continued

Test	Variable		Comparison	U value	Difference
	PASAT4	(trial 4)	Recent vs Long Term	6.00	
			Recent vs Intermediate	15.50	
			Intermediate vs Long Term	11.50	
	PACATTOT	(total score)	Recent vs Long Term	7.00	
			Recent vs Intermediate	9.00	
			Intermediate vs Long Term	9.00	
STROOP	STROOP1	(trial 1: speed)	Recent vs Long Term	7.50	
			Recent vs Intermediate	13.00	
			Intermediate vs Long Term	15.50	
	STROOP2	(trial 2: speed)	Recent vs Long Term	8.00	
			Recent vs Intermediate	10.00	
			Intermediate vs Long Term	10.00	
	STROOP3	(trial 3: speed)	Recent vs Long Term	7.00	
			Recent vs Intermediate	13.00	
			Intermediate vs Long Term	13.00	
	STROOP4	(trial 4: speed)	Recent vs Long Term	8.00	
			Recent vs Intermediate	9.00	
			Intermediate vs Long Term	7.50	
	SUBT32	(speed difference: trials 3 and 2)	Recent vs Long Term	8.00	
			Recent vs Intermediate	15.00	
			Intermediate vs Long Term	15.00	
	SUBT42	(speed difference: trials 4 and 2)	Recent vs Long Term	7.50	
			Recent vs Intermediate	10.00	
			Intermediate vs Long Term	11.50	
	STR1ACC	(trial 1: accuracy)	Recent vs Long Term	6.50	
			Recent vs Intermediate	14.00	
			Intermediate vs Long Term	11.50	
	STR2ACC	(trial 2: accuracy)	Recent vs Long Term	7.00	
			Recent vs Intermediate	5.00	
			Intermediate vs Long Term	*3.50	Inter < Long Term
	STR3ACC	(trial 3: accuracy)	Recent vs Long Term	6.00	
			Recent vs Intermediate	15.50	
			Intermediate vs Long Term	11.00	
	STR4ACC	(trial 4: accuracy)	Recent vs Long Term	5.00	
			Recent vs Intermediate	12.00	
			Intermediate vs Long Term	12.00	
REY 15-ITEM	FIFTEEN	(total correct)	Recent vs Long Term	5.00	
			Recent vs Intermediate	9.50	
			Intermediate vs Long Term	14.50	
RDS	RDSFORW	(total score forward)	Recent vs Long Term	6.00	
			Recent vs Intermediate	11.00	
			Intermediate vs Long Term	15.00	
	RDSBACK	(total score backwards)	Recent vs Long Term	7.00	
			Recent vs Intermediate	15.50	
			Intermediate vs Long Term	14.00	
	RDSTOT	(overall total)	Recent vs Long Term	5.50	
			Recent vs Intermediate	11.00	
			Intermediate vs Long Term	15.50	
	RDSDIFF	(forward minus backward score)	Recent vs Long Term	5.50	
			Recent vs Intermediate	11.50	
			Intermediate vs Long Term	12.50	

Note. *p < .05

8.2.1.2. Comparison between Recently Injured, Malingering, and Noninjured Groups

Test	Variable		Comparison	U value	Difference
PCL	PCL1	(pre-injury total symptoms)	Recent vs Mal	*8.00	Mal < Recent
			Recent vs Non	28.50	
	PCL2	(post-injury total symptoms)	Recent vs Mal	*3	Recent < Mal
			Recent vs Non	20.50	
	PCLDIFF	(difference in total symptoms)	Recent vs Mal	*0	Recent < Mal
	PCLPCS1	(pre-injury typical PSC)	Recent vs Mal	13.00	
			Recent vs Non	24.50	
	PCLPCS2	(post-injury typical PCS)	Recent vs Mal	*5	Recent < Mal
			Recent vs Non	23.00	
	PCLPCDIF	(difference in typical PCS)	Recent vs Mal	*0	Recent < Mal
PCSC	PCSC1TOT	(pre-injury total symptoms)	Recent vs Mal	*11	Mal < Recent
			Recent vs Non	26.50	
	PCSC1FRQ	(pre-injury symptom frequency)	Recent vs Mal	12.00	
			Recent vs Non	29.00	
	PCSC1INT	(pre-injury symptom intensity)	Recent vs Mal	12.00	
			Recent vs Non	21.50	
	PCSC1DUR	(pre-injury symptom duration)	Recent vs Mal	11.50	
			Recent vs Non	25.00	
	PCSC2TOT	(post-injury total symptoms)	Recent vs Mal	*4	Recent < Mal
			Recent vs Non	28.50	
	PCSC2FRQ	(post-injury symptom frequency)	Recent vs Mal	*4.5	Recent < Mal
			Recent vs Non	24.50	
	PCSC2INT	(post-injury symptom intensity)	Recent vs Mal	*2.5	Recent < Mal
			Recent vs Non	23.50	
	PCSC2DUR	(post-injury symptom duration)	Recent vs Mal	15.00	
			Recent vs Non	29.50	
	TOTDIFF	(difference in total symptoms)	Recent vs Mal	*0	Recent < Mal
	FRQDIFF	(difference in symptom frequency)	Recent vs Mal	*0	Recent < Mal
	INTDIFF	(difference in symptom intensity)	Recent vs Mal	*0	Recent < Mal
	DURDIFF	(difference in symptom duration)	Recent vs Mal	*0.5	Recent < Mal
	HEADACH1	(pre-injury headaches)	Recent vs Mal	29.00	
			Recent vs Non	13.00	
	DIZZINE1	(pre-injury dizziness)	Recent vs Mal	23.50	
			Recent vs Non	27.50	
	IRRITAB1	(pre-injury irritability)	Recent vs Mal	15.50	
			Recent vs Non	20.50	
	MEMORY1	(pre-injury memory problems)	Recent vs Mal	23.00	
			Recent vs Non	19.50	
	CONCENT1	(pre-injury concentration problems)	Recent vs Mal	11.50	
			Recent vs Non	23.00	
	FATIGUE1	(pre-injury fatigue)	Recent vs Mal	16.50	
			Recent vs Non	28.50	
	VISION1	(pre-injury vision problems)	Recent vs Mal	*8.5	Mal < Recent
			Recent vs Non	21.50	
	NOISEIN1	(pre-injury noise intolerance)	Recent vs Mal	26.50	
			Recent vs Non	10.50	
	JUDGEME1	(pre-injury judgement problems)	Recent vs Mal	12.50	
			Recent vs Non	24.50	
	ANXIETY1	(pre-injury anxiety)	Recent vs Mal	*9	Mal < Recent
			Recent vs Non	*8	Recent < Mal
	HEADACH2	(post-injury headaches)	Recent vs Mal	*3.5	Recent < Mal
			Recent vs Non	17.50	
	DIZZINE2	(post-injury dizziness)	Recent vs Mal	*7.5	Recent < Mal
			Recent vs Non	21.50	

8.2.1.2. Recently Injured, Malingering, and Noninjured Groups - continued

Test	Variable		Comparison	U value	Difference
	IRRITAB2	(post-injury irritability)	Recent vs Mal	15.00	
			Recent vs Non	20.50	
	MEMORY2	(post-injury memory problems)	Recent vs Mal	*6	Recent < Mal
			Recent vs Non	19.50	
	CONCENT2	(post-injury concentration problems)	Recent vs Mal	14.50	
			Recent vs Non	23.00	
	FATIGUE2	(post-injury fatigue)	Recent vs Mal	15.00	
			Recent vs Non	30.00	
	VISION2	(post-injury vision problems)	Recent vs Mal	21.50	
			Recent vs Non	19.50	
	NOISIN2	(post-injury noise intolerance)	Recent vs Mal	*5	Recent < Mal
			Recent vs Non	15.00	
	JUDGEME2	(post-injury judgement problems)	Recent vs Mal	15.00	
			Recent vs Non	21.50	
	ANXIETY2	(post-injury anxiety)	Recent vs Mal	*5.5	Recent < Mal
			Recent vs Non	*8	Recent < Non
	HEADADIF	(difference in headache incidence)	Recent vs Mal	*0	Recent < Mal
	DIZZDIF	(difference in dizziness incidence)	Recent vs Mal	*4	Recent < Mal
	IRRITDIF	(difference in irritability)	Recent vs Mal	*4	Recent < Mal
	MEMDIF	(difference in memory problems)	Recent vs Mal	*4	Recent < Mal
	CONCDIF	(difference in concentration problems)	Recent vs Mal	*4	Recent < Mal
	FATIGDIF	(difference in fatigue)	Recent vs Mal	*2.5	Recent < Mal
	VISIODIF	(difference in vision problems)	Recent vs Mal	*7.5	Recent < Mal
	NOISEDIF	(difference in noise intolerance)	Recent vs Mal	*6	Recent < Mal
	JUDGDIFF	(difference in judgement problems)	Recent vs Mal	*10.5	Recent < Mal
	ANXDIFF	(difference in anxiety)	Recent vs Mal	*2.5	Recent < Mal
BVRT	BVRCOR_C	(copy task correct)	Recent vs Mal	21.50	
			Recent vs Non	28.00	
	BVRERR_C	(copy task errors)	Recent vs Mal	19.50	
			Recent vs Non	26.50	
	OMIS_C	(copy task omissions)	Recent vs Mal	31.50	
			Recent vs Non	29.00	
	DISTOR_C	(copy task distortions)	Recent vs Mal	*10.5	Recent < Mal
			Recent vs Non	26.50	
	PERSEV_C	(copy task perseverations)	Recent vs Mal	30.00	
			Recent vs Non	30.00	
	ROTAT_C	(copy task rotations)	Recent vs Mal	*10	Recent < Mal
			Recent vs Non	24.00	
	MISPLA_C	(copy task misplacements)	Recent vs Mal	29.50	
			Recent vs Non	29.50	
	SIZE_C	(copy task size errors)	Recent vs Mal	28.00	
			Recent vs Non	28.00	
	LEFT_C	(copy task left-sided errors)	Recent vs Mal	16.50	
			Recent vs Non	25.50	
	RIGHT_C	(copy task right-sided errors)	Recent vs Mal	24.50	
			Recent vs Non	27.50	
	BVRCOR_D	(recall task correct)	Recent vs Mal	17.00	
			Recent vs Non	29.00	
	BVRERR_D	(recall task errors)	Recent vs Mal	17.00	
			Recent vs Non	26.50	
	OMIS_D	(recall task omissions)	Recent vs Mal	24.00	
			Recent vs Non	29.50	
	DISTOR_D	(recall task distortions)	Recent vs Mal	11.50	
			Recent vs Non	27.50	

8.2.1.2. Recently Injured, Malingering, and Noninjured Groups - continued

Test	Variable		Comparison	U value	Difference
	PERSEV_D	(recall task perseverations)	Recent vs Mal	22.50	
			Recent vs Non	23.50	
	ROTAT_D	(recall task rotations)	Recent vs Mal	24.00	
			Recent vs Non	22.50	
	MISPLA_D	(recall task misplacements)	Recent vs Mal	19.50	
			Recent vs Non	23.00	
	SIZE_D	(recall task size errors)	Recent vs Mal	30.00	
			Recent vs Non	22.30	
	LEFT_D	(recall task left-sided errors)	Recent vs Mal	*7.5	Recent < Mal
			Recent vs Non	19.50	
	RIGHT_D	(recall task right-sided errors)	Recent vs Mal	31.00	
			Recent vs Non	20.00	
PASAT	PASAT1	(trial 1)	Recent vs Mal	22.50	
			Recent vs Non	18.50	
	PASAT2	(trial 2)	Recent vs Mal	*9	Mal < Recent
			Recent vs Non	28.00	
	PASAT3	(trial 3)	Recent vs Mal	13.00	
			Recent vs Non	25.50	
	PASAT4	(trial 4)	Recent vs Mal	14.50	
			Recent vs Non	25.50	
	PASATTOT	(total score)	Recent vs Mal	13.00	
			Recent vs Non	28.00	
STROOP	STROOP1	(trial 1: speed)	Recent vs Mal	22.00	
			Recent vs Non	10.50	
	STROOP2	(trial 2: speed)	Recent vs Mal	16.50	
			Recent vs Non	23.50	
	STROOP3	(trial 3: speed)	Recent vs Mal	24.00	
			Recent vs Non	20.50	
	STROOP4	(trial 4: speed)	Recent vs Mal	23.50	
			Recent vs Non	28.00	
	SUBT32	(speed difference: trials 3 and 2)	Recent vs Mal	23.00	
			Recent vs Non	24.50	
	SUBT42	(speed difference: trials 4 and 2)	Recent vs Mal	31.50	
			Recent vs Non	27.50	
	STR1ACC	(trial 1: accuracy)	Recent vs Mal	16.50	
			Recent vs Non	28.50	
	STR2ACC	(trial 2: accuracy)	Recent vs Mal	*5	Mal < Recent
			Recent vs Non	23.00	
	STR3ACC	(trial 3: accuracy)	Recent vs Mal	10.50	
			Recent vs Non	29.00	
	STR4ACC	(trial 4: accuracy)	Recent vs Mal	*7.5	Mal < Recent
			Recent vs Non	27.00	
REY 15-ITEM	FIFTEEN	(total correct)	Recent vs Mal	*3.5	Mal < Recent
			Recent vs Non	11.50	
RDS	RDSFORW	(total score forward)	Recent vs Mal	13.00	
			Recent vs Non	24.50	
	RDSBACK	(total score backwards)	Recent vs Mal	14.50	
			Recent vs Non	26.00	
	RDSTOT	(overall total)	Recent vs Mal	*10.5	Mal < Recent
			Recent vs Non	28.00	
	RDSDIFF	(forward minus backward score)	Recent vs Mal	16.00	
			Recent vs Non	22.00	

Note. *$p < .05$

8.2.1.3. Comparison between Intermediate Injured, Malingering, and Noninjured Groups

Test	Variable		Comparison	U value	Difference
PCL	PCL1	(pre-injury total symptoms)	Intermediate vs Mal	*8	Mal < Inter
			Intermediate vs Non	55.00	
	PCL2	(post-injury total symptoms)	Intermediate vs Mal	*20.5	Mal < Inter
			Intermediate vs Non	44.50	
	PCLDIFF	(difference in total symptoms)	Intermediate vs Mal	*1	Inter < Mal
	PCLPCS1	(pre-injury typical PSC)	Intermediate vs Mal	*6	Mal < Inter
			Intermediate vs Non	42.50	
	PCLPCS2	(post-injury typical PCS)	Intermediate vs Mal	*19	Inter < Mal
			Intermediate vs Non	58.50	
	PCLPCDIF	(difference in typical PCS)	Intermediate vs Mal	*0	Inter < Mal
PCSC	PCSC1TOT	(pre-injury total symptoms)	Intermediate vs Mal	43.00	
			Intermediate vs Non	30.50	
	PCSC1FRQ	(pre-injury symptom frequency)	Intermediate vs Mal	49.00	
			Intermediate vs Non	34.00	
	PCSC1INT	(pre-injury symptom intensity)	Intermediate vs Mal	41.00	
			Intermediate vs Non	*27	Inter < Non
	PCSC1DUR	(pre-injury symptom duration)	Intermediate vs Mal	42.00	
			Intermediate vs Non	33.00	
	PCSC2TOT	(post-injury total symptoms)	Intermediate vs Mal	*20.5	Inter < Mal
			Intermediate vs Non	50.50	
	PCSC2FRQ	(post-injury symptom frequency)	Intermediate vs Mal	*16	Inter < Mal
			Intermediate vs Non	42.00	
	PCSC2INT	(post-injury symptom intensity)	Intermediate vs Mal	*23.5	Inter < Mal
			Intermediate vs Non	54.50	
	PCSC2DUR	(post-injury symptom duration)	Intermediate vs Mal	34.50	
			Intermediate vs Non	54.50	
	TOTDIFF	(difference in total symptoms)	Intermediate vs Mal	*20	Inter < Mal
	FRQDIFF	(difference in symptom frequency)	Intermediate vs Mal	*16	Inter < Mal
	INTDIFF	(difference in symptom intensity)	Intermediate vs Mal	*20	Inter < Mal
	DURDIFF	(difference in symptom duration)	Intermediate vs Mal	*27	Inter < Mal
	HEADACH1	(pre-injury headaches)	Intermediate vs Mal	56.00	
			Intermediate vs Non	44.00	
	DIZZINE1	(pre-injury dizziness)	Intermediate vs Mal	60.00	
			Intermediate vs Non	50.00	
	IRRITAB1	(pre-injury irritability)	Intermediate vs Mal	56.50	
			Intermediate vs Non	57.50	
	MEMORY1	(pre-injury memory problems)	Intermediate vs Mal	63.00	
			Intermediate vs Non	35.00	
	CONCENT1	(pre-injury concentration problems)	Intermediate vs Mal	49.50	
			Intermediate vs Non	52.50	
	FATIGUE1	(pre-injury fatigue)	Intermediate vs Mal	54.50	
			Intermediate vs Non	*26	Inter < Non
	VISION1	(pre-injury vision problems)	Intermediate vs Mal	59.50	
			Intermediate vs Non	49.50	
	NOISEIN1	(pre-injury noise intolerance)	Intermediate vs Mal	37.00	
			Intermediate vs Non	37.00	
	JUDGEME1	(pre-injury judgement problems)	Intermediate vs Mal	41.50	
			Intermediate vs Non	58.50	
	ANXIETY1	(pre-injury anxiety)	Intermediate vs Mal	48.00	
			Intermediate vs Non	*26	Inter < Non
	HEADACH2	(post-injury headaches)	Intermediate vs Mal	44.50	
			Intermediate vs Non	39.00	
	DIZZINE2	(post-injury dizziness)	Intermediate vs Mal	*31	Inter < Mal
			Intermediate vs Non	47.00	

