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# Incidence and Neuropsychological Sequelae of Head Injury in a New Zealand Adolescent Sample.

A thesis presented in partial fulfilment
of the requirements for the degree
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at Massey University.

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# ABSTRACT

The purpose of this study was to determine if there were head-injured students experiencing difficulties that were not being recognised by parents and teachers alike. The study involved two parts. The first part involved a survey of all fourth formers at Awatapu College in Palmerston North, New Zealand, and was concerned with obtaining information regarding incidence, etiology, and awareness of head injury. The second part of the study examined a proportion of students who reported ongoing problems of the kind common after a head injury in more detail. Information was obtained through a self-report questionnaire, neuropsychological measures, a teacher rating form and a parent rating form. The results yielded a incident rate of nearly 14% which is substantially higher than that reported by previous studies, and the results also suggest that head-injured students are more aware of common symptomatology following head injury in comparison to non head-injured students. Apart from on Trial 5 and 6 of the AVLT, there was no significant difference between the head-injured and control groups on the neuropsychological measures. With regards to behavioural and cognitive difficulties that the students may be experiencing, there was a low level of agreement between students, teachers and parents.

Dedicated in loving memory to my
brother Christopher John Body

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# Chapter 1:

## Introduction

Although official incidence rates put the figure at 200 people per 100,000 each year, head injury is a condition that is significantly under-reported because whereas those with moderate and severe head injuries come to the attention of medical professionals, those with mild head injury often do not. Head injury may be associated with problems in memory and cognition, behaviour and with headaches. Whilst these outcomes are typical of severe brain injury, they can occur seemingly out of proportion to the severity of the injury and affect those with very mild head injury as well (Levin, Eisenberg, Wigg & Kobayashi, 1982). Because these problems are often unrecognised and are seen more as a failure in the victim themselves and because official incident rates underestimate the problem, head injury has been rightly regarded as a major silent epidemic.

It is not surprising then that considerable evidence and research has emerged on the serious neurological and behavioural difficulties experienced by individuals who suffer severe head injuries, but little on mild head injury. Some clinical evidence suggests organic brain damage can result from minor head injury, including concussion, and is primarily manifested by difficulty in processing information at a normal rate (Gronwall, 1991).

A major study by Rimel, Geordani, Barth, Boll, and Jane (1981) showed that a small proportion of these individuals continued to suffer ongoing cognitive and behavioural disturbances that are sometimes not detected or are regarded to be unrelated to the original head injury. A recent study by Leininger, Gramling, Farrell, Kreutzer and Peck (1990) concluded that symptomatic mild head-injury patients performed significantly poorer than

uninjured controls on four of the eight neuropsychological measures. Although a comprehensive study by Gentilini, Nichelli, Schoenhuber, Bortolotti, Tonelli et al., (1985) found no conclusive evidence of any cognitive or behavioural sequelae resulting from mild head injuries, there was a general trend for the head injured subjects to perform at a lower level than the controls.

An increasing number of people are surviving head injuries due to advances in medical care and as more is learned about risk factors, causes and cognitive and behavioural sequelae improvements will occur in prevention and public policy. In New Zealand this year for example, policy makers implemented significant law changes, including the compulsory wearing of bicycle helmets for everyone, and seat restraints for all children under the age of 2 years in motor vehicles (previously only those children over the age of 8 years had to wear seat belts in a motor vehicle). There is however, still a large gap in the law protecting children aged 2-8 years, who are not legally required to wear age appropriate seat restraints. Legislation was to be introduced earlier this year but for various reasons was delayed, and is expected to be introduced at the beginning of 1995.

In general, children and adolescents with mild head injuries show good recovery and only a handful have any long term sequelae. In comparison, children with severe injuries often show neurological impairments, lowered intelligence, slowed motor speed, memory problems, expressive language difficulties, reading problems and behavioural disorders (Knights, Ivan, Venturey, Bentivoglio, Stoddart, Winogron & Bawden, 1990). Evidence indicates that some people are more vulnerable to suffering adverse reactions from head trauma than others, such as those who have previously sustained a head injury, the elderly, and those with a history of psychiatric illness (Gronwall, 1978).

Because minor head injuries out number severe head injuries many times over, and the fact that there is much more known about the likely neuropsychological sequelae of severe head injuries, the researcher believed that possible sequelae from mild head injuries was an area that needed further study.

The purpose of this study was to obtain data on incidence rates and types of head injuries in an adolescent population in New Zealand. The researcher was also interested in any cognitive or behavioural sequelae persisting for a reasonable period after the injury and whether this sequelae were noted by teachers or parents alike. The data would also be explored for possible links between behavioural and/or academic difficulties reported by students, teachers and parents and previously sustained head injuries.

The following chapters will outline the previously reported incidence rates and etiology of head injuries and compare these with this studies findings. Common behavioural and cognitive sequelae of head injuries will also be examined, and the likely implications of these for day to day school functioning.

# Chapter 2:

## Incidence and Etiology of Head Injury

### Incidence

The term "incidence" refers to the number of new cases during a specified time period relative to the general population at risk. Investigation into the incidence of head trauma is often complicated by a number of inconsistencies (Goldstein & Levin, 1987). These include, a lack of consistent definition of head injury across studies with a variety of measures used to classify severity; hospital records which exclude mild or fatal cases that are not followed up; and because hospital and administration records generally classify head injury as a single medical diagnosis, there is a tendency not to differentiate between mild, moderate and severe cases.

*Overseas Incidence Rates.*

Statistics from North America, Great Britain and Australasia indicate that for every 100,000 people, some 200-300 individuals will be admitted to hospital each year as a result of a head injury. In an early survey conducted in the United States, it was estimated that head injury occurred at the rate of 200/100,000 in the general population (Morse and Montgomery, 1992). These figures did not include those who had died prior to arrival at the hospital, or the many patients with mild head injury who were not admitted or did not present to an emergency department. Subsequent studies (within the U.S.) have revealed similar occurrence rates, ranging from 152 to 295 per 100,000. The results of three major studies on incident rates by Kraus, Black, Hessol, Ley, Rokaw et al., (1984), Klauber, Barret-Conner, Marshall, & Bowers (1981) and Annegers, Grabow, Kurland, & Laws (1980), are summarized in Table 2.1 below.

**Table 2.1**

*Overall incident rates ( per 100,000) of head injury by age group.*

| Authors | Age | Males | Females | Proportions male/ female |
|---|---|---|---|---|
| Kraus | 5 | 200 | 150 | 1: 1.3 |
| et al. (1984) | 10 | 250 | 100 | 1: 2.5 |
| | 15 | 350 | 110 | 1: 3.2 |
| | 20 | 360 | 160 | 1: 2.3 |
| Klauber | 5 | 200 | 120 | 1: 1.7 |
| et al. (1981) | 10 | 390 | 250 | 1: 1.6 |
| | 15 | 600 | 390 | 1: 1.5 |
| | 20 | 620 | 410 | 1: 1.5 |
| Annegers | 5 | 210 | 180 | 1: 1.2 |
| et al. (1980) | 10 | 300 | 170 | 1: 1.8 |
| | 15 | 480 | 180 | 1: 2.7 |
| | 20 | 680 | 190 | 1: 3.6 |

In Kraus et al.'s (1984) study the proportion of male and females is 1:1.3 at the 5 year age group. This age group consistently has the least difference in rates between the sexes (Klauber et al. (1981) 1:1.17; Annegers et al. (1980) 1: 1.2). The difference between males and females increases steadily to 1: 3.6 at the 20 year age group.

All three studies report similar incidence rates for the 5 year age group of 200-210/100,000 for males and 120-180/100,000 for females.

At the 10 year age group the studies show more variation with Kraus et al. (1984) reporting an incident rate of 250/100,000 for males and 100/100,000 for females of this age group. A significantly higher rate of 390/100,000 and 250/100,000 is presented by Klauber et al. (1981) for males and females respectively. At the 15 year age group, there is again strong variation between results with Klauber et al.'s (1980) study reporting the highest rate or 600/100,000 for males and 390/100,000 for females, and Kraus et al. (1984) reporting the lowest rates of 350/100,000 for males and 110/100,000 for females. Finally for the 20 year age group, the rates range from 360-680 for males and 160-410 for females. Annegers et al. (1980) presents the highest rate for males at 680/100,00 and Klauber et al. (1981) the highest for females for this age group at 410/100,000.

Half of all deaths each year in children aged under 15 years occur from head injury; with a death from head injury rate ranging from approximately 7/100,000 in children aged 0-4 years, 10/100,000 in children aged 5-9 years, to 19/100,000 in children aged from 10-14 years (Bell & Britton,1989). Statistics from England and Wales report that 990 children under the age of 15 years died following accidents in 1984 and this represented almost 1 in 8 of all deaths in this age group (Hayes and Jackson, 1989). The contribution of head injuries to these deaths was high in all age groups, ranging from 19% among babies to almost 50% among 4 year olds.

The Hospital In-Patient Enquiry (HIPE) for England in 1985, gives details of the numbers of deaths and discharges from National Health Service (NHS) hospitals, based upon a random 10% sample provided by the Regional Health Authority. These figures were regarded as closely approximating the number of children suffering accidents and requiring admission to hospital. Of the 818,610 children under 15 years admitted to hospital in England in 1985, 119,550 (14.6%) were accident victims. Just over one third of these casualties were admitted because of head injuries. The

annual admission rate in England in 1985 in this same age group per 10,000 for head injuries was 42 (Hayes & Jackson, 1989). However, there are no statistics from this study that indicate the degree of severity of each injury. Local policies on admitting head injured patients may be different from one region to another and may reflect the clinicians competence in the area as well as the care-givers ability to provide adequate monitoring of the patient at home.

A widely reported epidemiological study of head injury was conducted at the University of Virginia (Rimel, Jane, & Bond,1990) between 1977-1979. Here the typical head-injured patient is described as:

a) approximately 20 years of age
b) male
c) from a rural background
d) single
e) income under $US 10,000 per annum
f) lower socio-economic background
g) previously sustained a head injury

In Annegers et al.'s (1980) study, patients with a previous head injury were found to be three times more likely than the general population to have another, and after a second head injury, were eight times more likely to have a third.

*Head Injury Data for New Zealand.*

There are a limited number of statistics on head injury in New Zealand as no formal epidemiological studies on the incidence and prevalence of head injury have been undertaken. The Accident Compensation Corporation (ACC) gives a total figure of 7,182 head injuries (excluding facial injuries) for the year ending March 1991. This figure includes 5,467 males and 1,715 females, and only includes those head injures registered with ACC (ACC, 1991).

The estimated cost of public hospital care in New Zealand for head injuries is $25 million (ACC, 1992). This figure is conservative as it does not take into account the ongoing social, and rehabilitation costs to the individual and their families.

The New Zealand Head Injury Society suggests that approximately 9,000 people are admitted to hospital each year from head injuries. In Auckland, with its population of 1 million, 2500 children are seen in four hospitals each year. Only 20 per cent of head injuries result in admission to hospital and the rest are minor injuries and patients are looked after at home (Wrightson, 1994). It is assumed that elsewhere in New Zealand the rates are similar.

In summary, two major trends are evident from the study of the epidemiology literature. Firstly, males are more likely than females to sustain a head injury, with an average reported ratio of approximately 2.5:1 (Goldstein & Levin, 1987) which is confirmed by data collated in New Zealand by the Accident Compensation Corporation. Secondly there are age specific differences in the peak incidence of head trauma in male and female children. Males show an increased incidence 5 - 25 years while females show a decline throughout the first 15 years. Males generally have more serious head injuries than females and this is reflected in a significantly higher mortality ratio for males estimated to be as high as 4:1 (Moyes,1980).

**Etiology**

Etiological studies of head injury describe the source of an injury and indicate how this varies significantly with age (Goldstein & Levin,1987). Motor vehicle accidents (MVA's) are the most common cause of a severe head injury which is typically sustained in association with other injuries (Currie,1993). Between the ages of 1-14 years, accidents are the most common cause of death and head injuries account for 40% of these (Hall, Johnson, & Middleton, 1990). In younger children 25% of fatal injuries occur in a MVA's,

with most fatalities occurring when the child was a pedestrian or cyclist, while in the adolescent age group (over 15 years), MVA's injuries are the leading cause of death. Table 2.2 summarizes a major study by Kraus and Nourjah (1989) on the etiology of head injuries in an adolescent sample.

**Table 2.2**

*Leading cause of head injury, and ranking in adolescent males and females. (Kraus & Nourjah, 1989).*

| Cause of injury | Males/100,000 (ranking) | | Females/100,000 (ranking) | |
|---|---|---|---|---|
| Age | 10–14 | 15–19 | 10–14 | 15–19 |
| Sport | 125 (1) | 140 (1) | 22 (1) | 80 (1) |
| MVA's | 45 (2) | 40 (3) | 20 (2=) | 10 (2=) |
| Falls | 40 (3) | 60 (2) | 20 (2=) | 5 (4) |
| Assaults | 5 (4) | 30 (4) | 5 (4) | 10 (2=) |

Etiological studies have demonstrated that recreational and sports related injuries predictably rise with age, with falls and bicycle accidents predominating in the 5 –14 age group and sports injuries account for 20–30 percent (Currie,1993). In contact sports such as rugby, clashes of heads or kicks cause blunt head injury of differing severity. But horse-riding is the single most dangerous sport in the context of head injury. Some 33% of equestrian accidents involve a head injury, and in 1983 there were twelve deaths in the UK. Not surprisingly, studies of equestrian head injuries have shown a significant reduction in

severity associated with the wearing of protective head gear. Whereas industrial accidents are more common amongst younger men, falls and domestic accidents are much more common in the elderly.

Alcohol is an important factor both in the etiology of head injury and as a complicating factor. It is particularly implicated in head injuries caused by falls and assaults and in pedestrians injured in road traffic accidents; but irrespective of the cause of injury alcohol intoxication is associated with a higher incidence of head injury than is found in sober victims of injury and overall is the most common causative factor.

**Classification of head injuries.**

The definition of head injury often includes lacerations to the scalp, and blows to the head without necessarily any loss of consciousness. Therefore there may be people who have had a "head injury" though may not have sustained any impairment to their brain as a result. This could obscure the relationship between "head injury" behaviour characteristics and cognitive functioning post-injury. Traditionally the severity of head injury has been classified into three categories, mild, moderate and severe. The following paragraphs outline the major criteria and symptomatology of these categories.

*Mild head injury* (MHI) is generally defined as:

(a) no loss of consciousness, or loss of consciousness not exceeding 20 minutes

(b) a Glasgow Coma Scale (GCS) score of 13 or over, and a period of post-traumatic amnesia (PTA) of less than one hour is also indicative of a mild head injury

(c) hospitalization for less than 48 hours

(d) no clinical evidence of brainstem, or cortical contusion (Kraus & Nourjah, 1989).

People with such an injury may receive no medical attention or there may be brief observation and routine tests. Neurological signs generally appear normal, however it is now known that permanent structural damage to the brain can occur in these injuries (New Zealand Head Injury Society, 1993). Approximately 5-10% of this population are unable to return to pre-morbid levels of functioning. Mild head injuries account for the majority of total head injuries.

Concussion is the most common type of mild head injury and has been defined as 'a condition of widespread paralysis of the functions of the brain which comes on as an immediate consequence of a blow to the head, has a strong tendency to spontaneous recovery and is not necessarily associated with any gross organic change in the brain substance' (cited in Bannister,1992, p 295). This paralysis of brain activity is thought to be the result of damage to the nerve cells, without necessarily causing permanent damage to brain structures, bruising or vascular lesions, which in milder cases is reversible, but may be permanent (Bannister, 1992). In severe cases of concussion, there is the likelihood of diffuse damage to the brain stem and cerebrum and this may be followed by diffuse demyelination. Patients who sustain a concussion are, for a period, unable to process information at a normal rate (Gronwall & Wrightson, 1974). Post concussion syndrome is a group of symptoms that can appear in a small number of people after sustaining a concussion. Typical symptoms include frequent headaches, dizziness, difficulty in concentration and in sustaining attention, and a general feeling of being unwell. These symptoms, can, in some cases, still be present months after the original injury.

*Moderate head injury* is generally diagnosed if the individual has any of the following:

(a) loss of consciousness for more than 20 minutes (unconsciousness can range from 1-24 hours)
(b) a GSC score of 8-12
(c) if there is a fracture with contusions (actual structural damage to the brain).

People diagnosed in this category can generally manage day-to-day living requirements, but often work and social activities are no longer possible at the same level as they were before the injury. Neurobehavioural sequelae are often quite variable in this group, though it is usually at least 6-12 months before full employment or study is resumed often at a lower level. A large number of individuals in this group are unable to return to their previous occupation or level of study.

*Severe head injury* is generally diagnosed if the individual has any of the following:

(a) a GCS score of 7 or less
(b) an intracranial haematoma
(c) a depressed fracture with major neurological deficit
(d) a loss of brain tissue
(e) a subarachnoid haemorrhage
(f) has been in a coma for more than 24 hours (Knight et al.,1990).

After a severe head injury the person is often conscious but may need assistance with many, and in some cases, all the activities of daily living (New Zealand Head Injury Society, 1993). Rehabilitation programmes for these individuals are prolonged and often intense involving both inpatient and outpatient care.

Many remain dependent on families or social support agencies for the rest of their lives.

This study will report the major etiological factors and incident rates of mild head injury in an adolescent sample, and compare them with previous New Zealand and overseas research. It is unique in the fact that it will not only include those people who have had hospital admissions, but also those who have sustained a head injury and did not seek medical attention. Accordingly it is likely to yield incident rates higher than the 200-300/100,000 frequently reported in the literature.

# Chapter 3:

## Common behavioural and cognitive sequelae resulting from head injury

Previous studies have found that closed head injury is associated with major sequelae on cognitive tests, timed motor activities, memory and attentional skills. These cognitive and accompanying behavioural deficits, which may interfere with the persons ability to function, have been demonstrated in severe, moderate and mild head injuries. In spite of the fact that most patients who have suffered minor head injuries are discharged with a negative neurological examination after a short period in hospital, recover rapidly and soon return to normal routine, some of them continue to report symptoms, such a headache, dizziness, loss of memory and concentration, and behavioural changes (Gentilini et al., 1985).

As has been stated in the previous chapters, the mild head injury group is of considerable concern both because of the large number of people sustaining mild head injuries each year, and the delayed recognition of both behavioural and cognitive sequelae. This chapter will examine the common neurological, cognitive and behavioural sequelae that arise from head injury, and review the relevant research, with a special focus on mild head injury.

It is now widely recognized that after head injury most people complain for a time of headache, dizziness and some reduction in mental capacity and that these early symptoms are based on physical changes (Wrightson, 1989). Although controlled studies of consecutive hospital admissions after mild head injury have shown little evidence of neuropsychological deficits one month after injury, there are a small percentage of individuals who suffer ongoing difficulties and post-concussive symptoms which

can persist for up to three years after the initial injury (Leininger et al., 1990).

***Physical sequelae after head injury.***

Wrightson (1989), states that individuals who have sustained a mild head injury can be classified into 3 main groups- acute, middle and late. Individuals with acute symptoms, present immediately after the head injury, and in 50% of cases, symptoms continue for a number of days. The major acute physical symptomatology include:

(a) headache, nausea, and general malaise.
(b) dizziness, which may be true vertigo related to movement,but is often a term used to describe a sense of detachment and unreality.
(c) irritability, and sensitivity to light and noise.
(d) susceptibility to fatigue and a need for long hours of sleep (Wrightson,1989).

People in the middle to late group generally are recognised several weeks or even months after the injury, when they come to medical attention. They may not have been concussed but nonetheless report the same behavioural disturbances reported by the early group.

There are various opinions about the pathological mechanisms underlying these symptoms. Some authors suggest that they represent an anxiety reaction to the trauma (Leininger et al., 1990), while others maintain that the symptoms are caused by cerebral damage. Experimental models have shown that acceleration/deceleration can provoke axonal tears and degeneration especially in the brainstem. Axonal degeneration in the brain stem would be expected to have a disruptive affect on cortical arousal and hence on cognitive performance.

***Common cognitive sequelae following head injury:***

Cognition is "the mechanics of the thinking process involved in the perception, acquisition, organisation and utilization of information" (Harrington,1990, p482). Since a primary goal of the education field is to convey and increase knowledge in the students, understanding how cognitive functions are affected after head injury is critical.

Although there are common symptomatology in individuals with mild-severe head injury, symptoms differ significantly depending on the severity of the injury. Common difficulties, however, occur in the following areas: attention/concentration; memory/learning; executive functions; problem identification and goal formulation; planning/organization and initiation. Other cognitive areas, such as reasoning, intelligence, language, visuospatial, and mathematics may also be affected (Morse & Montgomery,1992).

