Following up the head injured driver: self versus family assessment.

Thesis

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'FOLLOWING UP THE HEAD INJURED DRIVER : SELF VERSUS FAMILY ASSESSMENT'

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ABSTRACT

Driving is an important issue after head injury. This study explores the usefulness of self and family report measures in enhancing our knowledge of head injured peoples' driving. The data was gained from a screening questionnaire given to a head injury clinic cohort and from separate interviews with both head injured drivers and healthy family members.

Fifty head injured people who had driven pre-injury participated in the screen and 18 of those who had returned to driving participated in interviews with a close family member. It was predicted changes compared to pre-injury would be perceived in head injured people's driving across the domains of driving skills, behaviours/attitudes and accident rates. It was further predicted issues of insight would be raised from differences between the perceptions of head injured people themselves and family members.

Respondents suggested driving was an important issue for head injured people regardless of whether they had returned to driving. Despite this, some had not received information or informed the authorities about their head injuries. Three consistent themes were suggested about post-injury driving. Firstly, there was no evidence of perceived declines in basic driving aspects or increased accident rates. Secondly, specific changes were perceived in : variables similar to the residual psychological difficulties of head injury; head injured drivers' attempts to engage in less risky driving; and the amount of anxiety engendered by driving. Thirdly, although less of an issue than expected, single cases were highlighted where insight may have been a problem.

Although interpretation of the results was tempered by methodological considerations, the findings are discussed and the service implications considered. A further longitudinal research programme has been proposed.

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1.0 INTRODUCTION

Annually, an estimated 1,778 per 100,000 of the population present at UK hospitals with head injuries (Jennett and McMillan 1981). Driving is considered by most adults to be an 'essential' Activity of Daily Living (Fox, Bashford and Caust 1992). However, as up to 70% of head injuries are caused by road traffic accidents (Kolb and Wishaw 1990), returning to driving after injury is a sensitive issue and raises complex dilemmas for head injured people, their families and rehabilitation professionals. Driving post-injury can be an important symbol of returning to 'normal' for many (Fox et al 1992). However the range of physical, sensory, cognitive and personality changes found after head injury raise intuitive concerns about the abilities of head injured drivers. Based on the depth of coma on admission, Miller and Jones (1985) report 84% of typical head injury admissions are mild, 11% moderate and 5% severe. As the estimated prevalence of disability following head injury is around 250-375 people per average health district (Medical Disability Society, 1988), whether head injured people should drive is a common question in rehabilitation contexts. Despite this, little is really known about the everyday experiences of head injured drivers. It is the aim of this project to shed some light on this area by : determining how many head injured people actually return to driving; and exploring the experiences of head injured drivers themselves and the close family members they drive.

The literature review begins by exploring where such concerns come from. The review firstly describes the nature and common deficits of head injury. Secondly, Michon (1979)'s model of the psychological challenges posed by driving is used to highlight the aspects of driving that head injury may particularly affect. Thirdly, the review asks how well empirical work and re-licensing practice informs these concerns. This section assesses the validity of neuropsychological testing and the practices of the British Driver Vehicle Licensing Authority (DVLA). Finally, the review investigates whether self and other report may expand our knowledge.

1.1 BACKGROUND INFORMATION ABOUT HEAD INJURY

(a) What is a Head Injury?

Head injuries typically occur to males under 25 (Field 1976) after car accidents. In such accidents, the brain is compacted into the skull as the head rapidly decelerates with impact. This leads to diffuse axonal damage and more focal haemorrhagic bruising and oedema (Kolb and Wishaw 1990). Common sights of damage are on the under sides of the frontal lobes and around the poles of the temporal lobes. As predictable from theories of localisation of function (e.g. Lezak 1983), this results in a range of cognitive, personality and physical difficulties. Although head injuries from falls or assaults can lead to similar problems, the damage tends to be more focal (Kolb and Wishaw 1990).

(b) Common Difficulties

The extent of difficulties are concomitant with the amount of brain damage. Severity is most commonly classified by Post Traumatic Amnesia (PTA). Unlike depth of coma, PTA is possible to assess retrospectively and is defined as : the time from the injury to the reinstatement of continuous day-day memory (British Psychological Society 1988). Mild (PTA 10-60mins) head injuries are the least studied group as their care is focused on their general medical needs. Sweeney (1992)'s review highlights the prevalence of post-concussional syndromes (Binder 1986) which include chronic fatigue, reduced concentration and poor memory.

Severe (PTA more than 24 hours) head injuries have received more attention as they form rehabilitation populations. A survey of 62 severely head injured people in contact with services in Southampton (Wilkinson, Fisher and Bronfield 1989) found persistent difficulties on follow up. Psychometric testing highlighted memory difficulties and slowed information processing. Up to a third of Wilkinson et al's sample had frontal lobe deficits (e.g. affecting decision-making and impulse control). On self report, 80.9% of Wilkinson et al's sample reported memory difficulties,

47.6% concentration, 45.2% decision-making, 40.5% problem solving and 38.1% orientation. Further, the study points to the personality change that can follow head injury (Krefting 1989) (e.g. aggression was reported by 35.7%). This can be from frontal damage to emotional and behavioural control systems. Sivak, Olson, Kewman, et al (1981) also point to the commonness of right hemisphere deficits which restrict visual fields and impair visuo-spatial judgements.

Long-term outcome is also poor for the severely head injured. Previous research shows difficulties in regaining employment (Brooks, Campsie, Symington et al 1987) and reduced family roles (Young 1994). Importantly both job opportunities and many family roles depend on driving (Fox et al 1992).

(c) Head Injury and Self-Awareness

In both the Wilkinson et al (1989) survey and the longer-term outcome research, head injured participants tend to underreport their difficulties compared to close relations. Sixty-three percent of carers reported difficulties with problem solving compared to 40.5% of head injured people themselves in Wilkinson et al (1989)'s study for example. This discrepancy taps into the common issue of reduced insight into deficits post injury (Lezak 1983). Workers such as Stuss (1991) feel frontal damage accounts for this either through a breakdown of a multiple-domain awareness system or through reduced access to the knowledge contained in specific domains (as lack of insight is rarely complete). This means head injured people often find it difficult to be fully aware of impairments and compensate for difficulties (Prigatano and Schachter 1991).

1.2 A MODEL OF DRIVING AND INTUITIVE CONCERNS ABOUT DRIVING

(a) Michon's Driving Hierarchy

Driving is complex and not only asks the driver to mechanically operate the vehicle but also to respond to a huge array of information such as other vehicles, fluctuating

light and varying road surfaces. Michon (1979)'s driving model provides a useful conceptual framework of the psychological systems used whilst driving. See Figure 1.

LEVEL	EXAMPLES OF ACTIONS	TIME PRESSURE	PSYCHOLOGICAL ABILITIES REQUIRED
STRATEGIC	DECIDING WHETHER TO DRIVE IN BAD WEATHER	LOW/NON-EXISTENT	PLANNING, MEMORY, SELF APPRAISAL OF ABILITIES
TACTICAL	LOOKING AHEAD IN TRAFFIC, DECIDING WHETHER TO CHANGE LANES	MEDIUM	PLANNING, ANTICIPATION, DECISION-MAKING
OPERATIONAL	SECOND-BY-SECOND MANOEUVERING (EG GEAR CHANGING STEERING, REACTING TO EVENTS)	HIGH	PSYCHOMOTOR SPEED, ACUTE PERCEPTUAL ABILITIES

FIGURE 1 : MICHON'S DRIVING HIERARCHY AND THE PSYCHOLOGICAL ABILITIES DEMANDED BY DRIVING (FROM MICHON 1979, WEDDING 1992)

According to Michon we operate cars according to a hierarchy of decisions :

Strategic decisions involve frontally-mediated planning and judgement skills (e.g. whether to drive in bad weather) (Hopewell and van Zomeren 1990). It is rarely studied (Christie 1994) although Verplanken, Aarts, van Kippenberg and Kippenberg (1995) showed habit is a chief determinant of driving planning and influences what sort of trips we take.

Tactical decisions involve prospecting ahead whilst in the car to e.g. change lanes. Although again encapsulating frontal abilities, tactical decisions are poorly studied with Van Wolffelaar, van Zomeren, Brouwer and Rothengatter (1988)'s study (reviewed below) a rare foray.

Operational decisions are the most commonly conceptualised aspects of driving (Christie 1994) and involve the second by second manoeuvres used to control the car (e.g. steering). The work at this level looks at the cognitive-perceptual load and emphasises speed of response. Perceptually the driver must have an adequate visual field of both acute and peripheral vision (North 1985) to make the decision. The

motoric response to stimuli can be seen as a perceptuo-motor interaction based on visuo-spatial judgement variables such as time to contact (based on objects' rate of optical dilation , Lee 1976).

Michon's model provides parsimonious theoretical insights into how the driver's complex cognitive-perceptual systems may be integrated into a working system. Time pressures to make decisions are minimal at the strategic level and progressively increase to be great at the operational level (Christie 1994). Hopewell and van Zomeren (1990) see the hierarchy operating in a 'top-down' fashion with higher level decisions determining the workload on lower levels in at least two ways. Firstly, decisions such as avoiding the rush hour may reduce the pressure of decisions placed on tactical and operational decisions. Secondly, Brouwer, van Zomeren and van Wolffelaar (1990) see the frontal lobe-mediated higher levels as having a monitoring function which uses the feedback from the operational level to determine the most appropriate strategy. An example would be reducing car speed to corner safely.

(b) Applying the Model

Michon's model also provides a psychological framework for understanding driver errors. For Rumar (1990) one basic driver error is conceptualised by the phrase "I didn't see them". According to Rumar this is separable into two components : a perceptual detection error where the driver fails to select out relevant information from the visual array and cognitive detection errors where there is a failure to direct attention. The latter is a function of the frontally-mediated supervisory attentional control system (Shallice 1982).

Driving is also affected by who the driver is and their social psychological context. Age is an important factor. Korteling (1988) suggests ageing can reduce speed of response but can be compensated by driving more slowly. Further, most accidents involve males under 25 (HMSO 1993). Groeger and Brown (1989) suggest younger

drivers overestimate their skill levels and make tactical and strategic decisions (such as driving fast) that put their operational level abilities under impossible strain (van Zomeren, Brouwer and Minderhoud 1987). Other affective variables include personality traits where Neuroticism may be related to higher accident rates for example (Matthews, Dorn, Hayes and Glendon 1991). Recent concern about 'road rage' (e.g. Saumerez-Smith, 'Sunday Express' May 26th. 1996) highlights the potentially fatal consequences of not controlling aggressive outbursts whilst driving.

As said in the introduction, driving also has a social significance and is perceived as a source of freedom and independence (Hailwood 1988). Therefore to not drive has an enormous impact.

(c) Intuitive Concerns About Head Injured Drivers

The review highlighted the role of a range of lower sensory, cognitive and higher organisational psychological systems in driving. The common deficits of head injury clearly have a role in the functioning of each of these systems. Korteling (1990) suggests slowed information processing impairs operational task performance for example. This raises intuitive concerns about the ability of head injured drivers to attend to the vast array of information in the driving environment and make complex decisions under pressure of time. Of particular concern, not only can head injury impair the psychological systems used in driving but also to reduce the driver's ability to recognise their effects and compensate for them.

At a clinical level, Tyerman (personal communication) describes several case examples of clients with severe perceptual and cognitive difficulties. Each successfully passed driving assessments despite residual cognitive difficulties and observed difficulties in manoeuvring their cars at the rehabilitation centre. Similarly, Brouwer, van Zomeren and van Wolffelaar (1990)'s study describes a single head injured driver who failed to "....take account of other traffic participants...(who).. if he

had right of way...would take it, whatever the consequences...(and)..post-traumatically:... had been involved in a substantial number of rather peculiar accidents " (p 95).

1.3 EMPIRICAL RESEARCH : PREDICTING 'ON THE ROAD' DRIVING PERFORMANCE FROM NEUROPSYCHOLOGICAL TESTS

The key issues are the extent empirical research is theoretically derived, extends what we know about driving after head injury and provides a practical clinical framework.

(a) Rationale

There are two strands to this research. Firstly it is part of a movement in neuropsychology to extend the ecological validity of psychometric tests into real life settings (Tupper and Cicerone 1990). Within driving the most accessible ecological reference criterion is actual driving under test conditions (Hopewell and van Zomeren 1990). Secondly, if reliable correlations can be found with road tests, psychometrics offer the potential to screen out severely impaired people even before they get behind the wheel. Henderson (1994) notes:

"... the use of a battery of tests, as a screening tool administered prior to an on the road assessment, makes the assessment more safe for the client as well as others"(p-9)

Tests offer a cost-effective way to facilitate driving where possible and protect clients and other road users where necessary (Tupper and Cicerone 1990). The research has been concentrated at Gronigen in the Netherlands (e.g. Brouwer et al 1990) and the USA (e.g. Engum, Pendergrass, Cron et al 1988). Representative examples are described below.

(b) Subjects

'Patient' groups vary from undifferentiated 'brain damaged' groups of head injured and other neurological conditions (e.g. Stokx and Gaillard 1986) to head injured people with different difficulties and time post injury (e.g. van Zomeren, Brouwer, Rothengatter and Snoek 1988). While some research has no control group (e.g. Engum, Lambert et al 1989), control groups are mostly used and range from 'normal' drivers (i.e. without any medical or neurological condition) (e.g. van Zomeren et al 1988) to other non-neurological patients such as spinal patients (Schweitzer, Gouvier and Horton 1987).

(c) Psychometric Measures

Some researchers use full formal batteries such as the Halstead-Reitan Neuropsychological Battery (e.g. Rothke 1989). Most pick out subtests of common neuropsychological tests (such as the WAIS-R) and use functional tests (e.g. of attention) aimed to capture the perceptual, cognitive and motoric aspects of driving (e.g. van Zomeren et al 1988).

In van Zomeren et al (1988)'s study 9 head injured patients and 9 age and driving experience matched controls were given a neuropsychological test battery which included : memory tests (e.g. Benton Visual Retention); visual perception and search tests (e.g.. WAIS Picture Completion subtests and Trail-Making Forms); attention (e.g. Stroop Colour Word Test); and a range of motor function tests (e.g. The Minnesota Rate of Manipulation Test). These aim to tap the tactical and operational domains of driving. van Wolffelaar et al (1988)'s study of 20 head injured people and 15 matched controls tapped strategic abilities with Shallice (1982)'s problem solving Tower of London Task.

Engum (e.g. et al 1988) has developed the Cognitive Behavioural Drivers' Index (CBDI). Guided by the Michon hierarchy, their measures cross the tactical and

operational domains. While their 1988 study includes WAIS-R subtests, a range of computer-based functional tasks are also used. These included attention and reaction time tests (using a joystick to react to the direction of a stimulus) and visual scanning tasks (matching groups of alphabet characters from one side of the screen to the other).

(d) Driving Tests

These attempt to test the discriminatory validity of neuropsychological tests. They can be described according the extent they approximate everyday driving:

Few use simulators (Christie 1994) with Kewman, Siegerman, Kintner et al (1985)'s study a rare example of analogue cars. However, van Wolffelaar et al (1988) also asked subjects to undertake an adaptive behaviour control task where subjects had to sit in a static rig with a steering wheel and pedals fitted to a computer. A video of moving along a long flat road was screened in front of the rig to mimic the visual experience of driving. Computer generated "sidewinds" pushed the rig off course. The test then becomes a frontal flexibility test of applying compensatory strategies to counteract the sidewinds and then flexibly applying further strategies when required (van Wolffelaar et al 1988).

Going onto actual car driving, instrumented cars were used by Van Zomeren et al (1988) to measure Lateral Position Control (LPC)[1] and by van Wolffelaar et al (1988) in a traffic merging task[2]. However, most studies rely on driving instructor ratings. The ratings vary in their sophistication from Sivak, Hill, Henson et al (1984) dichotomous sufficient/insufficient ratings to the relatively sophisticated 6 point 'very good' to 'insufficient' ratings provided by the Dutch Advanced Driving Test (ANWB)

[1]Deviation from the centre of the lane is recorded by an electro-optical transducer aimed at the interrupted white line between the first and second lane of a highway track (van Zomeren et al 1988).

[2]The instrumented vehicle was parked at an intersection. At random time intervals, a warning light cues the driver to look outside and judge whether it would be safe to merge into the traffic at that moment by pressing a yes/no button.

used at Gronigen. The ANWB's dimensions include Perception and Insight (anticipating, spotting and avoiding hazards), Vehicle Handling (steering around corners) and Specific Manoeuvres (like driving backward around a corner). The ANWB has a long history of general use and driving instructors are used to rating its dimensions.

The content of driving tests vary according to whether the test is undertaken on closed tracks or the open road. Stokx and Gaillard (1986) asked 10 head injured people and 10 controls to negotiate a track and tested their abilities to perform : gear shifting and acceleration (physical manipulation skills), braking to a stop line (reaction time), slalom driving through cones (vehicle handling) and pressing a car horn in response to a light (distraction). It is often difficult to compare the complexity of the open road routes used as they are often poorly described (e.g. Galski, Ehle and Bruno 1989's traffic situations test). Where the test is described in detail, Sivak et al (1984)'s elaborate 17km course which included 2 and 4-lane highways in light traffic is typical (50% of the test was undertaken in 40km/h limit zones).

(e) Research Findings

The Gronigen group generally find no reduction in higher mental abilities amongst head injured drivers (e.g. van Wolffelaar et al 1988). However, van Wolffelaar et al (1988) find "striking" differences between the performance of head injured drivers and controls on operational visuo-motor tasks such as the Minnesota Hand-Eye Co-ordination task. Van Zomeren et al (1988) suggest the relatively preserved higher cognitive processes found in their samples could allow them to compensate for their reduced speed of information processing.

The picture is less clear when psychometric tests are correlated with instrumented tests and the Advanced Driving Test (ANWB). While van Zomeren et al's (1988) study showed head injured drivers performed significantly worse on the Lateral

Position Control (comparable to the effect of two alcoholic drinks), correlations were significant only with movement reaction time, the Minnesota Test and the other instrumented sidewind test! On the ANWB, head injured drivers showed non-significantly greater errors in the traffic actions, perception and insight subsections. The authors suggest the head injured driver errors were more serious (this is unexplained). Five patients in that study were rated insufficient. While, van Wolffelaar et al (1988) say only that their head injured group performed below the population average on the ANWB, only 2/20 were judged unfit to drive. In the van Wolffelaar et al study (1988) the only test of any kind which correlates with the ANWB is the LPC. This suggests neuropsychological tests discriminate between head injured and non head injured people as they are supposed to but carry little predictive validity for ANWB performance.

Outwith the Gronigen group, Hartje, Hannem, Pack and Willmes (1989)'s German study suggests aphasia (an indication of severe damage) is the only reliable predictor of road traffic performance. Rothke (1989)'s Chicago study of 18 neurological patients (of which only 9 were head injured) suggests a similar picture of poor correlation between his full WAIS-R and Halstead-Reitan neuropsychological test batteries and passing a driving test. Only delayed memory and psychomotor planning/problem solving strongly correlated with the pass/fail criterion of the test.