8.2.1.3. Intermediate Injured, Malingering, and Noninjured Groups - continued

Test	Variable		Comparison	U value	Difference
	IRRITAB2	(post-injury irritability)	Intermediate vs Mal	*23	Inter < Mal
			Intermediate vs Non	49.50	
	MEMORY2	(post-injury memory problems)	Intermediate vs Mal	46.50	
			Intermediate vs Non	52.00	
	CONCENT2	(post-injury concentration problems)	Intermediate vs Mal	*28	Inter < Mal
			Intermediate vs Non	53.00	
	FATIGUE2	(post-injury fatigue)	Intermediate vs Mal	47.00	
			Intermediate vs Non	58.50	
	VISION2	(post-injury vision problems)	Intermediate vs Mal	44.00	
			Intermediate vs Non	48.00	
	NOISIN2	(post-injury noise intolerance)	Intermediate vs Mal	*30	Inter < Mal
			Intermediate vs Non	56.50	
	JUDGEME2	(post-injury judgement problems)	Intermediate vs Mal	*29.5	Inter < Mal
			Intermediate vs Non	49.50	
	ANXIETY2	(post-injury anxiety)	Intermediate vs Mal	*22	Inter < Mal
			Intermediate vs Non	48.50	
	HEADADIF	(difference in headache incidence)	Intermediate vs Mal	40.00	
	DIZZDIF	(difference in dizziness incidence)	Intermediate vs Mal	*26.5	Inter < Mal
	IRRITDIF	(difference in irritability)	Intermediate vs Mal	*12	Inter < Mal
	MEMDIF	(difference in memory problems)	Intermediate vs Mal	37.00	
	CONCDIF	(difference in concentration problems)	Intermediate vs Mal	*18.5	Inter < Mal
	FATIGDIF	(difference in fatigue)	Intermediate vs Mal	46.50	
	VISIODIF	(difference in vision problems)	Intermediate vs Mal	42.00	
	NOISEDIF	(difference in noise intolerance)	Intermediate vs Mal	*24	Inter < Mal
	JUDGDIFF	(difference in judgement problems)	Intermediate vs Mal	*24	Inter < Mal
	ANXDIFF	(difference in anxiety)	Intermediate vs Mal	*20.5	Inter < Mal
BVRT	BVRCOR_C	(copy task correct)	Intermediate vs Mal	*31	Mal < Inter
			Intermediate vs Non	38.00	
	BVRERR_C	(copy task errors)	Intermediate vs Mal	*30	Inter < Mal
			Intermediate vs Non	36.00	
	OMIS_C	(copy task omissions)	Intermediate vs Mal	51.50	
			Intermediate vs Non	47.00	
	DISTOR_C	(copy task distortions)	Intermediate vs Mal	*18.5	Inter < Mal
			Intermediate vs Non	46.50	
	PERSEV_C	(copy task perseverations)	Intermediate vs Mal	60.00	
			Intermediate vs Non	60.00	
	ROTAT_C	(copy task rotations)	Intermediate vs Mal	*20	Inter < Mal
			Intermediate vs Non	48.00	
	MISPLA_C	(copy task misplacements)	Intermediate vs Mal	56.50	
			Intermediate vs Non	58.00	
	SIZE_C	(copy task size errors)	Intermediate vs Mal	56.00	
			Intermediate vs Non	56.00	
	LEFT_C	(copy task left-sided errors)	Intermediate vs Mal	*27	Inter < Mal
			Intermediate vs Non	43.00	
	RIGHT_C	(copy task right-sided errors)	Intermediate vs Mal	39.00	
			Intermediate vs Non	37.50	
	BVRCOR_D	(recall task correct)	Intermediate vs Mal	38.50	
			Intermediate vs Non	55.00	
	BVRERR_D	(recall task errors)	Intermediate vs Mal	*28	Inter < Mal
			Intermediate vs Non	51.00	
	OMIS_D	(recall task omissions)	Intermediate vs Mal	54.00	
			Intermediate vs Non	52.50	
	DISTOR_D	(recall task distortions)	Intermediate vs Mal	*17	Inter < Mal
			Intermediate vs Non	59.50	

8.2.1.3. Intermediate Injured, Malingering, and Noninjured Groups - continued

Test	Variable		Comparison	U value	Difference
	PERSEV_D	(recall task perseverations)	Intermediate vs Mal	37.50	
			Intermediate vs Non	41.00	
	ROTAT_D	(recall task rotations)	Intermediate vs Mal	37.50	
			Intermediate vs Non	56.50	
	MISPLA_D	(recall task misplacements)	Intermediate vs Mal	49.00	
			Intermediate vs Non	33.00	
	SIZE_D	(recall task size errors)	Intermediate vs Mal	52.00	
			Intermediate vs Non	60.00	
	LEFT_D	(recall task left-sided errors)	Intermediate vs Mal	*21	Inter < Mal
			Intermediate vs Non	59.00	
	RIGHT_D	(recall task right-sided errors)	Intermediate vs Mal	36.50	
			Intermediate vs Non	57.50	
PASAT	PASAT1	(trial 1)	Intermediate vs Mal	56.50	
			Intermediate vs Non	*25.5	Inter < Non
	PASAT2	(trial 2)	Intermediate vs Mal	36.50	
			Intermediate vs Non	36.50	
	PASAT3	(trial 3)	Intermediate vs Mal	40.50	
			Intermediate vs Non	52.50	
	PASAT4	(trial 4)	Intermediate vs Mal	*26.5	Mal < Inter
			Intermediate vs Non	46.00	
	PASATTOT	(total score)	Intermediate vs Mal	49.50	
			Intermediate vs Non	33.00	
STROOP	STROOP1	(trial 1: speed)	Intermediate vs Mal	45.50	
			Intermediate vs Non	34.50	
	STROOP2	(trial 2: speed)	Intermediate vs Mal	53.50	
			Intermediate vs Non	*25	Non < Inter
	STROOP3	(trial 3: speed)	Intermediate vs Mal	61.00	
			Intermediate vs Non	43.00	
	STROOP4	(trial 4: speed)	Intermediate vs Mal	60.00	
			Intermediate vs Non	36.50	
	SUBT32	(speed difference: trials 3 and 2)	Intermediate vs Mal	47.50	
			Intermediate vs Non	54.00	
	SUBT42	(speed difference: trials 4 and 2)	Intermediate vs Mal	49.50	
			Intermediate vs Non	47.00	
	STR1ACC	(trial 1: accuracy)	Intermediate vs Mal	35.50	
			Intermediate vs Non	51.50	
	STR2ACC	(trial 2: accuracy)	Intermediate vs Mal	25.50	
			Intermediate vs Non	36.50	
	STR3ACC	(trial 3: accuracy)	Intermediate vs Mal	22.00	
			Intermediate vs Non	59.50	
	STR4ACC	(trial 4: accuracy)	Intermediate vs Mal	*21	Mal < Inter
			Intermediate vs Non	51.00	
REY 15-ITEM	FIFTEEN	(total correct)	Intermediate vs Mal	*14	Mal < Inter
			Intermediate vs Non	48.50	
RDS	RDSFORW	(total score forward)	Intermediate vs Mal	36.50	
			Intermediate vs Non	51.50	
	RDSBACK	(total score backwards)	Intermediate vs Mal	*31.5	Mal < Inter
			Intermediate vs Non	50.00	
	RDSTOT	(overall total)	Intermediate vs Mal	*30.5	Mal < Inter
			Intermediate vs Non	48.50	
	RDSDIFF	(forward minus backward score)	Intermediate vs Mal	47.00	
			Intermediate vs Non	58.50	

Note. *p < .05

8.2.1.4. Comparison between Long Term Injured, Malingering, and Noninjured Groups

Test	Variable		Comparison	U value	Difference
PCL	PCL1	(pre-injury total symptoms)	Long Term vs Mal	*6	Mal < Long Term
			Long Term vs Non	29.50	
	PCL2	(post-injury total symptoms)	Long Term vs Mal	11.50	
			Long Ter[illegible]	26.50	
	PCLDIFF	(difference in total symptoms)	Long Term [illegible]	*1	Long Term < Mal
	PCLPCS1	(pre-injury typical PSC)	Long Term vs Mal	*2	Mal < Long Term
			Long Term vs Non	13.50	
	PCLPCS2	(post-injury typical PCS)	Long Term vs Mal	13.00	
			Long Term vs Non	24.50	
	PCLPCDIF	(difference in typical PCS)	Long Term vs Mal	*5	Long Term < Mal
PCSC	PCSC1TOT	(pre-injury total symptoms)	Long Term vs Mal	21.50	
			Long Term vs Non	*7	Long Term < Non
	PCSC1FRQ	(pre-injury symptom frequency)	Long Term vs Mal	20.00	
			Long Term vs Non	17.50	
	PCSC1INT	(pre-injury symptom intensity)	Long Term vs Mal	25.50	
			Long Term vs Non	*3.5	Long Term < Non
	PCSC1DUR	(pre-injury symptom duration)	Long Term vs Mal	20.00	
			Long Term vs Non	*9	Long Term < Non
	PCSC2TOT	(post-injury total symptoms)	Long Term vs Mal	18.50	
			Long Term vs Non	23.50	
	PCSC2FRQ	(post-injury symptom frequency)	Long Term vs Mal	18.00	
			Long Term vs Non	21.00	
	PCSC2INT	(post-injury symptom intensity)	Long Term vs Mal	15.00	
			Long Term vs Non	26.50	
	PCSC2DUR	(post-injury symptom duration)	Long Term vs Mal	23.00	
			Long Term vs Non	23.00	
	TOTDIFF	(difference in total symptoms)	Long Term vs Mal	16.00	
	FRQDIFF	(difference in symptom frequency)	Long Term vs Mal	15.50	
	INTDIFF	(difference in symptom intensity)	Long Term vs Mal	13.00	
	DURDIFF	(difference in symptom duration)	Long Term vs Mal	18.50	
	HEADACH1	(pre-injury headaches)	Long Term vs Mal	18.00	
			Long Term vs Non	22.0[illegible]	
	DIZZINE1	(pre-injury dizziness)	Long Term vs Mal	30.0	
			Long Term vs Non	25.00	
	IRRITAB1	(pre-injury irritability)	Long Term vs Mal	25.00	
			Long Term vs Non	27.00	
	MEMORY1	(pre-injury memory problems)	Long Term vs Mal	32.00	
			Long Term vs Non	13.50	
	CONCENT1	(pre-injury concentration problems)	Long Term vs Mal	26.00	
			Long Term vs Non	16.00	
	FATIGUE1	(pre-injury fatigue)	Long Term vs Mal	28.5[illegible]	
			Long Term vs Non	13.00	
	VISION1	(pre-injury vision problems)	Long Term vs Mal	25.50	
			Long Term vs Non	29.00	
	NOISEIN1	(pre-injury noise intolerance)	Long Term vs Mal	27.50	
			Long Term vs Non	10.50	
	JUDGEME1	(pre-injury judgement problems)	Long Term vs Mal	28.50	
			Long Term vs Non	22.00	
	ANXIETY1	(pre-injury anxiety)	Long Term vs Mal	30.00	
			Long Term vs Non	*6	Long Term < Non
	HEADACH2	(post-injury headaches)	Long Term vs Mal	17.00	
			Long Term vs Non	25.50	
	DIZZINE2	(post-injury dizziness)	Long Term vs Mal	18.50	
			Long Term vs Non	20.00	

8.2.1.4. Long Term Injured, Malingering, and Noninjured Groups - continued

Test	Variable		Comparison	U value	Difference
	IRRITAB2	(post-injury irritability)	Long Term vs Mal	22.00	
			Long Term vs Non	15.50	
	MEMORY2	(post-injury memory problems)	Long Term vs Mal	24.50	
			Long Term vs Non	26.00	
	CONCENT2	(post-injury concentration problems)	Long Term vs Mal	26.00	
			Long Term vs Non	17.00	
	FATIGUE2	(post-injury fatigue)	Long Term vs Mal	18.50	
			Long Term vs Non	25.50	
	VISION2	(post-injury vision problems)	Long Term vs Mal	20.50	
			Long Term vs Non	28.50	
	NOISIN2	(post-injury noise intolerance)	Long Term vs Mal	17.00	
			Long Term vs Non	28.00	
	JUDGEME2	(post-injury judgement problems)	Long Term vs Mal	24.50	
			Long Term vs Non	16.00	
	ANXIETY2	(post-injury anxiety)	Long Term vs Mal	13.00	
			Long Term vs Non	19.50	
	HEADADIF	(difference in headache incidence)	Long Term vs Mal	*3	Long Term < Mal
	DIZZDIF	(difference in dizziness incidence)	Long Term vs Mal	18.00	
	IRRITDIF	(difference in irritability)	Long Term vs Mal	19.50	
	MEMDIF	(difference in memory problems)	Long Term vs Mal	25.50	
	CONCDIF	(difference in concentration problems)	Long Term vs Mal	28.00	
	FATIGDIF	(difference in fatigue)	Long Term vs Mal	24.00	
	VISIODIF	(difference in vision problems)	Long Term vs Mal	19.00	
	NOISEDIF	(difference in noise intolerance)	Long Term vs Mal	19.50	
	JUDGDIFF	(difference in judgement problems)	Long Term vs Mal	23.00	
	ANXDIFF	(difference in anxiety)	Long Term vs Mal	*8	Long Term < Mal
BVRT	BVRCOR_C	(copy task correct)	Long Term vs Mal	*10.5	Mal < Long Term
			Long Term vs Non	12.00	
	BVRERR_C	(copy task errors)	Long Term vs Mal	*9.5	Long Term < Mal
			Long Term vs Non	11.00	
	OMIS_C	(copy task omissions)	Long Term vs Mal	22.00	
			Long Term vs Non	20.00	
	DISTOR_C	(copy task distortions)	Long Term vs Mal	*10.5	Long Term < Mal
			Long Term vs Non	26.50	
	PERSEV_C	(copy task perseverations)	Long Term vs Mal	30.00	
			Long Term vs Non	30.00	
	ROTAT_C	(copy task rotations)	Long Term vs Mal	14.50	
			Long Term vs Non	29.50	
	MISPLA_C	(copy task misplacements)	Long Term vs Mal	16.00	
			Long Term vs Non	14.00	
	SIZE_C	(copy task size errors)	Long Term vs Mal	28.50	
			Long Term vs Non	24.50	
	LEFT_C	(copy task left-sided errors)	Long Term vs Mal	16.50	
			Long Term vs Non	25.50	
	RIGHT_C	(copy task right-sided errors)	Long Term vs Mal	*10	Long Term < Mal
			Long Term vs Non	*6	Long Term < Mal
	BVRCOR_D	(recall task correct)	Long Term vs Mal	*7.5	Mal < Long Term
			Long Term vs Non	20.00	
	BVRERR_D	(recall task errors)	Long Term vs Mal	*9.5	Long Term < Mal
			Long Term vs Non	25.00	
	OMIS_D	(recall task omissions)	Long Term vs Mal	24.00	
			Long Term vs Non	29.50	
	DISTOR_D	(recall task distortions)	Long Term vs Mal	15.00	
			Long Term vs Non	17.50	

8.2.1.4. Long Term Injured, Malingering, and Noninjured Groups - continued

Test	Variable		Comparison	U value	Difference
	PERSEV_D	(recall task perseverations)	Long Term vs Mal	21.50	
			Long Term vs Non	20.00	
	ROTAT_D	(recall task rotations)	Long Term vs Mal	19.50	
			Long Term vs Non	28.00	
	MISPLA_D	(recall task misplacements)	Long Term vs Mal	*11	Long Term < Mal
			Long Term vs Non	17.50	
	SIZE_D	(recall task size errors)	Long Term vs Mal	28.50	
			Long Term vs Non	22.50	
	LEFT_D	(recall task left-sided errors)	Long Term vs Mal	16.50	
			Long Term vs Non	25.50	
	RIGHT_D	(recall task right-sided errors)	Long Term vs Mal	*6.5	Long Term < Mal
			Long Term vs Non	16.00	
PASAT	PASAT1	(trial 1)	Long Term vs Mal	17.00	
			Long Term vs Non	21.00	
	PASAT2	(trial 2)	Long Term vs Mal	*7.5	Mal < Long Term
			Long Term vs Non	24.50	
	PASAT3	(trial 3)	Long Term vs Mal	12.00	
			Long Term vs Non	29.00	
	PASAT4	(trial 4)	Long Term vs Mal	*8.5	Mal < Long Term
			Long Term vs Non	25.50	
	PASATTOT	(total score)	Long Term vs Mal	*9	Mal < Long Term
			Long Term vs Non	29.50	
STROOP	STROOP1	(trial 1: speed)	Long Term vs Mal	21.50	
			Long Term vs Non	15.50	
	STROOP2	(trial 2: speed)	Long Term vs Mal	15.00	
			Long Term vs Non	27.00	
	STROOP3	(trial 3: speed)	Long Term vs Mal	23.00	
			Long Term vs Non	25.50	
	STROOP4	(trial 4: speed)	Long Term vs Mal	22.50	
			Long Term vs Non	25.50	
	SUBT32	(speed difference: trials 3 and 2)	Long Term vs Mal	20.00	
			Long Term vs Non	25.00	
	SUBT42	(speed difference: trials 4 and 2)	Long Term vs Mal	29.00	
			Long Term vs Non	28.50	
	STR1ACC	(trial 1: accuracy)	Long Term vs Mal	13.50	
			Long Term vs Non	26.00	
	STR2ACC	(trial 2: accuracy)	Long Term vs Mal	*3	Mal < Long Term
			Long Term vs Non	18.50	
	STR3ACC	(trial 3: accuracy)	Long Term vs Mal	11.00	
			Long Term vs Non	26.50	
	STR4ACC	(trial 4: accuracy)	Long Term vs Mal	*6	Mal < Long Term
			Long Term vs Non	19.50	
REY 15-ITEM	FIFTEEN	(total correct)	Long Term vs Mal	*10	Mal < Long Term
			Long Term vs Non	29.50	
RDS	RDSFORW	(total score forward)	Long Term vs Mal	16.50	
			Long Term vs Non	28.00	
	RDSBACK	(total score backwards)	Long Term vs Mal	16.00	
			Long Term vs Non	22.00	
	RDSTOT	(overall total)	Long Term vs Mal	15.00	
			Long Term vs Non	22.50	
	RDSDIFF	(forward minus backward score)	Long Term vs Mal	19.50	
			Long Term vs Non	25.00	

Note. *$p < .05$

2.1.4. Examination of Pre-, Peri-, and Post-injury Factors

The injured group was then examined in more detail, with regard to the above factors.

Subgroups defined in terms of gender, region, circumstances of injury, and culpability, were compared, also using the Mann-Whitney U test. In terms of circumstances of injury, it was decided only to compare sports injured subjects with violently injured subjects. The small numbers in other categories made their inclusion unfeasible. Given numbers available, it was not possible to extend consideration of these factors to the three chronicity-defined injured subgroups (recent, intermediate and long term).

For each of the subgroup comparisons, results are shown in tables 8.2.2., 8.2.3., 8.2.4., and 8.2.5., respectively.