Differences in etiology make it difficult to compare the cognitive outcomes of mild head injury in children with that of adults. The primary source, as already noted among adults is the motor vehicle accident, whereas among children under 15 years, the major sources are falls, and for boys in this age range, especially, sports. Accidents in children produce relatively low velocity injuries that may go unreported, as these sorts of accidents are often considered part of normal growing up. Studies of adults and children show that most cognitive recovery following a head trauma takes place in the first 6 months after the injury, although in more severe cases recovery is often at a slower pace and over a longer period.

*Attention/Concentration.*

As one of the major symptoms in severe head injury, attention may decline after only a short period (1-2 minutes) of continuous work and may be enduring. In some patients performance may

dramatically decline after only a short period (1–2 minutes) of continuous work. There are typically reports of difficulty in sustaining attention over a long period of time, following a conversation, concentrating on reading or focusing on a television programme (Schapiro & Sacchetti,1993). Patients may exhibit difficulties with selective attention (ability to remain focused on a task in the face of distractions), alternating attention (involves mental flexibility and the ability to shift sets) and divided attention (monitoring and responding simultaneously to multiple pieces of information), that the greatest compromise is observed.

*Memory/learning.*

The most common cognitive symptom following head injury involves impairment in learning and memory usually due to ischemic damage to the hippocampal regions. Memory for conversation, appointments, activities, material read are commonly affected.

In mild head injury, memory disturbances typically involve inability to recall new information, while long-term recall of prior knowledge remains intact (Schapiro & Sacchetti, 1993). Individuals will often complain of forgetfulness, difficulty recalling phone messages and forgetting what they had done prior to an interruption. Memory problems tend to be most evident on measures of retrieval of new information, especially with a substantial delay between initial presentation and attempted retrieval. Often ~~head injured persons~~ will experience significant problems retrieving newly learned information on their own. That is, they may be unable to recall new information spontaneously, but when asked to recognize new information from a series of choices, they have less difficulty. Learning is affected by poor incidental memory and by compromised executive functioning which affects different components of problem solving (Morse & Montgomery,1992).

*Executive functioning.*

Executive functioning generally encompasses the processes and abilities involved in completing a goal or solving a problem. Since frontal systems are particularly involved in regulating executive functions, it is not surprising that severely head injured patients who generally sustain frontal injuries, exhibit problems in this area . Although the patient may be able to generate a plan to achieve a goal, getting started or initiating the plan is difficult. Further there is difficulties revising these plans, detecting errors and being able to correct them.

Information processing capacity can be broadly explained as the number of operations that the brain can carry out at the same time (Gronwall, 1989). Information processing rate refers to how quickly an individual can perform mental operations. Head injury compromises information processing rate and capacity, and as a result important information is often missed and simple tasks such as writing their name slowed. Problems with rate of processing represents a common long-term symptomatology following minor head trauma. This is thought to be primarily a consequence of the diffuse axonal shearing injuries (Morse & Montgomery,1992).

There have been studies that have refuted much of the evidence presented regarding neuropsychological sequelae following mild head injury in particular. These studies propose that persistent neuropsychological disability resulting from mild head injury only occurs in rare instances (Leininger et al, 1990). Gentilini et al. (1985) report that there is no conclusive evidence showing that mild head injury causes cognitive impairment one month after trauma. However in both these studies, the head-injured group performed at a lower level across nearly all of the neuropsychological measures administered. Also both studies acknowledge that there is a subgroup of mild head injured patients who continue to complain of symptoms such as headache,

dizziness, loss of memory and concentration and behavioural changes.

It is often thought that the younger brain is far more "plastic" than older brains, thereby making it less vulnerable to the effects of trauma. This is based on the notion that the younger brain is able to compensate to a larger degree for any deficits that result from injury because it has not yet fully developed (Levin et al.,1982). Although this may be true when comparing young adults to older adults, children who have sustained a serious head injury will often remain significantly impaired in specific areas of functioning for much of their lives. When Levin et al., (1982) compared the memory and intellectual functioning in groups of children and adolescents who were matched for severity of injury, their findings produced no evidence that the young brain confers an advantage with respect to the development and restitution of higher functions after a head injury. Therefore, it appears to be the severity of the diffuse brain injury, rather than the presence or lateralization of a focal lesion which is the primary determinant of cognitive recovery in both children and adolescence. The duration of impaired consciousness rather than the initial GCS score, had the strongest relationship to cognitive outcome.

**Personality and behavioural sequelae following head injury.** Stern and Stern (1985) have suggested that mild and severe head injuries exhibit different personality and behavioural sequelae. They reported that 2-3 years after an injury, patients with mild head injury exhibited characteristics of an "extroverted nature" (narcissistic, over-demanding and could not delay gratification). The severely head-injured group was described as high on an "introversion" scale (passive, apathetic, dependent, low self-esteem).

Some studies have suggested that pre-injury behavioural characteristics such as aggression and over-activity may put children at increased risk for accidental injuries (Donders,1992). It is not clear if premorbid behavioural and personality characteristics contribute in any way to head trauma or any of its sequelae. However this relationship has not always been proven, and in other studies there has been no connection found between behaviours observed pre-injury and the injury itself.

Table 3.1 outlines the behavioural and emotional problems most frequently observed in head injured patients.

**Table 3.1**

*Common behavioural and emotional changes observed in head-injured patients (Prigatano et al.,1993).*

| External changes: | Internal changes |
|---|---|
| poor anger control | anxiety |
| irritability | dependence and regression |
| low frustration tolerance | depression |
| aggression | somatization and denial |
| hyperactivity | unawareness of problems |
| poor social adaption | insensitivity |
| reduced athletic skills with associated clumsiness | changes in emotional regulation |

However, in relation to mild head injuries the relationship is thought to be stronger than in more serious head injuries (Donders,1992). Annegers et al. (1980) found that the relative risk for a second head injury was age related. Observed over expected incidence rates doubled after a head injury sustained in children less than 14 years of age, tripled through 15 - 24, and was 5 times the expected rate after age 25. Annegers (1983) also reported that boys with head trauma have a 2:1 risk of subsequent injury. A possible explanation for this is that individuals develop behavioural patterns that predispose them to additional injuries and/or neuropsychological sequelae such as slowed reaction time may also contribute.

The major behavioural symptoms believed to result from head injury in children and young adults include restlessness, impulsiveness, aggression and resistance to discipline (Rutter,1980; Michaud, Rivara, Jaffe, Fay & Darlay, 1993). Further, when there is a pre-existing personality problem, a head injury can trigger an emotional imbalance which can lead to exaggeration of these symptoms. Craft, Shaw & Cartridge (1972) found a higher incidence of teacher reported pre-existing behaviour problems (e.g. hyperactivity, antisocial actions) in head injured children versus the classmates that were acting as controls. This evidence is in contrast to Klonoff's 1971 study that showed no evidence for increased pre-morbid behavioural disturbance in children sustaining CHI over controls. This study included children aged less than one year to 16 years. Later research (Klonoff& Paris, 1974) reported a sex-related finding of positive pre-morbid factors (e.g. developmental problems, learning difficulties) in younger boys versus girls. The researchers suggest an increased vulnerability of head injury in boys that may be related not only to differences in stereotyped patterns (e.g. rough play), but also pre-morbid status.

*Reduced frustration tolerance.*

After a head injury many individuals blow up over the slightest provocation and have little patience for the frustration encountered in their daily environment. Family members often describe them as moody, argumentative and always on edge (Schapiro & Sacchetti,1993) and as a result this is probably the most common complaint involving personality change.

*Depression.*

It is important to keep in mind that a neurologically compromised brain is especially vulnerable to any form of stress and hence is at risk for developing a mood disorder. Head injury and evidence of depression are frequently intertwined. Depressed mood states may also be accompanied by additional symptomatology such as agitation, psychomotor retardation, ruminations of guilt and shame, and psychotic symptomatology such as delusions (Morse & Montgomery,1992).

Depressive symptomatology can include preoccupation with the awareness of loss of pre-injury functioning levels, as the patient mourns over the loss and often results in increased isolation and withdrawal, thus compounding the problem.

*Apathy, lack of initiation.*

Apathy is frequently associated with moderate-severe injuries involving basal ganglia (frontal-sub-cortical) systems, and results in slowed performance on formal testing and reduced initiation of tasks without prompting from the examiner.

*Unawareness of problems/ denial.*

Many head injured patients are said to be denying their problems or lack insight. It is important to distinguish between defense denial vs neurologically-based unawareness.The sole diagnostic formulation of defensive denial should be made with extreme

caution, because it can often lead to a non-supportive attitude amongst the patient's team of health care providers, as well as family. In head injury, it is most likely damage to the frontal areas that results in patients' poor insight and unawareness of their deficits (Morse & Montgomery,1992).

It is well recognized that severe head injuries in either children or adults may result in intellectual impairment. In the acute stage of recovery the severely injured patient is often confused and amnestic and shows acute behavioural changes (Chadwick, Rutter, & Schaffer, 1981). It has also been shown that more severe head injuries increases the risk of psychiatric disturbance in childhood and adolescence (Rutter et al.,1980). However, cross-sectional studies have shown that the behavioural changes that result from brain damage are quite variable with no consistent syndrome or group of behavioural symptoms which can be attributed to a head injury (Rutter et al.,1980).

It is apparent from what has been discussed so far that head injuries can have implications for school performance and overall academic functioning. It is possible that some students who are labelled as "apathetic", "lacking motivation" or as "having an attitude problem" by parents and teachers alike, may in fact have impaired neuropsychological functioning due to single or consecutive head injuries. In reviewing the intellectual and academic outcomes for children with head injury, Goldstein and Levin (1985) concluded that "head injury leads to impressive cognitive and academic difficulties" (p.201).The following chapter examines the likely implications of head injury on academic functioning and other school related activity.

**General awareness of head injury sequelae.**

Previous studies have shown that people in general have misconceptions regarding head injury (O'Jile, Ryan, Parks-Levy, Gouvier, Betz, Groves, & Coon, 1994). Gouvier, Prestholdt and Warner (1988, cited in O'Jile et al., 1994) surveyed 221 individuals in a south Louisiana shopping mall and found a high number of misconceptions concerning head injury and seat-belt safety. This was regardless of age, sex, occupational status, or head injury status. O'Jile et al.'s (1994) study focused on the misconceptions held by college students regarding head injury and its sequelae. The authors also examined the effect that experience with head injury had on the level of misconceptions. Results from this study showed that although there were some significant differences between the responses given by the head-injured and non head-injured students, the pattern of responses was similar. The authors concluded that experience with head injury did not necessarily increase a student's knowledge of sequelae, and at times biased their perceptions.

In New Zealand organisations such as the Head Injury Society are developing a training programme for health care workers who have limited or no experience in the field of head injury. It covers areas such as the neuropathology, severity and recovery following head injury, along with approaches to rehabilitation. However, there is currently no formal programme on head injury education being offered in New Zealand schools.

# Chapter 4:

## Implications of Head Injury for School Functioning

Students with head injury will often suffer from a number of academic and behavioural difficulties that can lead to severe disruption of school life. These difficulties can lead to secondary emotional problems in individuals who are already vulnerable due to compromised ability to cope with stress as a result of their injury. Children with injuries that appear initially to be severe often experience significant recovery of physical and global intellectual functioning, but are frequently left with residual information processing and self-regulatory deficits than may resemble those seen in learning disabled children (Ylvisaker, Szekeres & Hartwick, 1992). When investigating likely academic and social implications of head injury for a student, it is necessary to differentiate these from typical behavioural difficulties encountered by teachers from students in general.

This chapter will examine problem behaviour in general, issues surrounding the assessment of the head-injured student, and the relationship between head injury and learning disabilities. Finally, the implications of a head-injured student for the educator is discussed. The term "educator" is used throughout this chapter instead of "teacher", because the author recognizes that there are often a number of professionals involved with a student that has special needs.

***Problem behaviour in the classroom.***

Disruptive behaviour by students in the classroom is a common problem affecting many schools. According to Church and Langley (1990) 'behaviour disordered' children and adolescents are those labelled as 'unmanageable' 'difficult' and 'delinquent' by

teachers. Although all children from time to time act in ways that are aversive to adults, behaviour disordered children and adolescents do so more frequently than their peers and across more settings.

There is an agreement that the some 2-3 percent of the school-aged children are likely to be behaviour disordered (Church & Langley, 1990). In a survey of 14 Christchurch secondary schools (Munroe, 1980) staff nominated 2.6% of students for whom 'regular means of discipline were ineffective'. In a similar study by Norman, Sritheran and Ridding (1984), 763 New Zealand primary and intermediate school teachers identified 3.4% as 'maladjusted' while principals identified 1.9 %. In New Zealand, the population of children aged 5 to 14 years is just over half a million (514,000 in 1986). If 2.5% of these children are in fact behaviour disordered, this equates to approximately 13,000 children of school age.

In extreme cases, head teachers in New Zealand are empowered to suspend pupils indefinitely from attendance. Galloway and Barrett (1984) gathered data from secondary schools in New Zealand into circumstances surrounding school suspensions in 1980 and 1981. They found that the peak age for suspensions was the final year of compulsory schooling and that boys and girls were suspended with similar frequency. The top five reasons given for suspension of male students were refusing punishment (26%), theft (19.5%), assaulting peers (8%), being insolent to teachers (8%) and drug offenses (7.8%). For female students the top five reasons were drug offenses (27%); disobedience (17%); being insolent to teachers (12.7%); refusing punishment (12.7%); and assaulting peers (7.9%). The reason for raising this here is through concern that these behaviours are often associated with head injury, i.e there may be head-injured students whose behaviour is misattributed and who are being suspended due to a lack of awareness of these sequelae by staff.

***Assessing the head-injured student in the school environment.*** The presentation and assessment of the student with head injury is often complicated due to the following reasons:

(a) complex and multiple problems can occur when the brain is injured
(b) brain injuries are never the same, and even when the injury is in a similar location, the presentation from individual to individual can vary considerably
(c) recovery is dependent on many factors including age, developmental stage, intensity of medical intervention, medications, location of lesion, time since accident, pre-accident traits and familial support
(d) very few tests that have been developed and standardised specifically for the head-injured relate directly to the education field
(e) few staff in the education system have the background knowledge and experience in evaluating neurologically based condition (Harrington,1990).

Formal measures of intellectual ability often do not provide accurate estimates of a head-injured student's potential, since they are typically administered in a highly controlled setting and are likely to overestimate an individual's actual level of functioning in the classroom, where demands and distraction are greater. In addition, measures of intellectual ability are circumscribed in terms of the neuropsychological abilities they assess, and even students who perform within normal limits on intellectual scales may demonstrate serious impairments in other areas (Telzrow,1987).

Harrington (1990) highlights characteristics of the head-injured student that need to be carefully observed by the educator, both in testing situations as well as in the classroom:

(a) level of attention span, distractibility and orientation to time, place and task
(b) preservation, i.e tendency to repeat certain words, phrases or actions
(c) tolerance to stress, such as time, noise, distractions.
(d) fatigue
(e) factors related to emotional adjustment, including anxiety, depression, fear of failure, frustration-tolerance.
(f) passive-aggressiveness, i.e. resistance to complete tasks, work refusals, belligerence.
(g) degree of confusion or comprehension
(h) degree to which new information interferes with recent learning
(i) processing time, delayed response or slowed performance (Harrington, 1990).

In the case of mild head injury, where so many go unreported and where there is often an underestimation of its consequences, the educator may be unaware of any academic and/or behavioural difficulties that result from the injury.

*Implications of problem behaviour in the classroom.*
The behavioural sequelae of head injury that were discussed in the previous chapter can cause serious problems in the classroom for the student, his or her peers, and the educator. Inappropriate classroom behaviours displayed by the head-injured student, such as acting out, non-compliance and disrupting peers, may be used to divert attention away from difficulties they are having in academic work. Acting out behaviour can also indicate anxiety, confusion and specific performance difficulties.

Effective classroom learning is dependent on intact ability in a number of areas, such as motor skills, visual perception, sensorimotor integration, verbal and non-verbal memory, language, verbal and non-verbal reasoning, and social

adaptability (Johnson, Uttley, & Wyke, 1989). These complex behaviours in turn require ability to sequentially order (sensory input, integration and output) which may be disrupted after a head injury and misperceived by the educator as being careless attention, distractibility, laziness or unco-operation (Johnson et al., 1989). For example if the head-injured student cannot follow what is being said because of slowed information processing ability, he or she may just switch off. When reprimanded for doing so, it reduces the likelihood that he or she tries again, hence creating a pattern of failure which may be difficult to change.

Lezak (1983) and Oddy (1984) have suggested that disinhibited behaviour is one of the most common sequelae of head injury in children which can lead to rejection by peers and helping professionals alike. In addition, Barin, Hanchett, Jacob, and Scott (1985, cited in Deaton, 1987) have suggested that these behaviours increase the risk for further injury, in that risk taking occurs due to problems in judgement and the head-injured child's difficulty accepting the injury-related changes. Further, severe head-injury typically results in an increase in behavioural problems in those who exhibited them before the head injury and the more severe the injury the more likely that subsequent behavioural problems will develop.

*Academic performance.*

Behaviour problems can develop from the frustration and anxiety that the student is experiencing from not being able to complete academic tasks to the same standard as before. Also memory and language difficulties will hinder the ability to make quick accurate replies to questions and make it more difficult for the head-injured student to be able to express themselves clearly (Johnson et al., 1989). However, despite the importance of academic performance to a child's overall adaptive functioning in society, information and data on the post-traumatic academic problems suffered by head-injured students across all degrees of injury is

limited.

A study of children and adolescents after a severe head injury Richardson (1963) described reports from school teachers reflecting academic difficulties that were not present before the accident. The classroom problems encountered ranged from patients difficulties with reading and other complex tasks, to teachers complaints of distractibility, poor comprehension, concrete and preservation performance.

Although language skills generally recover well in head-injured children, dysnomia (difficulty in retrieving names for items or people), and dysarthria (slow, poorly articulated speech) may persist. The student may experience difficulties with written language skills either because of underlying language deficits or because of motor deficits (Telzrow,1987). The educational implications of language related deficits are dependent on the nature and degree of the difficulties. In most cases it is important of educators to avoid situations, such as confrontational naming tasks, that may exacerbate the dysnomic symptoms.

Educational implications of memory and attention deficits have been less extensively studied in children, Memory deficits can affect the child in a number of ways in the educational environment. For example the child or young adult may have difficulty remembering the day's timetable, may have trouble locating rooms, or remembering sequences of procedures, especially if these are changed or new.

***Mild Head Injury.***

Boll (1983, cited in Telzrow, 1987) believes that even mild head injuries are characterized by behaviour and personality changes that can have implications for their school functioning. Younger children display more hyperactive behaviour, attention problems and aggressiveness, while older students are observed having

less impulse control and difficulty in self monitoring.

The behavioural and educational difficulties that arise from head injury can pose difficult problems for teachers. Teachers are often ill prepared to cope with the unpredictability and emotional lability of the student, also traditional behaviour management approaches to these students are likely to be unsuccessful (Telzrow, 1987). It is important for teacher to recognize how environmental demands and neuropsychological deficits can interact and possible exacerbate the symptomatology.

Klonoff and Paris (1974) performed a longitudinal study on 231 mostly mild head-injured children. The incidence of academic difficulties for the older students (ages 9-16) increased from 11% in one year subsequent to injury to 17% two years later . Other complaints recorded included physical and psychological symptoms, including personality changes, learning difficulties and problems with memory and concentration. These were reported for 56% of the group at one year follow up and 44% at two years follow up. Klonoff, Low, and Clark (1977) followed this group to five years post-injury. They reported that 15.4% of the younger group and 17.9% of the older group had experienced grade failure, although they still attended regular classes. Special/remedial education was required by 10.3% of the younger and 2.6% of the older subjects. Although the mean reading and maths achievement scores of the head-injured children were somewhat lower than the non head-injured group, and their mean aggressiveness and hyperactivity scores were higher, the magnitude of these differences was small. However, hyperactivity was present in a greater proportion of the head injured sample than would normally be expected.

***Differentiation between head injury and learning disabilities.***
There are a number of difficulties that head-injured and learning disabled children share. For example they both tend to display

uneven cognitive and academic profiles, have greater difficulty learning new information, processing information at a normal rate and as efficiently, and have difficulty with attention and impulse control (Ylvisaker et al., 1992). However, as well as sharing common cognitive deficits, there are important differences between a "typical" head-injured and a "typical" learning disabled child.

Early in their recovery, head-injured students have a much greater degree of overall confusion, disorientation, and episodic memory impairment than their learning disabled peers. Because of the predictably good return of pre-traumatically overlearned information and skills, students in the late stages of recovery from head injury may have little difficulty with skills such as reading recognition, spelling, writing, and calculating, that learning disabled students may have trouble to acquire (Ylvisker et al., 1992). Often head-injured students will display significant improvement over time, and consequently the prognosis for a head-injured student is often superior to that of a learning disabled student.

The head-injured students' profile is often more fragmented with surprisingly good knowledge and skill in some areas as well as unexpected deficits or gaps at lower functioning levels than would be expected in the case of a child whose learning disability has been present from birth.