However the CBDI studies add significantly to the picture. 35 % of Engum et al (1989)'s patient group were classified as 'borderline' on psychometric testing. It was impossible to predict their driving performance. This suggests the relationship between psychometric performance and driving ability is only strong when cognitive impairment is either so gross that the driver will make obvious mistakes during the driving test or is so minimal that cognition and driving are not affected significantly. When psychometric performance is poor enough to suggest some degree of difficulty, actual driving performance may be more dependent on the adequacy of higher level

compensation. In such circumstances Engum, Lambert and Scott (1990) suggest reports from family members may help un-ravel such borderline cases.

Overall, the research produces a confusing picture. Individually, psychometrics, instrumented cars and driving tests can discriminate between head injured and control drivers. However, such discrimination does not reliably predict performance across testing domains - especially in borderline cases. However, it is important to note a number of difficulties with the research paradigm.

(f) Methodological Problems

The review highlights examples of poor descriptions of samples (Engum et al 1989), diagnostic groups (Sivak et al 1984) and road tests (Rothke 1989). Further, while much of the research body uses relatively small head injured samples (e.g. 9 in van Zomeren et al 1988), others have up to 215 in mixed neurological groups (e.g. Engum et al 1990). Compounding this, the drivers who agree to take part are likely to be a positively self-selected subgroup of head injured drivers from rehabilitation centres who are not intimidated by being tested and are confident of passing (Brouwer and van Zomeren 1992). Indeed, matching for confounding factors such as age (Lambert and Engum 1992) and driving experience (van Wolffelaar et al 1988) is variable. This undermines attempts to make global inferences about head injured drivers. Small group studies are vulnerable to skew by individuals who exhibit extremes of behaviour (Kerlinger 1986) whilst large group studies concomitantly hide individual differences (Miller 1994) and ignore the possibility that psychometric to driving correlations may vary according to diagnostic group (Henderson 1994).

Finally the psychometric properties of the driving test criterions used may be questionable. While the ANWB's coding system has been used on a large number of 'normal' Dutch drivers, van Wolffelaar et al (1988) note the coding system for driver behaviour does not fit within a cognitive psychological framework. It relies on the

intuitive concepts of driving schools. Rather than testing interrater reliability, van Wolffelaar et al (1988) note: "in the absence of a scientifically more suitable alternative...(the ANWB)... should reflect driving quality quite reliably" (p 305). Further, Engum et al (1989) note the possibility of criterion contamination in their 1988 because the instructor knew who had failed the cognitive tests. While most Gronigen studies make instructors blind to the results of cognitive assessment (e.g. Brouwer et al 1992), further criterion contamination is possible as instructors are either informed who is head injured or can deduce this from obvious physical disabilities.

(g) Conceptual Difficulties

Much of the non-Gronigen work has the appearance of being problem-focused and atheoretical (Christie 1994). Rothke (1989)'s study, employing whole WAIS-R and Halstead-Reitan Batteries, yields little. The advantages of a theoretical approach are shown by comparing the "21 physical and cognitive items thought to be relevant to driving" used by Galski et al (1988) (yielding only 4 predictive variables) to the more focused approach yielded by their Cybernetic Model (Galski, Bruno and Ehle 1992) which resembles many of the behavioural outputs of the Michon model. However, having a theory does not guarantee empirical work tests every premise. While van Wolffelaar et al (1988) attempt to test strategic decisions, this is relatively rare within the Gronigen group. They have concentrated on operational decisions. Hopewell and van Zomeren (1990) use limited evidence to conclude frontally-mediated skills are unaffected in head injured drivers. Allied to this, the unsophisticated nature of much of the research is particularly unhelpful in head injury as the range of deficits produced by damage to different areas is wide. Thus it may be important to control for the localisation of injury rather than just look at head injury per se (Christie 1994)

The ecological validity of the research enterprise may be questionable. Psychometrics seem not to correlate reliably with road tests. Neuropsychological tests may do no

more than we expected - differentiate organic brain damage in the test room. This may be because they are paper and pencil tests which share cognitive skills only in the most theoretical sense (i.e. you can test for attention with tests and driving 'should' involve attention) but bear almost no ergonomic relationship to driving tasks. It is difficult to say much about the utility of simulators as they have either been so far removed from what a car looks or feels like (e.g. Kewman et al 1985's wheelchair) or have little predictive ability (e.g. van Wolffelaar et al 1988's sidewinds). There may be some limits to the ecological validity of driving tests. Christie (1994) feels driving tests over-emphasise motor control at the expense of cognitive aspects. As widely accepted in neuropsychological testing, the structured and motivating context of the test situation often allow head injured people to perform to acceptable levels during evaluation (Lezak 1983). Thus, while on-the-road driving test criterions may pick up gross motor difficulties, there is a suspicion they may miss the crucial driving-relevant deficits of long term attention, concentration and planning. These will only become obvious over repeated and non-test driving situations.

(h) The Paucity of Knowledge About Everyday Driving

Finally, there has been little qualitative follow up of the everyday experiences of head injured drivers. Brouwer, van Zomeren and van Wolffelaar (1990) sent postal questionnaires to a rehabilitation sample of 100 severely head injured people injured 6-10 years previously and a control group of 86 mildly head injured out-patients. 34/37 (92%) of the severely head injured returnees who had a licence pre -injury had restarted driving an average of 9 months post injury. Only one of the 27 mildly injured returnees with a licence pre-injury had not returned. Looking at actual post injury driving, over 50% of the severely head injured drivers had been supervised on their first few post-injury drives - usually by relatives or driving instructors. Regular drivers in both groups were driving approximately 20,000km/year. There was no evidence of increased drink driving which the authors used as an index of social responsibility. Night driving had become more demanding (from the glare of

headlamps), they tended to drive more slowly and preferred partners to drive on longer journeys. Fewer head injured people suffering a PTA exceeding 1 month had returned to driving or took longer to get back. van Zomeren et al (1988) also interviewed their subjects on their driving experience, accident history and post-injury driving style. Six of the patient group said they now drove more carefully to compensate for their difficulties. While van Zomeren et al (1988) found no significant change in accident rates post-injury and have since abandoned its use, Brown, Groeger and Biehl (1987) note accident rates provide a broad external criterion of driving ability. Although this qualitative picture increases understanding of post-injury driving and may help clarify the risk potential of borderline patients, researchers have neglected this outside Holland.

This is a glaring gap in our knowledge about driving after head injury in the UK. We have little information on what motivates head injured people to drive again or even the numbers who return. Conversely, the impact of not being able to resume driving and alternative transport use has not been studied.

1.4 THE LEGISLATIVE CONTEXT

Withaar (1994) has recently studied the UK's complex re-licensing process. A key component of this is the responsibility placed on head injured drivers themselves to inform the Driver and Vehicle Licensing Authority (DVLA) of their injury and any difficulties they have with driving (Taylor 1995). On notification of a head injury, the driver's licence is suspended for a minimum of 6 months (Jennett 1995). The DVLA's medical branch usually ask for a medical report from the GP, hospital consultant, or may request examination by their own medical personnel. Clinical practice suggests GPs have the most pivotal role in re-licensing process and opinions are rarely sought from 'others' such as clinical psychologists (Tyerman , personal communication). Indeed this stage is medically dominated both in terms of the operational definitions of severe head injury used (e.g. acute intracerebral

haematoma, Jennett 1995) and in the DVLA's Form BCLE 1081 (1995) which is sent to reporting professionals. The form is essentially a medical symptom checklist with little space to detail psychological concerns. Licences may then be refused if the reports indicate gross difficulties or 'bar disabilities' such as epilepsy (a 10% risk post-injury, Jennett 1995) with recommendations for review. Licenses may be restored on a full or 3 year review basis (Withaar 1994) if reports do not suggest difficulties.

If the medical branch feel they require more information, then the driver may be referred to a driving assessment centre. Examples include Banstead in Surrey or the Astley Ainslie in Edinburgh. While the exact practices of each centre vary, they generally include physical and eye examinations, psychometric testing and either closed course or open road driving (Withaar 1994). The results are given to the client and sent to the GP. It is the client's responsibility to give the results to the DVLA before re-licensing.

Crucially, the system relies on clinical judgement by GP's and self-regulation by head injured people. GP's judgements are often 'educated guesses' from the physical and cognitive difficulties they see in the surgery or from reports of other professionals (Nouri 1988). Subtle cognitive difficulties may not be picked up. Nouri (1988) found 43% of GPs surveyed were not confident about assessing fitness to drive. Further, as assessment centres follow similar procedures to the reviewed research, the GP is not aided by highly reliable and predictive information. Successful self-regulation demands patients not only honestly inform the DVLA (the proportion that actually do is unknown) but also that they **accurately self-appraise** their performance once they have returned to driving. As stated above, reduced insight is often a head injury-specific deficit (e.g. Tyerman 1987).

Fundamentally, this has restricted much of our knowledge about the head injured driver to the anecdotal concerns reported by clinicians on a case by case basis. Clinicians **know** difficulties exist but have no clear empirical basis to back their clinical practice.

1.5 WAYS FORWARD : SELF REPORT AND MATCHED PAIRS

From the review, the main difficulty in the area is obtaining a valid and reliable method of sampling the performance of the head injured driver during everyday driving situations. Clinical neuropsychology has an established alternative methodology which is relevant here. Researchers recognise living with a head injured person gives families a valuable perspective on the **changes** wrought by the injury. As shown above, head injured people consistently underestimate cognitive (Tyerman 1987), personality (Tyerman, Booth and Young 1994), family and lifestyle difficulties (Young 1994) post injury in comparison to the ratings of other family members. When a head injured person returns to driving, family members will have the most experience in being driven by the head injured driver in those repeated everyday situations that are so crucial. Thus, any changes and differences in driving performance reported by head injured drivers and their family members may be expected to yield a valid clinical picture of driving post-injury. Researchers have been slow too pick this up and although Engum et al (1989) feel the perceptions of family members may be crucial sources of additional information when the CBDI paradigm provides only a borderline picture they have not followed this up.

Self -reported driving performance has been investigated by the social-psychological literature as driving is a highly constrained arena to explore self-appraisal processes (McKenna, Stanier and Lewis 1991). Studies show non-clinical drivers report their own driving abilities are above average (Groeger and Brown 1989) and their risk-taking below average (Delhomme 1991). Further, Gulian, Glendon,Matthews et al (1988) have developed a Driving Behaviour Inventory measure to tap into the self-

perceived attitudes and behaviours that office workers bring to driving. While such measures are influenced by a social desirability process (robust even when responses are anonymous, Groeger and Brown 1989) they offer the potential to give a rich picture of driving-relevant variables that drivers themselves feel affect their driving such as awareness, judgement and overtaking skill.

1.6 RESEARCH QUESTIONS

The review suggests there is a clinical dilemma between facilitating the independence of head injured people through driving and ensuring only those 'safe' drivers return to driving. It is hoped the present study will extend the published research by exploring the extent rehabilitation centres should be concerned about head injured drivers. This will be achieved by clarifying :

- The proportions of a head injury rehabilitation population who return to driving; the perceived importance of the return to driving; the services offered in the process of returning to driving.
- Whether self and family ratings enhance the clinical picture of the difficulties faced by head injured people who return to driving
- Whether head injured drivers report accurate perceptions of post injury driving compared to family perceptions in line with other psychological indices previously researched

This will hopefully lead to the recognition that self and family driving perceptions are important indices to guide clinical practice.

1.7 **HYPOTHESES** :

The literature review suggested head injury may effect driving skills and behaviour. Accidents may be a useful external criterion of driving performance. In each case, Hypothesis 'a' refers to whether raters noted broad driving changes per se. In

Hypotheses 'b' , self-other rating discrepancies are used to highlight insight issues in each domain.

HYPOTHESIS 1 : DRIVING PERFORMANCE/SKILL (2 TAILED)

1a HEAD INJURED DRIVERS WILL BE REPORTED TO SHOW CHANGES IN THEIR DRIVING PERFORMANCE COMPARED TO PRE-INJURY LEVELS

$1a_o$ THERE WILL BE NO DIFFERENCE IN HEAD INJURED DRIVERS' REPORTED DRIVING PERFORMANCE

1b THERE WILL BE A DIFFERENCE IN SELF VERSUS FAMILY REPORTS

$1b_o$ THERE WILL BE NO DIFFERENCE BETWEEN RATERS

HYPOTHESIS 2 DRIVING BEHAVIOUR (2 TAILED)

2a HEAD INJURED DRIVERS WILL BE REPORTED TO SHOW CHANGES IN THEIR DRIVING BEHAVIOUR COMPARED TO PRE-INJURY LEVELS

$2a_o$ THERE WILL BE NO DIFFERENCE IN HEAD INJURED DRIVERS' REPORTED DRIVING BEHAVIOUR

2b THERE WILL BE A DIFFERENCE IN SELF VERSUS FAMILY REPORTS

$2b_o$ THERE WILL BE NO DIFFERENCE BETWEEN RATERS

HYPOTHESIS 3 : ACCIDENT RATES (2 TAILED)

3a HEAD INJURED DRIVERS' ACCIDENT RATES WILL BE REPORTED TO HAVE CHANGED POST-INJURY COMPARED TO PRE-INJURY LEVELS

$1a_o$ THERE WILL BE NO DIFFERENCE IN HEAD INJURED DRIVERS' REPORTED ACCIDENT RATE

3b THERE WILL BE A DIFFERENCE IN SELF VERSUS FAMILY REPORTS

$3b_o$ THERE WILL BE NO DIFFERENCE BETWEEN RATERS

2.0 METHODOLOGY

2.1 CLINICAL CONTEXT

Rayners Hedge is a purpose-built community physical rehabilitation unit. Head injured people aged 16-64 and their carers are seen by members of a Head Injury Clinic Team. The clinic offers neuropsychological assessment, as well as cognitive and occupational retraining. Individual and group support is also available. While driving often arises as an issue at clinic review, it had not previously been addressed systematically.

2.2 DESIGN

The study was a small scale exploratory one, in which both qualitative and quantitative data were collected. The design was two-staged :

(1) a cross-sectional postal survey of the driving experiences of a head-injured cohort attending the Rayners Hedge Head Injury Clinic (1988-January 1996).

(2) a matched pairs comparison of the driving of head injured drivers post-injury as perceived by head injured people themselves and close family members

The independent variables were :

(i) having, or being closely related to, someone with a head injury
(ii) time since injury
(iii) severity of injury (as measured by duration of PTA)
(iv) length of driving experience pre- and post head injury

The dependent variables were pre and post-injury:
(i) Driving Skill
(ii) Driving Behaviour

(iii) Accident Rates

2.3 PARTICIPANTS

(a) Cross-Sectional Head Injury Clinic Cohort

Participants were identified through the Head Injury client register at Rayners Hedge. The following inclusion and exclusion criteria were applied by the consultant clinical psychologist to the 150 subjects on the register:

INCLUSION CRITERIA

1) PRIMARY DIAGNOSIS OF HEAD INJURY

2) PATIENTS ASSESSED BY HEAD INJURY CLINIC

3) PATIENTS WHO HAD DRIVEN A CAR PRE-HEAD INJURY OR HOLD A CURRENT PROVISIONAL /FULL DRIVING LICENCE.

4) PATIENTS NOT FULFILLING ANY OF THE EXCLUSION CRITERIA BELOW

EXCLUSION CRITERIA

1) HEAD INJURY IS NOT PRIMARY DIAGNOSIS

2) DIAGNOSIS/EXISTENCE OF HEAD INJURY IS UNCLEAR

3) EXISTENCE OF MARKED PRE-EXISTING PSYCHIATRIC ILLNESS

4) EXISTENCE OF ADDITIONAL NEUROLOGICAL CONDITION/ILLNESS

5) WHERE THE RESPONSIBLE CLINICIAN/HEAD INJURY TEAM JUDGE THAT THE PATIENT WOULD BE UNABLE TO COMPLETE EITHER THE INITIAL SCREEN OR THE INTERVIEW WITHOUT HELP AND WHERE NO FAMILY MEMBER WOULD BE AVAILABLE TO HELP THE COMPLETION PROCESS (EG CLIENTS LIVING IN RESIDENTIAL CARE)

6) WHEREVER THE RESPONSIBLE CLINICIAN/HEAD INJURY TEAM CONSIDER THAT THE PATIENT/FAMILY MEMBER'S PARTICIPATION IN THE RESEARCH WOULD BE CLINICALLY INAPPROPRIATE IN ANY WAY (E.G. WHERE PARTICIPATION COULD BE ANTICIPATED TO CAUSE EXTREME DISTRESS TO ANY PARTY).

From the screening process, a final group of 114 head injured people were approached to take part in the screening questionnaire. Of the 9 clients considered 'clinically inappropriate', 2 had significant difficulties in controlling aggression during previous interviews. One person was unhappy with the Rayners Hedge service and had not attended appointments.

(b) Screening Questionnaire

The 114 selected head injured people were invited by letter to participate in the study (See Appendix 1a). Sixty-five head injured people completed the questionnaire (representing a 57.02 % participation rate). There was no response from 42 clients and 4 returned the questionnaire without filling it in. Three people had moved from the area. The participation rate is considered reasonable for a follow-up study of a population with cognitive problems.

General Characteristics of Sample

The age range of the participants was 17-65 years, with the average being 35.97 years (s.dev 10.69). Forty-eight of the head injured people were male and 17 female.

Specific Information About Head Injured Participants

Post-Traumatic Amnesia (PTA) information was gained from client files. The range of PTA was for between less than one day to 335 days (Median = 21 days). Twenty-four people's injuries would be classified as extremely severe, 22 as very severe, 12 as severe and 3 as mild or moderate. In three cases there was no evidence of PTA and 1 could not be classified. This is comparable to previously researched UK neurosurgical groups (e.g. Brooks, Campsie, Symington et al 1987's Glasgow group median PTA was 3-4 weeks).

Glasgow Outcome Scores (Jennett, Snoek, Bond and Brooks 1981) were rated separately by the team consultant clinical psychologist and social worker. As the

interrater reliability was .89 (Pearson's r, $p<.0001$), the psychologist's ratings are quoted. The original scale was converted into numerical categories for statistical analysis (See Appendix 4). The population had a median 'moderate disability' outcome (24 people) and had a range from 'severe disability- requiring continual supervision' (4 people) to 'good recovery - with residual symptoms' (27 people). Ten people had 'severe disability' but could mange on their own with considerable support. None of the participants had a 'good recovery - with no symptoms'.