8.2.2. Gender Comparisons

8.2.2 1. Male Injured versus Female Injured

Test	Score		U value	Significant differences
PCL	PCL1	(pre-injury total symptoms)	12.00	
	PCL2	(post-injury total symptoms)	*7	Male Injured < Female Injured
	PCLDIFF	(difference in total symptoms)	*5.5	Male Injured < Female Injured
	PCLPCS1	(pre-injury typical PSC)	18.00	
	PCLPCS2	(post-injury typical PCS)	*7	Male Injured < Female Injured
	PCLPCDIF	(difference in typical PCS)	*3.5	Male Injured < Female Injured
PCSC	PCSC1TOT	(pre-injury total symptoms)	21.50	
	PCSC1FRQ	(pre-injury symptom frequency)	22.50	
	PCSC1INT	(pre-injury symptom intensity)	20.50	
	PCSC1DUR	(pre-injury symptom duration)	20.00	
	PCSC2TOT	(post-injury total symptoms)	*5.5	Male Injured < Female Injured
	PCSC2FRQ	(post-injury symptom frequency)	*4	Male Injured < Female Injured
	PCSC2INT	(post-injury symptom intensity)	*4	Male Injured < Female Injured
	PCSC2DUR	(post-injury symptom duration)	*7.5	Male Injured < Female Injured
	TOTDIFF	(difference in total symptoms)	*4	Male Injured < Female Injured
	FRQDIFF	(difference in symptom frequency)	*3	Male Injured < Female Injured
	INTDIFF	(difference in symptom intensity)	*4	Male Injured < Female Injured
	DURDIFF	(difference in symptom duration)	*3	Male Injured < Female Injured
	HEADACH1	(pre-injury headaches)	15.00	
	DIZZINE1	(pre-injury dizziness)	19.00	
	IRRITAB1	(pre-injury irritability)	22.50	
	MEMORY1	(pre-injury memory problems)	20.00	
	CONCENT1	(pre-injury concentration problems)	18.00	
	FATIGUE1	(pre-injury fatigue)	10.00	
	VISION1	(pre-injury vision problems)	24.00	
	NOISEIN1	(pre-injury noise intolerance)	19.50	
	JUDGEME1	(pre-injury judgement problems)	15.50	
	ANXIETY1	(pre-injury anxiety)	15.50	
	HEADACH2	(post-injury headaches)	*7.5	Male Injured < Female Injured
	DIZZINE2	(post-injury dizziness)	6.50	
	IRRITAB2	(post-injury irritability)	8.50	
	MEMORY2	(post-injury memory problems)	*3	Male Injured < Female Injured
	CONCENT2	(post-injury concentration problems)	14.50	
	FATIGUE2	(post-injury fatigue)	*5	Male Injured < Female Injured
	VISION2	(post-injury vision problems)	20.00	
	NOISIN2	(post-injury noise intolerance)	15.50	
	JUDGEME2	(post-injury judgement problems)	20.00	
	ANXIETY2	(post-injury anxiety)	15.50	
	HEADADIF	(difference in headache incidence)	11.00	
	DIZZDIF	(difference in dizziness incidence)	12.00	
	IRRITDIF	(difference in irritability)	12.00	
	MEMDIF	(difference in memory problems)	*3	Male Injured < Female Injured
	CONCDIF	(difference in concentration problems)	11.00	
	FATIGDIF	(difference in fatigue)	*2	Male Injured < Female Injured
	VISIODIF	(difference in vision problems)	21.00	
	NOISEDIF	(difference in noise intolerance)	13.00	
	JUDGDIFF	(difference in judgement problems)	18.50	
	ANXDIFF	(difference in anxiety)	10.00	

Note. *p < .05

9.2.2.2. Male Noninjured versus Female Noninjured

Test	Score		U value
PCL	PCL1	(pre-injury total symptoms)	24.50
	PCL2	(post-injury total symptoms)	24.50
	PCLPCS1	(pre-injury typical PSC)	22.00
	PCLPCS2	(post-injury typical PCS)	22.00
PCSC	PCSC1TOT	(pre-injury total symptoms)	19.00
	PCSC1FRQ	(pre-injury symptom frequency)	25.50
	PCSC1INT	(pre-injury symptom intensity)	16.50
	PCSC1DUR	(pre-injury symptom duration)	21.50
	PCSC2TOT	(post-injury total symptoms)	19.00
	PCSC2FRQ	(post-injury symptom frequency)	25.50
	PCSC2INT	(post-injury symptom intensity)	16.50
	PCSC2DUR	(post-injury symptom duration)	21.50
	HEADACH1	(pre-injury headaches)	25.00
	DIZZINE1	(pre-injury dizziness)	22.50
	IRRITAB1	(pre-injury irritability)	26.50
	MEMORY1	(pre-injury memory problems)	18.50
	CONCENT1	(pre-injury concentration problems)	20.00
	FATIGUE1	(pre-injury fatigue)	26.50
	VISION1	(pre-injury vision problems)	22.50
	NOISEIN1	(pre-injury noise intolerance)	26.50
	JUDGEME1	(pre-injury judgement problems)	19.50
	ANXIETY1	(pre-injury anxiety)	19.00
	HEADACH2	(post-injury headaches)	25.00
	DIZZINE2	(post-injury dizziness)	22.50
	IRRITAB2	(post-injury irritability)	26.50
	MEMORY2	(post-injury memory problems)	18.50
	CONCENT2	(post-injury concentration problems)	20.00
	FATIGUE2	(post-injury fatigue)	26.50
	VISION2	(post-injury vision problems)	22.50
	NOISIN2	(post-injury noise intolerance)	26.50
	JUDGEME2	(post-injury judgement problems)	19.50
	ANXIETY2	(post-injury anxiety)	19.00

Note. *$p < .05$

8.2.3. Region

8.2.3.1. Gauteng Injured versus Mpumalanga Injured

Test	Score		U value	
PCL	PCL1	(pre-injury total symptoms)	22.00	
	PCL2	(post-injury total symptoms)	25.50	
	PCLDIFF	(difference in total symptoms)	28.00	
	PCLPCS1	(pre-injury typical PSC)	21.00	
	PCLPCS2	(post-injury typical PCS)	19.00	
	PCLPCDIF	(difference in typical PCS)	20.50	
PCSC	PCSC1TOT	(pre-injury total symptoms)	29.00	
	PCSC1FRQ	(pre-injury symptom frequency)	27.50	
	PCSC1INT	(pre-injury symptom intensity)	29.50	
	PCSC1DUR	(pre-injury symptom duration)	28.00	
	PCSC2TOT	(post-injury total symptoms)	20.00	
	PCSC2FRQ	(post-injury symptom frequency)	26.00	
	PCSC2INT	(post-injury symptom intensity)	21.50	
	PCSC2DUR	(post-injury symptom duration)	17.00	
	TOTDIFF	(difference in total symptoms)	24.00	
	FRQDIFF	(difference in symptom frequency)	25.00	
	INTDIFF	(difference in symptom intensity)	23.00	
	DURDIFF	(difference in symptom duration)	22.50	
	HEADACH1	(pre-injury headaches)	20.50	
	DIZZINE1	(pre-injury dizziness)	20.00	
	IRRITAB1	(pre-injury irritability)	28.00	
	MEMORY1	(pre-injury memory problems)	24.00	
	CONCENT1	(pre-injury concentration problems)	26.00	
	FATIGUE1	(pre-injury fatigue)	29.00	
	VISION1	(pre-injury vision problems)	29.00	
	NOISEIN1	(pre-injury noise intolerance)	20.00	
	JUDGEME1	(pre-injury judgement problems)	24.50	
	ANXIETY1	(pre-injury anxiety)	25.00	
	HEADACH2	(post-injury headaches)	27.50	
	DIZZINE2	(post-injury dizziness)	24.50	
	IRRITAB2	(post-injury irritability)	28.00	
	MEMORY2	(post-injury memory problems)	22.00	
	CONCENT2	(post-injury concentration problems)	*9	Mpumalanga Injured < Gauteng Injured
	FATIGUE2	(post-injury fatigue)	20.50	
	VISION2	(post-injury vision problems)	28.00	
	NOISIN2	(post-injury noise intolerance)	24.00	
	JUDGEME2	(post-injury judgement problems)	19.50	
	ANXIETY2	(post-injury anxiety)	19.00	
	HEADADIF	(difference in headache incidence)	28.00	
	DIZZDIF	(difference in dizziness incidence)	26.50	
	IRRITDIF	(difference in irritability)	29.00	
	MEMDIF	(difference in memory problems)	25.00	
	CONCDIF	(difference in concentration problems)	15.00	
	FATIGDIF	(difference in fatigue)	20.00	
	VISIODIF	(difference in vision problems)	30.00	
	NOISEDIF	(difference in noise intolerance)	15.50	
	JUDGDIFF	(difference in judgement problems)	23.00	
	ANXDIFF	(difference in anxiety)	15.00	

Note. *p < .05

8.2.3.2. *Gauteng Noninjured versus Mpumalanga Noninjured*

Test	Score		U value	Significant differences
PCL	PCL1	(pre-injury total symptoms)	15.00	
	PCL2	(post-injury total symptoms)	15.00	
	PCLPCS1	(pre-injury typical PSC)	19.00	
	PCLPCS2	(post-injury typical PCS)	19.00	
PCSC	PCSC1TOT	(pre-injury total symptoms)	24.00	
	PCSC1FRQ	(pre-injury symptom frequency)	13.00	
	PCSC1INT	(pre-injury symptom intensity)	21.50	
	PCSC1DUR	(pre-injury symptom duration)	23.00	
	PCSC2TOT	(post-injury total symptoms)	24.00	
	PCSC2FRQ	(post-injury symptom frequency)	13.00	
	PCSC2INT	(post-injury symptom intensity)	21.50	
	PCSC2DUR	(post-injury symptom duration)	23.00	
	HEADACH1	(pre-injury headaches)	24.50	
	DIZZINE1	(pre-injury dizziness)	24.00	
	IRRITAB1	(pre-injury irritability)	21.50	
	MEMORY1	(pre-injury memory problems)	*3.5	*Gauteng Non < Mpumalanga Non*
	CONCENT1	(pre-injury concentration problems)	18.00	
	FATIGUE1	(pre-injury fatigue)	15.00	
	VISION1	(pre-injury vision problems)	18.50	
	NOISEIN1	(pre-injury noise intolerance)	22.50	
	JUDGEME1	(pre-injury judgement problems)	23.00	
	ANXIETY1	(pre-injury anxiety)	20.00	
	HEADACH2	(post-injury headaches)	24.50	
	DIZZINE2	(post-injury dizziness)	24.00	
	IRRITAB2	(post-injury irritability)	21.50	
	MEMORY2	(post-injury memory problems)	*3.5	Gauteng Non < Mpumalanga Non
	CONCENT2	(post-injury concentration problems)	18.00	
	FATIGUE2	(post-injury fatigue)	15.00	
	VISION2	(post-injury vision problems)	18.50	
	NOISIN2	(post-injury noise intolerance)	22.50	
	JUDGEME2	(post-injury judgement problems)	23.00	
	ANXIETY2	(post-injury anxiety)	20.00	

Note. *$p < .05$

8.2.4. Circumstances of Injury (Sports Injury versus Violent Injury)

Test	Score		U value	Significant differences
PCL	PCL1	(pre-injury total symptoms)	3.50	
	PCL2	(post-injury total symptoms)	*0	Sports Injured < Violently Injured
	PCLDIFF	(difference in total symptoms)	*1	Sports Injured < Violently Injured
	PCLPCS1	(pre-injury typical PSC)	3.00	
	PCLPCS2	(post-injury typical PCS)	1.50	
	PCLPCDIF	(difference in typical PCS)	2.00	
PCSC	PCSC1TOT	(pre-injury total symptoms)	4.00	
	PCSC1FRQ	(pre-injury symptom frequency)	5.50	
	PCSC1INT	(pre-injury symptom intensity)	4.50	
	PCSC1DUR	(pre-injury symptom duration)	8.00	
	PCSC2TOT	(post-injury total symptoms)	*0	Sports Injured < Violently Injured
	PCSC2FRQ	(post-injury symptom frequency)	*0.5	Sports Injured < Violently Injured
	PCSC2INT	(post-injury symptom intensity)	1.50	
	PCSC2DUR	(post-injury symptom duration)	4.00	
	TOTDIFF	(difference in total symptoms)	6.00	
	FRQDIFF	(difference in symptom frequency)	6.00	
	INTDIFF	(difference in symptom intensity)	6.00	
	DURDIFF	(difference in symptom duration)	6.00	
	HEADACH1	(pre-injury headaches)	6.00	
	DIZZINE1	(pre-injury dizziness)	6.00	
	IRRITAB1	(pre-injury irritability)	7.50	
	MEMORY1	(pre-injury memory problems)	2.00	
	CONCENT1	(pre-injury concentration problems)	4.50	
	FATIGUE1	(pre-injury fatigue)	6.00	
	VISION1	(pre-injury vision problems)	4.00	
	NOISEIN1	(pre-injury noise intolerance)	3.00	
	JUDGEME1	(pre-injury judgement problems)	6.50	
	ANXIETY1	(pre-injury anxiety)	6.00	
	HEADACH2	(post-injury headaches)	7.50	
	DIZZINE2	(post-injury dizziness)	4.50	
	IRRITAB2	(post-injury irritability)	7.00	
	MEMORY2	(post-injury memory problems)	*0	Sports Injured < Violently Injured
	CONCENT2	(post-injury concentration problems)	3.50	
	FATIGUE2	(post-injury fatigue)	*1	Sports Injured < Violently Injured
	VISION2	(post-injury vision problems)	4.50	
	NOISIN2	(post-injury noise intolerance)	6.50	
	JUDGEME2	(post-injury judgement problems)	6.50	
	ANXIETY2	(post-injury anxiety)	6.50	
	HEADADIF	(difference in headache incidence)	6.00	
	DIZZDIF	(difference in dizziness incidence)	6.00	
	IRRITDIF	(difference in irritability)	8.00	
	MEMDIF	(difference in memory problems)	4.00	
	CONCDIF	(difference in concentration problems)	6.00	
	FATIGDIF	(difference in fatigue)	4.00	
	VISIODIF	(difference in vision problems)	7.50	
	NOISEDIF	(difference in noise intolerance)	6.00	
	JUDGDIFF	(difference in judgement problems)	8.00	
	ANXDIFF	(difference in anxiety)	6.00	

Note. *p < .05

8.2.5. Culpability (Blaming Another Party versus No Blame)

Test	Score		U value
PCL	PCL1	(pre-injury total symptoms)	25.50
	PCL2	(post-injury total symptoms)	19.00
	PCLDIFF	(difference in total symptoms)	16.50
	PCLPCS1	(pre-injury typical PSC)	26.00
	PCLPCS2	(post-injury typical PCS)	23.50
	PCLPCDIF	(difference in typical PCS)	24.50
PCSC	PCSC1TOT	(pre-injury total symptoms)	25.00
	PCSC1FRQ	(pre-injury symptom frequency)	28.50
	PCSC1INT	(pre-injury symptom intensity)	23.00
	PCSC1DUR	(pre-injury symptom duration)	20.00
	PCSC2TOT	(post-injury total symptoms)	26.00
	PCSC2FRQ	(post-injury symptom frequency)	21.00
	PCSC2INT	(post-injury symptom intensity)	21.00
	PCSC2DUR	(post-injury symptom duration)	27.00
	TOTDIFF	(difference in total symptoms)	26.00
	FRQDIFF	(difference in symptom frequency)	26.50
	INTDIFF	(difference in symptom intensity)	24.50
	DURDIFF	(difference in symptom duration)	27.50
	HEADACH1	(pre-injury headaches)	15.00
	DIZZINE1	(pre-injury dizziness)	30.00
	IRRITAB1	(pre-injury irritability)	17.50
	MEMORY1	(pre-injury memory problems)	26.00
	CONCENT1	(pre-injury concentration problems)	27.50
	FATIGUE1	(pre-injury fatigue)	25.50
	VISION1	(pre-injury vision problems)	21.00
	NOISEIN1	(pre-injury noise intolerance)	27.00
	JUDGEME1	(pre-injury judgement problems)	23.00
	ANXIETY1	(pre-injury anxiety)	24.00
	HEADACH2	(post-injury headaches)	28.50
	DIZZINE2	(post-injury dizziness)	23.50
	IRRITAB2	(post-injury irritability)	24.00
	MEMORY2	(post-injury memory problems)	13.50
	CONCENT2	(post-injury concentration problems)	25.50
	FATIGUE2	(post-injury fatigue)	16.00
	VISION2	(post-injury vision problems)	28.00
	NOISIN2	(post-injury noise intolerance)	26.50
	JUDGEME2	(post-injury judgement problems)	22.50
	ANXIETY2	(post-injury anxiety)	27.00
	HEADADIF	(difference in headache incidence)	24.00
	DIZZDIF	(difference in dizziness incidence)	24.50
	IRRITDIF	(difference in irritability)	22.00
	MEMDIF	(difference in memory problems)	19.00
	CONCDIF	(difference in concentration problems)	29.50
	FATIGDIF	(difference in fatigue)	16.00
	VISIODIF	(difference in vision problems)	21.50
	NOISEDIF	(difference in noise intolerance)	29.50
	JUDGDIFF	(difference in judgement problems)	26.50
	ANXDIFF	(difference in anxiety)	21.50

Note. *p < .05

Correlation matrices were then generated to investigate relationships between scores and education, age, time since injury. Injury number was not examined, given that only one subject had sustained more than one injury (the subject had sustained two injuries).

Where cell sizes contained at least fifteen subjects, and where assumptions of approximate normality could be made, Pearson product-moment correlation coefficients were generated. Where cell sizes were smaller, or where strong deviations from normality occurred, Kendall's Tau correlation coefficients were generated. Correlations between assessment scores and the above factors are given in Table 9. As elsewhere, significant values are highlighted..

Pearson product-moment correlation coefficients are listed for education and cognitive scores, as well as age and cognitive scores, in Table 9.1.1.. Pearson product-moment correlation coefficients for education and postconcussive symptoms, as well as for age and postconcussive symptoms, are listed in Table 9.2.1..

Kendall tau correlation coefficients for time since injury and cognitive scores are listed in Table 9.1.2., while Kendall tau correlations for relationships between time since injury and postconcussive symptoms are listed in Table 9.2.2..

Table 9.

Relationships between Test Performance and Demographic Factors for the Total Injured Group

9.1. *Relationships between Cognitive Performance and Demographic Factors*

9.1.1. Normally Distributed Variables: Pearson Product-Moment Correlation Coefficients

Test	Score		Education	Age
BVRT	BVCORR_C	(copy task correct)	0.10	0.31
	BVERR_C	(copy task errors)	-0.10	-0.31
	BVCORR_D	(recall task correct)	-0.41	0.17
	BVERR_D	(recall task errors)	0.32	-0.19
PASAT	PASAT1	(trial 1)	0.20	0.44
	PASAT2	(trial 2)	0.20	0.44
	PASAT3	(trial 3)	0.23	0.43
	PASAT4	(trial 4)	0.36	0.46
	PASATTOT	(total score)	0.25	0.47
STROOP	STROOP1	(trial 1: speed)	-0.23	-0.39
	STROOP2	(trial 2: speed)	-0.13	-0.26
	STROOP3	(trial 3: speed)	-0.26	-0.34
	STROOP4	(trial 4: speed)	0.33	0.01
	SUBT32	(speed difference: trials 3 and 2)	-0.35	-0.37
	SUBT42	(speed difference: trials 4 and 2)	*0.63	0.24
	STR1ACC	(trial 1: accuracy)	0.23	0.47
	STR2ACC	(trial 2: accuracy)	-0.09	0.31
	STR3ACC	(trial 3: accuracy)	0.30	0.39
	STR4ACC	(trial 4: accuracy)	0.22	-0.12
REY 15-ITEM	FIFTEEN	(total correct)	0.22	0.41
RDS	RDSFORW	(total score forward)	-0.38	-0.37
	RDSBACK	(total score backwards)	-0.05	0.02
	RDSTOT	(overall total)	-0.34	-0.29
	RDSDIFF	(forward minus backward score)	-0.23	-0.27

Note. *$p < .05$

9.1.2. Distribution Free Correlations: Relationships between Time Since Injury and cognitive Performance

Test	Score		Kendall tau
BVRT	BVCORR_C	(copy task correct)	*0.38
	BVERR_C	(copy task errors)	*-0.38
	BVCORR_D	(recall task correct)	0.23
	BVERR_D	(recall task errors)	-0.25
PASAT	PASAT1	(trial 1)	0.10
	PASAT2	(trial 2)	0.10
	PASAT3	(trial 3)	-0.10
	PASAT4	(trial 4)	0.13
	PASATTOT	(total score)	0.01
		(trial 1: speed)	
STROOP	STROOP1	(trial 1: speed)	0.08
	STROOP2	(trial 2: speed)	0.12
	STROOP3	(trial 3: speed)	0.07
	STROOP4	(trial 4: speed)	-0.01
	SUBT32	(speed difference: trials 3 and 2)	0.10
	SUBT42	(speed difference: trials 4 and 2)	-0.03
	STR1ACC	(trial 1: accuracy)	-0.09
	STR2ACC	(trial 2: accuracy)	0.06
	STR3ACC	(trial 3: accuracy)	-0.20
	STR4ACC	(trial 4: accuracy)	0.10
REY 15-ITEM	FIFTEEN	(total correct)	-0.29
RDS	RDSFORW	(total score forward)	-0.04
	RDSBACK	(total score backwards)	-0.06
	RDSTOT	(overall total)	-0.09
	RDSDIFF	(forward minus backward score)	-0.04