Head-injured students who are more functionally compromised by their injury may have intelligence tests that place them in a category with children with mental retardation. Although the learning efficiencies of these two groups may be similar, there are important differences. Firstly, significantly impaired children with head injury may perform well on pre-traumatically overlearned tasks and in familiar environments. Furthermore they may retain global adaptive skills, have a well preserved sense of

humour and sense for social reality.

*The Educators Role.*

Educators play a vital role in the rehabilitation process of the head-injured student. They facilitate and in some cases re-teach the student how to follow instructions, improve their listening skills and conceptual thinking, practise social skills and consistently reinforce appropriate behaviour.

A major consideration for both the teaching staff and the psychologist involved with the student on his or her return to the school environment, is in being aware of the student's premorbid academic potential since any pre-existing reading or learning difficulties for example are likely to be worse after the injury. This information gained from the school helps assess the effects of the injury on current behaviour and in re-establishing goals (Johnson et al., 1989).

Unfortunately in many cases, the teachers are not informed about a students head injury on his or her return to school and hence may be unaware of any learning, social or emotional difficulties that the child currently has. Also, students returning to school with sensory and physical disabilities are generally more accepted for school integration than those students with behaviour and learning difficulties common after head injury. The importance of conveying accurate and detailed information concerning the head injured-student is highlighted in a study by Mepsted (1988, cited in Johnson et al.,1989) who found that teachers attitudes towards the students behaviour was dependent on their degree of knowledge, understanding and experience of their student and their particular condition.

The association between early mild head injury and developmental disabilities in the developing child have been recognized (Segalowitz & Brown, 1991). Researchers know that attentional

and control mechanisms usually associated with frontal lobe systems are at risk in individuals with closed head injury and impairment of complex attentional processes is common after head injury.

There are a number of important factors that need to be considered at the time of school reintegration:
(a) the sequelae of head injury generally produces relative degrees of cognitive, emotional, physical and social difficulties in adjusting with the day to day demands exist in a school environment
(b) return to school may need to be gradual to build up both the mental and physical stamina required and it is often helpful for the student to begin with more familiar subjects to build confidence with learning (Johnson et al., 1989).

In secondary school it is common for students to move about from one classroom to another for different lessons. This can be physically tiring as well as creating mental difficulties for the head-injured student who has to think about what the next subject is, what items he or she needs to take. There is also the added pressure of having to make these decisions in the brief time period between classes and with increased vulnerability to distraction and difficulties in memory, attention, organization and planning (Johnson et al., 1989).

There are a number of specific adjustments that can be made to the school environment that can help reduce the difficulties and prevent exacerbation of symptoms in the head-injured student. Some of these involve changes within the classroom and some involve more larger environmental changes. These recommendations apply to the more severely head-injured student, although they may need to be considered for students who have sustained moderate or mild injuries also.

Within the classroom environment educators need to consider:
(a) modifying the method of student response, such as allowing for pointing, gesturing, underling and so forth
(b) modifying the length, complexity and modality of test instructions
(c) giving multiple choice or examples
(d) enlarging or decreasing the amount of print on a page
(e) giving opportunity for timed and untimed responses
(f) providing assessment in a number of settings
(g) continually reinforcing and encouraging the student and to help the student focus on success rather than failure
(h) flexibility in classroom work and differentiated assignments (Harrington,1990).

The following recommendations are offered by Savage and Carter (1991) and include more administrative and organizational changes to the school environment that need to be considered for the head-injured student.

Recommendations

(a) the student with a head injury needs a place to check into and check out of each school day. The key is to set up organizational structure before the student becomes confused or overwhelmed.
(b) test scores, both on standardized and teacher made tests,do not necessarily provide accurate measurements of how well of how poorly a student is performing. Caution is required when interpreting such results and in the communication of these results to families.
(c) the physical layout of the school must be carefully considered so that the student is not placed in a highly distracting environment.
(d) personnel must be aware that increased visual and auditory distractions especially during break times may confuse the

student and cause self-monitoring problems.
(e) the student may need to reschedule their school day in order to allow for fatigue.
(f) the student should be encouraged to keep a daily journal of activities to which he or she can continually refer when necessary. Teachers and parents should continually review the journal to make sure the student is keeping track of assignments, appointments and activities.
(g) effort should be made to educate the students peers about head injury, especially at the higher grade levels. Socialization for the adolescent is compounded by a head injury (p. 213).

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In summary, the academic and behavioural sequelae of head injury, can cause severe disruption of school life for the student. There are already a significant number of behaviourally disordered students attending schools in New Zealand, and it is likely that head-injured students are categorised with this group and penalised accordingly because staff are unaware of the common behavioural sequelae of head injury. There are similarities in the cognitive and academic profiles of learning disabled and head-injured students, however there are also important differences. The head-injured student will often show improvement especially during the two years following the injury, and consequently, the student needs special learning programmes need to be constantly reassessed. Specific environmental changes may be necessary to help the head-injured student cope with school reintegration. Finally, it is important to consider the student's pre-injury status and abilities. It is generally believed that the student with above average intellectual and academic and social abilities has a better prognosis for long-term recovery.

# Chapter 5:

## Objectives and Hypotheses

This study was conducted in two parts. Part one involved a survey of the entire fourth form (13-14 year-olds) in a secondary school. The second part involved selecting a group of students who reported ongoing problems similar to those experienced after head injury. They were given neuropsychological tests, and information obtained from parents and teachers regarding any difficulties they were having.

## Objectives

### Part I

The purpose of Part 1 of this study was to determine the incidence of head injury in an adolescent population. The etiology and the proportion of males and females sustaining head injuries would be examined. Part 1 of the study will also look at the role that sport plays in the etiology of head injuries in this population and the students' level of awareness of head injury symptoms. This information will be obtained by administering a screening questionnaire.

### Part 2.

The second part of this study examined a proportion of those students reporting ongoing problems of the kind common after a head injury. This includes both cognitive and behavioural difficulties. This information would be obtained through the self-report screening questionnaire, neuropsychological measures, the Teacher Report Form and the Behaviour Checklist.

## Hypotheses.

**Hypothesis 1:**

*That 3-4% of our N=180 sample population will report that they have sustained a head injury of some description in the last 3 years.*

The estimated cumulative risk for head injury in children up to 15 years is 4.0% in boys and 2.5% in girls (Harrington, 1990). This is in line with overseas studies (Goldstein & Levin, 1987; Goldstein et. al., 1989: Anneger et al., 1980; Kraus et al., 1986), and New Zealand ACC statistics.

**Hypothesis 2:**

*There will be a significantly higher proportion of males than female reporting head injuries, with a ratio of approximately 3:1.*

Based on research by Kraus et al. (1984) and Annegers, (1983) reported in Chapter 1 reporting a strong trend in all the epidemiology literature for males to be more susceptible than females to head injury across all age groups with the biggest ratio difference being in the 15-19 age group with a differential rate of 200/100,000 between males and females.

**Hypothesis 3:**

*Males will experience more severe head injuries than females.*

This hypothesis is supported by the higher male mortality rate as discussed in Chapter 2 the rationale for which is still not clear but may be due to stereotyped play differences and the existance of premorbid conditions (e.g. learning disabilities) (Goldstein & Levin, 1987).

**Hypothesis 4:**

*The major source of head injury in this population is likely to be sport, followed by motor vehicle accidents and falls.*

This is based on the figures for this age group presented by Kraus & Nourjah (1989) .

**Hypothesis 5:**

*Head-injured students will on average play more hours of sport per week than non-head injured students.*

This is based on the fact that sport is one of the leading contributors to head injury in this population (highlighted in Chapter 2).

**Hypothesis 6:**

*That those students who have sustained a head injury will have higher mean scores on the symptom measure and the measure of general functioning.*

**Hypothesis 7.**

*There will be no difference in the level of awareness of symptoms of head injury between those students who have sustained a head injury and those who have not.*

This is based on the research discussed in Chapter 2 by O'Jile et al. (1994) who found that experience with head injury does not increase knowledge of head injury sequelae, and may bias perceptions.

## Part II

**Hypothesis 8:**

*Head-injured students will perform lower than the non head-injured students on the :*

*(a) concentration and verbal memory task (AVLT)*

*(b) information processing speed task (PASAT)*

*(c) psychomotor and attention tasks (word fluency and coding).*

**Hypothesis 9:**

*There will be no significant difference between the two groups on the neuropsychological measures, it is because the high number of light head injuries within the sample are masking the deficits of the head injured students.*

**Hypothesis 10:**

*That there will be a number of students reporting difficulties and performing at a lower level on the neuropsychological measures, and that these will be recognized by teachers and parents alike.*

# Chapter 6:

# Method

## Research Setting

The students in this study were fourth formers from Awatapu College, which is one of three co-educational secondary schools in Palmerston North, New Zealand. The total population of the school is 900 students, with a fourth form population of 180. Palmerston North is situated at the lower end of the North Island, and has a population of 70,300.

## The Participants

From a population of 180 fourth form students, a total of 135 completed the initial questionnaire. Of the 45 students who did not complete the questionnaire in Part I of the study, 20 did not wish to take part, another 15-20 students were absent on the days that the questionnaire was administered, and 5 students had such severe language or learning difficulties that made it impractical for them to take part.

From the original sample of 135, a control group of 17 students and a head-injured group of 18 students were finally selected to complete the neuropsychological measures. The head-injured students were selected based on their type of injury, and their scores on the "symptom" and "general functioning" scales of the initial questionnaire (Appendix 1). The "symptom" scale consisted of nine questions, with high score reflecting a high number of symptoms. The possible range of scores is from 0-27. The "general functioning" scale consists of 15 questions, with a high score reflecting a *low* level of general functioning. The possible range of scores is from 15-75. There were a total of 6 students selected with a "symptom" score of 15 or over; 4 students with a score of 10-15, and 8 students with a score of less than 10. Within this

group, 5 students had a "general functioning" score of between 40 and 51; 7 between 30 and 40, and 6 between 20 and 30.

The characteristics of the students who participated in Part I of the study are shown in Table 6.1. The characteristics of the students that participated in Part II of the study are shown in Table 6.2.

**Table 6.1**

*Characteristics of Sample Population (N=135).*

| | Head-injured | | Non head-injured | |
|---|---|---|---|---|
| | N | (%) | N | (%) |
| Sex | | | | |
| Male | 26 | (47) | 41 | (51) |
| Female | 29 | (53) | 39 | (49) |
| Total (N) | 55 | | 80 | |
| Ethnic Origin | | | | |
| European | 36 | (65) | 60 | (75) |
| Maori | 9 | (16) | 9 | (11) |
| Maori/European | 4 | (7) | 1 | (1) |
| Other | 6 | (11) | 10 | (13) |
| Average Grade | | | | |
| A | 11 | (21) | 21 | (26) |
| A-B | 20 | (38) | 27 | (34) |
| B | 13 | (25) | 24 | (30) |
| B-C | 6 | (11) | 5 | (6) |
| C | 2 | (4) | 3 | (4) |
| C-D | 1 | (2) | 0 | (0) |
| Number who play sport | 47 | (85) | 59 | (74) |
| Mean hours sport/week | 6.7 | | 4.9 | |
| Number who have seen a psychologist/counsellor | 14 | (25) | 10 | (12) |

**Table 6.2**

*Characteristics of the control group and head-injured group (N=35).*

| | Control | | Head-injured | |
|---|---|---|---|---|
| | N | (%) | N | (%) |
| Sex | | | | |
| Male | 6 | (35) | 8 | (44) |
| Female | 11 | (65) | 10 | (56) |
| Ethnic Origin | | | | |
| European | 12 | (71) | 14 | (78) |
| Maori | 3 | (18) | 1 | (6) |
| Maori/European | 1 | (6) | 2 | (11) |
| Other | 1 | (6) | 1 | (6) |
| Average Grade | | | | |
| A | 2 | (12) | 4 | (22) |
| A-B | 5 | (29) | 2 | (11) |
| B | 7 | (41) | 7 | (39) |
| B-C | 3 | (18) | 2 | (12) |
| C | 0 | (0) | 2 | (12) |
| C-D | 0 | (0) | 1 | (6) |
| Number who play sport | 12 | (71) | 16 | (89) |
| Mean hours sport/week | 4.8 | | | 6.7 |
| Number who have seen a psychologist/counsellor | 3 | (17) | 8 | (44) |

**Measures**

The following measure was administered in Part I of the study.

**Head Injury Screening Questionnaire (Appendix 1).**

This questionnaire was developed by the researcher to gain general information about the incidence of head injury in this

sample and also to identify those students who had sustained a head injury of some form in the last three years (Appendix 1). It included questions from the Patient Competency Rating Form and also the Symptom Checklist-90 (SCL-90). These total content from these two questionnaires were not used because there were a number of questions on both that were not relevant to head injury symptoms, and in order to keep the questionnaire a reasonable length.

All students were asked to complete questions about their academic grades, sport played and general symptoms that are associated with head injury. For those students who had sustained some form of head injury in the last three years specific questions were included on the type(s) of head injury; whether they were currently experiencing any symptoms; and treatment they had received.

The following measures were administered in Part II of the study.

**The Auditory Verbal Learning Test (AVLT) (Appendix 13)**
The Auditory Verbal Learning Test (AVLT) is an easily administered test of verbal memory and learning (Rey, 1964). The AVLT involves 5 presentations of a 15-word list of common nouns (List A). This is followed by the presentation and recall of a second 15-word list (List B). Following the B-List (Trial 6), the subject is requested to recall as many words from the first list that they can remember (Trial I). Finally, Trial 7 is a recall trial following a delay period of 30 minutes.

In the present study the delay period was approximately 30 minutes (+/- 5 minutes) and this time was filled with the PASAT, Word Fluency and Coding tests.The dependent measure was the number of words correctly recalled across all trials.

The reliability, validity and clinical utility of the AVLT are now well established. Powell, Cripe and Dodrill (1991) found the AVLT to be an effective measure of brain impairment because of the complex memory fuctions that it assesses. In particular, the AVLT scores obtained on Trials 1-5 are said to reflect the "combined functioning of a wide cross section of neurobehavioural mechanisms, including arousal, motivation, attention, concentration, auditory perception, verbal comprehension, imediate verbal memory span, short term verbal memory storage and retrieval, and progressive serial learning abilities" (Powell et al., 1991, p.248). In addition it provides a learning curve and elicits an individuals learning strategies (Lezak,1983). It is therefore sensitive to memory impairments that result from head injury.

The AVLT has shown to be highly correlated with school learning disorders with the delayed-recall trial is the most sensitive to memory impairment (Bishop, Knights, and Stoddart,1990). Children with learning difficulties generally have relatively flat learning curves over the first five word presentation trials while children with attention problems tend to show an uneven acquisition of words.

Bishop et al., (1990) present data for each learning trial, total words recalled, the distactor, delayed recall and recognition trials for 195 English speaking children aged 5 to 16 years who were referred for neuropsychological assessment for a variety of reasons. In this study a moderate correlation between IQ scores and AVLT performance was found.

Much of the literature surrounding the AVLT is focused on establishing normative data (e.g. Agnew & Meyers, 1988; Geffen, Moar, O' Hanlon, Clark & Geffen, 1990) instead of examining aspects of subjective organisation and how this effects performance. The most relevant norms for 14-15 year-olds, are those presented by

Forrester and Geffen (1991) . In this study, a total of 80 Australian subjects were tested across four age groups. All subjects spoke English as a first language and learning-disabled children were not included. Forrester and Geffen found a high degree of stability across the ages 7 to 15 years for acquisition rate, serial position effects, effects of interference, and forgetting.

**The Paced Auditory Serial Addition Task (PASAT) (Appendix 14).** The Paced Serial Addition Task (PASAT) (Gronwall, 1977) was designed as a measure of information processing speed and efficiency, concentration skills and short-term memory, and is appropriate for individuals aged 14-55 years. It is commonly used to measure a reduction in a person's information processing speed following a head injury (Gronwall,1977). There is consistent evidence that shows information processing rate is reduced for some time after injury and that this reduction is associated with post-concussional complaints such as concentration problems, fatigue and inability to carry on with normal work (Gronwall, 1977). Gronwall (1977) reports that the PASAT is appropriate for individuals aged 14-/55 years.

The administration procedure is as follows:

A pre-recorded tape delivers a random series of numbers from 1-9. The subject is instructed to add pairs of numbers such that each number is added to the one that immediately preceeds it. The second is added to the first, the third to the second, the fourth to the third and so on. The same 60 numbers are presented in four consecutive fixed trials, differing in the rate of digit presentation (2.4, 2.0, 1.6, 1.2). A practice trial consisting of 10 numbers at the slowest rate was given to the students to ensure that they had understood the instructions.

The adult version of the PASAT was chosen ahead of the childrens (CHIPASAT). This was because of the additional data and literature

available on the adult version. In addition Gronwall (personal communication, March, 1994) stated that because the fourth formers were at the bottom age range for the adult version and the top range of the CHIPASAT it would be appropriate to use either.

In a number of tests Gronwall & Wrightson (1974, 1975) have been able to show, in the terms of this model of information processing, that concussed patients can process a limited number of items as swiftly as normal controls, however as the numbers of items increases at a critical point, the performance of the concussed patient falls off, and diverges further from the control group as more items are added.

Evidence of psychometric properties of the PASAT is relatively scarce. A comprehensive study by Stuss, Stethem and Poirier (1987) compared the PASAT with two other measures the purported to be sensitive to attentional disorders of limitations in information processing capacity in closed head injury. They found that education correlated highly with all levels of the PASAT at least at $p<.01$, and it correlated most highly with the digit presentations of 2.0 seconds and faster. The education effect reported for the PASAT may be due more to the calculation characteristics of the task rather than to the general speed of information processing. Roman, Edwall, Buchanan, and Patton (1991) found that IQ bears a minimal relationship to PASAT performance, at least for subjects falling within the normal to superior ranges.

Test-retest relability is not an appropriate psychometric indicator because of the PASAT's high practice effect. With regards to the validity of the PASAT, it has been shown to positively correlate with subjective complaints and functionnal difficulties. Roman et al.'s study provides norms for 3 age ranges. It should be noted, that many normal subjects find the PASAT to be an aversive,

stressful test and become anxious during its administration which can adversly affect performance.

**Digit Symbol (Appendix 15)**

The digit symbol test is a subtest of the Wechsler Intelligence Scale for Children (WISC) which is appropriate for the age group of 6 years to 16 years and 11 months. It contains the same tests as the Wechler Adult Intelligence Scale, in similar format, all except the digit symbol which begins with considerably simpler items. This test is consistently more sensitive to brain damage, especially attention and response speed, than other Weschler subtests and is more likely to be depressed even with minor brain damage (Lezak, 1983).

The dependent measure was the number of correctly filled in boxes after a time period of 120 seconds.

**Word Fluency**

This is a written test that first appeared in the Thurstones' Primary Mental Abilities tests (1938, 1962). Individuals with frontal lobe lesions have a low output of words in this test, and frontal lobe damage is common after head injury. The student was required to write down as many words beginning with the letter "S" as they can in 5 minutes, and then write as many words beginning with the letter "C" in four minutes.

Although the principal locus of focus of this defect appears to be in the left-orbital frontal region, lesions in the right orbital-frontal region may produce a large reduction in verbal fluency. The average 18 year old can produce 65 words in the total nine minute writing time. Milner and her colleagues at the Montreal Neurological Institute use a cutting score of 45 to identify fluency problems (Lezak,1983).

**Teacher Report Form (Appendix 9)and Behaviour Checklist (Achenbach) (Appendix 10)**

In order to obtain teachers' views of childs' behaviour, Achenbach (1978) developed the Teacher Report Form (TRF) of the Child Behavior Checklist (CBCL). Page 1 and 2 of the TRF is designed to obtain demographics, information on the context in which the teacher knows the child, previous special services and ratings of academic performance (Achenbach & Edelbrock, 1983). Page 2 requests teachers' ratings on four general adaptive characteristics, plus standardized test data and other information teachers can provide. Pages 3 and 4 list behaviour problem items in the same format as the CBCL. In this study Pages 1 and 2 were altered to exclude questions that had already been answered on the earlier questionnaire. No changes were made to Pages 3 and 4 of the TRF. The behaviour problem scales of the teachers profile are derived from factor analysis of ratings of clinically referred children and are normed with data from randomly selected non-referred children and 85 of the 113 behaviour problem items on the TRF are identical to the CBCL. Because of the strong similarity between the CBCL and the TRF, it is assumed the psychometric properties are also similar.

In this study, the Teacher Report Form (TRF) was adapted to form a questionnaire for the parents (Behaviour Checklist) and the teachers (Teacher Report Form). Page one of the questionnaire was altered to include only that information that had not already been obtained from the initial head injury screening questionnaire. Pages 2 and 3 of the questionnaire were identical on the TRF and Behaviour Checklist.