(c) Matched Pairs Interview

Head injured interviewees were selected from the 65 respondents to the screening questionnaire according to Section 1 criteria except :

1) PATIENTS MUST HAVE DRIVEN BEFORE THEIR HEAD INJURY AND HAVE RETURNED TO DRIVING AT SOME POINT AFTER THEIR INJURY

2)PATIENTS MUST HAVE A CLOSE FAMILY MEMBER AVAILABLE FOR INTERVIEW

PTA SCORE	DRIVERS			GLASGOW OUTCOME RATING	DRIVERS		
	SCREEN (N=35)	MATCHED PAIRS (N=18)	INTERVIEWED WITHOUT RELATIVE (N=6)		SCREEN (N=35)	MATCHED PAIRS (N=18)	INTERVIEWED WITHOUT RELATIVE (N=6)
<1 DAY	2	1	1	3.5	6		
1-6 DAYS	6	3	1	4	12	8	2
1-4 WEEKS	16	9	2	5	17	10	4
1 MONTH	6	4	1				
3 MONTHS +	1	1					
N/A OR D/K	4	0	1				
MEDIAN	*2 WEEKS*	*2 WEEKS*	*2 WEEKS*		*4*	*4*	*5*

TABLE 1 DISTRIBUTION OF PTA AND GLASGOW OUTCOME SCORES IN SCREENED AND INTERVIEWED DRIVERS

Specific Characteristics of Post-Injury Drivers Responding to Screen

From the questionnaire responses, 35 head injured people were identified as suitable. The range of PTA reported for the screened drivers was between less than one day to 335 days. From Table 1, 7 people's injuries would be classified as extremely severe, 16 as very severe, 6 as severe and 2 as mild/moderate. The median outcome for the

screened group was moderate disability. Six had a severe disability, 12 had a moderate disability and 17 had a good recovery with residual symptoms. Thus, drivers had relatively less severe head injuries but similar outcomes to the entire cohort. Head injured drivers were then invited by letter to take part in the study with a relative (See Appendix 1c).

Twenty-five head injured people and 19 close relatives agreed to take part. Whereas 5 head injured people and 11 of their partners responded but did not give their consent, there was no response from 5 potential subject couples. (See Table 2).

	NO. OF HEAD INJURED	NO. OF HEALTHY CLOSE RELATIVES
CONTACTED	35	35
CONSENTED	25	19
DECLINED	5	11
NO RESPONSE	5	5
ELIMINATED FROM ANALYSIS	1	1

TABLE 2 OUTCOME OF INVITATIONS TO BE INTERVIEWED

One couple were eliminated from the sample as the head injured person was unable to complete the interview. In particular, she showed clear response biases (marking long strings of answers in exactly the same fashion) and expressed some distress at being unable to understand how to complete the questionnaire. The interview was terminated before completion.

Six head injured drivers wished to take part without a close relative. However, both the experimental hypotheses and the matched-pairs design of the study depend on the analysis of subject couples. Although these head injured drivers were excluded from statistical analysis, it was felt to be unreasonable to refuse to interview the subsample of 6 just because a relative was unavailable and important to acknowledge their interest in the study. Thus, the final interviewed group consisted of 18 head injured and family member couples. From Table 1, the median PTA and Outcome scores of the subsample of 6 were similar to the final interview group.

General Characteristics of Matched-Pairs Sample

The mean age of the 18 participants was 39.61 years (s.dev 14.47) for the head injured people and 48.611 years (s.dev 12.57) for their relatives. Sixteen of the head injured people were male, and 2 female. Conversely, 5 of the healthy relatives were male, and 13 were female. Ten of the relatives were partners, 5 were parents and 4 were siblings of the head injured person. Four head injured people lived with a partner, 13 with parents and 1 with a sibling. Six of the head injured were single, 13 in a relationship with a partner and 1 person was a widower. Two of the family participants were single, 15 in relationships and 1 was divorced.

Specific Characteristics of Matched-Pairs Sample

The clients had suffered their injuries between 9 months and 24 years previously (M = 5.59 years). The range of PTA was between less than one day to 335 days (Median = 2 weeks). From Table 1, 7 people's injuries were extremely severe, 16 were very severe, 6 were severe and 2 were mild/moderate. The median outcome score was good recovery with residual symptoms with 8 having a moderate outcome and 10 with a good recovery. This compares well with the median severity and outcome found for the 35 head injured drivers responding to the screen although 6 drivers with a severe disability did not wish to be interviewed.

The majority of the injuries (15) were sustained in road traffic accidents and three were the result of falls. Of those in car accidents, 5 were driving at the time, 3 were passengers, 3 were motorcyclists, 2 were cyclists and 2 were pedestrians.

Finally, 10 were currently employed, 2 were retired and 6 were involved in the a work rehabilitation project at Rayners Hedge.

2.4 MEASURES

(a) Screening Questionnaire (See Appendix 2a)

This measure was developed by the researcher following discussion with the unit consultant clinical psychologist (research supervisor). The questionnaire emphasised the complete confidentiality of answers. Questions were a mix of 6 five-point Lickert rating scales, ticking closed question responses and space for open-ended comments. Page 1 (background questions 1-5) asked demographic information (such as age, sex and length of time as a qualified driver), the relative importance given to being able to drive and the nature of any driving assessments. Page 2 (questions 6-11) asked about the cognitive and physical difficulties that non-drivers felt had prevented their driving return, their use of alternative modes of transport and feelings about not being able to drive. Page 3 (questions 12-20) asked post head injury drivers when they had returned to driving and the extent and nature of car use.

(b) Interview Measures

Alternate forms of each measure were developed for head injured and family participants with the wording altered on the family form to rate the head injured person's driving rather than their own.

(i) Semi-Structured Background Interview (See Appendix 2c)

This asked about the participant's age, occupation and the circumstances of the head injury. Further questions asked whether the DVLA had been informed of the injury, when driving had been resumed and the type of car driven pre and post injury. Head injured participants were also asked how easy the screening questionnaire had been to complete. Open-ended questions explored major themes from the screening questionnaire, and any driving assessments or changes seen in driving. Open comment on feelings when restarting driving, family attitudes to the head injured person restarting driving and who does most of the driving were also invited.

Two self-report measure were adapted from the literature :

(ii) Adapted Driving Behaviour Inventory (ADBI) (See Appendix 2d)

The Driving Behaviour Inventory (Gulian et al 1988) investigates the stress load on drivers. The measure was developed from subjects working for multinational companies and has driving experience sections which ask about accidents. The DBI uses 100mm visual analogue scales (VASs) to tap driving behaviours and attitudes towards driving. This is a well documented measure whose 5 factor solution of alertness, aggression, dislike of driving, irritation and frustration when being overtaken have an average test-retest reliability of .6 over a 5 month period (Glendon, Dorn, Matthews et al 1993). It has gained external validity across a range of domains from diary studies (Gulian, Glendon, Matthews et al 1989) to correlations of -.41 ($p<.01$) between the alertness factor and on the road attentional tests (Matthews et al, in press) for example. The DBI produces background information and variables that look relevant to head injury.

The original DBI had four sections (A-D) which were a mix of 4 and 5 point Lickert scales and 37 'not at all' to 'very much' VASs.

The Adapted DBI began with simplified completion instructions asking respondents to make two pre- and post head injury assessments of the head injured person's driving. The demographic questions in the original Section A were omitted as these were completed in the background questionnaire. Occupational car use questions were also omitted. This left 6 questions on basic driving background such as annual mileage and alternative transport use. Section B was for accidents and convictions. There was space to record open-ended comments on post-injury accidents. The DBI question on personal responsibility for accidents was discarded as it could appear to be blaming the head injured person. Section C used the 14 driving behaviour and attitudes questions from the old section B and added one rating of frequency of

'remonstrating with other drivers'. The original 37 100mm VASs which asked for ratings of usual driver behaviours under certain circumstances (e.g. bad weather) were retained in a new Section D. Two head injury-relevant ratings of driving tiredness and concentration difficulties were added following discussion with the research supervisor. The DBI's section on health problems was discarded as it was felt to be insensitively phrased and intrusive. Pre and post injury ratings were completed on the same sheet for sections A-C and Section D on separate identical forms circled 'pre' or 'post'. The final questionnaire consisted of 54 questions.

(iii) Adapted Driving Skills Questionnaire (ADSQ) (See Appendix 2e)

Groeger and Brown (1989)'s original Driving Skills Questionnaire asked respondents to compare their driving skill and 8 other reference variables (such as gardening) to a 0-100% 'average' standard. Respondents then either rate themselves or the average driver on a series of 25 VASs of driving dimensions gained from the literature. While the subjects uniformly rated themselves as better than average across all the percentile variables as expected, it may be interesting to see whether such ratings are sensitive to relative change pre to post-injury. Two qualitatively different 7 factor solutions emerged from the VAS data. Whilst 2 similar 'dissociation' factors emerged from 'self' and 'other' ratings (representing attention and concentration), 'other' ratings produced indecision, competitiveness, timidity, defensiveness and excitement factors. The self-assessment data produced smoothness, caution, recklessness, impulsivity and anticipation factors. This format allowed for both self and other ratings for driving skill and produced factors mirroring head injury-relevant variables.

An Adapted DSQ (ADSQ) was developed. While Section A retained the driving safety, skill, competitiveness and aggression items, the remaining comparisons were replaced by 5 head injury relevant variables from the literature and discussions with the research supervisor. The comparisons were of driving concentration, planning ahead, reaction times, stamina and confidence. Section B retained the 25 100mm

'never' to 'always' VAS ratings of the frequency of performing various driving skills. The 5 head-injury relevant questions added were the frequency of losing concentration, feeling tired, misjudging speed and space and parking difficulties. Pre and post injury ratings were completed on separate forms appropriately circled 'pre' or 'post'. The final questionnaire contained 40 questions.

2.5 APPROVAL AND BACKUP FOR THE STUDY

The proposed study was approved by the Consultant Clinical Psychologist (research supervisor), Clinical General Manager, and members of the Head Injury Team at Rayners Hedge.

A research proposal was submitted to the Local Research Ethics Committee responsible for the district. No alterations were requested (See Appendix 3).

With respect to clinical support and back-up, the service agreed to accept any referrals that arose during the study. The GP's of all those initially approached were informed of the study, and that their patient had been asked to participate (See Appendix 1b).

2.6 PILOTING

The screening questionnaire was piloted on 1 client with multiple sclerosis and another with a cerebellar cyst who attended Rayners Hedge. The interview measures were piloted on the above clients and both the cerebellar cyst client's mother and a couple where the husband had dementia. The latter couple were current clients of the researcher whilst on an elderly training placement. Their participation was agreed both by the client and his wife and the researcher's clinical supervisor. All pilot subjects currently drove, had 'neurological' conditions and were 'disabled' drivers who would be aware of the relevant issues. The pilot interviews enabled the measures to be checked for ambiguities and the understandability of the language used.

Both subjects completing the screening questionnaire reported it was understandable. On the basis of the pilot interviews, some minor modifications were made to the Semi-Structured Interview (adding whether any adaptations were made to cars or disabled badges had been issued) and the ADSQ (where the percentile scale in Section A was replaced by a series of 10 boxes numbered from 1-10 as subjects found the original scale hard to understand).

2.7 PROCEDURE

(a) Screening Questionnaire

The identified head injured people were sent a questionnaire pack containing an invitation letter and consent form explaining the nature and purpose of the study, the screening questionnaire and a stamped addressed envelope. A reminder letter was sent to those who had not responded after three weeks. Consent forms were returned with completed questionnaires. Non-consent was assumed if the questionnaire was not returned.

(b) Interviews

The clients and their relations who fulfilled the criteria for the interviews were sent an information letter and consent form and invited to participate (See Appendices 1c-d). A reminder letter was sent to non-respondents after three weeks. Consent forms were returned with completed questionnaires.

Those who consented were contacted by phone, and an appointment was made to see them. Four couples and seven head injured people were seen at Rayners Hedge. The rest were seen in their own home.

The interviews were conducted with the two members of a couple separately, but followed the same format. The researcher introduced himself and explained the structure of the interview (See Appendix 2b). The researcher emphasised all

responses were confidential. Participants were encouraged to ask questions, but advised they could refuse to respond to any items they did not want to answer. An independent "Headway" leaflet on returning to driving (1994) was also available for subjects.

Each interview took approximately one hour. The measures were administered in the order presented above, with all non-VAS questions of the ADBI being read out by the researcher. All of the ADSQ questions and the VAS section of the ADBI were given to respondents to complete after the researcher had run through examples of how to fill them in.

Finally, the participants were asked whether they would like to receive a written summary of the outcome of the completed study. All were keen to do so.

3.0 RESULTS

3.1 PREPARATORY ANALYSES

The data was analysed with the 'Windows' version of the Statistical Package for the Social Sciences. The choice of statistical tests was guided by : whether the data was ordinal or interval scaled; its distribution; and statistical advice.

(a) Level of Analysis

Where possible, Lickert scaling questionnaires were collapsed into binary choice data to increase the number of respondents per cell as required for χ_2 analysis. Statistical advice was to use the continuity correction χ_2 value to calculate p-values except where the frequency of cells with an expected frequency of less than 1 exceeded two. In such cases the Fisher's Exact T-Test was used.

Ideally, noting the study was primarily an initial exploration of whether the measures were useful in this context, a factor analysis would have been performed on the visual analogue and scaling data to derive the important constructs. However, as the subject numbers were less than the number of questions on each measure, a factor analysis would have been invalid (Kerlinger 1986). Therefore, each question was analysed separately.

(b) Exploring the Validity of Parametric and Non-Parametric Analyses

The visual analogue and 0-10 scaling data in the ADSQ and ADBI are interval scaled and potentially parametric. The Kolmogorov-Smirnov one-sample Goodness-of-Fit Test was used to confirm or preclude the use of parametric tests. The Kolmogorov-Smirnov Test only rejects data with marked deviations from the normal distribution. Noting the small sample-size, statistical advice was to lower the criterion for rejecting the null hypothesis of normality to a p-value of $< .10$. As the design was matched-pairs, the Kolmogorov-Smirnov Test was applied to every combination of mean difference scores between rater groups and time points of each variable. The results

are shown in the Appendix (5a (i)-(iv)). From this, the majority of the variables allowed parametric analysis. However, a total of 17 question responses were significantly different from the normal distribution (See Table 3) (e.g.. Family raters' time post-injury rating produced a Kolmogorov-Smirnov z-value of 1.82, $p<.002$).

MEASURE			
SEMI-STRUCTURED INTERVIEW	**ADSQ**	**ADBI**	**ACCIDENT INFORMATION**
VARIABLES			
time post head injury	drives riskily	too much driving waste of time	time driving
	difficulty finding gear	accidents always possible	total mileage
	unneccessary manoevres	slow moving vehicles are a hazard	no. accidents
	drives as if taking test	tense whilst overtaking	miles per accident
	misjudge space between self and other cars	annoyed by slow-moving traffic	accident rate
	use of rear view mirror		

TABLE 3 QUESTIONS IN EACH MEASURE WHERE THE KOLMOGOROV-SMIRNOV TEST REJECTED NORMALITY TO A LEVEL BELOW $p<.10$

Statistical advice was to use non parametric analyses on the differences between each of the person and time data points described above.

c) Tails of Testing and Significance Levels

As hypotheses 1-3 do not make firm predictions about the direction of differences between head injured drivers and their relations, 2-tailed tests of significance were used. As a large number of comparisons were made on the Lickert-scaled and VAS questions in the ADBI and ADSQ, statistical advice was to tighten statistical significance criteria to .01 there. However, a .05 level of probability was accepted for the basic driving experience and accident sections in the ADBI as they were separate from the behavioural change measures and could be treated as individual items.

3.2 PSYCHOMETRIC PROPERTIES OF THE INTERVIEW MEASURES

As the measures had been adapted for use with a new, head injured, population, it was important to explore the reliability and validity of the measures before further

analysis. The intention at this stage was to only check the measures had reasonable psychometric properties in this context per se. Therefore only a limited analysis was made of the ratings of current driving. The issues surrounding retrospective ratings are elaborated in the discussion.

Such analyses only make sense if component questions are added together into scales of like items measuring the same construct. From this, as factor analysis was not possible, the measures were split into conceptual scales based on : the nature of the task and whether head injury-specific items were added to the original scale. The ADSQ was split into three scales. The 0-10 comparative scalings became Sale A, the original VAS ratings Scale B and the additional 'head injury' ratings a 6 item Scale C. The ADBI was treated as a whole because fewer 'head injury' VAS questions were added making it difficult to justify separate scales without factor analysis. Thus, Scales A and C were effectively head-injury scales and Scales B and D general driving scales. All positively-phrased questions were reverse scored so that each scale item followed the same direction. The raw scale scores are shown in Appendix 5b.

(a) Reliability

Two measures of reliability were made. Firstly, each of the scales for each rater group were given a split-half reliability analysis with each half based on odd/even question orders. Statistical advice was to use Spearman-Brown correlation coefficients. This was followed by an analysis of internal consistency. The results of this analysis are shown in Table 4.

	SCALE A (ADSQ 0-10 SCALE)		SCALE B (ORIG. VASs)		SCALE C (HEAD INJ. Q's)		SCALE D ADBI	
SPLIT-HALF ANALYSIS	HI	FAM	HI	FAM	HI	FAM	HI	FAM
SPEARMAN-BROWN CORRELATIONS	0.96	0.51	0.78	0.84	0.85	0.8	0.95	0.89
INTERNAL CONSISTENCY								
CRONBACH ALPHA VALUES	0.89	0.85	0.85	0.8	0.9	0.76	0.87	0.86

TABLE 4 SPLIT-HALF AND INTERNAL CONSISTENCY ANALYSES PERFORMED ON POST-INJURY RATING SCALES

From Table 4, the reliabilities of the scales were generally high for both head injured and family ratings, with split-half reliability values ranging from .78 to .95 and internal consistency values ranging from .76 to .9 on Scales B to D. While Scale A internal consistencies were also high for both groups, head injured ratings had a high split-half reliability while the family raters' was relatively low.

(b) Validity

As suggested in the literature review, there is no reliable driving criterion with which to measure the validity of these scales. As the scales were generally reliable, it was possible only to look at the relationships between the scales and how well the head injury Scales A and C correlate with the original general driving Scales B and D. Pearson r correlations were calculated and are shown in Table 5.

		ADSQ SCALES						ADBI SCALES
		SCALE A		SCALE B		SCALE C		SCALE D
		HI	FAM	HI	FAM	HI	FAM	HI
SCALE A	HI							
	FAM	**0.70*** **						
SCALE B	HI	**0.85**** **	0.57*					
	FAM	0.44	**0.68*** **	0.22				
SCALE C	HI	**0.87**** **	**0.77**** **	**0.76**** **	0.56*			
	FAM	0.45	**0.64*** **	0.35	**0.82**** **	0.52*		
SCALE D	HI	**0.77**** **	0.39	**0.85**** **	0.06	**0.74**** **	0.16	
	FAM	**0.63****	0.49*	0.49*	0.4	0.56*	0.28	0.55*

TABLE 5 INTERRELATIONSHIPS BETWEEN MEASURE SCALE SCORES FOR POST-INJURY RATINGS
***p<.05; **p<.01; ***p<.001; ****p<.0001 (Pearson Correlation Coefficients)**

From Table 5, all of the head injured peoples' ratings of their own driving were significantly correlated across the scales. From family ratings the picture is less clear

cut, with Scale A significant correlating with Scales B and C and Scale B correlating with C. There were no significant family scale correlations with Scale D. Thus, there is some evidence to suggest the head injury scales are valid as measures of post-injury driving performance and behaviour. This issue is elaborated further in the discussion section.