Note, *p < .05

9.2. Relationships between Postconcussive C[illegible] and Demographic Factors

9.2.1. Normally Distributed Variables: Pearson Product-Moment Correlation Coefficients

Test	Score		Educatior	Age
PCL	PCL1	(pre-injury total symptoms)	-0.47	0.27
	PCL2	(post-injury total symptoms)	*-.64	0.09
	PCLDIFF	(difference in total symptoms)	*-.56	-0.22
	PCLPCS1	(pre-injury typical PSC)	-0.34	0.37
	PCLPCS2	(post-injury typical PCS)	*-.54	0.21
	PCLPCDIF	(differ[illegible] in typical PCS)	*-.50	-0.07
PCSC	PCSC1TOT	(pre-inj[illegible] total symptoms)	*-.11	-0.03
	PCSC1FRQ	(pre-injury symptom frequency)	*-.09	0.00
	PCSC1INT	(pre-injury symptom intensity)	-0.13	0.07
	PCSC1DUR	(pre-injury symptom duration)	-0.09	-0.13
	PCSC2TOT	(post-injury total symptoms)	*-.71	-0.09
	PSCS2FRQ	(post-injury symptom frequency)	*-.70	-0.20
	PCSC2INT	(post-injury symptom intensity)	*-.72	-0.04
	PCSC2DUR	(post-injury symptom duration)	*-.58	-0.01
	TOTDIFF	(difference in total symptoms)	*-.56	-0.06
	FRQDIFF	(difference in symptom frequency)	*-.59	-0.18
	INTDIFF	(difference in symptom intensity)	*-.56	-0.07
	DURDIFF	(difference in symptom duration)	*-.51	0.08
	HEADACH1	(pre-injury headaches)	0.15	0.17
	DIZZINE1	(pre-injury dizziness)	0.25	0.29
	IRRITAB1	(pre-injury irritability)	0.17	0.32
	MEMORY1	(pre-injury memory problems)	-0.49	0.15
	CONCENT1	(pre-injury concentration problems)	-0.31	-0.07
	FATIGUE1	(pre-injury fatigue)	-0.24	-0.27
	VISION1	(pre-injury vision problems)	-0.16	-0.07

9.2.1. Normally Distributed Variables : Pearson Product-Moment Correlation Coefficients - continued

Test	Score		Education	Age
	NOISIN1	(pre-injury noise intolerance)	0.19	-0.07
	JUDGEME1	(pre-injury judgement problems)	-0.09	-0.11
	ANXIETY1	(pre-injury anxiety)	-0.12	-0.43
	HEADACH2	(post-injury headaches)	-0.22	-0.01
	DIZZINE2	(post-injury dizziness)	-0.31	-0.03
	IRRITAB2	(post-injury irritability)	-0.02	0.22
	MEMORY2	(post-injury memory problems)	*-.75	0.06
	CONCENT2	(post-injury concentration problems)	*-.58	-0.02
	FATIGUE2	(post-injury fatigue)	*-.69	0.10
	VISION2	(post-injury vision problems)	*-.58	-0.15
	NOISIN2	(post-injury noise intolerance)	*-.[illegible]	-0.18
	JUDGEME2	(post-injury judgement problems)	*-.[illegible]	-0.47
	ANXIETY2	(post-injury anxiety)	-0.50	-0.18
	HEADADIF	(difference in headache incidence)	-0.34	-0.14
	DIZZIDIF	(difference in dizziness incidence)	-0.43	-0.18
	IRRITDIF	(difference in irritability)	-0.24	-0.08
	MEMDIF	(difference in memory problems)	*-.56	-0.01
	CONCDIF	(difference in concentration problems)	-0.39	0.02
	FATIGDIF	(difference in fatigue)	-0.40	0.29
	VISIODIF	(difference in vision problems)	-0.39	-0.09
	NOISEDIF	(difference in noise intolerance)	-0.45	-0.11
	JUDGDIFF	(difference in judgement problems)	-0.49	-0.36
	ANXDIFF	(difference in anxiety)	-0.42	0.18

Note. *p < .05

9.2.2. Distribution Free Correlations: Relationships between Time Since Injury and Postconcussive Complaints

TEST	SCORE		KENDALL TAU
PCL	PCL1	(pre-injury total symptoms)	0.03
	PCL2	(post-injury total symptoms)	0.02
	PCLDIFF	(difference in total symptoms)	0.06
	PCLPCS1	(pre-injury typical PSC)	-0.07
	PCLPCS2	(post-injury typical PCS)	0.09
	PCLPCDIF	(difference in typical PCS)	0.21
PCSC	PCSC1TOT	(pre-injury total symptoms)	-0.28
	PCSC1FRQ	(pre-injury symptom frequency)	-0.16
	PCSC1INT	(pre-injury symptom intensity)	-0.31
	PCSC1DUR	(pre-injury symptom duration)	-0.25
	PCSC2TOT	(post-injury total symptoms)	0.08
	PSCS2FRQ	(post-injury symptom frequency)	0.13
	PCSC2INT	(post-injury symptom intensity)	0.06
	PCSC2DUR	(post-injury symptom duration)	0.06
	TOTDIFF	(difference in total symptoms)	0.30
	FRQDIFF	(difference in symptom frequency)	0.34
	INTDIFF	(difference in symptom intensity)	0.32
	DURDIFF	(difference in symptom duration)	0.31
	HEADACH1	(pre-injury headaches)	0.07
	DIZZINE1	(pre-injury dizziness)	-0.19
	IRRITAB1	(pre-injury irritability)	-0.20
	MEMORY1	(pre-injury memory problems)	-0.23
	CONCENT1	(pre-injury concentration problems)	*-0.48
	FATIGUE1	(pre-injury fatigue)	-0.15
	VISION1	(pre-injury vision problems)	-0.16
	NOISIN1	(pre-injury noise intolerance)	0.02
	JUDGEME1	(pre-injury judgement problems)	-0.26
	ANXIETY1	(pre-injury anxiety)	-0.11
	HEADACH2	(post-injury headaches)	0.19
	DIZZINE2	(post-injury dizziness)	0.06
	IRRITAB2	(post-injury irritability)	-0.01
	MEMORY2	(post-injury memory problems)	0.12
	CONCENT2	(post-injury concentration problems)	0.04
	FATIGUE2	(post-injury fatigue)	0.10
	VISION2	(post-injury vision problems)	-0.11
	NOISIN2	(post-injury noise intolerance)	0.27
	JUDGEME2	(post-injury judgement problems)	0.19
	ANXIETY2	(post-injury anxiety)	0.16
	HEADADIF	(difference in headache incidence)	0.29
	DIZZIDIF	(difference in dizziness incidence)	0.13
	IRRITDIF	(difference in irritability)	*0.42
	MEMDIF	(difference in memory problems)	0.23
	CONCDIF	(difference in concentration problems)	*0.40
	FATIGDIF	(difference in fatigue)	0.23
	VISIODIF	(difference in vision problems)	-0.02
	NOISEDIF	(difference in noise intolerance)	0.18
	JUDGDIFF	(difference in judgement problems)	*0.46
	ANXDIFF	(difference in anxiety)	0.17

Note. *p < .05

2.1.5. Examination of Relationships between Indices of Injury Severity and Assessment Scores

Relationships between indices of injury severity and assessment scores were also investigated:

Kendall tau coefficients for posttraumatic amnesia and cognitive scores are listed in Table 10.1.1., and for posttraumatic amnesia and postconcussive symptoms in Table 10.2.1..

Kendall tau coefficients for loss of consciousness and cognitive scores are listed in Table 10.1.2., and for loss of consciousness and postconcussive symptoms in Table 10.2.2..

Kendall tau coefficients for hours of hospitalisation and cognitive scores are listed in Table 10.1.3., and for hours of hospitalisation and postconcussive symptoms in Table 10.2.3..

Table 10.

Relationships between Indices of Injury Severity and Assessment Performance for the Total Injured Group: Kendall's Tau Coefficients

10.1. Relationships between Indices of Injury and Cognitive Performance

10.1.1. Relationships between Cognitive Performance and Posttraumatic Amnesia

Test	Score		Kendall Tau
BVRT	BVCORR_C	(copy task correct)	0.22
	BVERR_C	(copy task errors)	-0.22
	BVCORR_D	(recall task correct)	0.17
	BVERR_D	(recall task errors)	-0.08
PASAT	PASAT1	(trial 1)	0.17
	PASAT2	(trial 2)	0.17
	PASAT3	(trial 3)	0.13
	PASAT4	(trial 4)	-0.05
	PASATTOT	(total score)	0.19
STROOP	STROOP1	(trial 1: speed)	*-0.37
	STROOP2	(trial 2: speed)	*-0.48
	STROOP3	(trial 3: speed)	-0.31
	STROOP4	(trial 4: speed)	*-0.62
	SUBT32	(speed difference: trials 3 and 2)	-0.10
	SUBT42	(speed difference: trials 4 and 2)	*-0.49
	STR1ACC	(trial 1: accuracy)	*0.42
	STR2ACC	(trial 2: accuracy)	0.13
	STR3ACC	(trial 3: accuracy)	0.04
	STR4ACC	(trial 4: accuracy)	*-0.36

10.1. Relationships between Indices of Injury and Cognitive Performance

10.1.1. Relationships between Cognitive Performance and Posttraumatic Amnesia

Test	Score		Kendall Tau
REY 15-ITEM	FIFTEEN	(total correct)	0.00
	RDSFORW	(total score forward)	*0.50
	RDSBACK	(total score backwards)	-0.04
	RDSTOT	(overall total)	*0.40
	RDSDIFF	(forward minus backward score)	*0.40

Note. *p < .05

10.1.2. Relationships between Cognitive Performance and Period of Loss of Consciousness

Test	Score		Kendall Tau
BVRT	BVCORR_C	(copy task correct)	0.02
	BVERR_C	(copy task errors)	-0.02
	BVCORR_D	(recall task correct)	-0.26
	BVERR_D	(recall task errors)	0.27
PASAT	PASAT1	(trial 1)	0.01
	PASAT2	(trial 2)	0.01
	PASAT3	(trial 3)	0.01
	PASAT4	(trial 4)	-0.12
	PASATTOT	(total score)	-0.01
STROOP	STROOP1	(trial 1: speed)	0.03
	STROOP2	(trial 2: speed)	-0.18
	STROOP3	(trial 3: speed)	-0.12
	STROOP4	(trial 4: speed)	-0.32
	SUBT32	(speed difference: trials 3 and 2)	0.00
	SUBT42	(speed difference: trials 4 and 2)	-0.32
	STR1ACC	(trial 1: accuracy)	0.01
	STR2ACC	(trial 2: accuracy)	0.16
	STR3ACC	(trial 3: accuracy)	0.18
	STR4ACC	(trial 4: accuracy)	-0.20
REY 15-ITEM	FIFTEEN	(total correct)	-0.11
RDS	RDSFORW	(total score forward)	*0.48
	RDSBACK	(total score backwards)	0.19
	RDSTOT	(overall total)	*0.49
	RDSDIFF	(forward minus backward score)	0.27

Note. *p < .05

10.1.3. Relationships between Cognitive Performance and Length of Hospitalization

Test	Score		Kendall Tau
BVRT	BVCORR_C	(copy task correct)	-0.05
	BVERR_C	(copy task errors)	0.05
	BVCORR_D	(recall task correct)	-0.04
	BVERR_D	(recall task errors)	0.12
PASAT	PASAT1	(trial 1)	-0.06
	PASAT2	(trial 2)	-0.06
	PASAT3	(trial 3)	-0.22
	PASAT4	(trial 4)	-0.15
	PASATTOT	(total score)	-0.17
STROOP	STROOP1	(trial 1: speed)	0.16
	STROOP2	(trial 2: speed)	-0.01
	STROOP3	(trial 3: speed)	0.04
	STROOP4	(trial 4: speed)	0.27
	SUBT32	(speed difference: trials 3 and 2)	0.18
	SUBT42	(speed difference: trials 4 and 2)	*-0.39
	STR1ACC	(trial 1: accuracy)	-0.09
	STR2ACC	(trial 2: accuracy)	0.01
	STR3ACC	(trial 3: accuracy)	-0.15
	STR4ACC	(trial 4: accuracy)	-0.16
REY 15-ITEM	FIFTEEN	(total correct)	-0.29
RDS	RDSFORW	(total score forward)	0.31
	RDSBACK	(total score backwards)	0.06
	RDSTOT	(overall total)	0.22
	RDSDIFF	(forward minus backward score)	0.30

Note. *$p < .05$

10.2. Relationships between Indices of Injury and Postconcussive Complaints

10.2.1. Relationships between Postconcussive Complaints and Posttraumatic Amnesia

Test	Score		Kendall Tau
PCL	PCL1	(pre-injury total symptoms)	0.36
	PCL2	(post-injury total symptoms)	0.28
	PCLDIFF	(difference in total symptoms)	0.33
	PCLPCS1	(pre-injury typical PSC)	*.38
	PCLPCS2	(post-injury typical PCS)	0.31
	PCLPCDIF	(difference in typical PCS)	0.16
PCSC	PCSC1TOT	(pre-injury total symptoms)	*0.38
	PCSC1FRQ	(pre-injury symptom frequency)	*0.38
	PCSC1INT	(pre-injury symptom intensity)	0.30
	PCSC1DUR	(pre-injury symptom duration)	0.31
	PCSC2TOT	(post-injury total symptoms)	0.23
	PSCS2FRQ	(post-injury symptom frequency)	0.22
	PCSC2INT	(post-injury symptom intensity)	0.18
	PCSC2DUR	(post-injury symptom duration)	0.16
	TOTDIFF	(difference in total symptoms)	-0.12
	FRQDIFF	(difference in symptom frequency)	-0.06
	INTDIFF	(difference in symptom intensity)	-0.12
	DURDIFF	(difference in symptom duration)	-0.11
	HEADACH1	(pre-injury headaches)	-0.08
	DIZZINE1	(pre-injury dizziness)	0.29
	IRRITAB1	(pre-injury irritability)	0.01
	MEMORY1	(pre-injury memory problems)	*0.41
	CONCENT1	(pre-injury concentration problems)	0.22
	FATIGUE1	(pre-injury fatigue)	0.25
	VISION1	(pre-injury vision problems)	*0.52

10.2.1. Relationships between Postconcussive Complaints and Posttraumatic Amnesia - continued

Test	Score		Kendall Tau
	NOISIN1	(pre-injury noise intolerance)	0.23
	JUDGEME1	(pre-injury judgement problems)	0.20
	ANXIETY1	(pre-injury anxiety)	0.26
	HEADACH2	(post-injury headaches)	-0.24
	DIZZINE2	(post-injury dizziness)	0.04
	IRRITAB2	(post-injury irritability)	0.06
	MEMORY2	(post-injury memory problems)	0.18
	CONCENT2	(post-injury concentration problems)	0.17
	FATIGUE2	(post-injury fatigue)	-0.01
	VISION2	(post-injury vision problems)	0.31
	NOISIN2	(post-injury noise intolerance)	0.12
	JUDGEME2	(post-injury judgement problems)	0.25
	ANXIETY2	(post-injury anxiety)	0.10
	HEADADIF	(difference in headache incidence)	-0.10
	DIZZIDIF	(difference in dizziness incidence)	-0.20
	IRRITDIF	(difference in irritability)	0.17
	MEMDIF	(difference in memory problems)	-0.04
	CONCDIF	(difference in concentration problems)	-0.01
	FATIGDIF	(difference in fatigue)	-0.23
	VISIODIF	(difference in vision problems)	0.02
	NOISEDIF	(difference in noise intolerance)	-0.09
	JUDGDIFF	(difference in judgement problems)	0.12
	ANXDIFF	(difference in anxiety)	-0.05

Note. *p < .05

10.2.2. Relationships between Postconcussive Complaints and Period of Loss of Consciousness

Test	Score		Kendall Tau
PCL	PCL1	(pre-injury total symptoms)	0.32
	PCL2	(post-injury total symptoms)	0.31
	PCLDIFF	(difference in total symptoms)	0.31
	PCLPCS1	(pre-injury typical PSC)	0.32
	PCLPCS2	(post-injury typical PCS)	0.34
	PCLPCDIF	(difference in typical PCS)	0.20
PCSC	PCSC1TOT	(pre-injury total symptoms)	0.03
	PCSC1FRQ	(pre-injury symptom frequency)	0.08
	PCSC1INT	(pre-injury symptom intensity)	-0.03
	PCSC1DUR	(pre-injury symptom duration)	-0.06
	PCSC2TOT	(post-injury total symptoms)	0.26
	PSCS2FRQ	(post-injury symptom frequency)	0.28
	PCSC2INT	(post-injury symptom intensity)	0.35
	PCSC2DUR	(post-injury symptom duration)	0.15
	TOTDIFF	(difference in total symptoms)	0.06
	FRQDIFF	(difference in symptom frequency)	0.06
	INTDIFF	(difference in symptom intensity)	0.15
	DURDIFF	(difference in symptom duration)	0.05
	HEADACH1	(pre-injury headaches)	-0.24
	DIZZINE1	(pre-injury dizziness)	-0.11
	IRRITAB1	(pre-injury irritability)	-0.23
	MEMORY1	(pre-injury memory problems)	0.32
	CONCENT1	(pre-injury concentration problems)	0.05
	FATIGUE1	(pre-injury fatigue)	-0.07
	VISION1	(pre-injury vision problems)	0.22
	NOISIN1	(pre-injury noise intolerance)	-0.10
	JUDGEME1	(pre-injury judgement problems)	0.12

10.2.2. Relationships between Postconcussive Complaints and Period of Loss of ness - continued

Test	Score		Kendall Tau
	ANXIETY1	(pre-injury anxiety)	0.08
	HEADACH2	(post-injury headaches)	-0.03
	DIZZINE2	(post-injury dizziness)	0.20
	IRRITAB2	(post-injury irritability)	-0.14
	MEMORY2	(post-injury memory problems)	*0.41
	CONCENT2	(post-injury concentration problems)	0.32
	FATIGUE2	(post-injury fatigue)	0.15
	VISION2	(post-injury vision problems)	0.31
	NOISIN2	(post-injury noise intolerance)	0.24
	JUDGEME2	(post-injury judgement problems)	0.23
	ANXIETY2	(post-injury anxiety)	0.33
	HEADADIF	(difference in headache incidence)	0.08
	DIZZIDIF	(difference in dizziness incidence)	0.26
	IRRITDIF	(difference in irritability)	0.11
	MEMDIF	(difference in memory problems)	0.25
	CONCDIF	(difference in concentration problems)	0.24
	FATIGDIF	(difference in fatigue)	0.19
	VISIODIF	(difference in vision problems)	0.06
	NOISEDIF	(difference in noise intolerance)	0.26
	JUDGDIFF	(difference in judgement problems)	0.12
	ANXDIFF	(difference in anxiety)	*0.45

Note. *p < .05

10.2.3. Relationships between Postconcussive Complaints and Length of Hospitalization

Test	Score		Kendall Tau
PCL	PCL1	(pre-injury total symptoms)	0.32
	PCL2	(post-injury total symptoms)	0.27
	PCLDIFF	(difference in total symptoms)	0.26
	PCLPCS1	(pre-injury typical PSC)	0.34
	PCLPCS2	(post-injury typical PCS)	*0.39
	PCLPCDIF	(difference in typical PCS)	*0.38
PCSC	PCSC1TOT	(pre-injury total symptoms)	0.03
	PCSC1FRQ	(pre-injury symptom frequency)	0.12
	PCSC1INT	(pre-injury symptom intensity)	-0.05
	PCSC1DUR	(pre-injury symptom duration)	0.00
	PCSC2TOT	(post-injury total symptoms)	*0.45
	PCSC2FRQ	(post-injury symptom frequency)	*0.40
	PCSC2INT	(post-injury symptom intensity)	*0.39
	PCSC2DUR	(post-injury symptom duration)	*0.41
	TOTDIFF	(difference in total symptoms)	0.25
	FRQDIFF	(difference in symptom frequency)	0.27
	INTDIFF	(difference in symptom intensity)	0.27
	DURDIFF	(difference in symptom duration)	0.23
	HEADACH1	(pre-injury headaches)	-0.05
	DIZZINE1	(pre-injury dizziness)	-0.32
	IRRITAB1	(pre-injury irritability)	-0.12
	MEMORY1	(pre-injury memory problems)	0.27
	CONCENT1	(pre-injury concentration problems)	0.00
	FATIGUE1	(pre-injury fatigue)	0.20
	VISION1	(pre-injury vision problems)	0.15
	NOISIN1	(pre-injury noise intolerance)	-0.18
	JUDGEME1	(pre-injury judgement problems)	0.04

10.2.3. Relationships between Postconcussive Complaints and Length of Hospitalization - continued

Test	Score		Kendall Tau
	ANXIETY1	(pre-injury anxiety)	0.01
	HEADACH2	(post-injury headaches)	0.07
	DI VE2	(post-injury dizziness)	-0.03
	IRRITAB2	(post-injury irritability)	0.02
	MEMORY2	(post-injury memory problems)	*0.46
	CONCENT2	(post-injury concentration problems)	*0.54
	FATIGUE2	(post-injury fatigue)	*0.38
	VISION2	(post-injury vision problems)	0.31
	NOISIN2	(post-injury noise intolerance)	0.29
	JUDGEME2	(post-injury judgement problems)	*0.63
	ANXIETY2	(post-injury anxiety)	0.34
	HEADADIF	(difference in headache incidence)	0.15
	DIZZIDIF	(difference in dizziness incidence)	0.11
	IRRITDIF	(difference in irritability)	0.32
	MEMDIF	(difference in memory problems)	0.32
	CONCDIF	(difference in concentration problems)	*0.51
	FATIGDIF	(difference in fatigue)	0.18
	VISIODIF	(difference in vision problems)	0.09
	NOISEDIF	(difference in noise intolerance)	0.32
	JUDGDIFF	(difference in judgement problems)	*0.52
	ANXDIFF	(difference in anxiety)	0.33

Note. *p < .05

2.1.6. Examination of Relationships between Postconcussive Symptoms and Cognitive Performance

The injured group was then examined for relationships between postconcussive complaints and cognitive performance. Scores denoting current complaints (that is, post-injury complaints), and scores denoting perceived deterioration relative to pre-injury functioning (that is, difference scores) were correlated with cognitive scores. Pearson product-moment correlation coefficients were generated, which are listed in Table 11. As above, significant values are highlighted. Coefficients were not generated for the BVRT error subscores, given that many error types were only made by a very small number of subjects (see the dataset in Appendix 5). The composite Error score was therefore believed to be more useful for the purposes of this examination.