The CBCL is one of the most evaluated instruments of its type. Developed by Achenbach, the CBCL consists of 118 items describing specific behaviour problems on a three point scale. Thorough psychometric evaluations of the CBCL have been conducted for both boys and girls in one of three age ranges (4-5,

6–11, and 12–16 years) (Bellack & Hersen, 1988). Achenbach and Edelbrock (1981) reported that 1 week test–retest reliabilities were high (0.82– 0.89), though interparent agreement was somewhat lower (0.54– 0.74).

In a large scale normative sample, Achenbach and Edelbrock (1981) presented information on the discriminant validity of the CBCL. They collected CBCL's for 1,300 nonreferred children and 450 children refered to mental health facilities for a variety of behaviour problems. Significant differences were found between the referred and non referred children on 108 of the 118 behaviour problem items, with referred children scoring higher on all of them (Bellack & Hersen, 1988). Once the TRF has been scored, individual T–scores based on the normative data provided by Achenbach and Edelbrock (1981) can be obtained for each factor to produce a Child Behaviour Profile.

An advantage of using the TRF is that behavioural characteristics known to be associated often with head injuries such as aggression, impulsivity, and overactivity are adequately represented on the TRF problem behaviour scales.

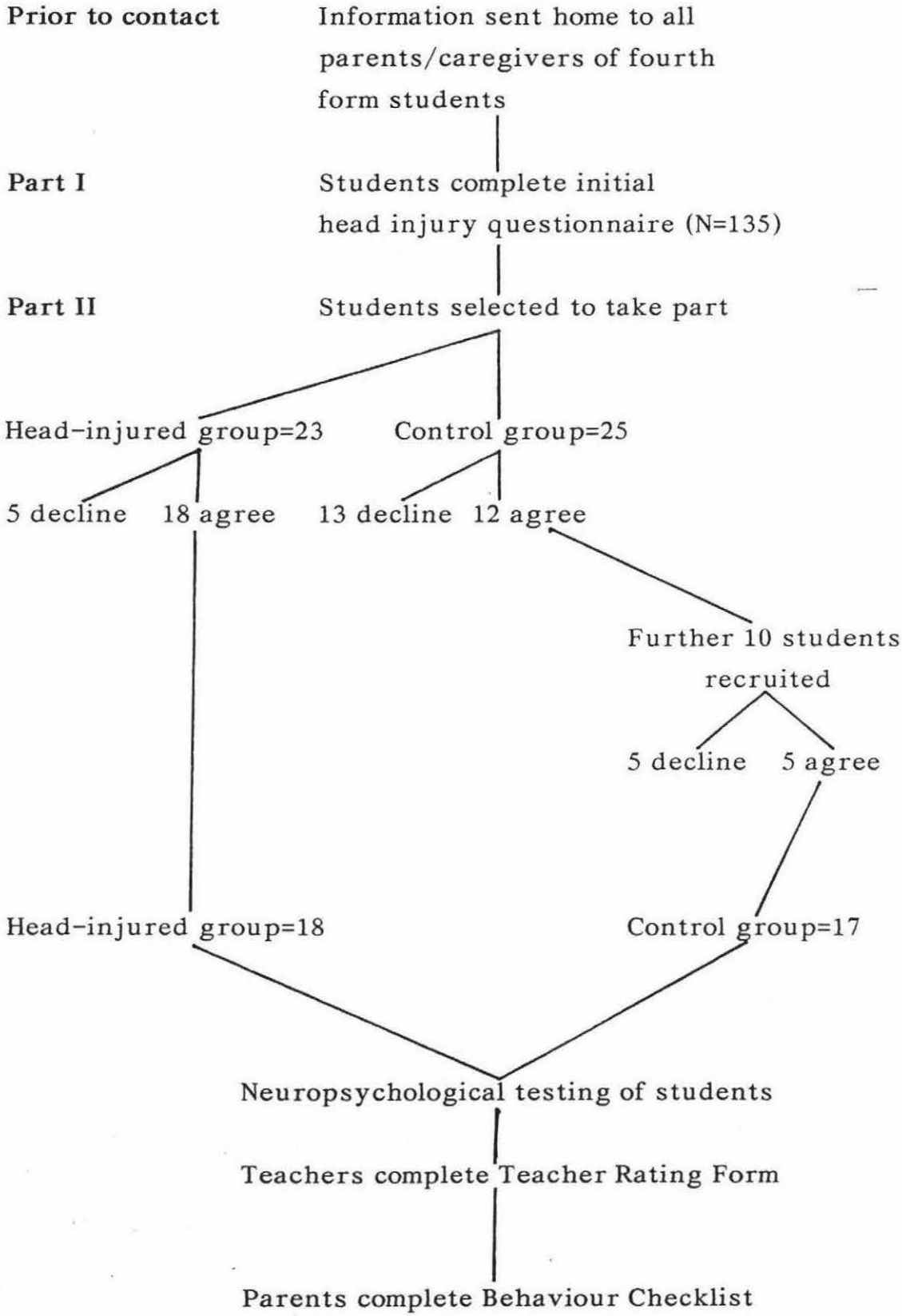
## Procedure

### Prior to contact

Initial contact was made with the principal of Awatapu College and a meeting held to discuss details of the proposed study. Details of the study were then presented to the Board of Trustees for approval and the Massey University Human Ethics Committee. After approval, a letter was sent home to the parents of all the fourth form students at Awatapu College outlining the study and asking them to return an attached form if they did not wish their son/daughter to take part. A flow diagram of the procedure is shown in Figure 6.1.

**Figure 6.1**

*Flow diagram of procedure*



Part I

All the fourth form students at Awatapu College who were present on the days the researcher entered the school where asked if they wanted to take part in the study. They were initially given an information sheet which outlined the details of the study, and where then asked to read and sign a consent form. A total of 135 students completed the intial questionnaire.

Part II

After the students had completed the initial questionnaire, a group of 23 students who stated that they had experienced a head injury in the last 3 years were selected to continue with Part II of the study. These students were selected based on their scores on the "symptom" and "general functioning" scales' and the type of head injury they had sustained (as described on page 40).

A control group of 25 matched on variables of sex, "symptom" and "general functioning" scores and academic level was selected at this time.

The selected students were given a letter in class (Appendix VI), approximately 4 weeks after they had completed the first questionnaire. This letter outlined Part II of the study and requested consent. A total of 12 students from the control group and 5 from the head injured group declined to take any further part in the study at this point. This left 12 students in the control group and 18 in the head injured group. A further 10 students were approached at this point to make up equivalent control group numbers. From this group, five students agreed to take part, and five declined or did not return their consent form. This left a total of 36 students, 18 in each group. During the data collection stage, a student in the head-injured group decided that she did not wish to take part and withdrew from the study. This

left a final total of 18 in the control group and 17 in the head-injured group.

The next stage involved contacting all the students parents/caregivers by phone to obtain permission for their son/daughter to take part. All the parents/caregivers contacted gave their permission.

Over the next four weeks all students were administered the neuropsychological measures. Each session was 40 minutes in length. Following this, the students' form teachers were asked to complete the Teacher Report Form. All forms were completed by the teachers.

Next the parents/caregivers of the 35 students were recontacted and asked to complete the Behaviour Checklist. A total of 27 were visited at home or at work and completed the questionnaire on the spot, while 8 asked for the TRF to be mailed because they were too busy to meet, or it was impractical to travel the distance required. All of the parents/caregivers completed the questionnnaire, however one was lost in transit after it was completed. The majority of the parent forms (33 out of 34) were completed by the students mother or stepmother.

At the completion of the study, a summary of the results was sent to students and parents who had requested it.

**Ethical Issues.**

This study was designed in accordance with the ethical guidelines of the New Zealand Psychological Society and was approved by both the Massey University Human Ethics Committee and the Awatapu College Board of Trustees. The main ethical issues to be considered were informed consent and confidentiality.

Before the study took place the students were given a detailed letter about the study to take home to their caregiver(s) (Appendix 3). This letter outlined the study and requested that if they had any objections to the study then they could return the attatched slip and their child would be excluded. As outlined in the procedure section, all the students who were asked to complete the original questionnaire were given an information sheet that outlined the study in detail, and informed that they were in no way obliged to take part (Appendix 4). They were then asked to read and sign a separate consent form (Appendix 5). The students that were selected to take part in the second part of the study were given an envelope containing a further consent form. Further, their caregiver(s) were contacted by phone when details of the second part of the study were explained and permission requested for their child to take part (Appendix 7).

Confidentiality was assured by restricting access of the questionnaires (completed by the students, teachers and parents) and the test results of the students, to the researcher and supervisor. Also the students were assigned individual identification numbers during Part 1 of the study. These identification numbers were used during the data analysis stage to ensure confidentiality.

# Chapter 7:

## Results

### Part I

The purpose of Part 1 of this study was to determine incident rates, etiology and awareness of head injury in an adolescent population, and to compare this data with existing New Zealand and overseas research.

**Hypothesis 1:**

**Based on both overseas studies and New Zealand ACC statistics, it is hypothesized that 10–12% of our sample population will report that they have sustained a head injury of some description in the last 3 years (3–4% per year).**

Results revealed that 55 (41%) of the 135 students reported that they had sustained a head injury of some description in the last three years as shown in Table 7.1. This equates to an incident rate of 13.6%. These figures include injuries that did not necessarily result in concussion. Within this group, a total of seven students (or 12%) reported some period of loss of conciousness (LOC), not exceeding 10 minutes. There was a total of 70 head injuries. Table 7.1 below summarises the number of head injuries sustained by the students.

**Table 7.1**

*Number of head injuries sustained by head-injured students in a total population of 55.*

| | Number (and percentage) of head injuries | | | | |
|---|---|---|---|---|---|
| | One | Two | Three | Four | LOC |
| No. students | 37(67) | 8 (14) | 2 (4) | 1 (2) | 7(13) |

**Hypothesis 2:**
**There will be a significantly higher proportion of males than females reporting head injuries, with a ratio of approximately 3:1.**

Of the 55 students reporting head injuries, 26 (47%) were male and 29 (53%) female giving a ratio of 1:1.12. The ratio of 1:1.5 for this age group, reported by Klauber et al. (1981) is closest to these results. Generally the ratio is higher (Kraus et al.,1984; Annegers et al., 1980. with 1:3.2 and 1:2.7 respectively).

**Hypothesis 3:**
**The nature of the reported head injuries by the males will be of greater severity in comparison to the females.**

To determine severity of injury, the researcher looked at loss of conciousness and the number of multiple head injuries. The results did not support the hypothesis. Three males and four females sustained a head injury that resulted in some period of loss of conciousness (not exceeding 10 minutes). The total number of students with multiple head injuries included five males (19%), and seven females (24%). Overall, the male students had a total of 33 head injuries and females had 38. All head injuries were mild.

**Hypothesis 4.**
**The major source of head injury in this population is likely to be sport, followed by motor vehicle accidents and falls.**

Figure 7.1 highlights the major sources of head injury in this population and by sex. Sports related accidents were the major source of injury overall (38.5%) , followed by collisions (26.8%), falls (not including from bikes or horses) accounted for 18.2% and falls from bikes, 8.3%.

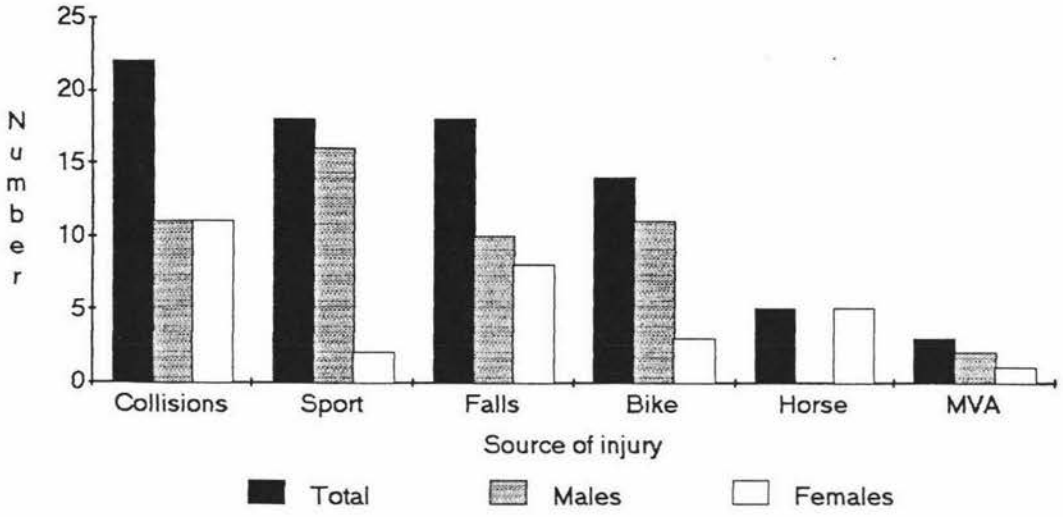



Figure 7.1

*Sources of head injury in student population.*

Sports related accidents were the major source for the males students (36%) followed by collisions (25%) and falls from bikes (18%). For the females the biggest source was collisions (33%), followed by falls (30%) and falls from horses (15%).

Hypothesis 5:

**That head-injured students would, on average, play more hours of sport per week than non head-injured students.**

A significant difference was found between the head-injured and non head-injured students in the hours spent playing sport each week ($t [133]= 1.85$, $p< 0.05$.) On average the head-injured students spent 6.8 hours each week playing some form of sport. This is in comparison to 4.9 hours each week spent by non-head injured students. Although males played, on average, more hours of sport each week than the females, with 6.1 (5.2) and 5.3 (6.2)

hours respectively, the difference was not statistically significant.

**Table 7.2**

*Mean hours of sport played per week (and standard deviation) by male and female head-injured and non head-injured students.*

| | Hours of sport | | |
|---|---|---|---|
| | M | (SD) | t-value |
| HI | 4.9 | (5.1) | 1.85** |
| NHI | 6.7 | (6.5) | |
| Males | 6.1 | (5.2) | -0.87 |
| Females | 5.3 | (6.2) | |

**p<.05, one-tailed significance.

**Hypothesis 6:**

**That students who have sustained a head injury will score higher on average on the head injury symptom measure, and have more difficulty on the measure of general functioning.**

Table 7.3 summarises the results between the head-injured and non head-injured students on these two measures. On the symptom measure the head-injured mean of 8.4 (SD 5.2) was higher than the non head-injured group mean of 6.9 (SD 5.0) on the symptom measure and the difference was statistically significant. (t [133]=1.72, p<0.05).

On the measure of general functioning, the results revealed no significant difference between the means of the two groups (head-injured, 34.3 [SD 9.5]; non head-injured, 30.8 [SD 6.0]).

**Table 7.3**

*Summary of means and t-test results for non head-injured and head-injured students.*

| | Non head-injured M (S.D) | Head-injured M (S.D) | t-value |
|---|---|---|---|
| General functioning | 29.7 (8.0) | 31.8 (7.6) | 1.50 |
| Symptom score | 6.9 (5.0) | 8.4 (5.2) | 1.72** |

** $p<0.05$, one tailed significance.

**Hypothesis 7:**

**There will be no difference in the level of awareness of symptoms after head injury between those students who have sustained a head injury and those who have not.**

The students responses to this question were summarized into 8 main symptom categories. Figure 7.3 summarises the percentage of head-injured and control group students listing the symptom categories for the three scenarios. The scenarios were as follows:

Scenario One: *"A 14 year-old rugby player sustains his fourth concussion in a season".*
Scenario Two: *"A 6 year-old girl falls head first down her back steps, losing conciousness for 1 minute".*
Scenario Three: *"An 18 year-old male is thrown through a car windscreen after colliding with another car at 80 km/h, and was in a coma for 4 weeks".*

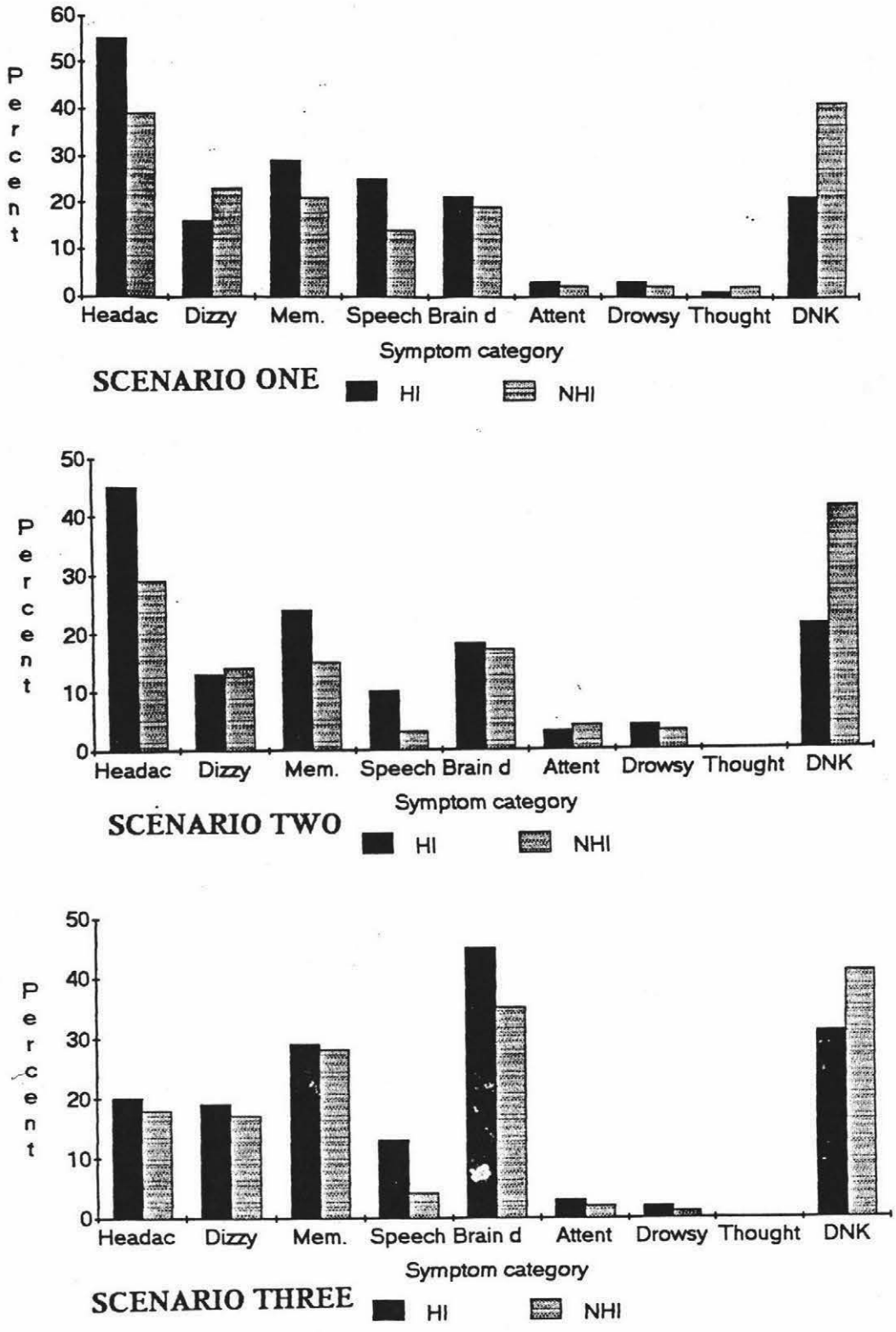



**Figure 7.3**

*The percentage of head-injured and non head-injured students listing the symptom categories for the three scenarios*

Table 7.4 summarises the percentage of head-injured and non head-injured students who listed each symptom category across the three scenarios.

**Table 7.4**

*Percentage of head-injured and non head-injured students who listed each symptom category.*

| | Scenario | | | | | |
|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | |
| | HI | NHI | HI | NHI | HI | NHI |
| Migraine | 54.6 | 38.0 | 45.5 | 28.8 | 20.0 | 15.0 |
| Dizziness | 31.0 | 27.5 | 27.3 | 17.5 | 18.2 | 7.5 |
| Memory | 27.3 | 20.0 | 25.0 | 13.8 | 27.3 | 25.0 |
| Blurred vision | 24.0 | 10.0 | N/A | N/A | 12.7 | 6.3 |
| Coma BD | 20.0 | 12.5 | 14.6 | 12.5 | 40 | 32.5 |
| DNK | 14.6 | 40.0 | 24.0 | 40.0 | 31.0 | 41.0 |
| Total % | 31.4 | 21.6 | 22.5 | 14.5 | 23.6 | 17.3 |

In scenario 1 and 2, the "mild" head injury examples, both head-injured and non head-injured students listed "migraines and headaches" as being the most commmon symptom. However, there were more non head-injured students who "did not know" or did not respond across all three scenarios. In scenario 3, the severe

head injury example, both groups listed "coma/brain damage" as the most common symptom. When the number of responses overall was examined, more students listed symptoms for the first "mild" scenario than the severe scenario.

The following quotes are specific examples of students answers to each scenario. They were categorised into correct or 'aware' answers and incorrect answers.