3.3 DRIVING AFTER HEAD INJURY : BACKGROUND INFORMATION

(a) Screening Questionnaire

Two main groups were identified from the returnees' pre-head injury driving status : non-drivers and drivers.

The 15 respondents who had not driven before their head injury were not relevant to the rationale of the study and are not discussed further.

All Fifty of the remaining returnees had driven pre-injury while 35 (or 70%) had returned to driving at some point post-injury.

As the study concentrates on the experiences of post-injury drivers, only a flavour of the post-injury non-driver data is presented. Importantly, 10 of the non-drivers knew why they had not returned to driving post-injury. (See Table 6 below).

	CONFID.	CONC.	SLOWED REACTION TIMES	SPATIAL JUDGEMENT	PHYS. DIFFICS	EYESIGHT	CO-ORD	EPILEPSY
FREQUENCY	4	3	3	2	2	3	1	1

TABLE 6 FREQUENCY OF SPECIFIC DIFFICULTIES PINPOINTED BY POST-INJURY NON-DRIVERS AS THE REASONS WHY THEY HAD NOT RETURNED TO DRIVING POST-INJURY

Eight people felt being able to drive was important to some extent and comments emphasised the role of driving in maintaining independence, aiding job opportunities and preventing isolation. However, 12 people reported little or no restrictions imposed by not being able to drive. Comments included not liking to rely on others

for lifts and the time consuming nature and infrequency of public transport. Alternative transport included taxis, public transport and walking. Nine people relied from lifts from others, principally from partners and parents.

A more detailed analysis of the driving experiences of the 35 post-injury drivers is presented below :

POST-INJURY DRIVING STATUS	AGE	TIME AS QUALIFIED DRIVER (YEARS)	WHEN RESUMED DRIVING (MONTHS)
DRIVER (N=35)	39.35	18.95	8.28
(STD. DEV)	13.07	11.34	4.65

TABLE 7 BASIC DRIVING CHARACTERISTICS OF SCREENED DRIVERS

From Table 7, the post-injury drivers were, on average, around 40 years old and had around 19 years of driving experience. They had returned to driving around 8 months post-injury (range a few days to 20 months).

Most respondents felt driving was 'very important', chiefly for work and maintaining independence. Four people felt they would be isolated without driving and two reported driving was a symbol of "getting back to normal" post-injury. As such, 17 respondents reported receiving information about driving. Open comments suggested the information provided was predominantly spoken and delivered during consultations with GPs or neurologists. Two respondents had talked with a clinical psychologist. Respondents reported the content of the information included the effects of head injury on driving (e.g. reduced reaction times), suggested compensation strategies (e.g. to slow down) and explaining the DVLA re-licensing process (e.g. how long licences are generally removed for). Only one person reported being given the Headway leaflet on returning to driving. Fourteen respondents had a driving assessment of some sort and included passing ordinary driving tests or going to a local driving school for driving lessons or "mock re-tests" (including motorway

driving). One person reported going to a driving assessment centre although they did not expand further.

Of the 3 people who had gone back to driving and then stopped, subject 43 reported stopping because of 2 accidents and feeling he was now 'dangerous'. A second person reported stopping because he had a neurosurgical shunt fitted[3] and the third person reported "excessive" anxiety each time he drove. He reported feeling every car would crash into him and was now "too scared to drive". Head injury-related reasons for giving up included : impulsivity, confidence, slow reaction times, spatial judgement and co-ordination.

Of the 32 people who were currently driving, the primary uses were for leisure and domestic reasons. Nineteen reported using their car for work. While most people reported driving as well or better than before, 6 felt they drove 'worse' to some extent. Of those reportedly driving better, the reasons cited included increased awareness of other road users and taking more notice of the weather conditions. One person reported being "better" as they now drove more slowly while another now felt more relaxed. Of those who felt they now drove worse, a number felt their judgement was worse whilst overtaking, and others reported high anxiety whilst driving. One of these people reported reduced concentration because of "subconsciously" recalling the "horror" of their head-injury accident each time they drove. Other reported driving changes included slower reactions and worse night sight. Overall, 25 people were now neutral about driving or enjoyed it less. Eleven reported using the car less than pre-injury. Those enjoying driving more reported appreciating the freedom of driving.

[3] This is a mechanical device inserted into the head cavity to prevent the build up of cerebrospinal fluid in the skull.

(b) Interviews

One family rater felt able to rate only post-injury driving as she had known her husband since his head injury. Thus, the statistical analysis refers to 18 matched-pairs for post-injury ratings but only 17 pairs pre-injury unless otherwise specified.

(i) The Semi-Structured Interview

While the family raters had been qualified drivers for slightly longer (mean 23.72 years, s. dev. 12.12) than the head injured drivers (mean 18.40 years, s. dev. 11.31) this was non-significant (Paired t-test, $t=-1.54$, $p<.142$). Both groups estimated the mean time drivers had resumed driving at around 8.5 months (head injured raters : mean 8.59, s. dev. 6.54, range : 2 weeks to 24 months; Family raters 8.41, s.dev. 10.28, range 2 weeks to 40 months).

From interview, both the head injured drivers and their relations reported the DVLA had been informed about the head injury in 10 cases. The DVLA had not been informed in 6 cases and 2 couples were unsure. Both head injured and family respondents said the informer had been the head injured person in 5 cases, a family member in 3 cases and the GP in 2 cases. In 4 out of the 6 cases where the DVLA was not informed, both partners claimed they did not know the DVLA had to be informed. In one case, the head injured person had deliberately not informed the DVLA as he feared the cost of assessments and re-testing.

Five head injured people continued to drink alcohol before driving (range : 1-2 units). Six reported a change in their pre-driving drinking habits and 12 reported no change.

Comments about resuming driving included reports of general anxiety, scared feelings, increased awareness of other drivers and feelings of being unsafe. Two head injured drivers reported initial difficulties with dividing attention to car dials and continued problems with route finding whilst driving.

In open comments many head injured respondents concentrated on changes in their driving. Positive changes ranged from driving more carefully to driving more slowly. Negative changes included disliking night driving which 2 head injured interviewees said was because oncoming headlights blinded them. A number of respondents reported a rise in post-injury driving anxiety (focusing on fears of further accidents and reduced skills in overtaking). Three drivers reported high anxiety (panic attacks in one case) when driving in the same conditions (e.g. in the wet) or locations (e.g. particular roundabouts) where they were told their head injury accident had occurred.

While family respondents also reported increased driving anxiety and changes such as reduced reaction times, these respondents also reported perceived problems with the DVLA re-licensing procedure. Problems included lack of information and "excessive" delays in receiving communication from the DVLA regarding dates of assessment etc.

Seven head injured drivers felt their families had been supportive about them resuming driving and 4 felt they had been neutral. Ten drivers were aware of family anxiety about their driving (e.g. one person reported his wife continually commented on his reduced concentration and driving too fast). Seven family respondents themselves reported feeling supportive or happy about the head injured person's return to driving.

(ii) Lickert-Scaled Questions (Sections A-C of the ADBI)

Head injured drivers reported their mean annual mileage dropped from 21,829 miles (s.dev14,800) per year pre-injury to 8,572 (s.dev 5,295) post-injury. Similarly, family raters mean reports suggested a drop from 15,953.33 (s.dev. 13,387.80) miles per year to 7,500 (s.dev. 7,825.00). A 2-Way Related Samples ANOVA confirmed this drop was significant ($F=7.07$, $p<.02$) but not affected by the rater group ($F=1.23$, $p<.29$).

The full analysis of the Lickert-scaled data analysed by χ_2 is shown in Appendix 5c. The only significant attitudinal or behavioural change reported for head injured drivers from pre- to post-head injury was feeling most drivers now drive too fast. This was significant for both head injured (χ_2= 8.38, d.f. =1, p<.004) and family raters (χ_2= 6.84, d.f. =1, p<.01). There was also some suggestion head injured drivers themselves felt more distractible whilst driving although this was only significant at a .05 level (χ_2= 4.02, df =1). In open comment, changes in driving style reported by both rater groups included reduced driving speed, increased caution, and reduced night driving. One head injured person felt less in control of their car and family raters also pointed to decreased gear changing smoothness.

For each hypothesis full tables of mean ratings and standard deviations for each question are presented in Appendices 5a(i)-(iv). The tables reported in the text include question means (parametric data) or medians (non-parametric data) and the results of statistical analyses.

3.40 EXPLORATION OF HYPOTHESES

3.41 HYPOTHESIS 1 : DRIVING PERFORMANCE/SKILL (2 TAILED)

1a HEAD INJURED DRIVERS WILL BE REPORTED TO SHOW CHANGES IN THEIR DRIVING PERFORMANCE COMPARED TO PRE-INJURY LEVELS

$1a_0$ THERE WILL BE NO DIFFERENCE IN HEAD INJURED DRIVERS' REPORTED DRIVING PERFORMANCE

1b THERE WILL BE A DIFFERENCE IN SELF VERSUS FAMILY REPORTS

1b$_0$ THERE WILL BE NO DIFFERENCE BETWEEN RATERS

(i) Comparison of Skills to the Average Driver

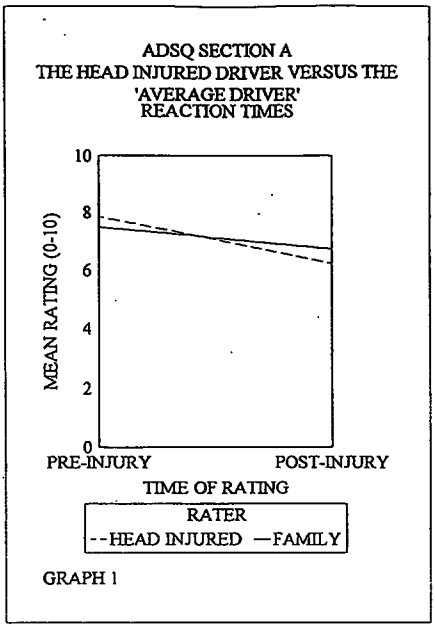
The means for this section are contained in Table 8 with graphs shown for questions showing statistically different changes.

	PERSON				2-WAY ANOVA VALUES		
	HEAD INJURED		FAMILY				
	PRE-INJ	POST-INJ.	PRE-INJ.	POST-INJ.	TIME	PERSON	T x P
VARIABLE	MEAN RATING (N=18)	MEAN RATING (N=18)	MEAN RATING (N=17)	MEAN RATING (N=18)	F-VALUE	F-VALUE	F-VALUE
Competitveness	5.33	3.06	6.47	4.06	21.40 ****	3.18	0.06
Aggressiveness	4.33	3.44	5.00	3.78	4.38	1.05	0.04
Safetiness	7.22	6.22	8.29	6.72	3.84	3.37	0.66
Skillfulness	7.89	5.89	8.24	6.83	15.73 ***	4.02	1.52
Concentration	7.83	5.50	8.35	5.89	18.17 ***	0.87	0.04
Planning Ahead	7.67	6.22	7.47	6.72	6.00 **	0.17	0.78
Reaction Times	7.83	5.00	7.65	6.06	10.85 **	1.16	3.96
Stamina	7.89	5.44	8.00	4.78	22.70 ****	0.33	1.97
Confidence	8.39	6.11	8.29	6.28	9.80 **	0.01	0.09

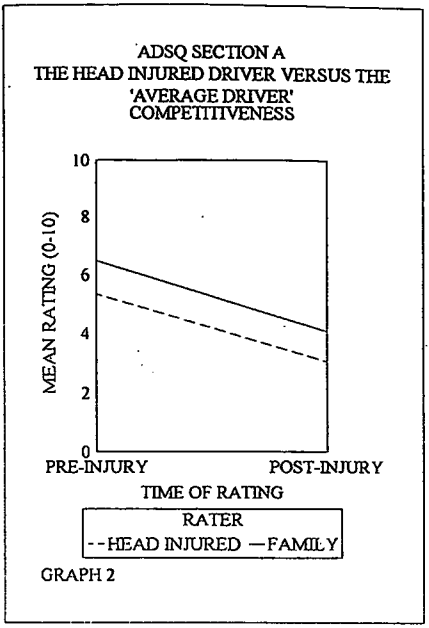
TABLE 8 MEAN SUBJECT COMPARISONS AND 2-WAY ANOVA ANALYSES OF COMPARISONS OF HEAD INJURED DRIVERS' SKILLS WITH THE AVERAGE DRIVER

* p< .05, **p< .01, ***p<.001, ****p<.0001

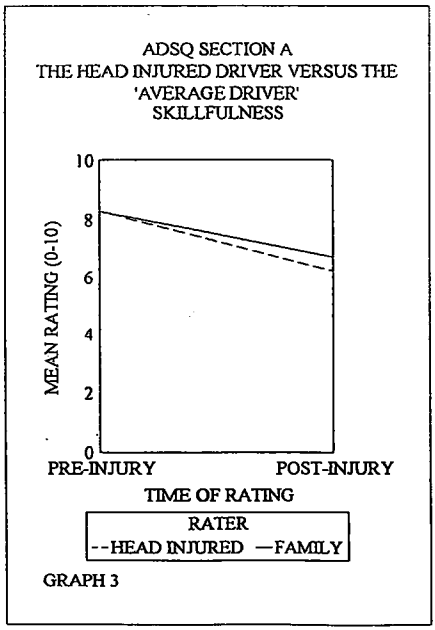
From Table 8, both head injured and family raters generally reported head injured driver skills to be above average apart from post -injury competitiveness, pre and post aggressiveness and family reported post-injury stamina. Each variable mean rating from both rater groups fell from pre- to post-injury. From the F-values reported in Table 8, there were significant changes following the head injury for competitiveness, skilfulness, concentration, planning ahead, reaction times, stamina and confidence. These are shown in Graphs 1 -7. From the graphs and the F-values, there was no significant group effect of rater or interaction effects. However, Graph 1 suggests the possibility of an interaction effect of rater and time for reaction times. From this, head



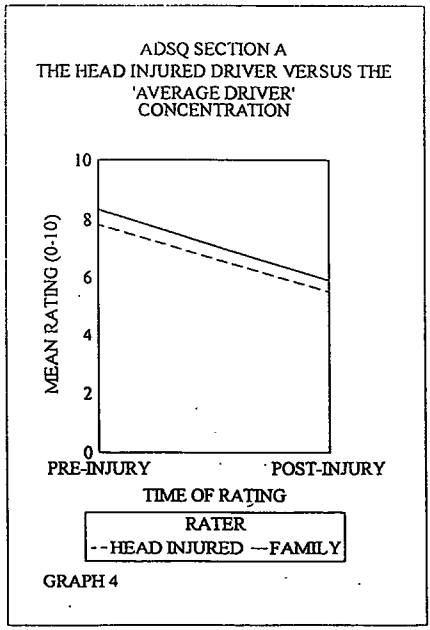
GRAPH 1



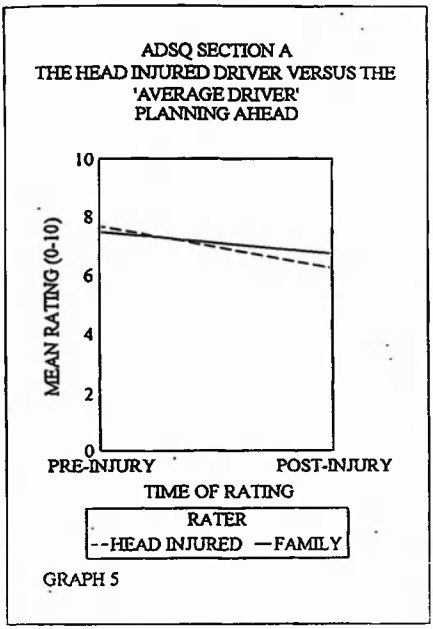
GRAPH 2



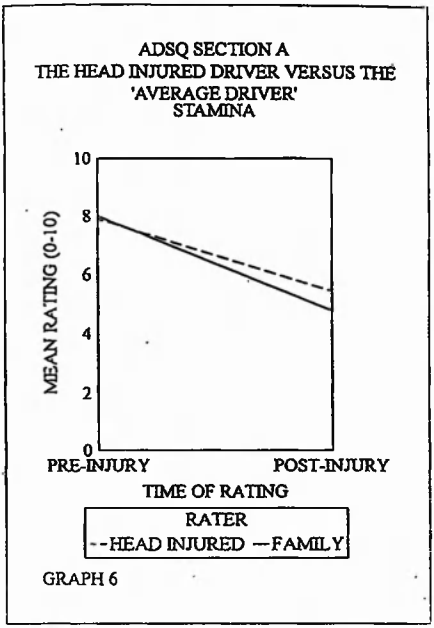
GRAPH 3



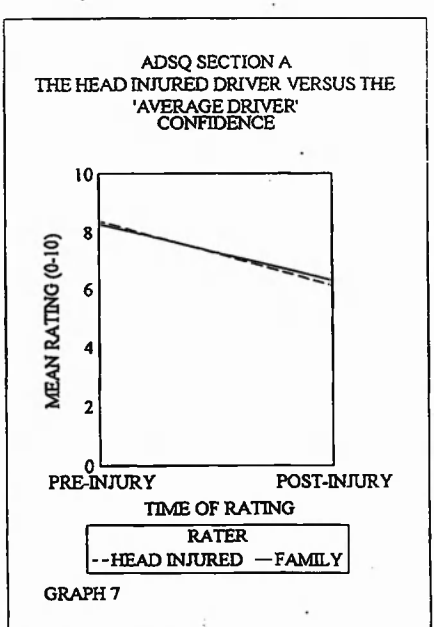
GRAPH 4



GRAPH 5



GRAPH 6



GRAPH 7

injured drivers rate more of a drop in their reaction times from pre- to post-injury than that perceived by family raters. This approaches significance (F-value 3.96, $p < .06$)

(ii) Visual Analogue Data

The analysis of the data is divided into parametric and non-parametric analyses :

Parametric Analyses

The means for this section are contained in Table 9 with graphs shown for questions showing statistically different changes.

From Table 9, both head injured and family raters tended to rate the frequency of individual variables as either above or below 50/100 for both pre- and post-injury driving. For example, variables such as hand position, moving smoothly and reading the road remained above 50 whilst such as driving too close, impulsivity and parking difficulties remained below 50. Head injured raters felt their frequency of being startled had risen from below to above 50. Further, while some variable frequencies reduced at post-injury (e.g. competing with others) other variable frequencies increased (e.g. poor road positioning). Significant changes following the head injury were observed for reductions in the frequency of driving too close to the car in front and competing with other drivers. Significant increases were shown in being made nervous, losing concentration and feeling tired. A significant rater effect was shown for being startled by other drivers with head injured drivers noting a higher frequency. A number of time and person changes exceeded the .05 significance level and suggests further effects could be appearing than would be expected by chance. There were no significant interaction effects although these approached significance at a .05 level with head injured ratings increasing for driving when unhappy and decreasing for family raters and the frequency of overtaking remaining stable over time for head injured raters but decreasing for family raters.