Table 11.
Relationships between Cognitive Performance, and Postconcussive Complaints (Absolute Post-injury Symptom Incidence and Perceived Deterioration Relative to Pre-injury Functioning): Pearson Product-Moment Correlation Coefficients

11.1. Postconcussive Complaints and Performance on the BVRT and PASAT-R

Test	Score	PCL2	PCLDIFF	PCLPCS2	PCLPCDIF	PCSC2TOT	PCSC2FRQ	PCSC2INT	PCSC2DUR	TOTDIFF	FRQDIFF	INTDIFF
BVRT	BVCORR_C	-0.05	0.08	-0.09	0.09	-0.13	0.01	-0.09	-0.29	0.11	0.14	0.12
	BVERR_C	0.05	-0.08	0.09	-0.09	0.13	-0.01	0.09	0.29	-0.11	-0.14	-0.12
	BVCORR_D	-0.15	-0.09	-0.18	-0.02	-0.25	-0.21	-0.40	-0.09	-0.37	-0.33	-0.43
	BVERR_D	0.14	0.01	0.20	-0.05	0.20	0.16	0.32	0.08	0.22	0.18	0.28
PASAT	PASAT1	-0.34	-0.27	-0.27	-0.13	-0.29	-0.27	-0.37	-0.17	-0.23	-0.23	-0.26
	PASAT2	-0.34	-0.27	-0.27	-0.13	-0.29	-0.27	-0.37	-0.17	-0.23	-0.23	-0.26
	PASAT3	-0.25	-0.28	-0.18	-0.10	-0.21	-0.21	-0.26	-0.13	-0.24	-0.24	-0.24
	PASAT4	-0.07	-0.06	0.05	0.14	0.00	-0.06	-0.04	0.12	0.03	-0.01	-0.01
	PASATTOT	-0.30	-0.26	-0.21	-0.08	-0.24	-0.24	-0.31	-0.12	-0.21	-0.21	-0.23

Note. *p < .05

11.1. Postconcussive Complaints and Performance on the BVRT and PASAT-R - continued

Test	Score	DURDIFF	HEADACH2	DIZZINE2	IRRITAB2	MEMORY2	CONCENT2	FATIGUE2	VISION2	NOISIN2	JUDGEME2	ANXIETY2
BVRT	BVCORR_C	0.06	-0.12	0.25	-0.25	0.09	-0.39	-0.26	-0.15	0.04	-0.12	0.05
	BVERR_C	-0.06	0.12	-0.25	0.25	-0.09	0.39	0.26	0.15	-0.04	0.12	-0.05
	BVCORR_D	-0.34	-0.27	-0.26	-0.04	-0.40	-0.24	-0.09	-0.19	-0.09	0.13	-0.09
	BVERR_D	0.18	0.20	0.03	0.12	0.26	0.32	0.09	0.17	0.07	-0.04	0.01
PASAT	PASAT1	-0.17	*-0.51	-0.25	-0.03	-0.33	-0.16	-0.21	-0.10	-0.23	-0.05	0.02
	PASAT2	-0.17	*-0.51	-0.25	-0.03	-0.33	-0.16	-0.21	-0.10	-0.23	-0.05	0.02
	PASAT3	-0.22	-0.35	-0.17	0.17	-0.18	-0.07	-0.31	-0.21	-0.14	-0.22	0.13
	PASAT4	0.12	-0.15	-0.14	0.05	-0.11	0.10	-0.09	0.05	0.11	0.00	0.24
	PASATTOT	-0.15	-0.44	-0.22	0.05	-0.27	-0.10	-0.23	-0.12	-0.16	-0.10	0.10

Note. *p < .05

11.1. Postconcussive Complaints and Performance on the BVRT and PASAT-R - continued

Test	Score	HEADADIF	DIZZDIF	IRRITDIF	MEMDIF	CONCDIF	FATIGDIF	VISIODIF	NOISEDIF	JUDGDIFF	ANXDIFF
BVRT	BVCORR_C	0.13	0.27	0.30	0.16	0.05	0.11	-0.08	-0.03	0.06	0.01
	BVERR_C	-0.13	-0.27	-0.30	-0.16	-0.05	-0.11	0.08	0.03	-0.06	-0.01
	BVCORR_D	-0.29	-0.35	0.14	-0.37	-0.26	-0.39	-0.40	-0.34	0.11	-0.37
	BVERR_D	0.18	0.12	-0.21	0.19	0.23	0.19	0.30	0.24	-0.08	0.28
PASAT	PASAT1	*-0.49	-0.21	0.02	-0.27	0.00	-0.14	-0.13	-0.10	-0.21	-0.06
	PASAT2	*-0.49	-0.21	0.02	-0.27	0.00	-0.14	-0.13	-0.10	-0.21	-0.06
	PASAT3	*-0.52	-0.13	0.13	-0.17	-0.03	-0.03	-0.22	-0.14	-0.46	-0.04
	PASAT4	-0.39	-0.17	0.07	-0.04	0.25	0.15	0.04	0.17	-0.09	0.27
	PASATTOT	*-0.52	-0.19	0.06	-0.22	0.03	-0.07	-0.14	-0.07	-0.29	0.00

Note. *p < .05

11.2. Postconcussive Complaints and Performance on the Stroop, Rey 15-item test, and RDS

Test	Score	PCL2	PCLDIFF	PCLPCS2	PCLPCDIF	PCSC2TOT	PCSC2FRQ	PCSC2INT	PCSC2DUR	TOTDIFF	FRQDIFF
STROOP	STROOP1	0.15	*0.57	0.04	0.24	0.25	0.27	0.39	0.04	*0.51	*0.50
	STROOP2	-0.03	0.33	-0.18	-0.07	0.05	0.10	0.21	-0.18	0.33	0.34
	STROOP3	0.06	0.41	-0.06	0.08	0.16	0.24	0.25	-0.03	0.35	0.38
	STROOP4	-0.06	0.20	-0.16	-0.05	-0.02	-0.03	0.12	-0.15	0.29	0.24
	SUBT32	0.15	0.42	0.08	0.21	0.25	0.33	0.24	0.13	0.31	0.34
	SUBT42	-0.07	0.04	-0.10	-0.03	-0.07	-0.14	0.02	-0.08	0.18	0.09
	STR1ACC	-0.18	-0.57	0.00	-0.20	-0.24	-0.28	-0.36	-0.04	-0.48	-0.49
	STR2ACC	-0.15	*-0.28	0.01	-0.08	-0.24	-0.21	-0.30	-0.17	-0.32	-0.31
	STR3ACC	0.05	-0.24	0.13	-0.05	-0.16	-0.26	-0.11	-0.08	-0.24	-0.32
	STR4ACC	0.10	0.13	0.26	0.16	0.01	-0.08	0.12	-0.03	0.11	0.06
REY 15-ITEM	FIFTEEN	-0.26	-0.48	-0.23	-0.42	*-0.56	*-0.68	*-0.59	-0.32	*-0.71	*-0.77
RDS	RDSFORW	0.40	0.39	0.34	0.36	0.39	0.41	0.38	0.33	0.25	0.27
	RDSBACK	-0.10	0.01	-0.17	0.06	0.12	0.08	0.06	0.19	0.10	0.10
	RDSTOT	0.25	0.32	0.15	0.33	0.41	0.35	0.35	0.41	0.28	0.29
	RDSDIFF	0.34	0.26	0.34	0.21	0.20	0.20	0.22	0.11	0.11	0.12

Note. *p < .05

11.2. Postconcussive Complaints and Performance on the Stroop, Rey 15-item test, and RDS - continued

Test	Score	INTDIFF	DURDIFF	HEADACH2	DIZZINE2	IRRITAB2	MEMORY2	CONCENT2	FATIGUE2	VISION2	NOISIN2	JUDGEME2
STROOP	STROOP1	*0.57	0.41	0.46	0.17	-0.29	0.32	-0.05	0.39	0.27	0.06	0.16
	STROOP2	0.41	0.21	0.36	0.12	-0.28	0.27	-0.25	0.22	0.06	-0.14	-0.07
	STROOP3	0.40	0.25	0.45	0.20	-0.16	0.25	-0.12	0.21	0.15	-0.05	0.12
	STROOP4	0.34	0.27	0.48	0.23	-0.06	0.21	-0.34	0.18	-0.09	-0.25	-0.37
	SUBT32	0.31	0.24	0.45	0.25	0.01	0.17	0.03	0.16	0.21	0.06	0.30
	SUBT42	0.19	0.25	0.45	0.26	0.15	0.10	-0.32	0.10	-0.19	-0.27	*-0.52
	STR1ACC	*-0.52	-0.39	-0.39	-0.29	0.28	-0.45	0.16	-0.47	-0.23	0.05	-0.07
	STR2ACC	-0.34	-0.29	-0.38	-0.28	-0.17	-0.48	0.09	-0.43	-0.09	0.16	0.14
	STR3ACC	-0.21	-0.17	-0.08	-0.22	0.00	-0.30	-0.01	-0.31	-0.16	0.30	-0.29
	STR4ACC	0.12	0.14	0.20	0.24	-0.14	0.13	0.13	0.26	-0.13	-0.11	-0.25
REY 15-ITEM	FIFTEEN	*-0.71	*-0.59	-0.19	-0.43	0.10	*-0.60	-0.41	-0.22	*-0.54	-0.37	*-0.58
RDS	RDSFORW	0.26	0.20	0.22	0.34	0.18	0.20	0.29	0.21	0.32	0.49	0.21
	RDSBACK	0.09	0.11	-0.16	-0.23	0.10	0.02	0.09	0.04	0.20	0.06	0.18
	RDSTOT	0.26	0.25	0.06	0.11	0.22	0.18	0.31	0.20	0.40	0.43	0.30
	RDSDIFF	0.12	0.07	0.25	0.37	0.06	0.13	0.14	0.12	0.10	0.30	0.03

Note. *p < .05

11.2. Postconcussive Complaints and Performance on the Stroop, Rey 15-item test, and RDS - continued

Test	Score	ANXIETY2	HEADADIF	DIZZDIF	IRRITDIF	MEMDIF	CONCDIF	FATIGDIF	VISIODIF	NOISEDIF	JUDGDIFF	ANXDIFF
STROOP	STROOP1	0.05	*0.76	0.27	0.00	*0.49	0.10	0.42	0.31	0.37	0.48	0.42
	STROOP2	-0.12	*0.69	0.29	-0.06	0.42	-0.09	0.29	0.27	0.14	0.18	0.12
	STROOP3	-0.09	*0.68	0.28	-0.04	0.38	-0.02	0.20	0.25	0.20	0.42	0.12
	STROOP4	-0.26	*0.64	0.27	-0.03	0.40	-0.11	0.44	0.17	0.04	0.00	0.16
	SUBT32	-0.04	*0.53	0.21	0.00	0.27	0.05	0.07	0.18	0.23	*0.58	0.09
	SUBT42	-0.32	0.42	0.18	0.00	0.28	-0.11	0.45	0.04	-0.05	-0.14	0.15
	STR1ACC	-0.06	*-0.76	-0.39	-0.10	*-0.56	0.03	-0.46	-0.28	-0.25	-0.37	-0.27
	STR2ACC	0.00	-0.44	-0.37	-0.25	*-0.54	0.04	-0.48	-0.22	0.00	0.05	-0.05
	STR3ACC	0.12	-0.27	-0.37	-0.23	-0.33	-0.06	-0.06	-0.23	-0.08	-0.32	0.24
	STR4ACC	-0.38	0.30	0.13	0.10	0.12	0.03	0.23	-0.18	0.03	0.04	0.11
REY 15-ITEM	FIFTEEN	-0.42	-0.33	*-0.62	-0.28	*-0.62	*-0.68	-0.34	*-0.62	*-0.69	*-0.55	-0.40
RDS	RDSFORW	0.16	0.26	0.17	0.17	0.19	0.20	0.10	0.08	0.23	0.26	0.22
	RDSBACK	*0.53	-0.33	-0.04	0.00	0.09	0.15	0.19	0.20	0.23	-0.12	0.31
	RDSTOT	*0.52	-0.02	0.11	0.14	0.22	0.27	0.22	0.22	0.35	0.12	0.41
	RDSDIFF	-0.23	0.39	0.14	0.11	0.08	0.05	-0.05	-0.07	0.02	0.26	-0.04

Note. *p < .05

2.1.7. Identification of Scores able to Suggest Malingerering, and the Development of Tentative Cutoffs

While the purpose of comparing injured subjects with each other and with noninjured subjects was to identify evidence of postconcussive sequelae, the purpose of comparing injured subjects with malingerers was to detect patterns of malingering and to identify scores that differentiate malingerers from actual injured subjects.

Two areas were examined: a) comparisons of test performance by the total injured group with that of the malingering group, and b) identification of scores that best differentiated the malingering and injured groups, and the development of tentative score cutoffs.

Regarding comparison of the total injured and malingering groups, results are included in Table 7.7.. Given the tendency for malingerers to be characterised by an idiosyncratic response style in terms of error types on the BVRT (see Table 7.7.), a summary of incidence rate of each error type within each main group was also calculated. Detailed statistics are given in Table 12.1., while a summary comparison is provided in Table 12.2..

Table 12.

Percentage of Subjects Producing at least One of any BVRT Error Type

12.1. Mean and Median Total Incidence of Error Type Within Group, and Proportion of Subjects with at least One of Each Error Type

Group	Task	Error type	Mean	Median	*n subjects with* at least 1 instance	% subjects with at least 1 instance
Total injured	Copy	Omissions	0.18	0	2	12.5
		Distortions	0.18	0	3	18.75
		Perseverations	0	0	0	0
		Rotations	0.06	0	1	6.25
		Misplacements	0.93	0	7	43.75
		Size errors	0.06	0	1	6.25
		Left-sided errors	0.5	0	4	25
		Right-sided errors	0.93	0.5	8	50
	Recall	Omissions	0.31	0	5	31.25
		Distortions	2.06	2	13	81.25
		Perseverations	1.25	1	10	62.5
		Rotations	1.37	1	11	68.75
		Misplacements	1.37	1	10	62.5
		Size errors	0.18	0	2	12.5
		Left-sided errors	2.18	2	13	81.25
		Right-sided errors	3.75	3	15	93.75
Malingering	Copy	Omissions	0.75	0	5	31.25
		Distortions	3.5	2.5	12	75
		Perseverations	0.06	0	1	6.25
		Rotations	1.68	1	11	68.75
		Misplacements	0.81	0.5	8	50
		Size errors	0.18	0	2	12.5
		Left-sided errors	2.37	2	11	68.75
		Right-sided errors	3.25	3.5	11	68.75

12.1 ' an and Median Total Incidence of Error Type Within Group,

and Proportion of Subjects with at least One of Each Error Type - continued

Group	Task	Error type	Mean	Median	n subjects with at least 1 instance	% subjects with at least 1 instance
	Recall	Omissions	1.5	0	7	43.75
		Distortions	6.06	6.5	16	100
		Perseverations	0.68	1	9	56.25
		Rotations	2.75	3	13	81.25
		Misplacements	1.81	1	13	81.25
		Size errors	0.18	0	3	18.75
		Left-sided errors	6	6	16	100
		Right-sided errors	6.06	5.5	15	93.75
Noninjured	Copy	Omissions	0.8	0	5	33 '3
		Distortions	0.6	0	5	33.33
		Perseverations	0	0	0	0
		Rotations	0.33	0	3	20
		Misplacements	1.4	1	8	53.33
		Size errors	0.06	0	1	6.66
		Left-sided errors	0.93	0	7	46.66
		Right-sided errors	1.93	2	12	80
	Recall	Omissions	0.73	0	3	20
		Distortions	2.13	1	11	73.33
		Perseverations	1	1	8	53.33
		Rotations	1.13	1	10	66.66
		Misplacements	1.26	1	9	60
		Size errors	0	0	0	0
		Left-sided errors	2.33	2	12	80
		Right-sided errors	3.46	3	14	93.33

12.2. Summary Comparison: Percentage of Subjects Producing any BVRT Error Type at least Once

Task	Error type	% Total Injured	% Malingerers	%Total Noninjured
Copy	Omissions	12.50	31.25	33.33
	Distortions	18.75	75.00	33.33
	Perseverations	0.00	6.25	0.00
	Rotations	6.25	68.75	20.00
	Misplacements	43.75	50.00	53.33
	Size errors	6.25	12.50	6.67
	Left-sided errors	25.00	68.75	46.67
	Right-sided errors	50.00	68.75	80.00
Recall	Omissions	31.25	43.75	20.00
	Distortions	81.25	100.00	73.33
	Perseverations	62.50	56.25	53.33
	Rotations	68.75	81.25	66.67
	Misplacements	62.50	81.25	60.00
	Size errors	12.50	18.75	0.00
	Left-sided errors	81.25	100.00	80.00
	Right-sided errors	93.75	93.75	93.33

Table 13.1. is a summary of the ability of each score to differentiate malingerers from injured subjects. This table was derived from Table 7.7., which, as stated above, summarises the significant differences, or otherwise, between the 3 main groups (injured, malingering, and noninjured).

Table 13.2. lists those variables for which malingerers scored significantly below injured subjects, and for which the development of lower cutoffs was believed might be feasible.

Table 13.3. lists those variables for which malingerers scored significantly above injured subjects, and for which the development of upper cutoffs was believed might be feasible.

Table 13.