**Scenario one:**

Specific examples of responses given by more 'āware', head injured (HI) and non head-injured (NHI) students for scenario one are given below.

> "you get dizzy, find it hard to focus on things and also find it hard to remember things" (HI)
> "major dizziness, eyes go bleary, and can't walk without help. Bright light hurts when doctor shines it into your eyes" (HI)
> "memory loss, vulnerability to other head injuries, lack of concentration" (HI)
> "dizziness, headaches" (NHI)
> "headaches, possible memory loss..." (NHI)
> "can throw up, major headaches, possible loss of sight for a short time" (NHI).
> "lack of concentration, headaches, trouble with eyesight, tiredness and bruising" (NHI)

Examples of incorrect or overstated responses from both head-injured and non head-injured students for scenario one included:

> "if he gets at least three or four more he could die"(HI)
> "I guess he would get sick lots...and end up 6 feet under the ground" (NHI)

**Scenario two:**

Examples of correct responses given by HI and NHI students for scenario two included:

"get dizzy afterwards, maybe feel a bit sick for a few days" (HI)
"short-term and long-term memory loss, migraine, dizzy spells, hearing problems, concentrating for long periods of time will be hard" (HI)
"very quiet, not moving around much, saying she is very tired" (HI)
"loss of memory around that time" (NHI)
"headaches, feels sick" (NHI)
"bad headache, bleeding, skull could be cracked" (NHI)
"a bit of brain damage,gets dizzy afterwards, hard to talk for a while" (NHI)
"headaches, not aware of what is going on, grumpiness, tiredness.." (NHI)

Examples of responses given by students showing less awareness in scenario two included:

"maybe she will be crazy" (NHI)
"brain tumor"(NHI)
"may not sleep"(HI)
"trouble walking" (HI)
"bleeding, scrapes"(NHI)
"could have memory loss, brain damage...as at her age her skull will not be complete, the fontanelle will not be closed"

Scenario three:

Examples of responses given by 'aware' HI and NHI students for scenario three included:

"May have major head injuries, loss of memory" (HI)
"shock, severe pain, dizziness, unable to concentrate, memory loss" (HI)
"never fully recover, serious brain injuries" (HI)
"dizziness, amnesia, black-outs, headaches, blurry vision" (HI)
"memory loss, severe swelling of the brain, dizziness, vision affected" (HI)
"might not remember what happened, serious injuries" (HI)
"brain damaged, paralyzed, unable to control body (could include breathing)" (NHI)
"remember nothing, nausea, headaches" (NHI)
"headaches, memory loss" (NHI)
"he would be very sick, have headaches, lack of memory" (NHI)
"loses ability to think straight" (NHI)
"brain swells, never wakes up" (NHI)
"cracked skull, expanded brain lining, amnesia" (NHI)

Examples of responses given by less aware students for scenario three included:

"maybe he develops a minor brain tumor"(HI)
"he might as well be dead"(NHI)

## Part II

The second part of this study aimed to determine what proportion of head-injured students report ongoing problems of the kind common afterwards. It included examination of the students' self reports and the teacher and parent ratings. Their results were compared to a non head-injured matched control group.

**Hypothesis 8:**
**Head-injured students will perform at a lower level than the non head-injured students on the:**
**(a) concentration and verbal memory task (AVLT)**
**(b) information processing speed task (PASAT)**
**(c) psychomotor and attention tasks (digit symbol and word fluency)**

**(a) concentration and verbal memory:**
The performance of the head-injured students and the control group on the AVLT are summarized below in Table 7.5.

Trials 5 and 6 of the AVLT yielded statistically significant results, with the head-injured students remembering (a mean of) 11.5 (SD 1.3) words on trial 5 in comparison to the control group mean of 12.3 (SD 1.6). On trial 6, the head-injured group remembered (on average) 9.6 (SD 2.2) words and the control group11.1 (SD 1.9). Although the head-injured group performed lower on 7 of the 8 trials, they performed significantly lower than the control group only on trials 5 and 6.

**Table 7.5**

*Mean AV LT results and standard deviations for the head-injured and control group students.*

| | Head Injured | | Control | | t-value |
|---|---|---|---|---|---|
| | M | S.D | M | S.D. | |
| Trial 1 | 6.6 | 1.7 | 6.4 | 1.4 | 0.63 |
| 2 | 9.0 | 1.9 | 9.2 | 1.9 | -.26 |
| 3 | 10.8 | 1.3 | 11.8 | 2.1 | -.30 |
| 4 | 11.4 | 1.3 | 12.3 | 1.4 | -.87 |
| 5 | 11.5 | 1.3 | 12.3 | 1.6 | -1.75** |
| I | 5.2 | 1.4 | 5.7 | 1.6 | -.79 |
| 6 | 9.6 | 2.2 | 11.1 | 1.9 | -1.97** |
| 7 | 9.9 | 3.0 | 10.5 | 2.0 | -.89 |
| Total | 75.1 | 11 | 79.0 | 11.4 | -1.0 |

** $p<0.05$, one tailed significance.

Table 7.6 summarises the results of the male and females students in both groups. The male control group students scored higher than the head-injured males on 2 of the 8 trials, and the female control students scored higher on trial one compared to the head-injured females. There was no significant difference between the male and female students in both groups across all trials.

**Table 7.6**

*Mean scores and standard deviations of the male and female control and head-injured students on the AVLT .*

Control Group

| | Males | | Females | | t-value |
|---|---|---|---|---|---|
| | Mean | S.D. | Mean | S.D. | |
| Trial 1 | 6.2 | 2.1 | 7.2 | 1.4 | 0.17 |
| 2 | 9.1 | 2.0 | 9.0 | 1.8 | -.10 |
| 3 | 11.2 | 0.8 | 10.6 | 1.6 | 0.32 |
| 4 | 11.3 | 1.6 | 11.5 | 0.8 | 0.18 |
| 5 | 12.5 | 1.2 | 12.2 | 1.6 | 0.28 |
| I | 5.6 | 0.7 | 5.7 | 0.9 | -.07 |
| 6 | 10.5 | 1.8 | 11.4 | 1.9 | -.91 |
| 7 | 10.5 | 1.8 | 10.6 | 2.2 | -.12 |

Head Injured

| | Males | | Females | | t-value |
|---|---|---|---|---|---|
| | M | S.D. | M | S.D. | |
| Trial 1 | 6.5 | 1.2 | 6.3 | 1.5 | -1.0 |
| 2 | 9.1 | 1.6 | 9.2 | 2.0 | 0.13 |
| 3 | 10.5 | 2.3 | 11.6 | 1.8 | 0.54 |
| 4 | 11.0 | 1.9 | 12.3 | 1.7 | -.04 |
| 5 | 12.5 | 1.2 | 12.3 | 1.6 | 0.34 |
| I | 5.6 | 0.7 | 5.7 | 1.9 | -1.34 |
| 6 | 10.5 | 1.8 | 11.4 | 1.9 | 0.75 |
| 7 | 10.5 | 1.8 | 10.6 | 2.1 | 0.97 |

**(b) information processing speed**

The PASAT is a measure of information processing speed and lowered performance is associated with post-concussion. The mean percentage correct responses at four presentation rates for the head injured and control group students are summarised below in Figure 7.3.

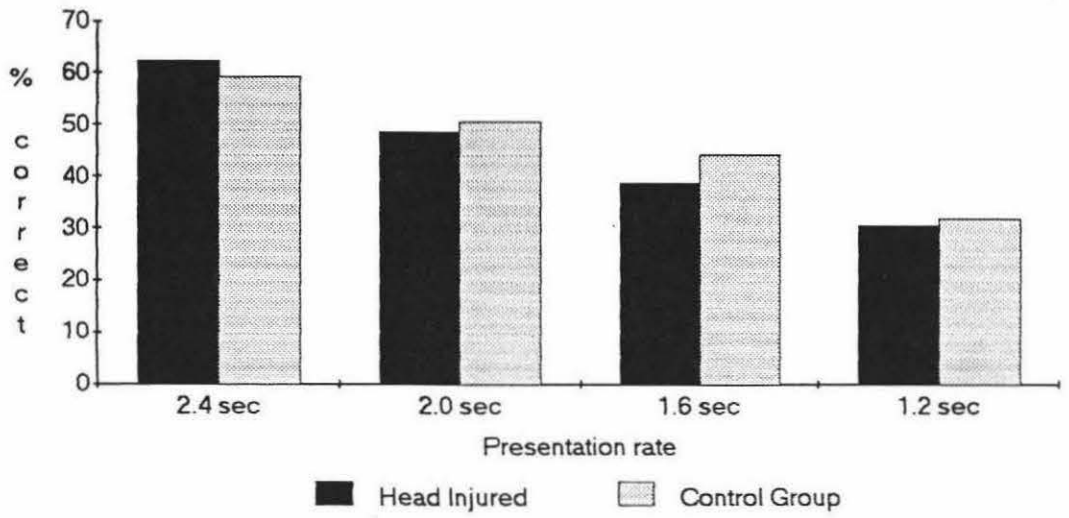



Figure 7.3
*Mean percentage correct responses for head-injured and control students*

Results of independent t-tests shown in Table 7.7 reveal that the head-injured group performed no worse than the control group on this measure.

**Table 7.7**

*Total mean correct responses and standard deviations across all four presentation rates of the PASAT.*

| Rate | Control Group M | (SD) | Head-Injured M | (SD) | t-value |
|---|---|---|---|---|---|
| 2.4 | 35.3 | (12.6) | 37.3 | (9.0) | 0.55 |
| 2.0 | 30.2 | (12.8) | 29.0 | (9.0) | −0.33 |
| 1.6 | 26.4 | (10.9) | 23.2 | (10.4) | −0.90 |
| 1.2 | 18.9 | (8.0) | 19.3 | (9.0) | 0.14 |

There was no significant difference between the two groups across all four presentation rates of the PASAT. The mean correct response time (how long, on average, it takes the student to respond with a correct answer) was calculated, and results for the head-injured and control group students are summarized below in Figure 7.4.

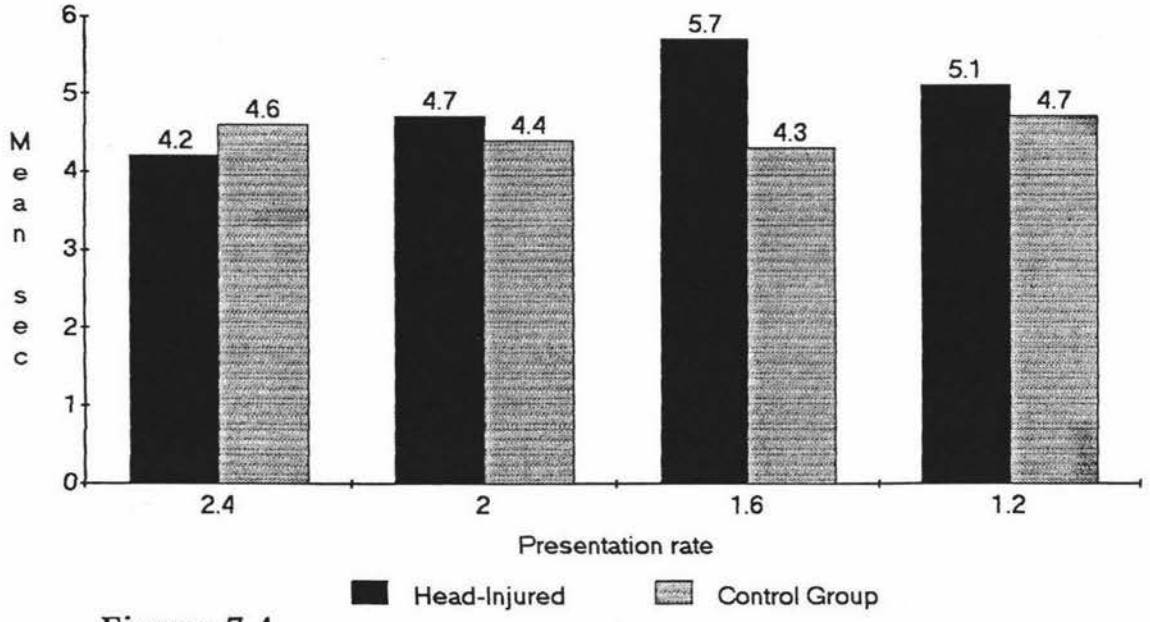



**Figure 7.4**

*Mean time (seconds) per correct response for control and head injured groups (SD).*

Although there was no significant difference, the head-injured group was slower (on average) across 3 of the 4 presentations, with the biggest difference for the presentation rate 1.6 seconds. At this speed the head-injured students were (on average) 1.4 seconds slower in responding. At the fastest rate of 1.2 seconds, the head-injured students were (on average) 0.4 seconds slower.

**(c) psychomotor and attention.**

Analysis of results of the word fluency test ("s" words + "c" words) yielded no significant difference between the two groups (head-injured group mean, 48.6 [13.8] and control group mean, 47.9 [12.9]). The range of scores was from 25-81 for both groups. Further there was no significant difference on the digit symbol test (head-injured group mean, 69.1 [SD 8.6] and control group mean, 66.9 [SD 8.8]).

**Hypothesis 9.**

**If there is no significant difference between the groups on the neuropsychological measures, it could be accounted for or due to the high number of light head injuries within the sample are masking the deficits of the head-injured students.**

This hypothesis was tested by selecting nine students who reported the worst head injuries and matching them with nine students from the control group, on variables of sex, race, grade, symptom and general functioning scores. Across all neuropsychological measures the more serious head-injured students performed no worse than the matched control group. On the "thought problems" subscale of the TRF, there was a statistically significant difference between the two groups, which indicated that the head injured students were rated higher on the subscale by both parents and teachers ( $t [16] = 0.036$, $p<0.05$). However, the head-injured group was not rated significantly higher on any of the other subscales of the TRF.

**Hypothesis 10.**
**That there will be a number of students reporting difficulties and performing at a lower level on the neuropsychological measures, and that these will be recognised by teachers and parents alike.**

Table 7.7 and 7.8 lists the students who scored more than one standard deviation above the mean for their group on the "symptom" scale and on the teacher and parent rating forms, and more than one standard deviation below the mean on the neuropsychological measures and general functioning scale.

**Table 7.8**
*A summary of the head-injured students' self-report ratings, parent and teacher ratings and neuropsychological test results.*

**Head-injured group**

| | Self-report | | | | |
|---|---|---|---|---|---|
| I.D | Symp. high | Funct. low | Neuropsych. low (No.of tests) | Parent probs. | Teacher probs. |
| (20) | * | * | * (1) | | * |
| (13) | * | * | * (1) | | * |
| (19) | * | * | * (1) | * | |
| (03) | * | * | * (1) | | |
| (01) | | * | * (2) | | |
| (04) | * | | * (2) | | |
| (16) | * | | | | |
| (05) | | | * (1) | | |
| (09) | | | * (1) | | |
| (11) | | | * (3) | | |
| (12) | | | * (2) | | * |
| (18) | | | * (1) | | * |

(* = one standard deviation above or below the mean)

As shown in Table 7.8, there were a total of six head-injured students rating "symptoms" higher than one standard deviation above the mean for their group, and 11 students scoring one standard deviation or lower on the neuropsychological measures. Four students who rated themselves high on the "symptom" measure, were also rated highly on one or more of the other measures. There were no head-injured students who were rated as having problems by both the parents and the teachers.

**Table 7.9**

*A summary of the control group's self-report ratings, parent and teacher ratings of problem behaviour and neuropsychological test results.*

**Control Group**

| | Self-report | | | | |
|---|---|---|---|---|---|
| I.D. | Sympt. high | Funct. low | Neuropsych. low (No.of tests) | Parent probs. | Teacher probs. |
| (81) | | | * (1) | * | * |
| (132) | * | * | | * | |
| (69) | * | * | | | |
| (82) | | | * (3) | | * |
| (128) | * | | | * | * |
| (57) | | * | | | |
| (113) | | * | | | |
| (91) | | | * (1) | | |
| (93) | | | * (3) | | |
| (95) | | | * (3) | | |
| (106) | | | * (1) | | |

(* = one standard deviation above or below the mean)

There was a total of three control group students rating "symptoms" one standard deviation or more above the mean for their group, and who also had a high rating on one or more of the other measures. A total of six students performed one standard deviation or more below the mean for the neuropsychological tests and two students who were rated by both the teachers and the parents as having problems.

# Chapter 8:

# Discussion

## Part 1

### Incidence and Etiology.

Of the 135 14-15 year-olds in this study, 41% reported that they had sustained a head injury of some description in the last three years. This is slightly higher than the Segalowitz and Brown (1991) study, also using self report measures with an adolescent population, which reported an overall prevalence rate of 31.2% The 41% reported in this study equates to an incidence rate (per year) of 13.6%, in comparison to the 10-12% predicted. A possible explanation for the difference could be that while our study surveyed all individuals of a certain age in the setting, the other studies used figures generated from hospital data which typically under represents mild head injury.

As was predicted, sport was the major source of injury in this population accounting for nearly 40% of all head injuries, followed by collisions and falls (not including falls from bikes or horses). In the Kraus and Nourjah study (1989) of adolescents, sport was also the major source, followed by motor vehicle accidents (MVA's) however these did not feature as a major source of head injury in our population. They also found that sport was the major source of head injury in females but in our study, collisions were the major cause.

It had also been expected that the rate of head injuries would be higher for male than female students, but no such difference was found. In fact overall, there were slightly more females than males reporting head injuries (53% compared to 47%). This equates to a ratio of 1.12:1 which is lower than those reported by

Klauber et al. (1981); Kraus et al., (1984); Annegers et al., (1980) and Segalowitz & Brown (1991),1:1.5,1:3.2, 1:2.7 and 1:2.1 respectively. An explanation for this could be that there is perhaps a higher level of participation in sport by female students in New Zealand, and the inclusion of all levels of head injury.

It had been expected that male students would sustain more serious injuries than females as had been reported in earlier literature. But instead, figures for the total number of injuries, numbers receiving more than one head injury, and for receiving a head injury where consciousness was lost, were nearly equal for male and female groups. Again, this could be because of high participation in sport by female students.

This study confirms the differences reported between the etiology and incidence rates of children with adults. Sport related head injury is much lower in velocity than those caused by MVA, and both physical and behavioural outcomes are likely to be different.

As sporting accidents had been identified in earlier studies as being a major cause of head injury in this population it was predicted that head-injured students in this study would spend more hours playing sport each week than non head-injured students. The results strongly support this, with a significant mean difference of nearly 2 hours a week more being played by the head-injured group compared to the non head-injured. In addition, male students on average spent one hour more playing sport than their female counterparts, although this difference was not significant.

Although some of the head injuries reported by the students were more serious than others, all the injuries were mild.

**Symptoms and General Functioning**

It had been anticipated that the head-injured students would score higher on the symptom measure and would indicate more difficulty on the measure of general functioning than the non head-injured group. This was confirmed for the symptom measure where the head-injured group scored significantly higher than the non head-injured group, but not for general functioning. One explanation for this result could be that although the head-injured students report more symptoms, they are not experiencing any difficulties with their level of functioning as a result. Another explanation could be that the head-injured students are unaware of any functional difficulties that they are having. Finally, it may be that the questions asked on this measure were not specific enough to detect any problems.

**Level of awareness**

When the students were given the details of head injury case studies and asked to record likely consequences, head-injured students listed more accurate symptoms in comparison to the control group. These findings are contrary to a similar study by O'Jile et al., (1994), where there was no significant difference found in the number of misperceptions surrounding head injury between those with and those without head injury.

The different findings in the two studies could be due to the differences in data collection methods. Students in the O'Jile et al. (1994) study were given a list of symptoms to endorse, while our students were asked to write down in their own words the changes that they thought would occur after mild and severe head injury. Where it had been predicted that students would be more accurate in their perceptions of what happened after severe head injury than they would be about mild head injury, the reverse was true. Both groups in our study listed more

accurate symptoms for the first "mild" scenario than the "severe" scenario. Perhaps this occurred because the students in this study had more experience of mild than severe head injury, and/or because friends or family members that they had contact with had sustained such an injury.

## Part II

The following paragraphs discuss the results for the head-injured and control group students on the neuropsychological and behavioural measures.

**Neuropsychological Measures.**

**AVLT:** Although the head-injured group (N=18) as predicted performed lower than the control group (N=17) on all the AVLT trials except one, the differences were significant only on Trials 5 and 6. These results suggest that head-injured students were displaying slower rates of learning, and were more affected by retroactive interference (Trial 6 compared to Trial 5), but performed equally well at recall.

**PASAT.**

Although the head-injured group performed at a lower level than our control group, across three of the four presentation rates, the magnitude of the difference was not significant. Of most importance with this measure, was the fact that the percentage correct for our control group was, on average, 20% lower than the control group results of Gronwall and Wrightson's sample (1974). This could be partly due to the 14-15 year-olds in this study being at the lower end of the age range for the PASAT recommended by Gronwall. They may have scored in a higher range on the CHIPASAT where they would have been at the top

end of the recommended age range.