	HEAD INJURED		FAMILY		2-WAY ANOVA VALUES		
	PRE-INJ.	POST-INJ.	PRE-INJ.	POST-INJ.	TIME	PERSON	T x P
VARIABLES	MEAN RATING (N=18)		MEAN RATING (N=17)	MEAN RATING (N=18)	F-VALUES		
Hands in recommended position	55.44	60.67	57.06	56.94	0.45	0.13	0.26
Brake without using gears correctly	++29.12	++11.77	38.29	++35.56	5.99*	4.37	2.25
Drive when unhappy	45.44	47.72	62.12	49.06	0.35	1.44	4.65*
Drive too close to car in front	30.89	15.56	41.71	30.06	9.61**	6.33*	0.04
Startled by other drivers	46.39	52.78	26.35	39.17	2.72	24.02****	0.66
Forget to indicate	16.44	16.33	23.24	27.39	0.62	3.48	0.33
Involved in near accidents	27	21.44	20.94	24.88	0.001	0.09	2.32
Move smoothly	82.17	82.33	83.41	80.56	0.21	0.001	0.64
Overtake	57.11	51.67	67.59	47.5	7.06*	0.18	5.88*
Made nervous by driving	10.61	36.06	13.35	33.33	11.27**	0.1	0.66
Compete with other drivers	32.44	9.44	39.59	26.67	15.23***	8.09*	0.85
Overtake only when road ahead completely clear	77.44	72.94	60.71	63.56	0.06	3.73	0.75
Steer out of hazard - insufficient time to brake	39.00	33.44	42.35	28.28	6.81*	0.07	0.37
Intolerance of other drivers' mistakes	37.39	46.44	55.12	52.22	0.15	3.05	1.12
Poor road positioning while cornering	13.28	20.33	19.77	23.06	3.38	1.46	0.11
Accelerate with clutch disengaged	++7.77	++14.29	11.75	++12.35	3.28	0.02	1.22
Show indecision at junctions	11.94	26.83	15.12	30.50	7.83*	0.78	0.04
Driving style causes difficulty for other drivers	17.22	23.56	23.77	29.94	2.6	1.07	0.001
Tend to drive as if other traffic wasn't on the road	17.67	10.72	28.35	20.78	5.28*	4.88*	0.001
Are able to read the road	76.33	70.83	76.47	65.94	2.95	0.07	0.32
Lose concentration whilst driving	20.89	40.28	29.59	35.28	9.31**	0.03	3.1
Feel tired whilst driving	26.33	43.61	28.94	46.17	11.76**	0.43	0.04
Are impulsive whilst driving	31.72	35.78	42.94	31.06	1.58	0.07	2.23
Misjudge the speed/the speed of other cars	17.89	25.44	27.24	31.61	1.58	0.07	2.23
Find it difficult to park	8.83	25.5	15.06	27.39	5.71*	1	0.52

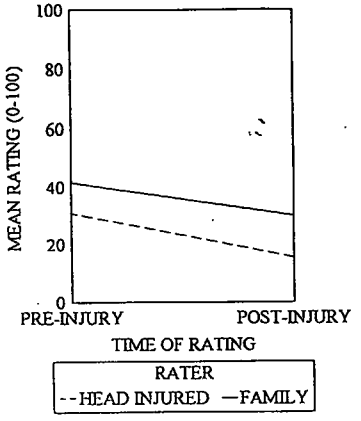
*** p<.05, **p<.01, ***p<.001, ****p<.0001**

++ N=17

TABLE 9 MEAN SUBJECT VISUAL ANALOGUE AND 2-WAY ANOVA ANALYSES OF HEAD INJURED DRIVERS' DRIVING SKILLS (SECTION B ADSQ) (PARAMETRIC DATA)

ADSQ VISUAL ANALOGUE SCALE RATINGS

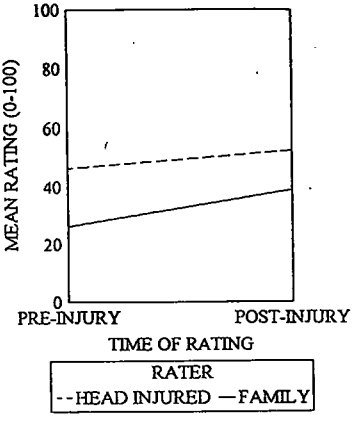
FREQUENCY OF DRIVING TOO CLOSE TO THE CAR IN FRONT



GRAPH 8

ADSQ VISUAL ANALOGUE SCALE RATINGS

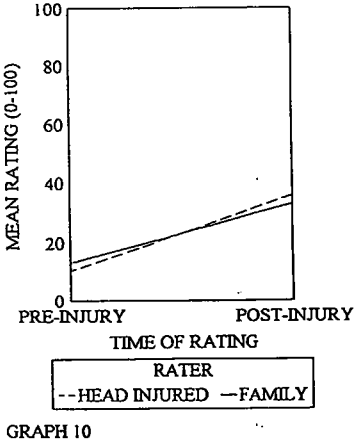
FREQUENCY OF BEING STARTLED BY THE BEHAVIOUR OF OTHER DRIVERS



GRAPH 9

ADSQ VISUAL ANALOGUE SCALE RATINGS

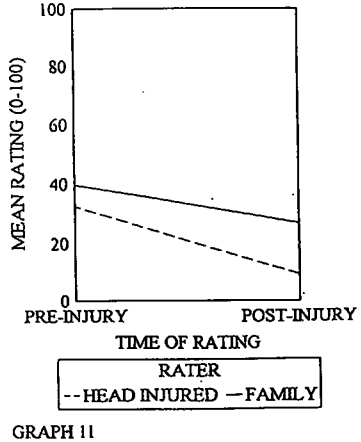
FREQUENCY OF BEING MADE NERVOUS BY DRIVING



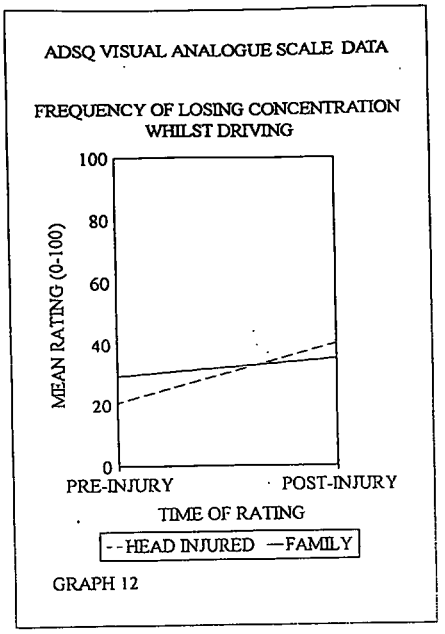
GRAPH 10

ADSQ VISUAL ANALOGUE SCALE DATA

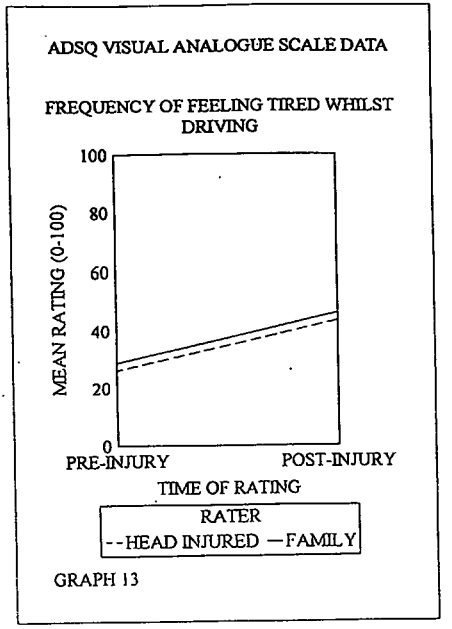
FREQUENCY OF COMPETING WITH OTHER DRIVERS



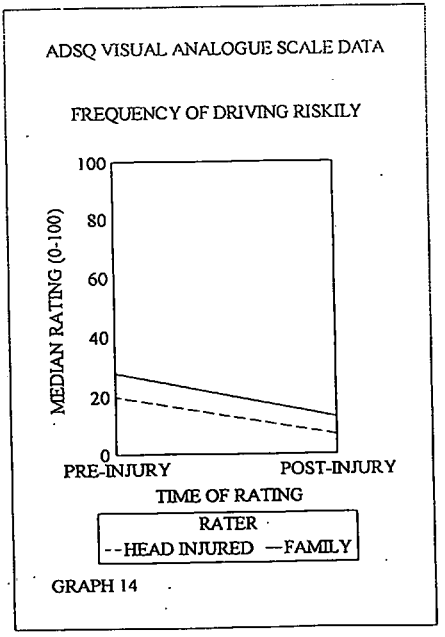
GRAPH 11



GRAPH 12



GRAPH 13



GRAPH 14

From the standard deviations reported in Appendix 5a(iii), there was a large variability in responses such that, in some cases, the standard deviation was larger than the actual mean value (e.g. head injured raters : poor road positioning mean = 20.33, s. dev. = 22.78). This may have affected the statistical analysis.

Non-Parametric Analyses

The medians for this section are contained in Table 10 with graphs shown for questions showing statistically different changes.

	RATER				WILCOXON SIGNED RANK TEST DATA			
	HEAD INJURED		FAMILY		TIME1 : TIME 2		HI DRIVER : FAMILY	
	PRE-INJ.	POST-INJ.	PRE-INJ.	POST-INJ.	HI DRIVER	FAMILY	PRE-INJ.	POST-INJ.
DRIVING VARIABLES	MEDIAN RATING (N=18)		MEDIAN RATING (N=17)	MEDIAN RATING (N=18)	WILCOXON Z-VALUES			
Drive riskily	20	7	28	13	-2.77**	-1.01	-0.76	-1.59
RANGE	6-94	1-65	3-85	0-61				
Have Difficulty in finding correct gear	7	7	8.5	11	-0.75	0	-1.29	-0.16
RANGE	0-30	1-76	0-54	0-45				
Carry out unnecessary manoevres	7.5	5.5	12	18.5	-0.91	-1.22	-1.75	-0.91
RANGE	0-33	0-71	0-49	0-72				
Drive as if taking a test	22.5	52	32	33	-2.50*	-0.12	-0.75	-0.93
RANGE	8-78	3-79	6-85	0-100				

TABLE 10 MEDIAN SUBJECT RATINGS AND WILCOXON SIGNED RANKS ANALYSES OF HEAD INJURED DRIVERS' DRIVING SKILLS (SECTION B ADSQ) (NON-PARAMETRIC DATA)
* p< .05, **p< .01, ***p<.001, ****p<.0001

From Table 10, the median scores also suggest some variable frequencies were consistently rated above 50 (e.g. rear-view mirror use) and others below 50 (e.g. driving riskily). The only significant change following head injury were median reductions in the head injured raters self-perceived frequency of driving riskily (See Graph 14). Other changes approached significance at a .05 level and suggested further effects were possible above chance.

Overall, although the majority of driving skills show no change, the results suggest some support for Hypothesis 1a. There is some evidence of significant perceived reductions in general driving skilfulness compared with the average driver and reductions in head injury relevant variables such as stamina and reaction times. However there was also some suggestion raters perceived a growth of less risky driving practices post-injury. These included less frequently driving too close to cars and being competitive. A high anxiety component to post-head-injury driving was suggested with such as being made nervous by driving being more frequent. However, as each of these changes were equally perceived by head injured drivers themselves the Null Hypothesis is suggested for Hypothesis 1b and no evidence of insight issues. Indeed, head injured drivers were more aware of being startled.

3.42 HYPOTHESIS 2 DRIVING BEHAVIOUR (2 TAILED)

2a HEAD INJURED DRIVERS WILL BE REPORTED TO SHOW CHANGES IN THEIR DRIVING BEHAVIOUR COMPARED TO PRE-INJURY LEVELS

$2a_0$ THERE WILL BE NO DIFFERENCE IN HEAD INJURED DRIVERS' REPORTED DRIVING BEHAVIOUR

2b THERE WILL BE A DIFFERENCE IN SELF VERSUS FAMILY REPORTS

$2b_0$ THERE WILL BE NO DIFFERENCE BETWEEN RATERS

Parametric Data

The means for this section are contained in Table 11 with graphs shown for questions showing statistically different changes.

From Table 11, some variables were rated consistently above 50/100 (e.g. driving enjoyment) whilst others remained below 50 (e.g. driving frustration). Also some variables were rated higher post-injury (e.g. controlling temper) while others fell (e.g. driving aggression). Most of these changes were modest, although 9 variables showed significant changes following head injury. Of these, both head injured and family mean ratings showed significant falls in driving enjoyment, confidence in ability to avoid an accident and taking risks. Ratings also fell in questions about overtaking whenever possible, feeling in command and feeling satisfied when overtaking. Significant mean increases from pre- to post- injury ratings were shown in worry about driving in bad weather, being more anxious on new roads, being tired when driving and difficulty in maintaining concentration whilst driving. While there were no significant person effects found at a .01 level, there was again evidence of .05 level person and time effects. Similarly, .05 level interaction effects were observed for worrying about driving in bad weather, overtaking anxiety, taking risks on the road and driving tiredness. From Graphs 16, 23, and 18, the mean family rating showed a larger proportional increase for the bad weather and tiredness ratings and a larger proportional fall in taking risks.

Non Parametric Data

The medians for this section are contained in Table 12. From Table 12, again some variables remained below 50 (e.g. too much driving) and others above 50 (e.g. accident possibilities). Following the head injury both rater groups rated a large fall in the power given by driving. However, none of the time and person effects were significant at a .01 level although some .05 level effects were again reported

From the data in Appendix5a(ii), there was evidence to suggest that the standard deviations of the VAS data were relatively high (e.g. head injured raters rating of driving enjoyment, s. dev = 31.97) and suggested high variability in group ratings.

	HEAD INJURED		FAMILY		2-WAY ANOVA VALUES		
	PRE-INJ.	POST-INJ.	PRE-INJ.	POST-INJ.	TIME	PERSON	T x P
DRIVING VARIABLES	MEAN (N=18)		MEAN (N=17)	MEAN (N=18)	F-VALUES		
Enjoy driving	81.94	59.11	78.53	62.06	11.51 **	0.04	0.58
Mind being overtaken	30.28	24.72	35.47	40.78	0.16	3.36	1.27
Irritated : drive aggressively	40.39	30.17	46.71	36.72	5.65*	1.62	0.06
Overtaken junction feel :							
Angry	48.06	34.17	47.77	44.33	6.59*	0.97	3.22
Anxious	32.28	42.67	28.59	35.11	1.99	0.22	0.09
Indifferent	53.22	38.33	44	41.94	0.08	0.13	0.08
Worry to drive in bad weather	30.61	47.28	16.53	41.56	11.06**	1.27	4.98*
Lose temper - other drivers' do something silly	53.89	56.94	45.53	51.33	0.48	0.97	0.04
Do not succeed in overtaking, usually feel :							
Frustrated	39	43.28	47.35	41.61	0.09	0.53	0.87
Anxious	23.72	43	27.41	30.83	4.88*	0.2	4.47*
Indifferent	45.83	42.83	33.77	35.61	0.08	1.92	0.1
Confident in ability to avoid an accident	77.72	64	80.82	63.17	9.35**	0.07	0.47
Worthwhile taking risks on the road	24.06	20.56	35.88	16.33	7.64**	0.1	4.53*
Annoyed when traffic lights change to red	44.67	42.67	50.59	43.17	0.85	0.12	0.35
Effort to look for potential hazards	70.56	80.11	68.41	72	1.7	0.59	0.96
Tend to overtake whenever possible	55.44	38.94	55.47	35.22	11.56**	0.31	0.42
Difficult to control temper	30.61	43.39	37.59	42.44	3.13	0.41	0.49
New road, usually more tense	35.06	58.11	32.06	52.33	20.88****	0.26	0.01
When overtake, feel :							
In command	78.39	61.83	78.88	69.06	6.58**	0.78	0.82
Satisfied	58.61	46.39	66.82	56.44	11.56**	3.43	0.04
Indifferent	44.56	44.83	30	36.22	0.42	3.86	3.94
Usually patient during rush hour	54.44	58.67	45.41	51.83	0.85	5.67*	1.78
Increase concentration	75.56	86.39	73.41	73.5	0.399	0.26	3.77
On the alert	76.5	80.33	77.71	73.5	0.1	0.33	0.77
Usually get bored during motorway journey	43.61	41.28	44.24	47.89	0.02	0.55	0.62

*** p< .05, ** p< .01, *** P< .0001**

TABLE 11 MEAN SUBJECT VISUAL ANALOGUE RATINGS AND 2-WAY ANOVA ANALYSES OF HEAD INJURED DRIVERS' DRIVING BEHAVIOURS (SECTION D ADBI) (PARAMATRIC DATA)

	HEAD INJURED		FAMILY		2-WAY ANOVA VALUES		
	PRE-INJ.	POST-INJ.	PRE-INJ.	POST-INJ.	TIME	PERSON	T x P
DRIVING VARIABLES	MEAN (N=18)		MEAN (N=17)	MEAN (N=18)	F-VALUES		
More anxious-driving in heavy traffic	44.06	57.06	34.18	46.11	3.73	1.5	0.09
Driving makes usually feel :							
Frustrated	22.67	30.22	20.65	32.06	2.95	0.001	0.28
Aggressive	29.17	25.56	34.71	37.28	0.22	3.19	1.85
Happy	57.44	52.44	60.06	56.33	0.35	0.14	0.01
Tired	37.89	43	20.47	47.72	8.66**	0.58	6.71*
Ready to react to other drivers' manoevres	75	44.78	77.18	67.67	2.53	0.15	0.78
Drive more carefully - approaching motorway contraflow	71.44	81.61	66	77.28	6.52*	1.29	0.04
Difficult maintaining concentration	19.61	41.61	22.41	46.56	18.42**	0.72	0.17
Consider driving stressful	36.44	46.61	36.24	43.83	2.17	0.02	0.33

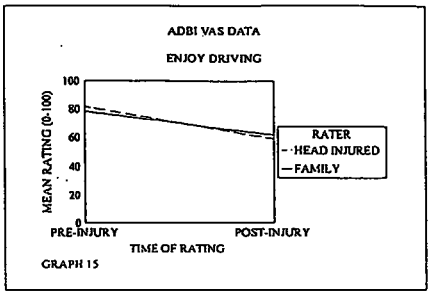
* p< .05, ** p< .01, *** P< .0001

TABLE 11 (CONTD.) MEAN SUBJECT VISUAL ANALOGUE RATINGS AND 2-WAY ANOVA ANALYSESOF HEAD INJURED DRIVERS' DRIVING BEHAVIOURS (SECTION D ADBI) (PARAMATRIC DATA)