Summary of Scores found to Differentiate Malingerers from the Total Injured Group

13.1. All Variables

Test	Score		Difference
PCL	PCL1	(pre-injury total symptoms)	MAL < INJ
	PCL2	(post-injury total symptoms)	INJ < MAL
	PCLDIFF	(difference in total symptoms)	INJ < MAL
	PCLPCS1	(pre-injury typical PSC)	MAL < INJ
	PCLPCS2	(post-injury typical PCS)	INJ < MAL
	PCLPCDIF	(difference in typical PCS)	INJ < MAL
PCSC	PCSC1TOT	(pre-injury total symptoms)	MAL < INJ
	PCSC1FRQ	(pre-injury symptom frequency)	No significant difference
	PCSC1INT	(pre-injury symptom intensity)	No significant difference
	PCSC1DUR	(pre-injury symptom duration)	No significant difference
	PCSC2TOT	(post-injury total symptoms)	INJ < MAL
	PSCS2FRQ	(post-injury symptom frequency)	INJ < MAL
	PCSC2INT	(post-injury symptom intensity)	INJ < MAL
	PCSC2DUR	(post-injury symptom duration)	No significant difference
	TOTDIFF	(difference in total symptoms)	INJ < MAL
	FRQDIFF	(difference in symptom frequency)	INJ < MAL
	INTDIFF	(difference in symptom intensity)	INJ < MAL
	DURDIFF	(difference in symptom duration)	INJ < MAL
	HEADACH1	(pre-injury headaches)	No significant difference
	DIZZINE1	(pre-injury dizziness)	No significant difference
	IRRITAB1	(pre-injury irritability)	No significant difference
	MEMORY1	(pre-injury memory problems)	No significant difference
	CONCENT1	(pre-injury concentration problems)	No significant difference
	FATIGUE1	(pre-injury fatigue)	No significant difference
	VISION1	(pre-injury vision problems)	No significant difference

13.1. All Variables - continued

Test	Score		Difference
	NOISIN1	(pre-injury noise intolerance)	No significant difference
	JUDGEME1	(pre-injury judgement problems)	No significant difference
	ANXIETY1	(pre-injury anxiety)	No significant difference
	HEADACH2	(post-injury headaches)	INJ < MAL
	DIZZINE2	(post-injury dizziness)	INJ < MAL
	IRRITAB2	(post-injury irritability)	INJ < MAL
	MEMORY2	(post-injury memory problems)	No significant difference
	CONCENT2	(post-injury concentration problems)	No significant difference
	FATIGUE2	(post-injury fatigue)	No significant difference
	VISION2	(post-injury vision problems)	No significant difference
	NOISIN2	(post-injury noise intolerance)	INJ < MAL
	JUDGEME2	(post-injury judgement problems)	No significant difference
	ANXIETY2	(post-injury anxiety)	INJ < MAL
	HEADADIF	(difference in headache incidence)	INJ < MAL
	DIZZIDIF	(difference in dizziness incidence)	INJ < MAL
	IRRITDIF	(difference in irritability)	INJ < MAL
	MEMDIF	(difference in memory problems)	INJ < MAL
	CONCDIF	(difference in concentration problems)	INJ < MAL
	FATIGDIF	(difference in fatigue)	INJ < MAL
	VISIODIF	(difference in vision problems)	INJ < MAL
	NOISEDIF	(difference in noise intolerance)	INJ < MAL
	JUDGDIFF	(difference in judgement problems)	INJ < MAL
	ANXDIFF	(difference in anxiety)	INJ < MAL
BVRT	BVCORR_C	(copy task correct)	MAL < INJ
	BVERR_C	(copy task errors)	INJ < MAL
	OMIS_C	(copy task omissions)	No significant difference
	DISTOR_C	(copy task distortions)	INJ < MAL

13.1. All Variables - continued

Test	Score		Difference
	PERSEV_C	(copy task perseverations)	No significant difference
	ROTAT_C	(copy task rotations)	INJ < MAL
	MISPLA_C	(copy task misp'acements)	No significant difference
	SIZE_C	(copy task size errors)	No significant difference
	LEFT_C	(copy task left-sided errors)	INJ < MAL
	RIGHT_C	(copy task right-sided errors)	INJ < MAL
	BVCORR_D	(recall task correct)	MAL < INJ
	BVERR_D	(recall task errors)	INJ < MAL
	OMIS_D	(recall task omissions)	No significant difference
	DISTOR_D	(recall task distortions)	INJ < MAL
	PERSEV_D	(recall task perseverations)	No significant difference
		(recall task rotations)	No significant difference
	MISPLA_D	(recall task misplacements)	No significant difference
	SIZE_D	(recall task size errors)	INJ < MAL
	LEFT_D	(recall task left-sided errors)	INJ < MAL
	RIGHT_D	(recall task right-sided errors)	No significant difference
PASAT	PASAT1	(trial 1)	No significant difference
	PASAT2	(trial 2)	MAL < INJ
	PASAT3	(trial 3)	MAL < INJ
	PASAT4	(trial 4)	MAL < INJ
	PASATTOT	(total score)	MAL < INJ
STROOP	STROOP1	(trial 1: speed)	No significant difference
	STROOP2	(trial 2: speed)	No significant difference
	STROOP3	(trial 3: speed)	No significant difference
	STROOP4	(trial 4: speed)	No significant difference
	SUBT32	(speed difference: trials 3 and 2)	No significant difference

13.1. All Variables - continued

Test	Score		Difference
	SUBT42	(speed difference: trials 4 and 2)	No significant difference
	STR1ACC	(trial 1: accuracy)	No significant difference
	STR2ACC	(trial 2: accuracy)	MAL < INJ
	STR3ACC	(trial 3: accuracy)	MAL < INJ
	STR4ACC	(trial 4: accuracy)	MAL < INJ
REY 15-ITEM	FIFTEEN	(total correct)	MAL < INJ
RDS	RDSFORW	(total score forward)	MAL < INJ
	RDSBACK	(total score backwards)	MAL < INJ
	RDSTOT	(overall total)	MAL < INJ
	RDSDIFF	(forward minus backward score)	No significant difference

13.2. Significant Group Differences suggesting Possible Lower Cutoffs

Test	Score		Difference
PCL	PCL1	(pre-injury total symptoms)	MAL < INJ
	PCLPCS1	(pre-injury typical PCS	MAL < INJ
PCSC	PCSC1TOT	(pre-injury total symptoms)	MAL < INJ
BVRT	BVCORR_C	(copy task correct)	MAL < INJ
	BVCORR_D	(recall task correct)	MAL < INJ
PASAT	PASAT2	(trial 2)	MAL < INJ
	PASAT3	(trial 3)	MAL < INJ
	PASAT4	(trial 4)	MAL < INJ
	PASATTOT	(total score)	MAL < INJ
STROOP	STR2ACC	(trial 2: speed)	MAL < INJ
	STR3ACC	(trial 3: speed)	MAL < INJ
	STR4ACC	(trial 4: speed)	MAL < INJ
REY 15-ITEM	FIFTEEN	(total correct)	MAL < INJ
RDS	RDSFORW	(total score forward)	MAL < INJ
	RDSBACK	(total score backwards)	MAL < INJ
	RDSTOT	(overall total)	MAL < INJ

13.2. Significant Group Differences suggesting Possible Upper Cutoffs

Test	Score		Difference
PCL	PCL2	(post-injury total symptoms)	INJ < MAL
	PCLDIFF	(difference in total symptoms)	INJ < MAL
	PCLPCS2	(post-injury typical PCS)	INJ < MAL
	PCLPCDIF	(difference in typical PCS)	INJ < MAL
PCSC	PCSC2TOT	(post-injury total symptoms)	INJ < MAL
	PSCS2FRQ	(post-injury symptom frequency)	INJ < MAL
	PCSC2INT	(post-injury symptom intensity)	INJ < MAL
	TOTDIFF	(difference in total symptoms)	INJ < MAL
	FRQDIFF	(difference in symptom frequency)	INJ < MAL
	INTDIFF	(difference in symptom intensity)	INJ < MAL
	DURDIFF	(difference in symptom duration)	INJ < MAL
	HEADACH2	(post-injury headaches)	INJ < MAL
	DIZZINE2	(post-injury dizziness)	INJ < MAL
	IRRITAB2	(post-injury irritability)	INJ < MAL
	NOISIN2	(post-injury noise intolerance)	INJ < MAL
	ANXIETY2	(post-injury anxiety)	INJ < MAL
	HEADADIF	(difference in headache incidence)	INJ < MAL
	DIZZIDIF	(difference in dizziness incidence)	INJ < MAL
	IRRITDIF	(difference in irritability)	INJ < MAL
	MEMDIF	(difference in memory problems)	INJ < MAL
	CONCDIF	(difference in concentration problems)	INJ < MAL
	FATIGDIF	(difference in fatigue)	INJ < MAL
	VISIODIF	(difference in vision problems)	INJ < MAL
	NOISEDIF	(difference in noise intolerance)	INJ < MAL
	JUDGDIFF	(difference in judgement problems)	INJ < MAL
	ANXDIFF	(difference in anxiety)	INJ < MAL
BVRT	BVERR_C	(copy task errors)	INJ < MAL
	DISTOR_C	(copy task distortions)	INJ < MAL

13.2. Signific Group Differences suggesting Possible Upper Cutoffs - continued

Test	Score		Difference
	ROTAT_C	(copy task rotations)	INJ < MAL
	LEFT_C	(copy task left-sided errors)	INJ < MAL
	RIGHT_C	(copy task right-sided errors)	INJ < MAL
	BVERR_D	(recall task errors)	INJ < MAL
	DISTOR_D	(recall task distortions)	INJ < MAL
	LEFT_D	(recall task left-sided errors)	INJ < MAL

Tentative cutoffs were then calculated following Greiffenstein et al. (1994). These researchers aimed for their cutoffs to have a 90 percent specificity for the injured group, assuming a normal distribution (that is, that 90 percent of injured subjects would be classified as injured). The cutoff score is therefore set at 1.3 standard deviations below the reference group mean. An incremental hit rate was calculated, which was the improvement over the base rate incidence of malingerers as a proportion of the group used (noninjured and malingerers). This study repeated this method, and the resulting cutoffs are listed in Table 14..

The cutoffs were applied to a group consisting of all injured and noninjured subjects. Specificity (the percentage of injured subjects correctly classified as such), sensitivity (the percentage of malingerers correctly classified as malingering), total hit rate (the total percentage of subjects correctly classified as either injured or malingering), and incremental hit rate were calculated. The incremental hit rate refers to the improvement of the base rate incidence of malingering (that is, 50 percent, when the 16 injured subjects and 16 malingering subjects are combined). One would expect to obtain a hit rate equal to the base rate incidence of malingering, if one's decision was based on guessing. The incremental hit rate therefore indicates the improvement over guessing.

After developing these cutoffs, incremental hit rates were examined and those scores with the best ability to discriminate were identified. This is dealt with in the Discussion section.

Table 14.

Tentative Cutoffs for Individual Scores

14.1. Lower Cutoffs (Malingerers tend to score Below the Cutoff)

Test	Score	Cutoff	Specificity	Sensitivity	Hit rate	Incremental hit rate
PCL	PCL1	3.62	93.75	68.75	81.25	31.25
	PCLPCS1	0.87	93.75	75.00	84.38	34.38
PCSC	PCSC1TOT	2.32	87.50	25.00	56.25	6.25
BVRT	BVRCOR_C	6.08	93.75	56.25	75.00	25.00
	BVRCOR_D	2.24	87.50	43.75	65.63	15.63
PASAT	PASAT2	7.15	93.75	56.25	75.00	25.00
	PASAT3	4.54	87.50	31.25	59.38	9.38
	PASAT4	4.77	81.25	68.75	75.00	25.00
	PASATTOT	25.15	100.00	37.50	68.75	18.75
STROOP	STR2ACC	91.99	93.75	43.75	68.75	18.75
	STR3ACC	92.79	93.75	37.50	65.63	15.63
	STR4ACC	91.09	87.50	50.00	68.75	18.75
REY 15-ITEM	FIFTEEN	10.99	87.50	75.00	81.25	31.25
RDS	RDSFORW	4.22	87.50	56.25	71.88	21.88
	RDSBACK	2.58	56.25	81.25	68.75	18.75
	RDSTOT	7.58	62.50	68.75	65.63	15.63

14.2. Upper Cutoffs (Malingerers tend to score Above the Cutoff)

Test	Score	Cutoff	Specificity	Sensitivity	Hit rate	Incremental hit rate
PCL	PCL2	25.58	87.50	62.50	75.00	25.00
	PCLDIFF	9.09	87.50	100.00	93.75	43.75
	PCLPCS2	12.91	81.25	62.50	71.88	21.88
	PCLPCDIF	6.05	81.25	100.00	90.63	40.63
PCSC	PCSC2TOT	103.34	87.50	62.50	75.00	25.00
	PCSC2FRQ	34.07	87.50	68.75	78.13	28.13
	PCSC2INT	34.44	87.50	68.75	78.13	28.13
	TOTDIFF	56.24	87.50	75.00	81.25	31.25
	FRQDIFF	18.75	87.50	75.00	81.25	31.25
	INTDIFF	19.94	87.50	62.50	75.00	25.00
	DURDIFF	18.20	81.25	68.75	75.00	25.00
	HEADACH2	13.19	81.25	31.25	56.25	6.25
	DIZZINE2	10.66	87.50	31.25	59.38	9.38
	IRRITAB2	10.52	93.75	31.25	62.50	12.50
	NOISIN2	12.33	87.50	50.00	68.75	18.75
	ANXIETY2	11.35	87.50	75.00	81.25	31.25
	HEADADIF	7.38	81.25	43.75	62.50	12.50
	DIZZDIF	6.64	87.50	12.50	50.00	0.00
	IRRITDIF	3.93	81.25	68.75	75.00	25.00
	MEMDIF	7.99	81.25	31.25	56.25	6.25
	CONCDIF	6.68	93.75	50.00	71.88	21.88
	FATIGDIF	8.25	75.00	12.50	43.75	-6.25
	VISIODIF	8.83	87.50	18.75	53.13	3.13
	NOISEDIF	7.00	87.50	56.25	71.88	21.88
	JUDGDIFF	6.32	81.25	62.50	71.88	21.88
	ANXDIFF	5.59	87.50	75.00	81.25	31.25

14.2. Upper Cutoffs - continued

Test	Score	Cutoff	Specificity	Sensitivity	Hit rate	Incremental hit rate
BVRT	BVRERR_C	3.92	93.75	68.75	81.25	31.25
	DISTOR_C	0.71	81.25	75.00	78.13	28.13
	ROTAT_C	0.39	0.00	100.00	50.00	0.00
	LEFT_C	1.84	87.50	56.25	71.88	21.88
	RIGHT_C	2.61	81.25	56.25	68.75	18.75
	BVRERR_D	11.84	87.50	56.25	71.88	21.88
	DISTOR_D	4.05	81.25	75.00	78.13	28.13
	LEFT_D	4.57	87.50	56.25	71.88	21.88

2.2. Findings

Description of findings will take place in terms of each the three main areas of examination: possible cognitive deficits, subjective postconcussive complaints, and identification of incomplete effort.

2.2.1. Cognitive Sequelae

1. Natur and Incidence of Cognitive Deficits

The main groups and subgroups were compared for differential performance on tests of visual memory, sustained attention, and divided attention. Chronicity of complaints was also investigated.

1. Memory (BVRT)

The total injured and noninjured groups were not significantly different in terms of performance on the task of visual memory (see the BVRT scores in Table 7.7.). The recently injured, intermediate injured, and long term injured groups were also not differentiable from the noninjured group in terms of performance on the visual memory task (see the BVRT scores in Table 8.2.1.2., Table 8.2.1.2., and Table 8.2.1.4.).

Some significant difference in performance was nevertheless was noted in comparing the recently injured, intermediate and long term injured groups. The intermediate group tended to make more errors of misplacement than the long term group (see BVRT scores in Table 8.2.1.1.).

2. Attention and Information Processing

1. Divided Attention (PASAT-R)

No differences were noted in the performance of the total injured and noninjured groups (see PASAT-R scores in Table 7.7.). This applied to the total score, as well as to performance at varying degrees of time pressure (that is, trials 1 to 4).

The same pattern was noted in the performance of the recently injured group, relative to that of the noninjured group (see PASAT-R scores in Table 8.2.1.2.). The intermediate injured group, however, scored more poorly on the least demanding task of divided attention (trial 1) than did the noninjured group (see PASAT-R scores in Table 8.2.1.3.).

No differences were noted in the performance of the long term injured group and the noninjured group (see PASAT-R scores in Table 8.2.1.4.).

Once again, some differentiation was noted within the injured group. The intermediate group tended to obtain poorer scores than the long term group on trials 1 and 2 (see PASAT-R scores in Table 8.2.1.1.).

2. Sustained Attention (Stroop)

The injured group performed significantly more slowly than the noninjured group on trial 1 of the Stroop (see Stroop scores in Table 7.7.).

No differences were found in comparing the recently injured and noninjured groups, in terms of speed or accuracy (see Stroop scores in Table 8.2.1.2.). The intermediate group, however, performed more slowly trial 2 than did the noninjured group. No differences were found in terms of accuracy of performance between these two groups (see Stroop scores in Table 8.2.1.3.).

No differences were found between the performance of the long term injured and the noninjured groups, either in terms of speed of performance, or in terms of accuracy of performance (see Stroop scores in Table 8.2.1.4.).

Again, some differentiation was found within the injured group. While there were no differences in terms of speed of performance, the intermediate group scored more poorly than

the long term group in terms of accuracy on trial 2 (see Stroop scores in Table 8.2.1.1.).

3. Tests of Malingering

No differences were found between the injured and noninjured groups on the Rey 15-item test of incomplete effort (see Rey 15-item scores in Table 7.7.). This finding also applied to the recently injured, intermediate injured and long term injured groups relative to the noninjured group (see Rey 15-item scores in Tables 8.2.1.2. to 8.2.1.4.). No differences were noted between the three injured subgroups (see Rey 15-item scores in Table 8.2.1.1.).

On the RDS, no differences were noted in the performance of the injured groups relative to the noninjured group. This applied to all injured groups: the total injured group (see RDS scores in Table 7.7.), as well as the recently injured, intermediate, and long term injured group (see RDS scores in Tables 8.2.1.2. to 8.2.1.4., respectively). No differences were noted between the three injured subgroups (see RDS scores in Table 8.2.1.1.).

Performance on the BVRT, also used to detect incomplete effort, is described above.

2. Injury Characteristics and Performance on Cognitive Tests, and Tests of Malingering

1. Injury Severity

Injury characteristics were correlated with cognitive scores. No correlation coefficients were generated for the subscores of the BVRT, however, given the small numbers involved. Post-traumatic amnesia, loss of consciousness, and length of hospitalisation were examined. Results are shown in Tables 10.1.1. to 10.1.3., respectively.

The longer the reported period of post-traumatic amnesia, the quicker performance on trials 1, 2, and 4 of the Stroop (see Stroop scores in Table 10.1.1.). In addition, the longer the reported post-traumatic amnesia, the less time difference between trials 2 and 4. At the same time, the longer the period of post-traumatic amnesia, the more accurate performance on trial 1 of the Stroop, but the less accurate performance on trial 4.

Length of loss of consciousness was also positively correlated with the performance on the RDS (see RDS scores in Table 10.1.2.).

Length of hospitalisation was positively correlated with SUBT42. Thus, the greater the length of hospitalisation,

the less difference in speed between trials 4 and 2 (see Table 10.1.3.).

2. Time Since Injury

Significant relationships were found between time since injury and the Correct and Error scores on the copy task of the BVRT (positive and negative relationships respectively: see Table 9.1.2.).