**Digit Symbol and Word Fluency.**

Although the digit symbol test is reported to be sensitive to effects of mild head injury, the head-injured students did not perform at a lower level in comparison to the control group, and both groups scored at the average level for their age group. The results of the word fluency test, also yielded a non significant difference between the two groups. These results suggest that the head-injured students in this study, on average, do not have difficulties with psychomotor and attention skills.

**Severity of Symptoms:**

It had been anticipated that those students having difficulties on the symptom and general functining measures would also perform at lower levels on the neuropsychological measures, and that these difficulties would be identified on the teacher and parent measures.

In the head-injured group, six of the eighteen students with mild head injury acknowledged that they were having difficulties (on the symptom measure). Five of the six students also performed at least one standard deviation below average on a neuropsychological measure. Only one acknowledged difficulties in general functioning which was endorsed by the parent. Of the five others reporting difficulty in general functioning, only two were acknowledged by their teacher.

As a result of these findings, a total of five students will be followed up. Students 3, 4, 13, 19, and 20 had identified difficulties themselves in both the symptom and general functioning measures, which had not been identified by their teacher or parents.

Three students in the control group also acknowledged problems on the symptom measure, but none of these students performed at a lower level than their peers on the neuropsychological measures. Two of these students were identified by either the teacher or the parent as having problems. Six students however did perform at a low level on at least one of the neuropsychological measures, but two of these students were identified by their teacher as having problems. Three students in the control group were identified by their parents as having difficulties, but once again there was little agreement between the students self-report of difficulties, neuropsychological measures and teacher and parent ratings. Students in the control group that will be followed up will be 81 and 82.

One explanation for this low agreement rate amongst students, teachers and parents is that perhaps there is a gap between awareness of the affects of head injury and recognition of it in themselves. Also the neuropsychological measures may tap less obvious or subliminal difficulties which are not easily attributed to a level of general functioning, and the difficulties that they assess for may not be apparent to teachers in normal classroom activities. Another possible explanation for the low agreement between teachers and parents is that the teachers are dealing with a large number of students each day and may have a different opinion of what is "problem behaviour" compared to parents. That is, behaviour may have to be more problematic before the teacher notices it and takes action.

As the data indicated that the head-injured group was not performing at a significantly lower level on the neuropsychological measures, it was hypothesised that the high number of light (mild) head injuries in the sample population could be masking the deficits of the more serious mild injuries. By seperating out those with more serious injury for comparison, it

might have yielded significant results. However, no significant differences were found when nine of the more serious head-injured students were compared to a matched control group, except on the "thought problems" subscale of the TRF. On this subscale the teachers rated the head-injured students as having more "thought problems" which included questions such as "can't get his/her mind of certain thoughts"; "has strange behaviour/ideas" and "repeats certain acts over and over". It is unclear why the head-injured students were rated higher on this measure.

**Suggestions for future research:**

(a) In studying the level of awareness among students, it would be useful to know about their experience with mild head injury i.e. had family members or friends who have sustained such an injury, and how much did this contribute to their knowledge of awareness of head injury sequelae. Also, it would be interesting to examine the parents and teachers' level of awareness of head injury sequelae.

(b) Asking parents to confirm details of head injuries reported by students (although it is recognised that parents are not necessarily aware of all head injuries that are sustained). It is acknowledged that gathering information by self-report is not the ideal. Some students did not know the full extent of their head injury, and many were unclear what months their injury occurred, though most reported the year. This lead to difficulties in classifying the head injuries.

(c) Controlling for the effect of student intelligence, so that stronger conclusions can be made regarding differences in performance on neuropsychological measures.

(a) Increasing the number of students tested in Part 2 of the study.

(b) Administering a more selective range of neuropsychological

measures that discriminate effectively, and neuropsychologically assessing more students who sustained the very mild head injuries. This would help lead to the identification of those mild head-injured students that were having difficulties and more could be learnt about what is unique about them.

(e) using the CHIPASAT in comparison to the PASAT for this age group. The CHIPASAT may have differentiated the students that were having information processing speed difficulties more accurately, as many students, both in the head-injured and control groups had difficulty with this task.

## Conclusions.

The incidence rate obtained in this study is probably a more accurate indicator of the level of head injury in this population than those that rely on hospital records. Undoubtedly there were many cases in which students reported a mild head injury which resulted in no more than a headache and bruising, and many of the cases reported no specific behavioural or cognitive difficulties. However it is possible that some of the mild group who are typically not included in the standard incidence figures do go on to have some difficulties. It is therefore essential to use a wide incidence base, and the second part of this study attempted to clarify the significance on this problem.

A major finding was that the level of males and females reporting head injury and the level of severity of those injuries was nearly equal, which is in contrast to previous studies. Also our results suggest that awareness of common sequelae is higher in those students who have already experienced some form of head injury.

Taken as a group, the head-injured students themselves reporting symptoms commonly associated with head injury did not , on average, perform at a lower level on the neuropsychological measures. This suggests that with regard to verbal memory, attention, information processing, concentration, and psychomotor skills the head-injured students are on the same level as their peers, but on an individual basis there were a number of students that had difficulties.

In general, the students who were reporting difficulties on the symptom and/or general functioning measure, were not identified by parents and teachers as having problems. It is apparent therefore that there is a need for increased awareness among students, teachers and parents, of the common sequelae associated with head injury with the expectation that some students may have difficulty after sustaining a mild head injury.

## References

Accident Compensation Corporation (1991). *ACC Injury Statistics, Home Injuries Vol. 3.* Wellington: Accident Compensation Corporation.

Accident Compensation Corporation (1992). *ACC Injury Statistcs, Vehicle. Vol. 4.* Wellington: Accident Compensation Corporation.

Achenbach, T. M. (1978). The Child Behavior Profile: I. Boys aged 6 through 11. *Journal of Consulting and Clinical Psychology,* 46, 478–488.

Achenbach, T. M., & Edelbrock, C. (1981). The Child Behavior profile: II. Boys aged 12–16 and girls aged 6–11 and 12–16. *Journal of Consulting and Clinical Psychology,* 47, 223–233.

Achenbach, T. M., & Edelbrock, C. (1983). *Manual for the Child Behavior Checklist and Revised Child Behavior Profile.* Department of Psychiatry, University of Vermont: Burlington.

Agnew, T. M., & Meyers, M. R. (1988). Age–related sex differences in verbal memory. *Journal of Clinical Psychology,* 44 (3), 403–411.

Annegers, J. F., Grabow, J. D., Kurland, L. T., & Laws, E. R. (1980). The incidence, causes and secular trends of head trauma in Olmstead County, Minnesota, 1935–1974. *Neurology,* 30, 912–919.

Annegers, J. F. (1983). The epidemiology of head trauma in children. In K. Shapiro (Ed.), Pediatric head trauma. New York: Futura Publishing Co.

Bannister, R. (1992). *Brain and Bannister's Clinical Neurology.* Oxford: Oxford University Publications.

Bell, B. A. , & Britton, J. (1989). Mechanisms of trauma. In D.A. Johnson (ed.). *Children's Head Injury. Who Cares?* (pp 1–12). London: Taylor Francis.

Bellack, A. S., & Hersen, M. (eds.) (1988). *Behavioral Assessment. A Practical Handbook* (3rd ed.). Pergamon Press: New York.

Bishop, J., Knights, R. M., Stoddart, C. (1990). Rey AVLT: performance of English and French children age 5 – 16. *Clinical Neuropsychologist,* 4 (2), 133 – 140.

Chadwick, O., Rutter, M., & Schaffer, D. (1981). A prospective study of children with head injuries: IV, specific cognitive deficits. *Journal of Clinical Neuropsychology,* 3 (2), 101 – 120.

Church, J. & Langley, J. (1990). Behaviour disordered children. *SET Research information for teachers,* 1, 1–5.

Craft, A. W., Shaw, D. A., & Cartridge, N. E. (1972). Head injuries in children. *British Medical Journal,* 4, 200 – 203.

Currie, D. G. (1993). *The Management of Head Injuries.* New York: Oxford University Press.

Deaton, A. V. (1987). Behavioral change strategies for children and adolescents with severe brain injury. *Journal of Learning Disabilities,* 20 (10), 581–589.

Donders, J. (1992). Premorbid behavioral and psychosocial adjustment of children with TBI. *Journal of Abnormal Child Psychology,* 20 (3), 233 – 246.

Forrester, G., & Geffen, G. (1991). Performance measures of 7 - 15 year old children on the auditory verbal learning test. *The Clinical Neuropsychologist,* 5 (4), 345 - 359.

Galloway, D., & Barrett, C. (1984). Factors associated with suspension from New Zealand secondary schools. Educational Review, 36 (3), 277–285.

Geffen, G., Moar, K. J., O'Hanlon, A. P., Clark, C.R., & Geffen, L. B. (1990). Performance measures of 16 - 86 year old males and females on the Auditory Verbal Learning Test. *The Clinical Neuropsychologist,* 4 (1), 45 - 63.

Gentilini, M., Nichelli, P., Schoenhuber, R., Bortolotti, P., Tonelli, L., Falasca, A. & Merli, G. (1985). Neuropsychological evaluation of mild head injury. *Journal of Neurology, Neurosurgery, and Psychiatry,* 48, 137–140.

Goldstein, F. C., & Levin, H. S. (1985). Intellectual and academic outcome following closed head injury in children and adolescents: research strategies and empirical findings. *Developmental Neuropsychology,* 1, 195 - 214.

Goldstein, F. C., & Levin, H. S. (1987). Epidemiology of pediatric closed head injury: incidence, clinical characteristics and risk factors. *Journal of Learning Disabilities,* 20, 518 - 525.

Gronwall, D. M. A., & Wrightson, P. (1974). Delayed recovery of intellectual function after minor head injury. *The Lancet,* 2, 605 - 609.

Gronwall, D. M. A., & Wrightson, P. (1975). Cumulative effects of concussion. *Lancet*, 2, 995–997.

Gronwall, D. M. A. (1977). Paced auditory serial-addition task: a measure of recovery from concussion. *Perceptual and Motor Skills,* 44, 367 - 373.

Gronwall, D. M. A. (1989). Effects of concussion on attention and concentration. In H. S. Levin, H. M. Eisenberg, & A. L. Benton (Eds.) *Mild Head Injury.* New York: Oxford University Press.

Gronwall, D. M. A. (1991). Minor head injury. *Neuropsychology,* 5, 253-265.

Hall, D. M. B., Johnson, S. L. J., & Middleton, J. (1990). Rehabilitation of head injured children. *Archives of Disease in Childhood,* 65, 553 - 556.

Harrington, D. E. (1990). Educational strategies. In M. Rosenthal et al. *Rehabilitation of the adult and child with traumatic brain injury,* (pp 476-492). F. A. Davis Company: Philadelphia.

Hayes, H. R. M. & Jackson, R. H. (1989). The incidence and prevention of head injuries. In D. A. Johnson (ed.). *Children's Head Injury. Who Cares?* London: Taylor Francis.

Johnson, D. A., Roethig-Johnston, K., & Middleton, I. (1988). 'CHIPASAT: the development of an attentional test for head-injured children. Information processing in a normal sample. *Journal of Child Psychology and Psychiatry,* 29, 11-21.

Johnson, D. A., Uttley, D., & Wyke, M. (eds.) (1989). *Children's Head Injury. Who Cares?* Taylor Francis: London.

Klonoff, H. (1971). Head injuries in children: predisposing factors, accident conditions, accident proneness and sequelae. *A.J.P.H.*, 61 (12), 2405 - 2417.

Klonoff, H., & Paris, R. (1974). Immediate, short-term and residual effects of acute head injuries in children: Neuropsychological and neurological correlates. In R. M. Reitan and L. A. Davison (Eds.), *Clinical Neuropsychology: Current Status and Applications* (pp 179-210). New York: John Wiley.

Klonoff, H., Low, M. D., & Clark, D. (1977). Head injuires in children: a prospective five-year follow up. *Journal of Neurology, Neurosurgery, Psychiatry,* 40, 1211-1219.

Klauber, M.R., Barret-Conner, E., Marshall, L.F., & Bowers, S.A. (1981). The epideiology of head injury: A prospective study of an entire community- San Diego County, California. *Journal of Epidemiology*, 112, 500-509.

Knights, R. M., Ivan, L. P., Venturey, E. C. G., Bentivoglio, C., Stoddart, C., Winogron, W., & Bawden, H. N. (1990). The effects of head injury in children on neuropsychological and behavioural functioning. *Brain Injury.* 5 (4), 339 - 351.

Kraus, J F., Black, M. A., Hessol, N., Ley, P., Rokaw, W., Sullivan, C., Bowers, S., Knowlton, S., & Marshall, L. (1984). The incidence of acute brain injury and serious impairment in a defined population. *American Journal of Epidemiology,* 119, 186-201.

Kraus, J. F. & Nourjah, P. (1989). The epidemiology of mild uncomplicated brain injury. *Journal of Head Trauma,* 28 (12), 1637-1643.

Leininger, B. E., Gramling, S. E., Farrell, A. D., Kreutzer, J. F., & Peck E.A. III. (1990). Neuropsychological deficits in symptomatic minor head injury patients after concussion and mild concusion. *Journal of Neurology, Neurosurgery, and Psychiatry,* 53, 293-296.

Levin, H. S., Eisenberg, H. M., Wigg, N. R., & Kobayashi, K. (1982). Memory and intellectual ability after head injury in children and adolescents. Neurosurgery, 11, 668-673.

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

Michaud, L. J., Rivara, F. P., Jaffe, K. M., Fay, G., & Darlay, J. L. (1993). Traumatic brain injury as a risk factor for behavioural disorders in children. *Archives of Physical Medical Rehabilitation,* 74, 368 - 375.

Morse, P.A., & Montgomery, C.E. (1992). Neuropsychological evaluation of traumatic brain injury. In R.F. White, *Clinical Syndromes in Adult Neuropsychology,* New York: Elsevier Science.

Moyes, C. D. (1980). Epidemiology of serious head injuries in childhood. *Childcare, Health and Development,* 6, 1-9.

Munroe, E. A. (1980). *Difficult pupils in Christchurch secondary schools.* Unpublished Masters Thesis, University of Canterbury, N.Z.

New Zealand Head Injury Society Inc. (1993). *Head injury, the silent epidemic. Research into the needs of New Zealand individuals and families effected by head injury.* New Zealand Head Injury Society: Wellington.

Norman, H., Sritheran, E., & Ridding, C. (1984). *Teacher perceptions of children with special needs.* Department of Education: Wellington.

O'Jile, J. R., Ryan, L. M., Parks-Levy, J., Gouvier, W. D., Betz, B., Groves, A., & Coon, R. C. (1994, Nov). *Prevalence of misconceptions regarding head injury in a college population: The effect of experience with head injury on knowledge of sequelae.* Poster presented at the 14th Annual Conference of the National Academy of Neuropsychology, Orlando, Florida.

Oddy, M. (1984). Head injury during childhood. *Neuropsychological Rehabilitation,* 3 (4), 321 - 340.

Powell, J. B., Cripe, L. I., & Dodrill, C. B. (1991). Assessment of brain impairment with the Rey AVLT: a comparison with other neuropsychological measures. *Archives of Clinical Psychology,* 6 (4), 241 - 249.

Prigatano, G. P., O'Brien, K. P., & Klonoff, P. S. (1993). Neuropsychological rehabilitation of young adults who suffer brain injury in childhood: clinical observations. *Neuropsychological Rehabilitation,* 3 (4), 411 - 421.

Rey, A. (1964). *L'examen clinique en psychologie.* Paris: Presses Universitaires de France.

Richardson, F. (1963). Some effects of severe head injury. A follow up study of children and adolescents after protracted coma. *Development Medical Child Neurology,* 5, 471-482.

Rimel, R., Geordani, B., & Barth, J., Boll, T J., & Jane, J. (1981). Disability caused by minor head injury. *Neurosurgery,* 9, 221 - 228.

Rimel, R., Jane, J., & Bond, M. (1990). Charachertistics of the head-injured patient. In M Rosenthal, E Griffith, M. Bond and J. Miller (Eds.). *Rehabilitation of the adult and Child with Traumatic Brain Injury.* Philadelphia: F. A. Davis, pp 8-126.

Rutter, M., Chadwick, O., Shafter, D., & Brown, G. (1980). A prospective study of children with head injuries. 1. Design and methods. *Psychological Medicine,* 10, 633 - 645.

Roman, D. D., Edwall, G. E., Buchanan, R. J., & Patton, J. H. (1991). Extended norms for the Paced Auditory Serial Addition Task. *The Clinical Neuropsychologist,* 4 (1), 45 - 63.

Savage, R.C., & Carter, R. R. (1991). Family and return to school. In J. M. Williams and T. Kay, *Head Injury. A Family Matter (pp203-216).* Paul H Brooks: Baltimore.

Schapiro, S. R., & Sacchetti, T.S. (1993). Neuropsychological sequelae of minor head trauma. In S. Mandel, R. Sataloff and S. Schapiro (eds.). *Minor head trauma. Assessment , management and rehabilitation,* (p86- 106). Springer-Verlag: New York.

Segalowitz, S. J., & Brown, D. (1991). Mild head injury as a source of developmental disabilities. *Journal of Learning Disabilities,* 24 (9), 551-558.

Stern, B., & Stern, J. M. (1985). Neuropsychological outcome during late stage of recovery from brain injury: a proposal. *Scandinavian Journal of Rehabilitation, Medical Supplement,* 12, 27-30.

Stuss, D. T., Stethem, L. L., & Poirier, C. A. (1987). Comparison of three tests of attention and rapid information processing across six age groups. *The Clinical Psychologist,* 1 (2), 139 - 152.

Telzrow, C. F. (1987). Management of academic and educational problems in head injury. *Journal of Learning Disabilities,* 20 (9), 536 - 545.

Wrightson, P. (1989). Management of disability an rehabilitation services. In H.S. Levin, H.M. Eisenberg, & A.L. Benton (eds.), *Mild Head Injury* (pp245-256). New York: Oxford University Press.

Wrightson, P. (1994, Sep/Oct). Children, concussion and school. *Safepath, Northland Association for Mental Health and Schizophrenic Fellowship,* 13, 3.

Ylvisaker, M., Szekeres, S. F., & Hartwick, P. (1992). Cognitive rehabilitation following traumatic brain injury in cildren. In M. G. Tramontana & S. R. Hooper (Eds.), *Advances in Child Neuropsychology, Vol 1.* (pp. 168-218). New York: Springer-Verlag.

# APPENDICES

# APPENDIX I: HEAD INJURY QUESTIONNAIRE

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FACULTY OF
SOCIAL SCIENCES

DEPARTMENT OF
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# Head Injury Questionnaire.

Confidential

Name:_____.

Sex:_____.

Ethnicity (optional):_____.

Date of Birth:____/____/____.

Class:_____.

Form Teacher:_____.

Mother's Occupation (optional):_____.

Father's Occupation (optional):_____.

This questionnaire is for everyone, whether or not you have had a head injury. It asks you some general questions about what you know about head injury, especially the consequences of head injury. A person can suffer a head injury from falling out of a tree or off a bike, running into someone in a sports game, or being involved in a car accident, as well as many other ways. You are asked to think carefully about any head injury that you may have had in the last 3 years, no matter how small. Please answer the questions as honestly and accurately as you can. When you are asked to answer yes or no, would you please circle your answer. Remember all your answers are confidential.

1. The following questions ask you about what you think are the major symptoms or difficulties that someone who has had a head injury may have. For each example please write what you think would be the most common symptoms. There are no right or wrong answers.

   a) A 14 year-old rugby player sustains his 4th concussion in a season.

   _____
   _____
   _____
   _____

   b) A 6 year-old girl falls head first down her back steps, losing consciousness for 1 minute.

   _____
   _____
   _____
   _____
   _____

c) An 18 year-old male is thrown through a car windscreen after colliding with another car at 80km/h, and was in a coma for 4 weeks.

_____
_____
_____
_____

2. Have you suffered any type of head injury in the last 3 years?

**Yes / No**

**If yes, please continue with the following questions.**
**If no, go to question 6.**

3. In the spaces provided could you please outline in as much detail as possible, **when** the injury occurred, **what happened**, and what some of the **symptoms** were that you had at the time or soon after.

a) Accident 1.

Month_____Year_____.

What happened?_____
_____
_____
_____

Symptoms (e.g. headaches, dizziness, nausea). If can't remember, please state.

_____
_____
_____
_____

b) Accident 2.

Month_____ Year_____.

What happened?_____
_____
_____
_____

Symptoms_____
_____
_____

**If you have had more than 2 head injuries, please write the details on the back page of this questionnaire.**

4. Do you feel that you are still experiencing some of these symptoms?

Yes / No.

If yes, which ones?

_____
_____
_____
How often?_____
_____

5. Did you receive any medical treatment at the time for any of the above injuries?

Yes / No.

If yes, what treatment did you receive?