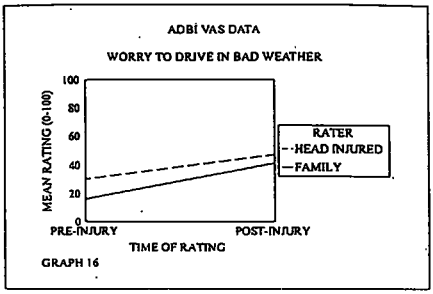
	RATER				WILCOXON SIGNED RANK TEST DATA			
	HEAD INJURED		FAMILY		PRE-INJ.	POST-INJ.	HI DRIVER	FAMILY
	PRE-INJ	POST-INJ.	PRE-INJ	POST-INJ	HI DRIVER	FAMILY	PRE-INJ.	POST-INJ
DRIVING VARIABLES	MEDIAN RATING (N=18)		MEDIAN RATING (N=17)	MEDIAN RATING (N=18)	WILCOXON Z-VALUES			
Too much driving is waste of time	20	14.5	17	20.5	-0.33	-1.07	-1.11	-0.0436
RANGE	3-93	2-81	2-87	1-100				
Accident possible because of others' poor judgements	89.5	90.5	78	82.5	-0.74	-1.37	-2.08*	-1.1541
RANGE	22-98	6-99	42-95	31-98				
Slow vehicles are traffic hazard	72.5	72	67	65	-1.26	-0.83	-1.23	-0.4573
RANGE	10-97	1-94	4-95	22-98				
Overtaking feel:								
Tense or nervous	13	42.5	15	21.5	-1.85	-2.39*	-0.44	-1.2847
RANGE	1-86	3-90	4-94	5-99				
Annoyed driving behind slow vehicle	50.5	53.5	70	88	-0.92	-2.15*	-1.54	-0.4137
RANGE	6-94	1-95	14-97	10-98				
Driving gives a sense of power	50	19	58	22.5	-1.94	-1.87	-1.02	-1.067
RANGE	5-92	2-84	11-94	8-99				

* p< .05, **p< .01, ***p<.001, ****p<.0001

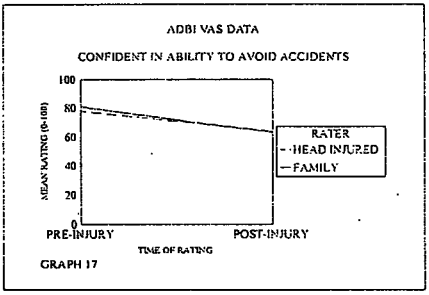
TABLE 12 MEDIAN SUBJECT VISUAL ANALOGUE RATINGS AND WILCOXON SIGNED RANKS ANALYSES OF HEAD INJURED DRIVERS' DRIVING BEHAVIOURS (SECTION D ADBI) (NON-PARAMETRIC DATA)



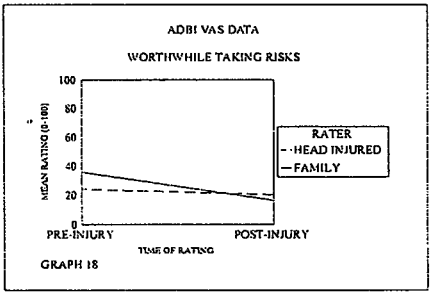
GRAPH 15



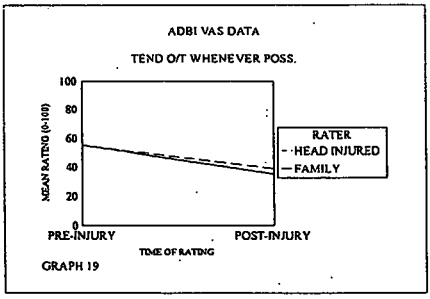
GRAPH 16



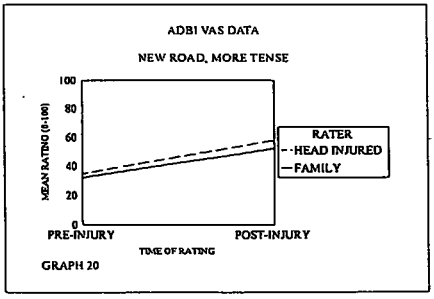
GRAPH 17



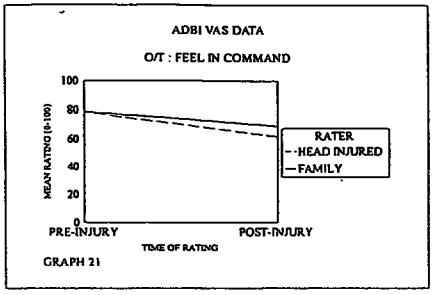
GRAPH 18



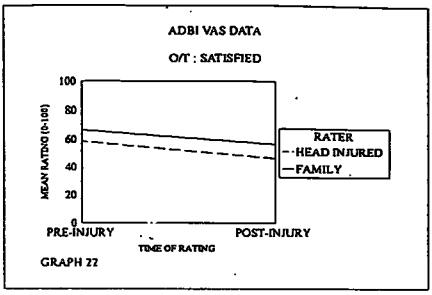
GRAPH 19



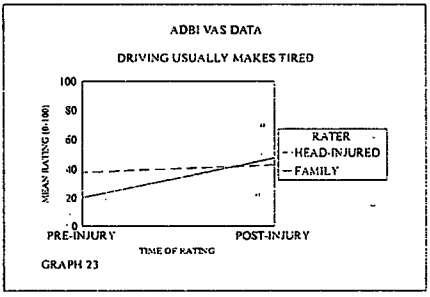
GRAPH 20



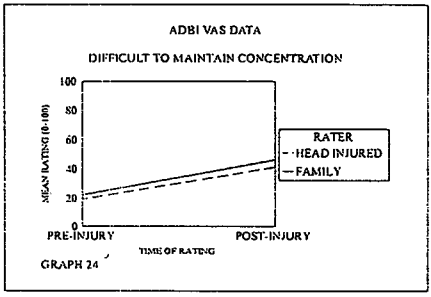
GRAPH 21



GRAPH 22



GRAPH 23



GRAPH 24

The data showed some support for Hypothesis 2a. Although most variables were unchanged, a number of specific changes in post-injury driving behaviour and attitudes were perceived. There was further support for the perceived importance of head-injury variables in driving such as increased fatigue and concentration difficulties. However, there was also support for the growth of less risky 'attitudes' with both rater groups feeling head injured drivers are less likely to take risks and overtake whenever possible. Finally, there was again support for an anxiety component to behavioural and attitudinal changes particularly in overtaking, driving in bad weather driving on unfamiliar roads and the ability to avoid accidents. Overall, such anxiety may contribute to the significant reductions in driving confidence and enjoyment of driving. As there was no difference between rater groups the Null Hypothesis is again suggested for Hypothesis 2b.

3.43 HYPOTHESIS 3 : ACCIDENT RATES (2 TAILED)

3a HEAD INJURED DRIVERS' ACCIDENT RATES WILL BE REPORTED TO HAVE CHANGED POST-INJURY COMPARED TO PRE-INJURY LEVELS

1a$_0$ THERE WILL BE NO DIFFERENCE IN HEAD INJURED DRIVERS' REPORTED ACCIDENT RATE

3b THERE WILL BE A DIFFERENCE IN SELF VERSUS FAMILY REPORTS

3b$_0$ THERE WILL BE NO DIFFERENCE BETWEEN RATERS

The means for this section are contained in Table 13. The raw scores are reported in Appendix 5d.

From Table 13 head injured respondents reported driving for a median of around 8 years pre-injury and 2.5 years post-injury. Family raters reported similar figures although their estimation of the time driven post-injury was significantly less at a .05 level. Further, both head injured and family raters suggested the median miles driven pre to post injury had also dropped. The calculated mileage drop was significant only from family raters' estimations. The family post-injury mileage estimations were significantly less than head injured peoples'.

While 9 head injured raters reported having accidents pre-injury, 6 reported post-injury accidents. Eight family raters report head injured people having accidents pre- and post-injury. Both rater groups reported a drop in median accident numbers at pre - injury. Although family raters suggested accident numbers post-injury were higher than head injured raters, no differences were significant following the head injury. Similarly, while the median miles per accident and accident rates calculated from head injured people's reports dropped post-injury and family rater medians rose, none of these differences were significant. However, as only a minority of head injured drivers were reported to have post-injury accidents, the group data tells us little about those individuals having accidents. From the raw data in the Appendix a number of individuals showed some changes. For example, subject 61 reported their miles per accident increased from 12,500 to 75,000 miles. His accident rate per year also fell from 2 to 0.33 and suggested their post-injury accidents were less frequent per miles driven. Their family raters also reported a similar picture. Subject 115's miles per accident dropped from 536,250 to 47,812.5 miles and their accident rate rose from .08 to .94 suggesting an increased frequency.

Qualitative analysis of post-injury accidents showed great variability with no consistent pattern. However a number reported accidents occurring when manoeuvring at junctions or roundabouts at speeds of less than 10 mph. For example subject 116 reported turning right at a junction and being hit by an oncoming driver

	MEDIAN RATING				WILCOXON SIGNED RANKS DATA			
	HEAD INJURED		FAMILY		PRE INJ. : POST INJ.		HI DRIVER : FAMILY	
VARIABLES	PRE	POST	PRE	POST	HI	FAMILY	PRE-INJ.	POST INJ.
TIME DRIVING (YEARS)	7.88	2.5	7.79	1.83	-1.6	- 2.35*	-1.43	-0.04
N	18	16	15	17				
RANGE	0.1-32.83	0.67-23.84	0.1-28.83	0.67-23.83				
TOT. MILEAGE (EST. ANN. MILES x T. DRIVING)	145000	47812.5	140000	18000	-1.25	- 2.76**	-0.7	- 2.29*
N	17	15	13	13				
RANGE	0-656667	2500-198958.3	7200-720833	6000-119166.7				
NO. ACCS.	0.5	0	1	0.5	-1.72	-1.01	-0.56	-0.49
N	17	18	16	16				
RANGE	0-4	0-3	0-6	0-3				
MILES PER ACC. (TOT. ANN. MILES/NO. ACCS.)	29166.66	0	1500	14166.67	-1.72	-0.42	-1.01	-0.68
N	16	17	16	12				
RANGE	0-328333.35	0-395000	0-350000	0-119166.7				
ACC. RATE (NO. ACCS./TIME DR.)	0.6	0	0	0.21	-1.17	-0.46	-0.66	-1.69
N	17	17	16	16				
RANGE	0-2	0-0.94	0-0.75	0-1.33				

TABLE 13 MEAN ACCIDENT INFORMATION AND WILCOXON SIGNED RANKS ANALYSES

* p< .05, ** p< .01, *** p<.001, **** p<.0001

whom he "didn't see". Two people blamed their accident on being tired, 1 on anger and 3 on anxiety. Subject 116 blamed his second accident on anxiety at driving on a new road and "impulsively" cutting across 2 lanes at a roundabout entrance before being hit from behind by an oncoming car. As reported before, subject 43's accidents had played a major role in his decision to stop driving. In particular, he blamed his first accident on misjudging the stopping distance behind another car at a roundabout and the second one on losing concentration before hitting another car at a roundabout.

Thus, the group data tends to support the null hypotheses of no change in accident rate or any differences between rater groups (although family raters reported slightly more accidents and a slightly higher post-injury accident rate). From open comments of the post-injury accidents there was a suggestion that being tired or anxious can make the head injured person vulnerable especially when turning at junctions and approaching roundabouts.

3. 5 SINGLE CASES

The group statistical analysis has enhanced our picture of the head injured driver and suggests changes in driving post-injury are perceived equally by family members and head injured people themselves. However, as shown in the accident analysis it is important to note whether individual experiences consistently depart from these trends. From the raw scale scores used in the reliability analyses (see Appendix 5b) it was possible to pick out consistent differences between subject couples within each scale. As all positively phrased questions were reverse scored to ensure all scores within a scale followed the same direction, relative score increases suggest the rater consistently perceived increases in unwanted driving variables and decreases vice-versa.

From Appendix 5b a number of cases show the head injured persons' rating consistently differently from their family rater. In 6 cases the head injured person's

ratings fell post-injury while their family raters' rose on at least 1 scale. Subject 12 stands out as this effect was consistent through each scale. On Scale A (scale comparisons on the ADSQ), Subject 12's summed rating fell from 22 to 17 pre- to post-injury and their family rater's score rose from 13 to 18. These scores suggest the head injured persons' post-injury driving experiences were of reductions in unwanted driving behaviours whilst their family raters saw them increase. In open comment, Subject 12 was positive about his driving and felt he had seen many positive changes such as driving more carefully and was now taking the Advanced Driving Test. While his mother felt his basic driving skills were "adequate", she highlighted examples of what she termed "irresponsible" behaviour (e.g. her son had recently driven through their village backwards as a "dare"). This may reflect disinhibition post-injury and suggest insight could have been an issue in this case. While such small numbers make it difficult to pinpoint trends for these individuals, it is interesting to note 5 had severe head injuries and had their accidents less than 4 years before the interview.

4.0 DISCUSSION

4.1 SUMMARY OF RESEARCH FINDINGS

The aims of the research were to explore the post-injury driving experiences of a head injury clinic cohort. The second, and principal, aim of the study was to determine the usefulness of both self and family report measures in enhancing our clinical knowledge of post-head injury driving.

Of a suitable rehabilitation population of 114 head injured people, 65 replied to the initial screening questionnaire. This was a reasonable participation rate for a head injured population and provided a cohort whose severity of injury and rehabilitation outcome was similar to previously researched neurosurgical populations. While 77% of the respondents had driven pre-injury, 70% of these pre-injury drivers had driven at some point post-injury. The 35 post-injury drivers participating in the screen had less severe head injuries than the whole cohort. Although the 18 head injured drivers subsequently interviewed were representative of the whole group of head injured drivers, none of the severely disabled drivers replying to the screen took part in the second stage.

From the qualitative information gathered in the screen and at interview, being able to drive post-injury was clearly important right across the private and work lives of head injured people regardless of whether they had actually returned to driving. In particular, many head injured respondents felt driving was an important source of independence and a symbol of normality as they recovered from their injuries. Despite this importance, the respondents suggested the involvement of both legislative and health services had been patchy. Information about returning to driving was often limited to verbal conversations with GPs about the legislative process or the potential effects of head injury on driving. A number pointed to a lack of information as a grievance with the system. Only a minority of respondents had an assessment of any kind and this was often confined to a number of driving lessons with an ordinary

driving instructor. Crucially, from the 18 people interviewed, 8 had not informed the DVLA about their head injury and hence had not been part of the re-licensing procedure. However, a majority of the 15 non-drivers responding to the screen knew why they were not driving (principally confidence and concentration).

Of those returning to driving, both the screened and interviewed drivers said this was around 8-9 months post-injury. Both head injured people themselves and family participants suggested anxiety was common in the process of resuming driving whilst others pointed to early difficulties in dividing attention to the array of car dials and route finding.

At the time of interview, most head injured people were perceived to have driven for less time post-injury and had smaller annual mileages than pre-injury (although family raters estimated significantly lesser post-injury mileages than head injured people). As regards the qualitative perceptions of head injured people's driving post-injury, the comments from both head injured drivers themselves and their families suggested some consistent themes. Firstly, respondents perceived head injured drivers enjoyed driving less and were more anxious whilst driving compared to pre-injury. Secondly, while the majority of participants reported few overall changes in driving style, a number of specific changes such as driving more slowly and having greater awareness of weather conditions. The Lickert scaled data on the ADBI also suggested few overall behavioural changes although there was evidence that head injured drivers were perceived to feel most drivers drive too fast.

The investigation of the experimental hypotheses tended to confirm the qualitative themes reported above and suggested a small number of specific driving changes. However, contrary to expectations such changes were equally perceived by both families and head injured people.

While exploration of Hypothesis 1 suggested head injured drivers' skills were perceived to have generally remained above average, significant declines were rated in driving skilfulness and a number of head injury relevant variables added to the ADSQ such as reaction times and driving stamina. The data also showed 'risky' driving practices such as competing with other drivers became less frequent. There was evidence to suggest the further involvement of anxiety in driving skills with increased frequencies of nervousness. Head injured drivers were more aware of being startled than family raters perceived.

Exploration of Hypothesis 2 paints a similar picture of the extent of behavioural and attitudinal change post-injury. While the majority of the visual analogue variables showed no significant changes, there was evidence that the rating of the head injury questions added to the ADBI such as concentration difficulties increased compared to pre-injury. There was again evidence of perceived reductions in behaviours and attitudes linked to risky driving such as taking risks. Finally, behavioural changes were also perceived to include anxiety-related variables such as reduced confidence about overtaking abilities, and worrying about driving in bad weather. Head injured drivers were perceived to enjoy driving less.

For the interviewed group there was no evidence of an increased accident rate post-injury, although the overall mileage post-injury was less than pre-injury.

While the group data unexpectedly did not suggest differences in the perceptions of head injured drivers' themselves and family raters, there were a number of single cases where the head injured person minimised the existence of unwanted driving behaviours post-injury while their family members felt they had substantially increased. While few definitive comments can be made at this stage, there is clearly a need for further investigation.

4.2 METHODOLOGICAL CONCERNS

This section is focused on the interview measures as the main thrust of the study was to explore their usefulness. The interpretation of the research findings can only be placed in a realistic context if a number of methodological concerns are addressed. These fall into three categories : the effect of the nature of the research sample; the suitability of the interview measures and study design in this context; and the sensitivity of accident rates.

(a) The Nature of the Sample

Firstly, while the sample size of participants in the screen provided an ample population base to gain some very broad information about post-head injury driving, the interviewed sample was relatively small. This makes it difficult to draw firm conclusions from the results and means the interpretation provided in the next section is relatively limited. Further, the small subject numbers also prevented the use of factor analysis as a basis for summing the high number of interval questions into scales for statistical analysis. While treating the questions on an individual basis provided a useful means for extracting the important variables, this meant a large number of statistical tests were performed on each measure. However, although a relatively strict level of probability for accepting significance was accepted because of the number of tests performed on individual items, the number of findings which exceeded the .05 probability level were greater than would be expected by chance. This may suggest the analysis excluded real differences.

Although the screened and interviewed drivers were comparable in terms of median PTA, the 6 severely disabled drivers replying to the screen were not interviewed. While it is impossible to know whether such people may have qualitatively different post-injury driving experiences from the interviewed group and their reasons for not participating, this does call into question the absolute representativeness of the findings for all head injured drivers.

The cross-sectional nature of the study also poses some difficulties. Being cross-sectional, the survey provides only a single snap-shot of drivers before their injury and now afterwards. This does not provide a picture of how driving changes over time from when drivers first go back to regular driving post-injury. From the interviews there was some suggestion that many head injured drivers found restarting driving stressful and exhibited early difficulties. The present study was unable to assess how, or to what extent, the respondents felt such difficulties had been resolved.