Inspection of the median scores of the 3 subgroups, defined in terms of time since injury, suggests that, rather than recently injured subjects tending to produce more errors and fewer correct responses, these results were the result of a tendency for more long term injured subjects to produce fewer errors and more correct responses (see Table 8). Median Correct and Error scores for the recently injured group were equal to those of the noninjured group, while the long term injured group produced had higher median scores on both measures than the noninjured group (although neither difference was significant: see Table 8.2.1.).

Time since injury did not have a significant relationship with any other cognitive scores.

3. Other Demographic Characteristics

No significant associations were found between age and cognitive performance (see Table 9.1.1.).

Only the SUBT42 score was significantly associated with years of education, being positively correlated (see Table 9.1.1.). Thus, subjects with more years of schooling were more likely to take longer on trial 4 of the Stroop, relative to time taken on trial 2.

2.2.2. Post-concussive Complaints (PCL and PCSC)

The study examined differences in reporting of postconcussive complaints between the total injured group and the noninjured group, as well as differences between injured groups of different chronicity and the noninjured group. The injured subgroups were also compared with each other. Links between postconcussive complaints and cognitive performance were then investigated, as were factors associated with the development of postconcussive complaints.

1. Differential Reporting of Postconcussive Complaints

Perceived Pre-Injury Status:

On the PCL, no differences were found regarding pre-injury total symptoms, as well as pre-injury occurrence of typical postconcussive symptoms. This was found for the total injured group (see pre-injury PCL scores in Table 7.7.), as well as for the recent, intermediate, and long term injured subgroups, relative to the noninjured group. For the latter, see the pre-injury PCL scores in Tables 8.2.1.2. to 8.2.1.4., respectively. In addition, no differences were found when the injured subgroups were compared with each other (see pre-injury PCL scores in Table 8.2.1.1.).

On the PCSC, however, the total injured group reported significantly lower pre-injury symptom incidence than the noninjured group. This applied to total symptoms, symptom intensity, and symptom duration. The total injured group also reported lower incidence of pre-injury fatigue, noise intolerance, and anxiety (see pre-injury PCSC scores in Table 7.7.).

As regards the responses of the three injured subgroups on the PCSC, the recently injured group displayed different responses to the total group. No differences were found between this injured group and the noninjured group in

terms of pre-injury total symptoms, or in terms of symptom frequency, intensity, or duration. The recently injured group nevertheless reported lower pre-injury incidence of anxiety (see pre-injury PCSC scores in Table 8.2.1.2.).

In terms of pre-injury total symptoms, the intermediate group reported only lower pre-injury symptom intensity than the noninjured group. With regard to specific symptoms, they reported less pre-injury anxiety and fatigue than the noninjured group (see pre-injury PCSC scores in Table 8.2.1.3.).

The long term injured group reported lower incidence of total pre-injury symptoms than the noninjured group, as well as less intensity and duration of such symptoms. As did the recently injured group, they also reported lower levels of pre-injury anxiety (see pre-injury PCSC scores in Table 8.2.1.4.). No pre-injury differences were found between the 3 injured subgroups, defined in terms of time since injury, either in terms of total symptoms, symptom frequency, intensity, or duration, or in terms of specific postconcussive symptoms (see pre-injury PCSC scores in Table 8.2.1.1.).

Perceived Post-Injury Status:

On the PCSC, no differences were found between the total injured and noninjured groups regarding post-injury total

symptoms, as well as post-injury occurrence of typical postconcussive symptoms (see post-injury PCL scores in Table 7.7.). No differences were found between the noninjured group and any of the three injured subgroups (recent, intermediate, and long term). See post-injury PCL scores in Tables 8.2.1.2. to 8.2.1.4.). There were also no differences between the injured subgroups (see post-injury PCL scores in Table 8.2.1.1.).

On the PCSC, too, no differences were found between the total injured group and the noninjured group in reporting of current symptoms. This applied to total symptoms, as well as symptom frequency, intensity, and duration. There were also no differences in specific post-injury symptoms (see post-injury PCSC scores in Table 7.7.).

With regard to the injured subgroups, the recently injured group reported greater absolute incidence of post-injury anxiety than the noninjured group (see Table 8.2.1.2.). The intermediate and long term groups, by contrast, did not report differently to the total injured group, either in terms of total post-injury symptoms, or in terms of specific post-injury symptoms (see Tables 8.2.1.3. and 8.2.1.4., respectively).

No significant differences were found between the 3 injured subgroups themselves, in terms of absolute incidence of post-injury symptoms, symptoms frequency, intensity, or

duration, or in terms of specific post-injury symptoms. Nevertheless, the long term group reported significantly more deterioration in terms of judgement ability than the intermediate group (the recently injured group was not significantly different to either of the groups). See Table 8.2.1.1..

Thus, in summary, the following breakdown of specific symptoms relative to the noninjured group was found:

* The total injured group reported less pre-injury fatigue, noise intolerance, and anxiety than the noninjured group, but did not differ from the noninjured group in terms of any post-injury symptoms.

* The recently injured group reported less pre-injury anxiety than the noninjured group, and they also reported more post-injury anxiety than the noninjured group.

* The intermediate injured group reported less pre-injury anxiety and fatigue than the noninjured group, but did not differ from the noninjured group in terms of any post-injury symptoms.

* The long term injured group reported less pre-injury anxiety than the noninjured group, but did not differ from the noninjured group in terms of any post-injury

symptoms.

Therefore, when using the noninjured group to estimate base rate symptoms, postconcussive complaints within the noninjured group as a whole tended to consist of differences in terms of fatigue, noise intolerance, and anxiety. Only the recently injured group reported more absolute post-injury symptoms, however. The post-injury symptoms reported by the intermediate and long term groups were not significantly different to those reported by the noninjured group.

When the total injured group was looked with reference only to itself (correlating time since injury with reported complaints), time since injury was found to be associated with several perceptions of pre- and post-injury functioning (see Table 9.1.2). Thus, as time since injury increased, so subjects tended to report lower incidence of pre-injury concentration difficulties (that is, their perception of their pre-injury status became more favourable), as well as greater post-injury deterioration relative to pre-injury functioning (greater deterioration in terms of irritability, concentration, and judgement).

2. Relationships between Postconcussive Complaints and Performance on Cognitive and Malingering Tests

Associations between reporting of present complaints and cognitive performance, as well as between perceived deterioration relative to pre-injury functioning and cognitive performance, were investigated. Correlations are presented in Table 11.

Several symptoms were significantly associated with performance on cognitive tests, although some of those symptoms were also significantly correlated with performance on tests of incomplete effort. The remaining symptoms were significantly associated only with performance on actual cognitive tests. For clarity of presentation, these two groups of symptoms are described separately.

1. Complaints associated with Poorer Performance on Tests of Incomplete Effort

Subjects reporting greater post-injury total symptoms incidence, and those reporting greater injury frequency or intensity, were more likely to perform poorly on the Rey 15-item test. Those reporting greater deterioration

relative to pre-injury functioning in terms of total symptoms, symptom frequency, or symptom intensity, were also likely to score more poorly on Rey 15-item test, as well as to work more slowly on trial 1 of the Stroop. Subjects complaining of greater deterioration in terms of symptom intensity were also more likely to obtain lower accuracy scores on trial 1 of the Stroop. Subjects reporting greater deterioration in terms of symptom duration, and those reporting greater post-injury incidence of memory difficulties, were also likely to perform more poorly on the Rey 15-item test.

Regarding absolute incidence of specific symptoms, claims of post-injury difficulties with memory and vision were associated with poorer performance on the Rey 15-item test only. Reported post-injury difficulties with judgement were associated with poorer performance on the Rey 15-item test, as well as with the SUBT42 of the Stroop (that is, the greater the reported post-injury judgement difficulties, the less likely that performance on trials 2 and 4 of the Stroop differed in terms of speed).

In contrast, the greater the reported levels of post-injury anxiety, the better performance on the RDS (also included to detect incomplete effort).

Reported deterioration in terms of specific symptoms, relative to pre-injury functioning, was examined. The

following types of deterioration were associated with poorer performance on the Rey 15-item test only: increased dizziness, increased concentration difficulties, worsened vision, and increased noise intolerance. Reported deterioration in memory was associated with worse performance on the Rey 15-item test, as well as with lower accuracy on trials 1 and 2 of the Stroop. Reported deterioration in terms of judgement was associated with an increase in the SUBT32 score of the Stroop (that is, the greater the deterioration reported, the slower performance on trial 3 was, relative to trial 2).

2. Complaints associated only with Poorer Performance on Cognitive Tests

Perceived deterioration in terms of total symptoms was associated with accuracy on trial 2 of the Stroop. Perceived deterioration in terms of headache incidence had a significant positive correlation with time scores on trials 1, 2, 3, and 4 of the Stroop (that is, the greater the deterioration, the slower the performance on these trials). A significant positive correlation also existed with the SUBT32 score of the Stroop (that is, the greater the reported deterioration, the slower the performance on trial 3, relative to trial 2).

In addition, reporting of deterioration in terms of headache (HEADADIF) was significantly associated with lower scores on trials 1, 2, and 3 of the PASAT-R, as well as on the PASAT-R total score. Reporting of higher incidence of absolute post-injury headache incidence (HEADACH2) was also significantly negatively related to trials 1 and 2 of the PASAT.

3. Factors Associated with Development and Incidence of Postconcussive Complaints

1. Pre-injury Factors

Several pre-injury factors and the association of each with reporting of postconcussive complaints, were investigated. More specifically, age, gender, region, and level of education were considered.

Examination of correlations between the available ages and postconcussive complaints found no significant relationships (see Table 9.2.1.).

Regarding gender, females complained of greater post-injury complaints, both with regard to complaints in general, as well as with regard to typical postconcussive complaints in particular. They complained of greater total postconcussive symptom incidence, as well as greater post-injury symptom

frequency, intensity, and duration. They also complained of greater deterioration since the injury in terms of total symptoms, typical postconcussive symptoms, and symptom frequency, intensity, and duration. In terms of specific symptoms, females complained of greater post-injury absolute incidence of headaches, memory problems, and fatigue. They also reported relative post-injury deterioration in terms of memory difficulties, and fatigue. See Table 8.2.2.1.).

There were no significant gender differences in scores of postconcussive complaints within the noninjured group (see Table 8.2.2.2.).

In terms of regional effects within the injured group, Gauteng residents tended to report worse post-injury concentration than Mpumalanga residents (see Table 8.3.2.1.). Regional differences were also noted in the noninjured group. Gauteng residents tended to report fewer pre- and post-injury memory difficulties than Mpumalanga residents (see Table 8.3.2.2.).

Those with higher levels of education tended to report lower incidence of pre-injury total symptoms, as well as lower pre-injury symptom frequency. Nevertheless, they also tended to complain of fewer post-injury symptoms, including total symptoms, typical postconcussive symptoms, frequency, intensity, and duration of symptoms, and fewer post-injury

difficulties in terms of memory, concentration, fatigue, vision, noise intolerance, and judgement. They were also reported less deterioration, relative to pre-injury functioning, in terms of total symptoms, typical postconcussive symptoms, frequency, intensity, and duration of symptoms, and deterioration in terms of memory. See Table 9.2.1.).

2. Peri- and Post-injury Factors

1. Physical Factors

Relationships between indices of injury severity and postconcussive complaints were investigated. More specifically, length of hospitalisation, period of loss of consciousness, and period of post-traumatic amnesia were examined in terms of relationships to postconcussive complaints.

Length of hospitalisation was significantly associated with incidence of several measures of post-injury complaints (see Table 10.2.3.). On the PCL, longer hospitalisation was associated with greater incidence of typical postconcussive symptoms, as well as greater perceived deterioration, relative to pre-injury status, in terms of typical postconcussive symptoms. On the PCSC, longer hospitalisation was associated with more post-injury total

symptoms, as well as greater frequency, intensity, and duration of such symptoms. In terms of specific symptoms, greater absolute post-injury difficulties were reported in terms of memory, concentration, fatigue, and judgement. Greater deterioration was reported relative to post-injury status in terms of concentration and judgement.

Increased loss of consciousness was associated with increased absolute experience of memory difficulties post-injury, as well as greater perceived deterioration relative to pre-injury functioning in terms of anxiety (see Table 10.2.2.).

The longer the period of posttraumatic amnesia reported, the greater the reported pre-injury incidence of typical postconcussive complaints, and the greater the incidence of total pre-injury postconcussive complaints, and the greater their frequency. In terms of specific symptoms, more pre-injury memory difficulties and vision difficulties were reported (a corollary of the above findings is that those subjects with shorter periods of posttraumatic amnesia tended to report lower pre-injury symptom levels). See Table 10.2.1..

2. Psychosocial Factors

Two factors were investigated: circumstances of injury, and blaming another party for the injury (versus absence of blame).

A comparison was made between mildly head injured subjects who had sustained their injuries in sports incidents, and those who had been involved in incidents of violence (see Table 8.2.4.). Sports-injured subjects reported fewer total post-injury complaints, as well as less deterioration relative to pre-injury status in terms of total symptoms. They also reported lower frequency of symptoms, and fewer problems in terms of post-injury memory and fatigue.

No effects for blame were found (see Table 8.2.5.).

2.2.3. Incomplete Effort

1. Nature of the malingering responses

1. Subjectively Reported Postconcussive Complaints

1. Comparison of Malingerers relative to Injured Subjects

Comparisons are summarised in Table 7.7..

Responses regarding pre-injury status were not consistent across both questionnaires used. For this reason, each will be described separately. Malingerers tended to claim a lower incidence of pre-injury symptoms than the total injured group, when the PCL was used. This applied to total pre-injury complaints (PCL1), as well as pre-injury incidence of typical postconcussive symptoms (PCLPCS1). They did not, however, report differently on pre-injury incidence of symptoms when the PCSC was used.

Regarding post-injury complaints, the results for the two questionnaires were more consistent. Malingerers reported greater incidence of post-injury complaints than injured subjects, both in terms of total complaints (PCL2), as well as in terms of typical postconcussive complaints in particular (PCLPCS2). They reported greater post-injury

total symptoms (PCSC2TOT), as well as greater symptom frequency (PCSC2FRQ) and intensity (PCSC2INT). Malingerers reported more current difficulties than injured subjects in terms of headaches, dizziness, irritability, noise intolerance, and anxiety.

Malingerers also obtained greater different scores on the PCL than injured subjects. This applied to perceived deterioration in terms of total complaints (PCLDIFF), as well as in terms of typical postconcussive complaints (PCLPCDIF). They also reported a greater relative increase in total symptoms on the PCSC (TOTDIFF), as well as in symptom frequency (FRQDIFF), intensity (INTDIFF), and duration (DURDIFF). Relative to pre-injury functioning, they reported deterioration in all ten symptoms queried by the PCSC, compared to the injured group (the symptoms are: headaches, dizziness, irritability, memory difficulties, concentration difficulties, fatigue, vision difficulties, noise intolerance, judgement difficulties, and anxiety).

Regarding a comparison of the injured subgroups (recent, intermediate, and long term) with the malingering group, a consistent pattern was seen. The malingering group consistently reported fewer pre-injury symptoms than any of the injured subgroups, while they also reported more post-injury complaints. At the same time, the number of scores for which this was found decreased from the recently injured group to the intermediate injured group, with the

long term injured group reporting the fewest differences. (For comparisons between the malingering group and the recently injured, intermediate, and long term injured groups respectively, see the PCL and PCSC scores in Tables 8.2.1.2., 8.2.1.3., and 8.2.1.4..)

Thus, on the PCL the malingering group reported significantly lower pre-injury incidence of total symptoms than both the recently injured and intermediate injured groups, and fewer typically postconcussive symptoms than both the intermediate and long term injured groups. Malingering subjects reported more post-injury incidence of total symptoms and typically postconcussive symptoms than both the recently injured and intermediate injured groups. Greater deterioration in terms of total symptom occurrence, relative to pre-injury functioning, was reported by the malingering group. This was found in relation to all three injured subgroups. The malingering group also reported greater post-injury deterioration in terms of typical postconcussive symptoms, than did the recently injured or intermediate injured groups.

On the PCSC, malingerers reported fewer total pre-injury symptoms than did recently injured subject, and more total post-injury symptoms than recently injured or intermediate injured subjects. Greater post-injury symptom frequency and intensity was reported by the malingering group than by the recently injured or intermediate injured groups.

Malingerers also reported more deterioration, relative to pre-injury functioning, than the recently injured or intermediate injured groups, in terms total symptoms, and symptom frequency, intensity, and duration.

In term of specific symptoms, malingerers reported fewer pre-injury difficulties than recently injured subjects in terms of vision and anxiety, and more post-injury dizziness than recently injured or intermediate injured subjects. They reported more post-injury irritability than intermediate injured subjects, and more post-injury memory difficulties than recently injured subjects. Malingerers also reported more post-injury concentration problems than intermediate injured subjects, and greater post-injury noise intolerance than recently injured or intermediate injured subjects. Malingerers reported greater post-injury judgement problems than intermediate injured subjects, and more post-injury anxiety than recently injured or intermediate injured subjects.

The pattern of differences between the injured groups and the malingering group decreasing, as time since injury increased, is most strikingly evident in looking at the difference scores for specific symptoms. The recently injured group reported less deterioration than the malingering group in terms of all 10 symptoms listed in the PCSC. The intermediate group, by contrast, reported less deterioration than the malingering group for 6 of the 10

symptoms (not reporting significantly differently regarding deterioration in terms of headache, memory difficulties, fatigue, and visual difficulties). The long term injured group reported less deterioration on only 2 of the 10 symptoms (they differed only with regard to deterioration in terms of anxiety and headaches).

2. Comparison of Malingerers relative to Noninjured Subjects

In addition to comparing the response patterns of malingerers to injured subjects, their responses were also looked at relative to noninjured subjects (see Table 7.7 for comparisons).

On the PCL, malingerers reported fewer total pre-injury symptoms (PCL1), and less pre-injury incidence of typical postconcussive symptoms (PCLPCS1) than noninjured subjects. Post-injury, both categories of symptoms were significantly greater than those of the noninjured group (PCL2 and PCLPCS2).

On the PCSC, malingerers reported lower incidence of total pre-injury symptoms than the noninjured group (PCSC1TOT), as well as lower frequency (PCSC1FRQ), intensity (PCSC1INT), and duration (PCSC1DUR) of such symptoms. In terms of specific symptoms, they reported fewer pre-injury headaches and memory problems, less fatigue, less noise

intolerance, and less anxiety than noninjured subjects.

Post-injury, they reported more total symptoms (PCSC2TOT) than noninjured subjects, as well as greater frequency (PCSC2FRQ), intensity (PCSC2INT), and duration (PCSC2DUR) of such symptoms than noninjured subjects. More specifically, they reported greater post-injury incidence of headaches, dizziness, irritability, memory problems, concentration difficulties, judgement difficulties, noise intolerance, and anxiety than noninjured subjects.

2. Performance on Cognitive Tests, and Tests of Malingering

1. Copying Ability and Visual Memory (Benton Visual Retention Test)

Malingerers tended to perform more poorly on the copying task than did injured subjects. This applied both to total production of correct designs, as well as to total production of incorrect designs. In addition, malingerers tended to have idiosyncratic error styles. In copying figures, they make more errors of distortion and rotation, as well as more errors involving the visual field (both right-sided and left-sided). See Table 7.7..

With regard to visual memory (the recall task), malingerers tended to produce more incorrect designs overall, as well

as fewer correct designs. With regard to specific error types, malingerers tended to produce more errors of distortion, as well as errors within the left visual field. See Table 7.7..

When considering the proportion of subjects within each group producing particular error types, the above patterns were maintained. These percentages are listed in Table 12..

For each of the following error types, a majority of the malingering group produced at least one instance of the following error types on the copy task: distortions, rotations left-sided errors, and right-sided errors. By contrast, for each of the latter error categories except right-sided errors, only a minority of genuinely injured subjects produced at least one error of that type. Half of the injured subjects produced at least one right-sided error, as opposed to a majority of malingering subjects (see Table 12.2.).