Accident 1:_____
_____
_____
Accident 2:_____
_____
_____

**Those who have not had a head injury, continue here.**

6. Are you currently taking any medication?

Yes / No

If yes, could you please describe the drug and reason prescribed_____
_____
_____
_____

7. Do you consume non-prescription drugs (such as alcohol and marijuana) frequently (i.e at least once a week).

Yes / No

8. Below is a list of statements that describe general problems that are sometimes experienced by people. Please circle the number that best describes you <u>in the last month.</u>

**0= Not true**
**1= Sometimes true**
**2= Often true**
**3= Always true**

| | |
|---|---|
| a) I have a lot of trouble remembering things. | 0 1 2 3 |
| b) I have frequent headaches | 0 1 2 3 |
| c) I have found myself getting into a lot more trouble than I used to. | 0 1 2 3 |
| d) I have trouble getting a good nights sleep. | 0 1 2 3 |
| e) My appetite has increased a lot. | 0 1 2 3 |
| f) My appetite has decreased a lot. | 0 1 2 3 |
| g) I find myself being more irritable | 0 1 2 3 |
| h) I behave more aggressively towards others. | 0 1 2 3 |
| i) My mood is much lower than it use to be. | 0 1 2 3 |

9. Have you ever required special assistance to help you with your school work? (This includes at primary school)

Yes / No

If yes, when and in what area (i.e. math, english):

_____
_____
_____
_____

10. Have you, your school teachers or parent(s)/guardian(s) ever sought help from other people (e.g. psychologist, counsellor) because of any emotional or behavioural problems you have had?

Yes / No

11. Could you please record below as accurately as possible, your last years report results.

| | Achievement | Effort |
|---|---|---|
| Subject: | | |
| Subject: | | |
| Subject: | | |
| Subject: | | |
| Subject: | | |

12. a) What subject(s), if any, did you find the most difficult?

_____

_____

_____

13. Do you play sport of any kind?

Yes / No

If yes, could you please write down what sport you play and how often?

Sport:_____

Time spent playing each week (hours):_____

Sport:_____

Time spent playing each week (hours):_____

14. If a friend was to describe you to a stranger, what sort of words would he or she use (e.g. outgoing, good sense of humour, quiet).

_____

_____

_____

_____

15. The following questions ask you to judge your ability to do a variety of practical tasks. Some of the questions may not apply directly to you, but you are asked to complete each question as if it were something you "had to do". On each question you should judge how easy or difficult a particular activity is for you and circle the appropriate space.

**1 = can do with ease**

**2 = fairly easy to do**

**3 = can do with some difficulty**

**4 = very difficult to do**

**5 = can't do**

How much of a problem do I have.....

| | |
|---|---|
| a) in taking care of my personal hygiene | 1 2 3 4 5 |
| b) in managing my money | 1 2 3 4 5 |
| c) keeping appointments on time | 1 2 3 4 5 |
| d) in starting a conversation in a group | 1 2 3 4 5 |
| e) staying involved in activities when bored or tired | 1 2 3 4 5 |
| f) remembering what I had for dinner last night | 1 2 3 4 5 |
| g) remembering the important things I have to do | 1 2 3 4 5 |
| h) remembering my daily timetable | 1 2 3 4 5 |
| i) coping with unexpected changes | 1 2 3 4 5 |
| j) accepting criticism from other people | 1 2 3 4 5 |
| k) stopping myself from crying | 1 2 3 4 5 |
| l) showing affection to people | 1 2 3 4 5 |
| m) controlling my temper when someone upsets me | 1 2 3 4 5 |
| n) keeping from being depressed | 1 2 3 4 5 |
| o) recognising when something I say or do upsets someone | 1 2 3 4 5 |

**Thank you for your co-operation in completing this questionnaire.**

**APPENDIX II: Letter to Principal & Board of Trustees**

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FACULTY OF
SOCIAL SCIENCES

DEPARTMENT OF
PSYCHOLOGY

Psychology Department,
Massey University,
PALMERSTON NORTH.

The Principal and Board of Trustees,
Awatapu College
Private Bag
PALMERSTON NORTH.

Dear Mr O'Conner and Board of Trustees,

We are writing to seek your permission to conduct research at Awatapu College, on the effects of head injury. The research involves administering a questionnaire to all of your fourth form students. This initial questionnaire is aimed at obtaining incidence rates and identifying the types of head injuries that these students may have sustained over the last three years.

From this information we would like to further test a selected group of between 30 and 35 students who have sustained a head injury. This testing will involve the administering of four neuropsychological assessment measures; the Paced Auditory Serial Addition Task; the Auditory Verbal Learning Test; and the Word Fluency and Digit Symbol tests. We would also like to seek further information from these students' parents and form teachers concerning the students' general day to day functioning. This would involve teachers and parents completing a short questionnnaire. The purpose of this research is to determine if these students have any ongoing problems related to the head injuries sustained.

It is anticipated that the initial questionnaire will take approximately 30 minutes to complete and it would be easier if these were given to all the students on the same day. The pupils responses would be treated in the upmost confidence and only the two researchers will have access to them. As there will be further testing taking place based on the results of the initial questionnaire, the students will be required to place their names on them. In the writing up of my thesis all students identities will be protected.

Participation will be voluntary and pupils will be informed that they have a choice whether they wish too participate. I will be providing parent permission forms to be returned by parents that do not wish their son/daughter to take part.

I realise that this study will cause some disruption to normal classroom routine but I would appreciate it if you are able to agree to participate.

Yours sincerely,

Catherine Body
M.A. Student

Janet Leathem (PhD)
Clinic Director
Senior Lecturer.

**APPENDIX III: Letter to Parents and Guardians.**

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FACULTY OF
SOCIAL SCIENCES

DEPARTMENT OF
PSYCHOLOGY

Psychology Clinic
Psychology Department,
Massey University,
Private Bag,
PALMERSTON NORTH.

Dear Parents/Guardians,

We are currently conducting research in the area of head injury in association with the Department of Psychology at Massey University. The study will be part of the Masters degree of the second researcher, Catherine Body. We are interested in determining incidence rates of head injury, any short-term and long-term consequences of these injuries, as well as students' perceptions and understanding about head injury in general.

In the initial part of the study all fourth formers will be asked to complete a 30 minute questionnaire which asks questions about head injuries that they may have suffered in the last three years. It also asks some general questions about what they think are some associated problems resulting from head injury. We are writing to request your permission for your child to participate in this study.

Later, when the questionnaires have been studied, a small group of students who have had a head injury will be invited to take part in the second part of the study. The purpose then would be to investigate further the relationship between head injury and school performance. The students will be asked further questions, and complete some short memory and learning tests. Parents and teachers will be asked to complete a questionnaire about the student as well. If a student is found to be experiencing difficulties that might be head-injury related there will be oppportunity to follow this up.

Your child does not have to complete the initial questionnaire, or any further tests and your child can decide to stop doing the tests at any time if he/she does not like them.

All questionnaire results will be treated confidentially, which means that only the two researchers will have access to them. When this study is completed, all names will be removed and replaced by numbers so that the students' identity is protected.

This study has been approved by the Human Ethics Committee at Massey University and by the Awatapu College Board of Trustees. If you have any questions about the study please contact Ms Body or Dr Leathem through the Psychology Clinic at Massey University, telephone 3505196.

If you do not wish your child to be involved in the first part of the study, please return the attatched portion to the school by Friday the 29th April.

Thank you.

Yours sincerely,

Catherine Body (Ms)
Researcher

Janet Leathem (PhD)
Senior Lecturer
Clinic Director

---

**Please return by Friday 29th April.**

I **do not** want my child to be involved in the study on head injury

Students name: _____

Students teacher and room number: _____

Signed: _____.

**APPENDIX IV: Information Sheet**

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FACULTY OF
SOCIAL SCIENCES

DEPARTMENT OF
PSYCHOLOGY

## INFORMATION ABOUT THE HEAD INJURY STUDY

You are being asked to take part in a study which is aimed at finding out how many students have had a head injury during the past three years. All fourth formers at Awatapu College are being asked to complete the questionnaire which will ask whether or not you have had a head injury, even if quite minor, how you think it has affected you and also about what you know about head injury in general. Some students who have had a head injury may be asked to answer more questions later in Part II of the study.

Today though you are just being asked to complete the first questionnaire. It is not compulsory. You have the right to refuse to take part, and you can even stop part way through or leave out a question if you wish. At all times your replies are confidential. This means that even though you are asked to write your name on the questionnaire only the researcher and her supervisor will be reading them. Also when we write up this study later, there will be no way that anyone can identify what you said or what your answer was. Just remember, everything is voluntary. For students who are asked later to be involved in the second part of the study, the same guarentees apply.

This study is being conducted by Catherine Body and Dr. Janet Leathem from the Psychology Department at Massey University. The research will go towards the completion of Catherine's Masters degree and we hope will help young people who have had head injuries in the future.

If you have any questions, please ask the researcher giving the questionnaire in class. Catherine Body can be contacted through the Psychology Clinic at Massey, telephone 3505196. She can also answer questions later if you wish.

If you've decided to do the questionnaire, that's great. Thanks for your co-operation. If not, thats OK too.

Catherine Body (Ms)
Researcher

Janet Leathem (Ph.D)
Senior Lecturer
Clinic Director

**APPENDIX V: Consent form**

## CONSENT FORM

I have read the information sheet for this study and have had the details of the study explained to me. My questions about the study have been answered to my satisfaction, and I understand that I may withdraw from the study at any time, or decline to answer any particular questions. I agree to provide information to the researchers on the understanding that it is completely confidential.

I wish to participate in Part I of this study under the conditions set out in the information sheet.

**Name:** _____.

**Signed:** _____.

**Date:** _____.

---

I would like a summary of the results sent to me: **Yes / No** (delete one).

Address for results to be sent:

_____

_____

**APPENDIX VI: Letter to students**

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FACULTY OF
SOCIAL SCIENCES

DEPARTMENT OF
PSYCHOLOGY

Psychology Department,
Massey University,
Private Bag,
PALMERSTON NORTH.

Dear (Students name),

Recently you answered a questionnaire which asked you whether or not you had had a head injury in the last three years. I am now ready to start the second part of the study and you are being asked whether or not you wish to be involved. It will involve you spending 1/2 an hour with the me doing four different tasks. These tasks are not like your normal school tests but are designed especially to measure aspects of your learning, such as memory. The results are **not** for the school and are only for the myself and my supervisor. This testing will take place during school time and if you agree to be involved, you are asked to write down below a convenient time for you. Mr O'Conner has agreed for you to be let out of class for this time.

The study also involves your parent(s) or guardian, and your form teacher, who will be asked to complete a short questionnaire. It is important to remember that everything is confidential and will not be looked at by your teachers or parent(s) at any stage of the study.

Before I start I need to make contact with your parent(s) or guardian, to ask them for permission for you to be involved in the study. However, under the Privacy Act (1993), the school is unable to give me your phone number. If you are happy to be part of the study, could you please fill out all the details below, and hand it in to your form teacher today. You will be contacted over the next week. If you have any questions, I can be contacted at the Psychology Clinic at Massey University ph. 3505196.

Yours faithfully,

Catherine Body (Researcher).

I agree to take part in the study as outlined above.

Name: _____.

Signed: _____.

Contact phone number: _____.

Preferred time during week: _____.

**APPENDIX VII: Dialogue of phone call to parents**

**Dialogue:**

Hello, my name is Catherine Body, and I am a Masters student from Massey University. I am currently doing research that involves (students name). Is it a convenient time for you to talk?

Recently (students name) completed a questionnaire at school as part of research on head injuries. Did you receive any information about this?

The purpose of this research is to help increase awareness among teachers and parents, of some of the difficulties that people with head injury may experience. I am also researching the types of head injuries that young people have and how much they know about some of the effects of head injuries. I have selected a group of students from the fourth form at Awatapu College, who completed the questionnaire, it involves some students who have had a head injury and also some students who haven't. (Students name) has given his/ her permission to be involved in the second part of the study, and the reason I am ringing is to ask you for your permission for (students name) to take part.

If you agree, it will involve (students name) completing a number of tasks designed to measure different aspects of learning, such as memory. This will take approximately 1/2 an hour and will take place during school time. It will also involve you answering a brief questionnaire which asks some general questions about (students name). I also have a brief questionnaire for (students name) form teacher. All this information is confidential and only myself and my supervisor, Dr Janet Leathem, will have access to it. Do you have any questions?

Thank you for your time.

**APPENDIX VIII: Letter to Principal.**

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FACULTY OF
SOCIAL SCIENCES

DEPARTMENT OF
PSYCHOLOGY

Mr O'Conner
Principal
Awatapu College
434 Botanical Road
PALMERSTON NORTH

Re: Head Injury Study.

Dear Mr O'Conner and staff,

I wish to pass on my thanks to you and your staff for the co-operation I received during my recent data collection at the school. All the staff I had contact with during my time at Awatapu were friendly and assisted me without hesitation. I appreciate the heavy workload that teachers have, and I would like to pass on special thanks to the fourth from teachers who completed the questionnaires on their students. I have now completed the data collection stage of my thesis and am in the process of analysing it. My aim is to have the study completed by the end of the year, and I will forward the school a copy of my research that I will be submitting for publication at this time.

Yours faithfully,

C Body

Catherine Body
Researcher

## APPENDIX IX: TEACHER'S REPORT FORM

### TEACHER'S REPORT FORM

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FACULTY OF SOCIAL SCIENCES
DEPARTMENT OF PSYCHOLOGY

Your answers will be used to compare the pupil with other pupils whose teachers have completed similar forms. The information from this form will also be used for comparison with other information about this pupil. Please answer as well as you can, even if you lack full information. Scores on individual items will be combined to identify general patterns of behavior. Feel free to write additional comments beside each item and in the space provided

PUPIL'S NAME _____

1. How long have you know this pupil? _____ months

2. How well do you know him/her? 1. ☐ Not Well 2. ☐ Moderately Well 3. ☐ Very Well

3. How much time does he/she spend in your class per week?

| 4. Compared to typical pupils of the same age: | 1. Much less | 2. Somewhat less | 3. Slightly less | 4. About average | 5. Slightly more | 6. Somewhat more | 7. Much more |
|---|---|---|---|---|---|---|---|
| 1. How hard is he/she working? | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 2. How appropriately is he/she behaving? | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 3. How much is he/she learning? | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 4. How happy is he/she? | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

Does this pupil have any illness, physical disability, or mental handicap? ☐ No ☐ Yes - please describe

What concerns you most about this pupil?

Please describe the best things about this pupil:

Please feel free to write any comments about this pupil's work, behavior, or potential, using extra pages if necessary.

Below is a list of items that describe pupils. For each item that describes the pupil now or within the past 2 months, please circle the 22 if the item is very true or often true of the pupil. Circle the 1 if the item is somewhat or sometimes true of the pupil. If the item is not true of the pupil, circle the 0. Please answer all items as well as you can, even if some do not seem to apply to this pupil.

0 = Not True (as far as you know) 1 = Somewhat or Sometimes True 2 = Very True or Often True

0 1 2 1. Acts too young for his/her age
0 1 2 2. Hums or makes other odd noises in class
0 1 2 3. Argues a lot
0 1 2 4. Fails to finish things he/she starts
0 1 2 5. Behaves like opposite sex
0 1 2 6. Defiant, talks back to staff
0 1 2 7. Bragging, boasting
0 1 2 8. Can't concentrate, can't pay attention for long
0 1 2 9. Can't get his/her mind off certain thoughts; obsessions (describe): _____
_____
0 1 2 10. Can't sit still, restless, or hyperactive
0 1 2 11. Clings to adults or too dependent
0 1 2 12. Complains of loneliness
0 1 2 13. Confused or seems to be in a fog
0 1 2 14. Cries a lot
0 1 2 15. Fidgets
0 1 2 16. Cruelty, bullying, or meanness to others
0 1 2 17. Daydreams or gets lost in his/her thoughts
0 1 2 18. Deliberately harms self or attempts suicide
0 1 2 19. Demands a lot of attention
0 1 2 20. Destroys his/her own things
0 1 2 21. Destroys property belonging to others
0 1 2 22. Difficulty following directions
0 1 2 23. Disobedient at school
0 1 2 24. Disturbs other pupils
0 1 2 25. Doesn't get along with other pupils
0 1 2 26. Doesn't seem to feel guilty after misbehaving
0 1 2 27. Easily jealous
0 1 2 28. Eats or drinks that are not food - don't include sweets (describe):_____
_____
0 1 2 29. Fears certain animals, situations, or places other than school (describe):_____
_____
0 1 2 30. Fears going to school
0 1 2 31. Fears he/she might think or do something bad
0 1 2 32. Feels he/she has to be perfect
0 1 2 33. Feels or complains that no one loves him/her
0 1 2 34. Feels others are out to get him/her
0 1 2 35. Feels worthless or inferior
0 1 2 36. Gets hurt a lot, accident-prone
0 1 2 37. Gets in many fights
0 1 2 38. Gets teased a lot
0 1 2 39. Hangs around with others who get in trouble
0 1 2 40. Hears sounds or voices that aren't there (describe):
_____
0 1 2 41. Impulsive or acts without thinking
0 1 2 42. Likes to be alone
0 1 2 43. Lying or cheating
0 1 2 44. Bites fingernails
0 1 2 45. Nervous, high-strung, or tense
0 1 2 46. Nervous movements or twitching (describe):
_____
0 1 2 47. Overconforms to rules
0 1 2 48. Not liked by other pupils
0 1 2 49. Has difficulty learning
0 1 2 50. Too fearful or anxious
0 1 2 51. Feels dizzy
0 1 2 52. Feels too guilty
0 1 2 53. Talks out of turn
0 1 2 54. Overtired
0 1 2 55. Overweight
56. Physical problems without known medical cause:
0 1 2 a. Aches or pains
0 1 2 b. Headaches
0 1 2 c. Nausea, feels sick
0 1 2 d. Problems with eye (describe):_____
_____
0 1 2 e. Rashes or other skin problems
0 1 2 f. Stomachaches or cramps
0 1 2 g. Vomiting, throwing up
0 1 2 h. Other (describe):_____
_____

0 = Not True (as far as you know) 1 = Somewhat or Sometimes True 2 = Very True or Often True

0 1 2 57. Physically attacks people
0 1 2 58. Picks nose, skin, or other parts of body (describe): _____
_____
0 1 2 59. Sleeps in class
0 1 2 60. Apathetic or unmotivated
0 1 2 61. Poor school work
0 1 2 62. Poorly coordinated or clumsy
0 1 2 63. Prefers being with older children
0 1 2 64. Prefers being with younger children
0 1 2 65. Refuses to talk
0 1 2 66. Repeats certain acts over and over; compulsions (describe): _____
_____
0 1 2 67. Disrupts class discipline
0 1 2 68. Screams a lot
0 1 2 69. Secretive, keeps things to self
0 1 2 70. Sees things that aren't there (describe):
_____
_____
0 1 2 71. Self-conscious or easily embarrassed
0 1 2 72. Messy work
0 1 2 73. Behaves irresponsibly (describe): _____
_____
0 1 2 74. Showing off or clowning
0 1 2 75. Shy or timid
0 1 2 76. Explosive and unpredictable behavior
0 1 2 77. Demands must be met immediately, easily frustrated
0 1 2 78. Inattentive, easily distracted
0 1 2 79. Speech problem (describe): _____
_____
0 1 2 80. Stares blankly
0 1 2 81. Feels hurt when criticized
0 1 2 82. Steals
0 1 2 83. Stores up things he/she doesn't need (describe):
_____
_____
0 1 2 84. Strange behavior (describe): _____
_____
0 1 2 85. Strange ideas (describe): _____
_____
0 1 2 86. Stubborn, sullen, or irritable
0 1 2 87. Sudden changes in mood or feelings
0 1 2 88. Sulks a lot
0 1 2 89. Suspicious
0 1 2 90. Swearing or obscene language
0 1 2 91. Talks about killing self
0 1 2 92. Underachieving, not working up to potential
0 1 2 93. Talks too much
0 1 2 94. Teases a lot
0 1 2 95. Temper tantrums or hot temper
0 1 2 96. Seems preoccupied with sex
0 1 2 97. Threatens people
0 1 2 98. Tardy to school or class
0 1 2 99. Too concerned with neatness or cleanliness
0 1 2 100. Fails to carry out assigned tasks
0 1 2 101. Truancy or unexplained absence
0 1 2 102. Underactive, slow moving, or lacks energy
0 1 2 103. Unhappy, sad, or depressed
0 1 2 104. Unusually loud
0 1 2 105. Uses alcohol or drugs for nonmedical purposes
(describe): _____
0 1 2 106. Overly anxious to please
0 1 2 107. Dislikes school
0 1 2 108. Is afraid of making mistakes
0 1 2 109. Whining
0 1 2 110. Unclean personal appearance
0 1 2 111. Withdrawn, doesn't get involved with others
0 1 2 112. Worrying
113. Please write in any problems the pupil has that were not listed above:
0 1 2 _____
0 1 2 _____
0 1 2 _____

## APPENDIX X: BEHAVIOR CHECKLIST

| CHILD'S NAME | | | PARENTS' USUAL TYPE OF WORK, even if not working now. *(Please be specific - for example, auto mechanic, high school teacher, homemaker, laborer, lathe operator, shoe salesman, army sergeant).* |
|---|---|---|---|
| SEX<br>☐ Boy ☐ Girl | AGE | ETHNIC GROUP OR RACE | FATHER'S TYPE OF WORK:_____ |
| TODAY'S DATE<br>Mo. ___ Date ___ Yr. ___ | CHILD'S BIRTHDATE<br>Mo. __ Date __ Yr. __ | | MOTHER'S TYPE OF WORK:_____ |
| Please fill out this form to reflect *your* view of the child's behavior even if other people might not agree. Feel free to write additional comments beside each item and in the space provided on page 2. | | | THIS FORM FILLED OUT BY:<br>☐ Mother (name):_____<br>☐ Father (name):_____<br>☐ Other - name & relationship to child:_____ |

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I. 1. About how many close friends does your child have? ☐ None ☐ 1 ☐ 2 or 3 ☐ 4 or more
(Do not include brothers & sisters)

2. About how many times a week does your child do things with friends outside of regular school hours?
(Do not include brothers & sisters) ☐ Less than 1 ☐ 1 or 2 ☐ 3 or more

---

II. Compared to other children of his/her age, how well does your child:

| | Worse | About Average | Better | |
|---|---|---|---|---|
| a. Get along with his/her brothers & sisters? | ☐ | ☐ | ☐ | ☐ Has no brothers or sisters |
| b. Get along with other children? | ☐ | ☐ | ☐ | |
| c. Behave with his/her parents? | ☐ | ☐ | ☐ | |
| d. Play and work by himself/herself? | ☐ | ☐ | ☐ | |

---

III. Has your child had any academic or other problems in school? ☐ No ☐ Yes - please describe

When did these problems start?