(b) The Suitability of The Measures For Post-Head Injury Driving

As suggested in the review, driving self-report has been relatively neglected by the head injury literature. Therefore this study, by necessity, had to adapt pre-existing questionnaires that measure general constructs of ordinary driving. As such, the focus of both of the original Driving Skill and Driving Behaviour Inventory measures is on basic driving skills and behaviours (such as gear use and driving behind slow vehicles). The results suggest little change in these basic driving techniques. In a sense this is not surprising given this moderately disabled group had no physical changes requiring car adaptations. From this, there is no logical reason why their mechanical control of the car would have altered and have lead to significant changes in the ratings of such questions in the measures. Indeed, the Gronigen literature tends to support this with few of their head injured subjects showing gross difficulties in basic car handling on the advanced driving test (e.g.. van Wolffelaar et al 1988). Further, clinical experience (Tyerman, personal communication) suggests overlearned basic motor skills are often relatively unaffected in most severely head injured people. The results here suggest the variables that do show perceivable changes for head injured drivers are more specifically related to their head injury, increased anxiety and attempts to reduce risky driving behaviours. Thus, it may be that the present measures are too broadly focused and do not explore the more directly relevant issues to a sufficient extent.

(c) The Suitability of The Research Design For Driving

The rationale of the research design was that perceptions of the everyday driving of head injured people would give a valid clinical picture of their driving. This is because repeated exposure to the head injured person's driving gives a unique impression of their driving. While, the author stands by this, it is important to note three major issues raised by using the design in this context that may affect the absolute accuracy of the ratings.

Firstly, driving is a very different context from those in which the technique of comparing the perceptions of head injured people and their families was originally developed. The technique is primarily used to assess clinically-relevant issues such as personality and family role change following head injury (e.g. Tyerman et al 1994). Importantly, these domains have intuitive meaning for both head injured people and family members and are arenas where they can be 'comparative experts' (van Zomeren and van den Berg 1985). For example, simple family role changes can include the extent that "Dad is still main earner" in the family (Young 1994). However, as Michon (1979)'s model suggests, driving involves an array of psychological, motor and environmental factors which range from easily conceptualised basic car handling techniques to complex higher level planning. Importantly, this means that the raters were faced with some questions on easily understood things like hand positions to complex issues like planning ahead. Therefore, it may be that some ratings were accurately made from what observers saw and experienced whilst others may have been 'educated guesses' from overall impressions. Further, family raters may have had particular difficulties where they were being asked to rate less concrete and observable entities. There is some evidence of this from the validity analysis. Family visual analogue ratings on the ADBI (which included questions asking about attitudes) were relatively unrelated to their ratings on the other scales (which principally ask about more concrete driving skills). Similarly, many of the head injury variables may be more difficult to accurately assess unless you are personally

experiencing them. In this respect, the reliability analysis suggested family ratings of Section A of the ADSQ were less reliable and internally consistent than head injured people's self assessments.

Secondly, the design asks for retrospective ratings of pre-injury driving. On a basic level, such ratings may be inaccurate purely because of the time that had elapsed since the head injured person's injury (over 20 years in a number of cases) and because memory difficulties are one of the most common residual difficulties that head injured people face (Wilkinson et al 1989). Further, driving is a commonplace activity which most people take for granted unless they experience problems. Thus it is likely that neither the head injured nor the family raters had clearly defined percepts of pre-injury driving performance. Therefore assessments about pre-injury driving could be rough guesses. However, as most of the respondents had received their injuries in a car accident and most are given the message that driving 'may be a problem post-injury', post-injury driving performance is likely to be given closer scrutiny by both head injured and family raters. This probably means contemporary ratings are likely to be more accurate.

Finally, driving is also unlike the previous contexts where the matched-pairs design has been used before because there is a clear element of risk. It is possible to speculate perceptions of any risky driving behaviour may be minimised by cognitive dissonance (Festinger 1957). The information from the screen indicated the great importance invested in driving post-injury. In line with Festinger's theory, should the head injured person start to self-perceive risk whilst driving they may place great store in their risk reduction strategies in order to have a consistent view of themselves as 'safe drivers'. In a similar way if a family member depending on the head injured driver to transport them also perceives the head injured person to be dangerous, this is very threatening. The family member may be motivated minimise this threat by seeing the head injured person as a 'safe driver who attempts to compensate'.

Thus, this context raises some questions about the absolute accuracy of driving perceptions - particularly at two time points and when you have to assess anothers' driving ability.

(d) The Sensitivity of Accident Rates

As Brown, Groeger and Biehl (1987) note, accidents represent only part of the picture of dangerous or risky driving. Driving includes a range of driving behaviours which are clearly risky but do not result in accidents. This may mean that accident rates per se may be relatively insensitive indices of risky driving and it is important to note that a lack of evidence of increased accidents post-injury does not necessarily suggest they drive more safely.

4.3 INTERPRETATION OF FINDINGS

(a) Resuming Driving and The Re-Licensing Process

Driving is clearly an important issue for most people after having a head injury. It is symbolic of independence and participation in family activities. However, the subjective impression from both head injured people and family members was of receiving sparse information about the process of returning to driving. While respondents may have lost or forgotten information they had been given, this information breakdown may explain why a substantial number of those interviewed had not informed the DVLA about their head injury or been tied into a system of driving assessments. This suggests a gap in the support provided for head injured people wishing to resume driving.

The above situation may arise because intensive involvement with head injured people by healthcare systems tends to be most intense within the first 6 months post-injury in hospital departments or within the first year in rehabilitation centres (British Psychological Society 1988). From the results, this period is likely to end before people attempt to resume driving at around 8 to 9 months post-injury. Indeed, driving

may not be seen as relevant for most people during their early rehabilitation as the attention of both head injured people themselves and health professionals is focused on remediating more acute physical and cognitive difficulties (British Psychological society 1989). Thus, while returning to driving is often raised by head injured people at some point during rehabilitation (Fox et al 1992), it is not routinely raised in most rehabilitation settings (Tyerman, personal communication) and may get missed out.

(b) The Experience of Post-Injury Driving

The interpretation here is confined to the data from the interview measures and therefore only tentative conclusions are made.

The results suggest the perceived picture was a mixture of both positive and negative findings. Positively, the data suggested little perceived change in the majority of driving variables and confirms that no gross alterations in driving were observed by the respondents. There was some evidence of perceived changes in specific areas which could be termed 'negative'. These included the increased relevance of specific head injury variables and anxiety. More positively, the results did not highlight issues of insight and suggested head injured drivers were generally perceived to engage in less risky driving behaviours. The findings which highlighted the perceived importance of head injury variables and anxiety in post-injury driving are discussed below. The issues surrounding insight and reductions in risky behaviour are discussed in the theoretical section.

The results suggested many of the variables which were added to the measures because they relate to psychological skills which are known to change following head injury increased in perceived frequency and relevance in the post-injury driving experiences of head injured drivers. This picture adds to the literature because it provides some evidence to tie the residual psychological difficulties commonly found within head injury rehabilitation populations (e.g. Wilkinson et al 1989) to the

perceived everyday driving experiences of head injured drivers. Importantly, the perceived changes are seen not only in basic operational abilities such as reaction time but also higher-level skills such as tactical planning. This provides some support for the intuitive concerns of clinicians.

Perhaps the most consistent finding produced throughout the data set was the extent of anxiety reported in post-injury driving. Anxiety seemed to affect each perceived component of driving and includes reduced confidence and increased nervousness. This is perhaps not surprising considering most of the respondents had received their head injuries in car accidents. Indeed, a number of head injured people reported fearing further accidents. However, three people reported symptoms reminiscent of a post-traumatic stress or anxiety reaction. While such reactions are common following road accidents in the general population (Mayou 1992) there is some single case evidence (e.g. McMillan 1991) to suggest the existence of PTSD-type symptoms such as startle responses in severely head injured people. In this study, there is some suggestion anxiety responses could be triggered by driving in the same conditions and locations they were told the accident occurred.

4.4 THEORETICAL CONTEXT

The most important theoretical issue underlying the study was the area of insight. As suggested in the literature review, insight has very practical implications both in the degree that drivers compensate for their difficulties and co-operate with the legislative requirements of the re-licensing procedure.

It was clear from the statistical analyses that the specific changes in driving were generally equally perceived by both head injured people and their family members. However, six single cases were highlighted because the head injured person consistently minimised perceptions of unwanted driving variables compared to their family respondents who saw them increase. While a statistical analysis was not

performed on these differences, insight may have been an important issue and there was a suggestion of increases in some of their accident rates post-injury. Without more detailed analysis little can be said definitively other than there are individuals where driving raises serious issues about insight and adequate compensation.

For the vast majority of head injured people, insight plays less of a role than expected in post-injury driving. Allied to this, ratings and comments suggested head injured drivers were perceived to drive less and engage in less risky driving behaviours. Such changes are reminiscent of the compensation strategies reported in Brouwer et al (1988)'s survey of head injured drivers. This then sets up the possibility that most head injured drivers are aware of a number of driving changes related to their head injuries and attempt to compensate for them in some way. However, the data reported here (particularly because of the insensitivity of accident rate measures) does not allow definitive interpretation of the extent of insight or how adequately it allows head injured people to compensate.

However, the qualitative reports of the respondents and the ubiquity of post-injury anxiety allow some speculation on mechanisms which may lead to a degree of compensation. Firstly, it may be reasonable to speculate that a basic 'filtering' process occurs with drivers with gross driving difficulties dropping out. The three people in the screen who had returned post-injury and then stopped driving particularly highlighted both concrete events such as accidents and emotional factors such as anxiety and subjective feelings of being 'unsafe' in their decision to stop. For these people, the emotional negativity of their post-injury driving experiences may have provided an impetus to stop. Anxiety may also play a significant role in the compensatory driving practices of those who continue to drive. Anxiety may inflate perceptions of risk particularly from 'other' drivers. Interestingly, the number of head injured people who were perceived to feel most drivers drive too fast significantly

increased. This may mean head injured drivers are compensating for their anxiety rather than for their head injury.

Secondly, on an impressionistic level, a number of respondents suggested driving was initially difficult but perceived few problems at the time of interview. While some cognitive improvement may be expected up to 2 years post injury (British Psychological Society 1988) and may account for some improvements in driving, it is interesting to speculate whether compensatory practices also arise from a feedback and learning process gained in repeated driving situations post-injury. Over time, the driver may learn their reaction times are not be as good as they used to be. Learning this may, for example, come from the emotional consequences of 'nearly crashing into the car in front' driving or from a family member making comments about driving mistakes. Such processes could be sufficient to make the driver slow down. While this may be enough to allow head injured drivers to drive reasonably safely, it is unlikely to have led to a complete process of self-awareness. It is likely that this develops over time and becomes more extensive from repeated exposure to such experiences. As five of the highlighted single cases had their head injuries relatively recently, it may be possible to speculate such learning experiences have not yet become extensive for these people.

What is important both theoretically and empirically from the above, is that we cannot know from this data the extent that insight is present and its effectiveness in orientating compensatory driving practices. However, it is possible to envisage alternative mechanisms- chiefly mediated by anxiety and experience over time - which may lead to partial compensation.

4.5 CLINICAL IMPLICATIONS

The results have a number of important clinical implications:

(a) A Support Role for Rehabilitation Services

Despite the importance placed on returning to driving, a substantial number of head injured drivers did not inform the DVLA about their injuries and/or felt they had not received much in the way of information or assessment. Concentrating on the rehabilitation context, this suggests the need for services to develop clear policies on handling driving issues. At the most basic level, policies could include routinely handing out the Headway leaflet on 'Returning to Driving' (1994) and encouraging clients to inform the DVLA about their injuries. Following on from this, if the head injured person wishes to try driving, services may have a useful role in supporting the client through the assessment process. Indeed, if driving is not realistic it may be important for clinicians to recognise the loss that this involves and the potential implications for clients social and family participation.

Beyond the assessment stage, there was strong evidence that returning to driving can be stressful. In the early stages, anecdotal evidence suggests specific problems can occur such as route finding. While such difficulties may resolve over time for most people, anxiety seems to remain a constant feature for all post-injury drivers and there may be a small number for whom difficulties continue. While it would be unrealistic to expect rehabilitation centres to follow up drivers over long periods of time, from the above most clients may benefit from support at least early on while others may need continuing support. This support could be facilitated by regular and specific driving clinics where clients could seek further information, referral on for specialist driving assessment and gain access to further interventions (particularly around anxiety issues) as required.

(b) The Usefulness of Self-Report

Although there are limits to the absolute validity of the findings, the experience of carrying out the research suggested self-report may indeed be a useful avenue to explore in enhancing our clinical picture of post-injury driving. At the most basic

level, the interview format provided a forum for both head injured people themselves and family members to air their concerns about driving. While further work needs to be carried out to improve the exact structure and content of the measures, they added to the literature by consistently highlighting the role of head injury-mediated psychological changes, anxiety and perceived compensatory changes made in post-injury driving. Finally, the experience of the study suggests both head injured and family members are useful informants for the clinician when considering driving.

4.6 FUTURE RESEARCH

Although the findings reported here are clearly exploratory, the above suggests they have clinical value and may have relevance for services. However, there is also much scope for further research - both to improve the research design and the measures used and to widen the scope of the work.

(a) Widening the Scope of the Research

At present, negotiations are ongoing with the Department of Transport's Research Laboratory at Crowthorne for a joint research project with Rayners Hedge. It is proposed that Head Injury Clinic clients will be assessed on a series of standard and specialist neuropsychological tests and a revised self and family report interview (See below) at Rayners Hedge and specialist driving tests at Crowthorne. The intention is to have a larger and more broadly based cohort than in this study and to follow them up longitudinally from the early stages of resuming driving. It is hoped this design will enhance the predictive validity of tests as repeated assessments are less vulnerable to skew from chance effects. This will also allow the researchers to build up predictive neuropsychological profiles of those clients whose driving presents difficulties both on formal testing and on reports of everyday driving. However it will be important to determine whether the instruments are sensitive to change and do not have large practice effects (Miller 1992). On a qualitative level, this design may give

a clearer picture of how problems develop and are compensated for over time. Currently, a steering group has been convened to agree the research proposal.

(b) Developing the Self and Other Interview Measures

In many ways this research has been an extended pilot exploration of the utility of self and other report in providing a picture of post-injury driving. The semi-structured interview was a useful forum for open comment as were the background sections of the Driving Behaviour Inventory. However, the visual analogue measures used in the interviews were relatively unsophisticated adaptations of general driving questionnaires. The results indicate the need to develop a specific head injury driving measure. It would make sense to merge the significant variables gleaned from the two interview measures into a single questionnaire. The qualitative data suggests additional items such as difficulties with route finding or night driving could usefully be added. If the new measure was then piloted on a large data set a factor analysis could be performed to derive the basic psychological constructs that comprise perceptions of head injured driving. This would allow the development of scales which could undergo a more sophisticated reliability analysis and pinpoint the variables which affect internal consistency. This larger subject sample may be difficult to recruit and may require clients from a series of other centres to increase subject numbers.

Secondly, it will be important to consider the nature of the comparisons made. The discussion suggested pre-injury ratings may well be difficult and unreliable. Thus, it may be more logical to assess only the head injured person's current driving. While this would have the added benefit of halving the length of the interview measures, it will be important to derive normative comparison data for the measures. From the literature review, previous work does not clearly indicate whether non-clinical or disabled driver groups are the most appropriate reference group. However, compared to a disabled group, a general non-clinical population may be more appropriate as

larger numbers could be assessed and could provide a broader ability range for a reference group.

4.7 CONCLUSIONS

The major conclusions from the study were :

1) Driving after head injury is important for most head injured people regardless of whether they now drive. Driving is important for independence, maintaining social participation and is a symbol of returning to normal after the injury.

2) Those who return to driving tend to have less severe head injuries and good rehabilitation outcomes. They tend to return around 8 months post-injury. A substantial minority do not inform the DVLA about their head injury and many receive little information or do not have driving assessments. High initial anxiety is reported when they return.

3) The overall picture of driving post-head injury is mixed. There was no evidence either of a perceived decline in most of the basic aspects of driving or reports of increases in accident rates. However, specific changes were perceived in : variables similar to the residual psychological difficulties of head injury; head injured drivers' attempts to engage in less risky driving; and the amount of anxiety engendered by driving. Although less of an issue than expected, single cases were highlighted where insight may have been a problem.

4) Clinically, the results highlight the need for rehabilitation services to develop policies around post-injury driving. Services may need to support their clients through the re-licensing process and be alert to both the anxiety common in post-injury driving and individuals where insight may be an issue.

5) It is proposed to replicate the findings of this exploratory study in a large-scale longitudinal cohort project. This study will also include specialist neuropsychological and 'on-the-road' driving measures. Revisions to the self- and other-report interview measures should include : collapsing questions into a single head-injury specific questionnaire; deriving its factor structure on a larger data set; assessing only current driving; and developing general population norms.

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APPENDICES

1. CORRESPONDENCE

STAGE 1 : INVITATION TO SCREEN

(a) Explanation Letter

(b) Letter to Participants' GPs

STAGE 2 : INVITATION TO INTERVIEWS

(c) Feedback Letter to Drivers (From Screen), and Invitation to Head Injured People and Family Members to Participate in Interviews

(d) Preliminary Results Handout

2. MEASURES

STAGE 1 : SCREEN

(a) Driving Experiences Questionnaire

STAGE 2 : INTERVIEWS

(b) Introductory Preamble

(c) Semi-Structured Interview

(d) Adapted Driving Behaviour Inventory (ADBI)

(e) Adapted Driving Skills Questionnaire (ADSQ)

3. ETHICAL SUBMISSION

Ethics Committee Letter of Approval

4. GLASGOW OUTCOME SCALE CATEGORIES (Following Conversion to Numerical Categories)

5. TABLES

(a) Variable Means, Standard Deviations and Kilmogorov-Smirnov One-Sample Goodness-Of -Fit Tests :

(i) ADSQ (Comparisons to Other Drivers)

(ii) ADSQ (VAS Data)

(iii) ADBI (VAS Data)

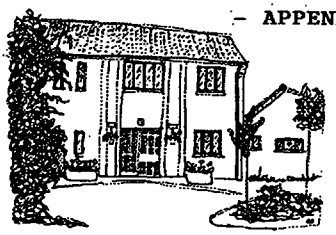
(iv) Driving Experience and Accident Information

(b) Raw Scale Scores

(c) Chi-Square Values of Lickert-Scaled Data From Sections A-C of the ADBI (Converted into Binary Choice Data)

(d) Raw Pre and Post-Injury Driving Experience and Accident Rate Data

- APPENDIX 1(a) -



Rayners Hedge

Croft Road, Aylesbury, Bucks HP21 7RD
Tel: Aylesbury (0296) 393319

Date Your Ref Our Ref

Dear ,

At Rayners Hedge we are currently undertaking a study about head injured people and car driving. We would be very interested in your views whether or not you are driving since your head injury. Some may feel that they now drive more safely while others may find driving more difficult. Very little is known about this topic at the moment. However, your views and experiences will help ensure that head injury services can provide the most effective support and advice for those who want to return to driving. We are aware from our clinical work and previous research just how important driving is.

Our first step to increase our knowledge is to find out some basic information about your experiences of driving after your head injury. We have enclosed a questionnaire specially developed for this purpose.