For the recall task, all of the malingering subjects were found to have produced at least one error of distortion. The same applied to left-sided errors. However, for both of these errors types, a (smaller) majority the noninjured subjects also produced at least one error of that type (see Table 12.2.).

2. Divided Attention (PASAT-R)

Malingerers tended to perform more poorly than injured subjects in relation to divided attention. This did not apply to the subtask involving the least time pressure (trial 1), but did apply to the three subsequent trials of increasing time pressure, as well as to the total score. see Table 7.7..

3. Sustained Attention (Stroop Colour Word Task)

With regard to sustained attention, the malingering group was not clearly different from the injured group in terms of speed of performance. This applies to al four trials, as well as to the two interference scores. Accuracy scores, however, clearly differentiated malingerers from injured subjects. As mentioned above, there was a tendency for some subjects to produce exaggeratedly incorrect responses. As explained above, these scores were eliminated, using as a rough guide the criterion of one quarter or fewer correct responses. It was believed that such subjects would be readily identifiable as malingering, as their case histories would be so at odds with their performance. With regard to the remaining, more subtle responses, malingerers scored significantly less accurately than injured subjects on trials 2, 3, and 4. Comparisons are set our in Table 7.7..

4. Specific Tests of Incomplete Effort

The malingering group performed more poorly than injured subjects on both tasks included to detect incomplete effort. With regard to the RDS specifically, malingerers performed more poorly than injured subjects on both the Forward and Backwards tasks. Their total RDS scores were also significantly poorer than those of injured subjects, although this groups scores denoting the difference in performance between the Forward and Backwards tasks (RDSDIFF) did not differ significantly from those of the injured group. See Table 7.7..

Performance on the BVRT has been described above.

2. Ability of Cutoffs to Differentiate Malingerers

Cutoffs and accompanying incremental hit rates are presented in Table 14. Cutoffs for tests of incomplete effort (that is, the RDS, the Rey 15-item test, and the BVRT) had incremental hit rates ranging from 18.75 percent to 31.25 percent. The best rates were found for the following scores: FIFTEEN, and BVERR_C (both 31.25 percent), DISTOR_C and DISTOR_D (both 28.13 percent), RDSFORW, LEFT_C, BVERR_D, and LEFT_D (all 21.88 percent).

Other scores, not specifically included to detect incomplete effort, had incremental hit rates ranging from 0 percent to 40.63 percent. The lowest incremental hit rates were obtained for the following scores: PCSC1TOT, PASAT3, HEADACH2, DIZZIDIF, MEMDIF, FATIGDIF, VISIODIF, and ROTAT_C. The following scores had incremental hit rates at, or above, 31.25 percent (the highest rate for any score on the tests included to detect incomplete effort): PCL1, PCLPCS1, PCLDIFF, PCLPCDIF, TOTDIFF, FRQDIFF, ANXIETY2, and ANXDIFF.

More detailed consideration is given to the cutoffs in the Discussion section.

CHAPTER 6: DISCUSSION

Discussion of results will take place in terms of each the three main areas of examination: cognitive deficits, subjective postconcussive complaints, and identification of incomplete effort. Since tests not specifically included to suggest incomplete effort nevertheless appeared able to do so, these findings will also be discussed. For the sake of clarity, performance will be discussed first in terms of cognitive deficits revealed, after which each instrument will be discussed in terms of ability to detect incomplete effort. This has been done in order to provide a focused discussion of results, rather than attempting to carry out two discussions simultaneously.

As stated above, post-injury outcome was not assessed in terms of external criteria such as return to work, but rather in terms of comparability of performance in the assessment.

1. Post-injury Sequelae

1.1. Cognitive Sequelae

1.1.1. Performance on Cognitive Tests

The main groups and subgroups were compared for differential performance on tests of visual memory, sustained attention, and divided attention. Chronicity of complaints was also investigated.

The assessment found no evidence suggesting visual memory deficits among any of the injured subgroups, relative to the noninjured group. The results of the assessment also do not suggest deficits in divided attention among the injured group, relative to the noninjured group.

Although the intermediate injured group scored significantly more poorly than the noninjured group on the least demanding task of divided attention (trial 1 of the PASAT-R), this seems unlikely to be related to differences in divided attention ability, given that performance on the more demanding tasks did not differ. One would expect such difficulties to have manifested in performance on the more demanding tasks of divided attention as well.

The specific category of time since injury for which this effect was found (that is, the intermediate injured group) is

also difficult to integrate with the literature. It would have been less surprising had the recently injured group performed most poorly, given claims that deficits are most noticeable in the more acute stages (for example, Miller, 1996). It would also have been less surprising had the most chronic group performed poorly, given claims that long term deficits in cognitive performance may be emotionally based (also, for example, Miller, 1996). There was no evidence of incomplete effort on the part of the intermediate injured group (see below), and this therefore also does not constitute a viable potential explanation for the effect found.

Some differentiation was also noted within the injured group itself. The intermediate subgroup tended to obtain poorer scores than the long term subgroup group on trials 1 and 2 of the Stroop. The remarks made above with regard to the anomalous performance of the intermediate group apply equally to this finding.

Demographically, the groups were not significantly different in terms of the information collected, and this therefore cannot be posed as an alternative explanation for the findings. It is nevertheless possible that other group differences exist, which were not assessed. It may be, for example, that the intermediate injured group took longer to acclimatise to the task at hand.

Nevertheless, the statistically stronger comparison of the total injured group with the noninjured group, as well as comparisons between all groups with regard to the more demanding subtasks, suggest that, relative to the noninjured group, the total injured group did not display deficits in divided attention. It is most likely that the effects seen in the intermediate group were an artifact of the limitations of the samples used, particularly their small sizes.

With regard to sustained attention, the total injured group was found to have performed significantly more slowly than the noninjured group on the least demanding trial. Once again, it is difficult to attribute this to difficulties with sustained attention, given that the effect was not found in the more demanding trials, either in terms of speed or accuracy. It seems unlikely that this difference was as a result of either differences in reading ability, or in terms of deficits in sustained attention among the injured group. If either explanation applied, one would expect to see this effect carried through to other trials that also demanded these skills, in addition to being more demanding in terms of sustained attention. Once again, it may be that the injured group took longer to acclimatise to the demands of the task, possibly because of increased anxiety. Since anxiety levels were not assessed, however, this is speculation.

As with divided attention, the intermediate injured group performed more slowly on one of the least demanding trials

(trial 2), than the noninjured group. Once again, this is difficult to attribute to difficulties with sustained attention. Trial 2 establishes a baseline level of ability to identify and name colours as quickly as possible (an ability that is crucial for later trials'. Given the lack of significant differences on other trials, it is likely that the difference found was as a result of either difficulty with identifying and naming colours, or difficulty with sustained attention.

The recently injured group's slower performance on trial 2 of the Stroop also does not appear to be the result of group differences in sustained attention, or in ability to name colours. The same reasons given above with regard to performance by the intermediate group relative to the noninjured group, apply here. It is also difficult to attribute this finding to differences in identifying and naming colours, or to differences in sustained attention. Once again, slower acclimatization to the demands of the task may have occurred, although this is speculation.

Overall, the results do not suggest deficits in sustained attention within any of the injured groups relative to the noninjured group.

The modified task suggested by Bohnen, Jolles, and Twijnstra (1992) was not useful in differentiating injured and

noninjured subjects. This applied to the extra task itself (trial 4), as well as the difference score derived from it (SUBT42). Nevertheless, the present sample differed from that of Bohnen et al., in terms of time since injury (the median posttraumatic interval of the recently injured group was 5.5 months, while intervals for the study cited had a range of 6 to 14 days). The present study is not able to comment on the usefulness or otherwise of the modified task in the acute stages of injury, and defers to the findings of Bohnen et al.. It nevertheless appears that whatever deficits may occur, do not persist into the periods examined by the present study.

Thus, it is concluded that there was no convincing evidence of cognitive difficulties, in terms of sustained attention, divided attention, and (verbal) memory, among the injured subjects, relative to the noninjured subjects. Once again, it is not possible to generalise this finding to all stages of injury, but it does not appear that deficits persisted into the posttraumatic periods assessed.

1.1.2. Performance on Tests of Malingering (Rey 15-item, RDS, and BVRT)

Performance on the tests of malingering provided no evidence to suggest incomplete effort by the injured group as a whole, or by any of the 3 subgroups compared (recently injured, intermediate, and long term injured). There therefore is no

evidence to suggest the injured groups were less motivated to do well than the noninjured group.

Given that these three tests all effectively differentiated injured and malingering subjects (see the Results section, as well as later in the discussion), but not injured and noninjured subjects, this study appears to support their use as tests of malingering. This is discussed further in the section dealing with incomplete effort.

1.2. Factors Affecting Cognitive Sequelae

The injured group's performance is discussed in terms of three characteristics: posttraumatic interval, injury severity, and other demographic characteristics.

1.2.1. Time Since Injury

There was some differentiation within the injured group on the copy task of the BVRT, with more long term injured subjects performing at a higher level than more recently injured subjects. It appears that the effect found was as the result of the more long term injured subjects performing particularly well, rather than the more recently injured subjects performing poorly. An alternative explanation, that the more recently injured subjects had difficulty with the copy task of the BVRT, but that this may have resolved with time in the more long term injured group, does not appear a

plausible possibility. If acutely injured subjects did in fact have difficulty with the copy task, this would suggest possible visuomotor or visuospatial difficulties, which would be difficult to reconcile with the fact that no such significant relationship was noted on the recall task. In addition to demanding visual memory, the recall task also requires visuospatial and visuomotor ability. One would therefore expect the effect to have carried through to the recall task, whereas the Correct and Error scores showed no significant relationship with time since injury.

While the evidence is incomplete, and any conclusions reached cannot be entirely satisfactory, it is concluded from the available evidence that the significant relationships found do not suggest deficits associated with acuteness of injury, but that the most likely explanation is that they are an artifact of the small sample sizes, and the specific characteristics of the more long term injured subjects (although the data that was collected does not appear to offer suggestions as to what these characteristics might be). No evidence was found of deficits, relative to the noninjured group, within either of the three subgroups (recent, intermediate, and long term). Any differences are therefore slight.

Posttraumatic interval did not have a significant relationship with any other cognitive scores. The evidence

therefore does suggest resolution or deterioration of cognitive complaints over time. At the same time, the sample included few subjects in the very acute stages of injury (within 3 months), during which, it has been claimed, deficits are greatest and resolution of symptoms over time most dramatic (for example, Miller, 1996). More detailed research, utilizing more subjects, particularly within the acute stages of injury, may have come to different conclusions to the above.

1.2.2. Injury Severity

A significant positive relationship was found between length of posttraumatic amnesia and speed of performance on most of the measures of sustained attention. The reasons for this relationship are not clear, but it may be that such subjects were especially motivated to do well. This is supported by findings in the present study with regard to performance on the RDS, for which a positive correlation existed between several scores and post-traumatic amnesia (a negative correlation would suggest poor motivation), although no similar effect was found for the Rey 15-item test. This suggestion is consistent with performance on the least demanding trial of the Stroop (trial 1), where increased posttraumatic amnesia was associated with greater accuracy. The negative association between length of posttraumatic amnesia and accuracy on trial 4 may have occurred despite (or even because of) attempts to work quickly. Alternatively, it

may be that deficits in sustained attention were present, and that quicker, less accurate performance related to a relative increase in injury severity, as evidenced in increased post-traumatic amnesia. The evidence is not, however, strong enough to move beyond these tentative suggestions. What is clear, however, is that it is limiting to focus on speed of performance, without also considering accuracy of performance, when using the Stroop. In this respect, the studies cited, which only examined speed of performance on the Stroop, ignoring accuracy, should be criticized for not considering the total responses of their subjects (for example, Bohnen, Jolles, and Twijnstra, 1992, as well as Batchelor et al., 1995).

No significant relationships were found between length of loss of consciousness and cognitive performance. Loss of consciousness did, however, have a significant positively correlation with performance on the RDS. The results therefore appear to suggest that the longer the period of posttraumatic amnesia or loss of consciousness, the less likely incomplete effort. This is not implausible, given that such subjects may have been particularly concerned about their injuries, and eager to participate fully. In the absence of more detailed research findings, however, the above suggestion is largely speculation. The suggestion is also weakened by the lack of a significant relationship between period of loss of consciousness and performance on the Rey 15-item test.

Length of hospitalisation was significantly positively correlated with one cognitive score (SUBT42). Thus, the longer the period of hospitalization, the slower the subject's performance on trial 4 of the Stroop, compared to trial 2. When trials 2 and 4 were examined on their own, however, as opposed to their combination into a composite score, no significant relationships were noted between length of hospitalisation and speed scores for either trial 2 or trial 4, or with accuracy scores for either of these two trials. Length of hospitalisation had no significant relationship with any other cognitive scores. Given the above, there may be some evidence of differentiation in term of sustained attention under more demanding conditions, depending on length of hospitalization. It may be that those subjects with longer periods of hospitalization had to perform especially slowly on the more difficult task, in order not to sacrifice accuracy. Such an effect did not, however, manifest sufficiently for the injured group, as a whole, to perform differently to the noninjured group in terms of sustained attention.

Overall, there was limited evidence for differentiation within the injured group in terms of injury severity and corresponding cognitive performance. No evidence of deficits in visual memory or divided attention were found, although there were suggestions of differentiation in terms of sustained attention. In this respect, the best barometer of

injury severity appeared to be length of post-traumatic amnesia. This finding is consistent with a view of concussion that emphasizes the presence of amnesia. Szymanski and Linn (1992) define concussion as "an acceleration/deceleration injury to the head almost always associated with a period of amnesia, and followed by a characteristic set of symptoms" (p. 358). The association with amnesia is also broadly consistent previous literature in which posttraumatic amnesia is used to define injury severity: for example, Russel (1971), cited in Bohnen and Jolles (1992), who based his differentiation of mild, moderate, and severe head injury on length of posttraumatic amnesia (although other writers, such as Gouvier et al. (1992) see this as problematic).

The findings should, however, be treated cautiously. Information about injury severity was based on personal recollection, which may have been inaccurate. It may also be that within the mild head injury group, the members of which were selected according to fairly stringent criteria, further differentiation was not meaningful, particularly given the small numbers involved. Given that there were no meaningful differences between the injured groups and the noninjured group, any effects were slight, possibly even an artifact of individual characteristics not controlled for. On the other hand, it may be useful to further investigate relative deficit in sustained attention, using larger samples, and more precise differentiations of injury severity. Further research may clarify the findings.

1.2.3. Other Demographic Characteristics

Within the injured group, the effects of age and education were examined. No significant associations were found between age and cognitive performance. Nevertheless, the actual range of subjects was fairly restricted (mean 25.06 years, standard deviation 8.8 years), and age differences may exist over a wider range.

Only score SUBT42 was significantly associated with years of education (a positive association). Thus, more educated subjects tended to perform more slowly on task 4, relative to task 2. This is difficult to explain, given that the obvious possible factor of differential reading ability would suggest a negative relationship. In addition, the range of education within the injured group was restricted (mean 10.88 years, standard deviation 1.26 years), with all subjects having a fairly high level of schooling (range: 9 to 12 years). It may be that subjects with higher levels of education were more cautious, and in this regard, it may be that the inclusion of adult education college students and adolescent high school students within the same group was problematic. Confounding variables, such as the reasons behind belated education, may have played a role. Unfortunately, the study design neglected to take this factor into account, and any suggested explanations would be speculation. It is difficult to know how much importance to give to the finding, but the presence

of the finding, in the absence of information that might explain it, nevertheless points to a weakness of the study.

1.2.4. Conclusions

Previous research has suggested that mild head injury is followed by difficulties with memory and attention (for example, Jacobson, 1995, and Bohnen and Jolles, 1992). There is nevertheless debate as to how long these difficulties persist. Kibby and Long (1996), for example, state that it is unlikely that the physical process of mild head injury alone would result in cognitive deficits beyond three months duration. On the other hand, Beers et al. (1994) maintain that cognitive deficits persist for years after the injury.

This study found little evidence to suggest that cognitive deficits existed within the injured group, relative to the noninjured group. It is nevertheless important to note that, for even the most acutely injured subgroup, the median time since injury exceeded three months (the recently injured group had a median posttraumatic interval of 5.5 months). The present study is therefore not able to comment on the very acute stages of injury, but it does appear that cognitive deficits were not present, in later stages. Although some associations were found between indices of injury severity and measures of sustained attention, these effects were not significant relative to the noninjured group.

The above findings are compatible with two views: that no cognitive deficits had ever existed, or that any cognitive difficulties had resolved by the time of the assessment. This study is not able to comment on the former, and would choose to defer to the many studies having found deficits in the acute stages of injury. It appears most likely that the latter possibility holds: that recovery generally occurs, following mild head injury, and that persistent deficits, beyond the first few months post-injury, are uncommon. Nevertheless, this conclusion derives from the assumption that the noninjured group constitute a valid control, and is weakened by any limitations to this assumption, as well as any other limitations to the study.

It has been recognised by previous researchers that the categories of mild and moderate injury have been insufficiently separated, and that the characteristics of each differ (for example, Kibby and Long, 1996). It may therefore be that the present sample included subjects that could have been classified as moderately injured (for example, three subjects had a PTA duration of "about" or "not more than" one hour). Nevertheless, such an explanation for the findings, if valid, is problematic to the classification system itself. Those borderline periods that were included, were only done so after carefully examining likely GCS scores on hospital admission. Thus, for these, or other possibly moderately injured subjects, deviations from the criteria, if any, would have been slight.

It could be argued that while the definitions for either type of injury may be discrete, it is misleading to see them as so. The extreme cases of each may be difficult to classify. For example, Kibby and Long differentiate the categories as follows: mild head injury is characterised by a GCS of 13 or higher, and PTA of less than one hour; moderate head injury is characterised by a GCS of 9 to 12, and PTA of one to 24 hours. The grey nature of borderline cases is especially pertinent when, as in the present study, subjective memory is relied on to obtain the necessary indices. It is suggested by this author that the issue is less one of possible misclassification, and more one of the greyness of the transition from mild to moderate injury. Given that differential classification carries with it differential assumptions (particularly with regard to litigation), it is argued that categorization that is crudely and absolutely applied, is potentially extremely unfair to litigants. Even within the context of precisely defined classification criteria, it may be that degrees of severity exist. It is suggested that this be investigated in further research.

Overall, however, the findings of this study do not appear to provide support for viewpoints that see chronic psychological complaints as being based on significant cognitive deficits, relative to a noninjured baseline (for example, Beers et al., 1994). The above is not necessarily evidence that subjects do not experience problems, but only that chronic problems do

not appear to be rooted in significant deterioration in cognitive capacity. The discrepancy between this finding and the personal perceptions reported by injured subjects will be discussed in the section dealing with postconcussive complaints. Associations between perceived absolute post-injury complaints and cognitive performance, as well as between perceived deterioration relative to pre-injury status and cognitive performance, will be discussed.

1.2. Post-concussive Complaints (PCL and PCSC)

While the often long post-injury intervals in this study were at odds with studies involving cognitive deficits (for example, Kibby and Long (1996) report that recovery generally occurs within 3 months), these periods were less unusual in the context of studies looking at persistent psychological sequelae (for example, Mittenberg et al. (1996) report that 35 to 50 percent of patients report symptoms one to three years post-injury, and Beers et al. (1994) found evidence of sequelae persisting for years).

It was not possible to calculate rate of incidence of the postconcussive syndrome, given that postconcussive symptoms, rather than a syndrome as such, were investigated. The reason that the syndrome concept was not employed, was that it was found to be of limited use, given that the syndrome has been so vaguely and so disparately defined in the literature.