Have these problems ended? ☐ No ☐ Yes - when?

---

Does your child have any illness, physical disability, or mental handicap? ☐ No ☐ Yes - please describe

---

What concerns you most about your child?

---

Please describe the best things about your child:

Below is a list of items that describe pupils. For each item that describes the pupil **now or within the past 2 months**, please circle the **22** if the item is **very true or often true** of the pupil. Circle the **1** if the item is **somewhat or sometimes true** of the pupil. If the item is **not true** of the pupil, circle the **0**. Please answer all items as well as you can, even if some do not seem to apply to this pupil.



**0 = Not True (as far as you know)  1 = Somewhat or Sometimes True  2 = Very True or Often True**

0 1 2 1. Acts too young for his/her age
0 1 2 2. Hums or makes other odd noises in class
0 1 2 3. Argues a lot
0 1 2 4. Fails to finish things he/she starts
0 1 2 5. Behaves like opposite sex
0 1 2 6. Defiant, talks back to staff
0 1 2 7. Bragging, boasting
0 1 2 8. Can't concentrate, can't pay attention for long
0 1 2 9. Can't get his/her mind off certain thoughts; obsessions (describe): _____
_____
0 1 2 10. Can't sit still, restless, or hyperactive
0 1 2 11. Clings to adults or too dependent
0 1 2 12. Complains of loneliness
0 1 2 13. Confused or seems to be in a fog
0 1 2 14. Cries a lot
0 1 2 15. Fidgets
0 1 2 16. Cruelty, bullying, or meanness to others
0 1 2 17. Daydreams or gets lost in his/her thoughts
0 1 2 18. Deliberately harms self or attempts suicide
0 1 2 19. Demands a lot of attention
0 1 2 20. Destroys his/her own things
0 1 2 21. Destroys property belonging to others
0 1 2 22. Difficulty following directions
0 1 2 23. Disobedient at school
0 1 2 24. Disturbs other pupils
0 1 2 25. Doesn't get along with other pupils
0 1 2 26. Doesn't seem to feel guilty after misbehaving
0 1 2 27. Easily jealous
0 1 2 28. Eats or drinks that are not food - don't include sweets (describe):_____
_____
0 1 2 29. Fears certain animals, situations, or places other than school (describe):_____
_____
0 1 2 30. Fears going to school
0 1 2 31. Fears he/she might think or do something bad
0 1 2 32. Feels he/she has to be perfect
0 1 2 33. Feels or complains that no one loves him/her
0 1 2 34. Feels others are out to get him/her
0 1 2 35. Feels worthless or inferior
0 1 2 36. Gets hurt a lot, accident-prone
0 1 2 37. Gets in many fights
0 1 2 38. Gets teased a lot
0 1 2 39. Hangs around with others who get in trouble
0 1 2 40. Hears sounds or voices that aren't there (describe):
_____
0 1 2 41. Impulsive or acts without thinking
0 1 2 42. Likes to be alone
0 1 2 43. Lying or cheating
0 1 2 44. Bites fingernails
0 1 2 45. Nervous, high-strung, or tense
0 1 2 46. Nervous movements or twitching (describe):
_____
0 1 2 47. Overconforms to rules
0 1 2 48. Not liked by other pupils
0 1 2 49. Has difficulty learning
0 1 2 50. Too fearful or anxious
0 1 2 51. Feels dizzy
0 1 2 52. Feels too guilty
0 1 2 53. Talks out of turn
0 1 2 54. Overtired
0 1 2 55. Overweight
56. Physical problems without known medical cause:
0 1 2 a. Aches or pains
0 1 2 b. Headaches
0 1 2 c. Nausea, feels sick
0 1 2 d. Problems with eye (describe):_____
_____
0 1 2 e. Rashes or other skin problems
0 1 2 f. Stomachaches or cramps
0 1 2 g. Vomiting, throwing up
0 1 2 h. Other (describe):_____
_____

0 = Not True (as far as you know) 1 = Somewhat or Sometimes True 2 = Very True or Often True

0 1 2 57. Physically attacks people
0 1 2 58. Picks nose, skin, or other parts of body (describe): _____

0 1 2 59. Sleeps in class
0 1 2 60. Apathetic or unmotivated

0 1 2 61. Poor school work
0 1 2 62. Poorly coordinated or clumsy

0 1 2 63. Prefers being with older children
0 1 2 64. Prefers being with younger children

0 1 2 65. Refuses to talk
0 1 2 66. Repeats certain acts over and over; compulsions (describe): _____

0 1 2 67. Disrupts class discipline
0 1 2 68. Screams a lot

0 1 2 69. Secretive, keeps things to self
0 1 2 70. Sees things that aren't there (describe):

0 1 2 71. Self-conscious or easily embarrassed
0 1 2 72. Messy work

0 1 2 73. Behaves irresponsibly (describe): _____

0 1 2 74. Showing off or clowning

0 1 2 75. Shy or timid
0 1 2 76. Explosive and unpredictable behavior

0 1 2 77. Demands must be met immediately, easily frustrated
0 1 2 78. Inattentive, easily distracted

0 1 2 79. Speech problem (describe): _____

0 1 2 80. Stares blankly

0 1 2 81. Feels hurt when criticized
0 1 2 82. Steals

0 1 2 83. Stores up things he/she doesn't need (describe):

0 1 2 84. Strange behavior (describe): _____

0 1 2 85. Strange ideas (describe): _____

0 1 2 86. Stubborn, sullen, or irritable

0 1 2 87. Sudden changes in mood or feelings
0 1 2 88. Sulks a lot

0 1 2 89. Suspicious
0 1 2 90. Swearing or obscene language

0 1 2 91. Talks about killing self
0 1 2 92. Underachieving, not working up to potential

0 1 2 93. Talks too much
0 1 2 94. Teases a lot

0 1 2 95. Temper tantrums or hot temper
0 1 2 96. Seems preoccupied with sex

0 1 2 97. Threatens people
0 1 2 98. Tardy to school or class

0 1 2 99. Too concerned with neatness or cleanliness
0 1 2 100. Fails to carry out assigned tasks

0 1 2 101. Truancy or unexplained absence
0 1 2 102. Underactive, slow moving, or lacks energy

0 1 2 103. Unhappy, sad, or depressed
0 1 2 104. Unusually loud

0 1 2 105. Uses alcohol or drugs for nonmedical purposes

(describe): _____

0 1 2 106. Overly anxious to please

0 1 2 107. Dislikes school
0 1 2 108. Is afraid of making mistakes

0 1 2 109. Whining
0 1 2 110. Unclean personal appearance

0 1 2 111. Withdrawn, doesn't get involved with others
0 1 2 112. Worrying

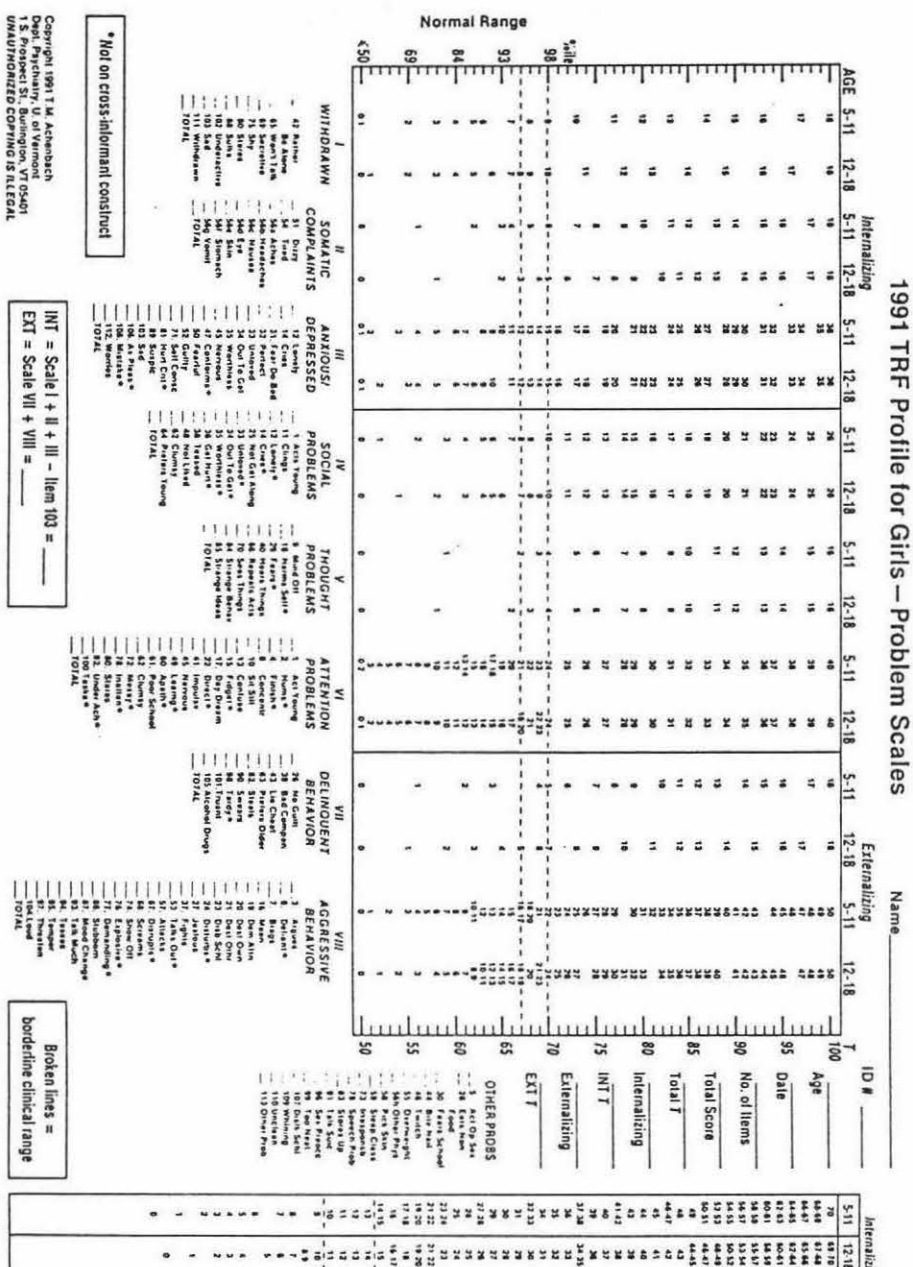
113. Please write in any problems the pupil has that were not listed above:

0 1 2 _____

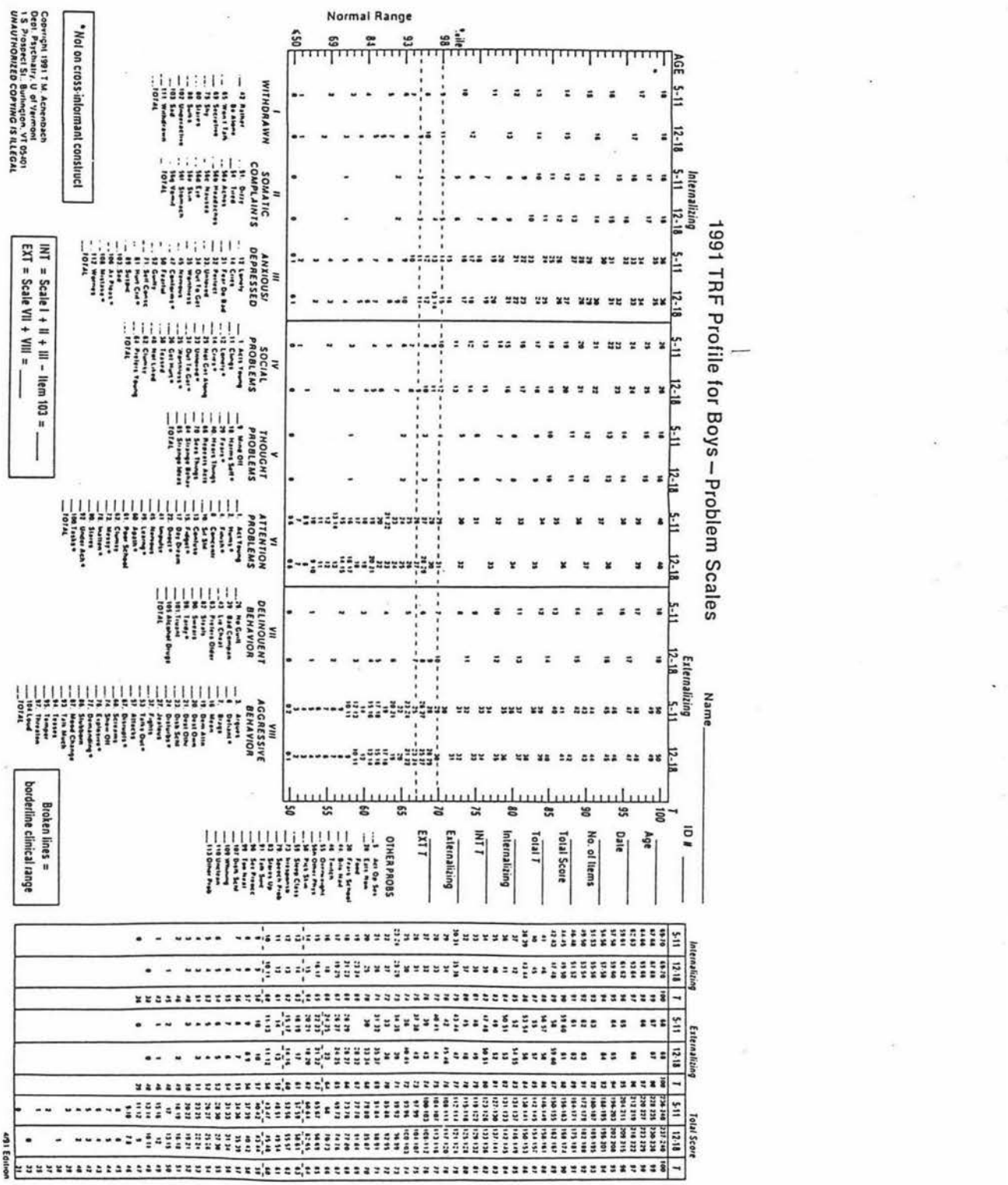
0 1 2 _____

0 1 2 _____

# APPENDIX XI: TRF PROFILE FORM (GIRLS)



# APPENDIX XII: TRF PROFILE FORM (BOYS)



**APPENDIX XIII: Instructions for the Auditory Verbal Learning Test.**

The specific instructions for the AVLT were as follows:

> "I am going to read a list of words. Listen carefully, for when I stop you are to say back as many words as you can remember. It doesn't matter in what order you repeat them. Just try to remember as many as you can".

When the student indicated that he or she could recall no more words, the researcher reread the list following a second set of instructions:

> "Now I am going to read the same list again and once again when I stop I want you to tell me as many words as you can remember, including the words you said the first time. It doesn't matter in what order you say them. Just say as many words as you can remember whether or not you said them before".

The list was reread for trials III, IV and V using trial II instructions. On completion of trial V the student was told:

> Now I am going to read a second list of words. This time again you are to say back as many words of this second list as you can remember. Again the order in which you say the words does not matter. Just try to remember as many as you can".

The second list of words was then read. After a delay period of 30 minutes the student was asked to recall as many words from List A that they could remember.

# APPENDIX XIV: AVLT ANSWER SHEET

Rey Auditory-Verbal Learning

| A | B | C |
|---|---|---|
| Drum | Desk | Book |
| Curtain | Ranger | Flower |
| Bell | Bird | Train |
| Coffee | Shoe | Rug |
| School | Stove | Meadow |
| Parent | Mountain | Harp |
| Moon | Glasses | Salt |
| Garden | Towel | Finger |
| Hat | Cloud | Apple |
| Farmer | Boat | Chimney |
| Nose | Lamb | Button |
| Turkey | Gun | Key |
| Colour | Pencil | Dog |
| House | Church | Glass |
| River | Fish | Rattle |

| | 1 | 2 | 3 | 4 | 5 | I | 6 | 7 (Delayed) |
|---|---|---|---|---|---|---|---|---|
| 1. | | | | | | | | |
| 2. | | | | | | | | |
| 3. | | | | | | | | |
| 4. | | | | | | | | |
| 5. | | | | | | | | |
| 6. | | | | | | | | |
| 7. | | | | | | | | |
| 8. | | | | | | | | |
| 9. | | | | | | | | |
| 10. | | | | | | | | |
| 11. | | | | | | | | |
| 12. | | | | | | | | |
| 13. | | | | | | | | |
| 14. | | | | | | | | |
| 15. | | | | | | | | |

## APPENDIX XV: PASAT RECORD FORM

NAME: .....  AGE: .....
DATE: .....  TEST: .....



2

| | | |
|---|---|---|
| 7(9) | 9(11) | 2(8) |
| 3(10) | 7(16) | 7(9) |
| 4(7) | 6(13) | 5(12) |
| 8(12) | 5(11) | 9(14) |
| 1(9) | 8(13) | 2(11) |
| 5(6) | 1(9) | 3(5) |
| 6(11) | 4(5) | 9(12) |
| 9(15) | 1(5) | 7(16) |
| 1(10) | 2(3) | 4(11) |
| 3(4) | 6(8) | 5(9) |
| 6(9) | 3(9) | 7(12) |
| 4(10) | 7(10) | 6(13) |
| 3(7) | 5(12) | 8(14) |
| 2(5) | 8(13) | 1(9) |
| 7(9) | 3(11) | 3(4) |
| 8(15) | 9(12) | 1(4) |
| 5(13) | 1(10) | 9(10) |
| 9(14) | 4(5) | 2(11) |
| 4(13) | 8(12) | 5(7) |
| 2(6) | 6(14) | 6(11) |

| Total Correct | Time per correct response |
|---|---|
| 2.4 sec pacing _____ | _____ |
| 2.0 sec pacing _____ | _____ |
| 1.6 sec pacing _____ | _____ |
| 1.2 sec pacing _____ | _____ |

Total time _____  Mean _____ sec per correct response

VSM -

| | |
|---|---|
| 1 | 13 |
| 2 | 14 |
| 3 | 15 |
| 4 | 16 |
| 5 | 17 |
| 6 | 18 |
| 7 | 19 |
| 8 | 20 |
| 9 | 21 |
| 10 | 22 |
| 11 | 23 |
| 12 | 24 |

ahdmw
< >

bfpts
< >

qjv
< >

yhv
< >

**APPENDIX XVII: Instructions and answer sheet for the Digit Symbol test.**

The examiner began by reading out the following instructions:

"Look at these divided boxes, notice that each has a number on the upper part and a mark on the lower part. Every number has a different mark. Now look here, where the boxes have numbers but the squares beneath them have no marks. I want you to put in each of these squares the marks that should go there like this. Here is 2 so put in this mark, here is 1 so put in this mark. Now you do it. Now begin here and fill in as many squares as you can without skipping any. Keep working until I tell you to stop. Go ahead" (Lezak, p283, 1983).

The dependent measure was the number of correctly filled in boxes after 120 seconds.