If you are interested in filling out the questionnaire please read the enclosed information sheet and fill in the enclosed consent form. If you find any difficulty, please feel free to fill in the questionnaire with the help of your family. **Any information you give us is completely confidential and will not be used by any authority to assess your driving.**

If you do wish to take part in the study, I would be grateful if you could complete and return the following in the envelope provided:

The enclosed consent form

If you have not returned to driving following your head injury :
* Pages **1 and 2** of the questionnaire

If you have returned to driving :
* Pages **1 and 3** of the questionnaire

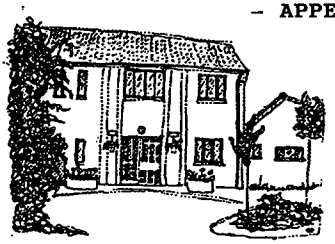
We look forward to hearing from you in due course and many thanks for your time. Please do not hesitate to get in touch with us at the above number if you have any query.

Yours sincerely

Gavin Newby M.A. (Hons)
Clinical Psychologist in Training

Dr. Andy Tyerman PhD., C.Psychol.
Consultant Clinical Psychologist

- APPENDIX 1 (b) -



Rayners Hedge

Croft Road, Aylesbury, Bucks HP21 7RD
Tel: Aylesbury (01296) 393319
Fax: Aylesbury (01296) 392480

Date | Your Ref | Our Ref

Dear Dr.

re:

The Rayners Hedge Head Injury Service are proposing to undertake a research project with people who have experienced a head injury. We are interested in head injured peoples' feelings about driving in general and their actual driving experiences if they have returned to car driving. We are writing to you as we would like to include your above patient in our research.

Little is known about how head injured people actually drive after they return to the car after their head injury. We intend to send head injured people a driving experiences questionnaire and then invite those who have returned to driving for an in-depth interview. Interviewing both head injured people themselves and someone who is close to them will provide an invaluable insight into the degree of any changes experienced in driving after the injury. We have enclosed copies of the invitation letters that would be sent to the above.

The research is being undertaken in part fulfilment of the British Psychological Society/Open University's Doctorate in Clinical Psychology.

We intend to send the initial questionnaire to the above patient in **two weeks time**. Please do not hesitate to get in contact with me at the above address within this time if you have any further queries or concerns.

Yours sincerely

Gavin Newby M.A. (Hons)
Clinical Psychologist in Training

Dr. Andy Tyerman PhD, C.Psychol.
Consultant Clinical Psychologist

Rayners Hedge

Croft Road, Aylesbury, Bucks HP21 7RD
Tel: Aylesbury (0296) 393319

Date Your Ref Our Ref

Dear

Many thanks for completing the questionnaire on driving that we sent you recently. The information that you provided will be invaluable in helping the head injury service to support other head injured people who want to return to driving. We are writing to all of the people who returned questionnaires to feedback the results. Please see the attached letter.

In order to get more detailed information **we would like to interview you about your experiences and views about driving**. Some may feel that they now drive more safely while others may find driving more difficult. **If possible, we would also be very interested in interviewing a close family member as it would be useful to have their observations on your driving**. If either you or a family member are not interested in participating, we would still be keen to hear from one of you if you would like to share your views with us.

We would like to interview you at Rayners Hedge or at home. If a family member would like to take part we would interview you separately and each interview would last approximately one hour.

If you are interested in being interviewed, we would be grateful if you and a family member (where possible) read the information in this letter and sign the enclosed consent forms. Please write your telephone number or address on the consent form. We will contact you to arrange convenient interview times.

Whether or not you decide to take part in the interviews, I would like to thank you for your time and effort in participating in our research.

Yours sincerely

Gavin Newby M.A. (Hons)
Clinical Psychologist in Training

Dr. Andy Tyerman PhD., C.Psychol.
Consultant Clinical Psychologist

RESULTS OF QUESTIONNAIRE

At the time of writing, 35 people have returned the questionnaires that we sent out. Of these, 19 people were currently driving and 16 people were not driving. The main results so far are shown below :

CURRENT DRIVERS

The current drivers had been driving for nearly 16 years. Most drivers rated being able to drive as either important or very important. They felt that driving allowed them to regain the personal independence that they felt that they had lost after their accidents. Many saw driving as crucial to keeping or looking for jobs and carrying on their social and domestic lives. A number of people felt a sense of achievement at being able to return to driving despite their injuries. 10 drivers had received some information about returning to driving (e.g. how head injuries can slow reaction times). Some drivers were encouraged to delay returning to driving until they either felt back to normal or had been assessed by a driving assessment centre. 3 people had taken driving lessons and 2 had successfully retaken the driving test.

While most resumed driving just over 6 months after their head injury, a number resumed more quickly and some resumed up to 4 years after their injury. At the moment, this group tended feel they drove about the same or slightly less in amount than they had before their accidents. On average, the group felt their driving was the same or slightly worse than before. 7 people noticed changes in their driving since their injuries. Some people felt "thrown" by the bad driving of others and found it difficult to make judgements while driving in bad weather or at night. On average, the group found driving slightly less enjoyable and were less confident than before. Some felt anxious when driving and were very aware of the potential dangers of driving. However, many felt that they were now safer drivers as they took more account of weather conditions and other drivers' mistakes.

CURRENT NON-DRIVERS

Of the people who were not currently driving, 10 lived with somebody who drove. Most non-drivers rated being able to drive as either neutral or important. They felt that being able to drive was crucial to being independent and getting work. Many people described being isolated and felt that the available public transport was poor. 6 people had received information about returning to driving, information on the effects of head injury on reactions and suggested assessments at driving assessment centres. 1 person mentioned the dispiriting effect of being told by the DVLA that they could not drive.

13 people knew why they had not been able to resume driving. The most common reasons were reduced confidence, poorer concentration, slowed reactions and physical disabilities. A number mentioned the cost of owning a car would be prohibitive. Most people felt that not driving had restricted their social, leisure and domestic activities. Several felt not driving had restricted job opportunities. Although most people were able to get lifts from friends and family or walk, many felt uncomfortable at having to rely on others. Alternatives such as buses and taxis were found to be time consuming and too costly. Overall, many felt frustrated and angry at not being able to drive and often felt isolated. While 2 people would like to return to driving as soon as possible, several felt that they would become overly anxious if they started again.

- APPENDIX 2 (a) -

DRIVING EXPERIENCES QUESTIONNAIRE

FOR OFFICE USE ONLY

LL OF YOUR ANSWERS ARE COMPLETELY CONFIDENTIAL AND WILL NOT BE USED BY ANY UTHORITY TO ASSESS YOUR DRIVING.

ACKGROUND

e ___

(___

ow Long Have You Been a Qualified Driver? _____

"o Do You Live With? _____

: They Drivers?_____

IVING EXPERIENCES

How important is being able to drive to you after your head injury?

Very Important	Important	Neutral	Unimportant	Very Unimportant

(Please tick one box)

Can you say why ?

omments : _____

_____

_____

Have you received any information or advice about driving after your head injury?

Yes	No

(Please tick one box)

es please explain : _____

_____

_____

Have you had a driving assessment since your head injury?

Yes	No

(Please tick one box)

yes , where was this and did the assessor make any recommendations?: _____

_____

_____

Have you actually returned to driving?

Yes	No

(Please tick one box)

o, please answer **Questions 6-11 on page 2**

Yes go straight to **Question 12 on page 3**

YOU ARE NOT CURRENTLY DRIVING(PLEASE CONTINUE COMMENTS ON BACK IF NECESSARY)

If you are not currently driving, do you know the reason why:

Yes	No

(Please tick one box)

Yes, was this because of any difficulties with: (Please tick as many boxes as you need)

pilepsy	Eyesight	Physical Problems	Medication	Coordination	Spatial Judgement	Slow Reactions	Concentration	Confidence	Being too Impulsive

ther, please explain/Any other comments _____

Overall, how much does not driving restrict your lifestyle:

Very Much	To some extent	Neutral	Very little	Not at all

(Please tick one box)

What areas of your lifestyle does this affect:

Job	Domestic Activities (eg shopping)	Social life	Leisure Opportunities	Family life	Holiday opportunities

(Tick as appropriate)

ther please explain/Any other comments _____

When you need to travel, do you :

Walk	Cycle	Use public transport	Take taxis	Rely on lifts from others (If so, who)

(Please tick as appropriate)

her please explain/Any other comments _____

Overall, how do you feel about not being able to drive ? _____

Have you any general comments to make about the topic of driving since your head injury : _____

THANK YOU FOR YOUR PARTICIPATION

YOU ARE CURRENTLY DRIVING **(PLEASE CONTINUE COMMENTS ON BACK IF NECESSARY)**

2) When did you start driving again?_____

) How long was this after your injury?_____

How much do you use your car now since your head injury:

A lot more	A little more	About the same	A little less	A lot less

5) What do you use your car for :

Job	Domestic Activities (eg shopping)	Social life	Leisure Opportunities	Family life	Holiday opportunities

(Tick as appropriate)

other, please explain/Any other comments_____

How do you feel that you drive since your injury:

A lot worse	Worse	The same	Better	A lot better

(Tick one box)

nments :_____

) How much do you enjoy driving since your injury :

A lot less	Less	The same	More	A lot more

(Tick one box)

mments :_____

How confidently do you drive since your injury :

Much More Confidently	More Confidently	The Same	Less Confidently	Much Less Confidently

(Please Tick One Box)

Have you noticed any changes in the way you drive now, after your head injury?

Yes	No

(Please tick one box)

es, please explain _____

Have you any general comments to make about the topic of driving since your head injury : _____

THANK YOU FOR YOUR PARTICIPATION

DRIVING AFTER A HEAD INJURY-EXPLANATION OF PROJECT

Hello, my name is Gavin Newby and I am currently a trainee clinical psychologist. I am interested in your views about driving after head injury. We currently know very little about the experiences of head injured people after they return to driving. I will be interviewing a number of head injured people who have returned to driving and close family members/partners for their views. The information that you can give us will help us to ensure that head injury services can provide the most effective support and advice for head injured people who wish to return to driving.

The interview will begin by asking you some general background questions and clarifying any outstanding issues from the first questionnaire that I sent you.

Then we will work through two questionnaires. In the first questionnaire I will ask you about your/the head injured person's usual driving behaviours (such as overtaking) and how you/they react to different driving situations (such as driving when tired). In the second questionnaire, I will ask you to rate how often you/the head injured person perform certain driving manoeuvres (such as driving fast).

For each question in both questionnaires I will ask you to make two judgements : one for your/the head injured person's driving before the head injury and a second judgement about driving after the head injury.

The information you give me is entirely confidential and will be seen only by myself. I am working independently of the head injury service at Rayners Hedge. None of your comments will be used by any authority to assess your/the head injured person's driving.

Please do not hesitate to ask me to repeat or explain questions if you have not fully heard the question or do not understand them. Please stop at any time if you feel tired.

Thank you for agreeing to take part.

FOR OFFICE USE ONLY

DRIVING AFTER A HEAD INJURY - BACKGROUND INFORMATION

1. Age _____

2. Who do you live with?

On own	Spouse/partner	Parents	Other family member (Please Specify)	Carer (Please Specify)	Other (Please Specify)

3. Marital status

Single	Married/Living with Partner	Divorced/ Separated	Widowed	Other (Please Specify)

4. Occupation _____

5. Do you have a driving license? Y/N

6. If Yes, What Year Did You Obtain Your Driving License? 19___

7. When was your head injury ? _____

8. How did you receive your head injury?

Road Accident	Fall	Assault	Other (Please Specify)

9. If you were involved in a road accident, were you a:

Pedestrian	Cyclist	Motorcyclist	Car Passenger	Car Driver	Other (Please Specify)

10. Has the Driver Vehicle Licensing Authority (DVLA) been informed about the head injury ? Y/N/DK

11. Who informed the DVLA ? Head Injured Person/Partner/Carer/GP/ Other (Please Specify _____)

12. When did you resume driving after the head injury? ___

13. What type of car did you drive before the injury? _____

14. What type of car do you drive now? _____

15. Have any adaptations been made to your car ? Y/N

If yes what are they? _____

16. Do you have a orange 'disabled' badge ? Y/N

17. Do you drink any alcohol now, if you know you are going to drive ? Y/N

If Yes, amount _____

18. Has this changed from before your accident? Y/N

OUTSTANDING ISSUES FROM SCREENING QUESTIONNAIRE

19. How easy was the questionnaire to complete :

Very Easy	Easy	Neutral	Difficult	Very Difficult

Comments : _____

20. Unclear/unusual comments in screening questionnaire : _____

Issues : _____

21. General comments about driving : _____

How feel when restarting : _____

Family attitude/support : _____

Who does most of the driving : _____

INSTRUCTIONS FOR THE COMPLETION OF THE ADAPTED DRIVING BEHAVIOUR INVENTORY (HEAD INJURED PERSON)

The Driving Behaviour Inventory is a questionnaire designed to find out what drivers usually do and feel, and how they react to different situations. We are asking you to assess your driving behaviour both **before** and **after** your head injury.

For most questions you will have to answer **twice**. Firstly, try to choose the answer that best describes your feelings/attitudes about driving **before** your head injury. Then, you must try to choose the answer that best describes your feelings/attitudes about driving **now**, after your head injury. However, for some questions more than one answer may be appropriate each time. Where appropriate this will be explained in the questionnaire.

Although some of the questions appear similar there are differences between them and you should treat each one as a separate question. The best approach is to answer each question fairly quickly. That is, don't try and remember the number of times you felt a particular way, but rather choose the alternative(s) that seem to apply most of the time.

Thank you for your co-operation.

ADAPTED GENERAL DRIVING BEHAVIOUR INVENTORY

RESPONDENT_____ FOR OFFICE USE ONLY

SECTION A- DRIVING BACKGROUND

For the following questions you will be asked to make one judgement about driving before your head injury and one judgement about driving after your head injury.

1. Where did/do you do most of your driving :

Type of Road	Pre- Head Injury	Post-Head Injury
Motorways		
A/B Roads		
Towns		
Country Roads		
Other (Please Specify)		

2. About how often did/do you drive?

Frequency of Driving	Pre- Head Injury	Post-Head Injury
Everyday		
2-3 Days a Week		
3-4 Days a Week		
4-6 Days a Week		
About Once a Week		
Less Often		
Other (Please Specify)		

3. Could you estimate roughly how many miles you drove/drive annually?

Annual Mileage	Pre- Head Injury	Post-Head Injury
Less Than 5,000 miles		
5,000-10,000 miles		
10,000-15,000 miles		
15,000-20,000 miles		
Other (Please Specify)		

4. If there was a good alternative mode of transport did/do you use it instead of driving?

Frequency of Alternative Transport Use	Pre- Head Injury	Post-Head Injury
Everday		
Most Days		
Sometimes		
Occasionally		
Never		

5. How much driving would you say your lifestyle involved/involves?

Amount of Driving	Pre- Head Injury	Post-Head Injury
A Lot		
Quite a Bit		
Not Very Much		
None		

6. Would you rather avoid all this driving?

Avoiding Driving	Pre- Head Injury	Post-Head Injury
Very Much		
Quite a Bit		
Not Very Much		
Not at All		

SECTION B - ACCIDENTS/CONVICTIONS

7. Have you ever been involved as a driver in a road accident?

	Pre-Head Injury	Post-Head Injury
Yes		
No		

8. How many accidents have you had as a driver?

Number of Accidents	*Years Pre-Head Injury	Post-Head Injury
None		
1		
2		
3		
More Than 3 (Please Specify)		

9. How serious were these accidents?

Seriousness of Accidents	Pre-Head Injury?	Post-Head Injury?
Very Serious (eg loss of life, severe injury		
Serious (eg minor injuries)		
Minor (eg hit another vehicle, but no injury)		
Minor (eg a scrape while parking, but no injury)		

Could you tell me how the post-head injury accidents happened (include information on time of day, weather conditions, type of road, speed, avoiding actions etc.) :

1) -time of day
-weather
-road type
-speed
-alone/passenger
-how feeling
-avoiding actions

2) -time of day
-weather
-road type
-speed
-alone/passenger
-how feeling
-avoiding actions

3) -time of day
-weather
-road type
-speed
-alone/passenger
-how feeling
-avoiding actions

10. Have you ever been convicted for a motoring offence?:

Offense	Pre-Head Injury	Post-Head Injury
Speeding		
Dangerous Driving		
Other Offense (Please Specify)		
None		

11. Following your head injury, have you changed your driving style?

Change of Style	Response
Very Much	
Quite a Bit	
Not Very Much	
Not At All	

SECTION C

12. Did/Do you listen to the radio or tape when driving?

Radio/Tape Listening	Pre- Head Injury	Post-Head Injury
Always		
Often		
Occasionally		
Never		

13. In a traffic build-up, did/do you switch the car radio or tape-player off?

Radio/Tape Listening	Pre- Head Injury	Post-Head Injury
Always		
Often		
Occasionally		
Never		

14. When you feel tired, did/do you usually take a break?

Taking a Break	Pre-Head Injury	Post-Head Injury
Yes		
No		

15. During the break, did/do you take any refreshment?

Taking Refreshment	Pre-Head Injury	Post-Head Injury
Yes		
No		

16. Did/Do you think that most drivers drive too fast?

Driving Too Fast	Pre-Head Injury	Post-Head Injury
Very Much		
Quite a Bit		
Not Very Much		
Not At All		

17. If another car tried/tries to overtake you at a junction/traffic lights/cross-roads did/do you:

Overtaking	Pre-Head Injury	Post-Head Injury
Slow Down and Let It Pass		
Accelerate		
Maintain Speed		

18. When in a hurry, did/do you tend to drive near the car in front of you?

Driving Near the Car in Front	Pre-Head Injury	Post-Head Injury
Always		
Often		
Seldom		
Never		

19. When in a traffic jam, did/do you usually : (tick one or more boxes as appropriate)

Traffic Jams	Pre- Head Injury	Post-Head Injury
Feel Irritated Even If You Are Not in a Hurry		
Get Angry and Lose Your Temper		
Feel Anxious		
Relax and Wait Patiently		
Other (Please Specify)		

20. When you are worried would you say that you drove/drive:

When Worried	Pre-Head Injury	Post-Head Injury
Drive at Usual Speed		
Drive More Cautiously		
Drive More Quickly		

21. When you are worried about something did/do you find you turn things over in your mind and do not concentrate on driving?

Concentration	Pre- Head Injury	Post-Head Injury
Always		
Often		
Occasionally		
Never		

22. Were/Are you distracted if someone talks to you when you are driving in heavy traffic?

Change of Style	Pre-Head Injury	Post-Head Injury
Very Much		
Quite a Bit		
Not Very Much		
Not At All		

23. Have you ever flashed the car lights or used the horn at others in anger?

Light Flashing	Pre-Head Injury	Post-Head Injury
Very Often		
Frequently		
Seldom		
Never		

24. Have you ever sworn at or sought to remonstrate with other drivers/road users :

Swear etc	Pre-Head Injury	Post-Head Injury
Very Often		
Frequently		
Seldom		
Never		

Comments_____
_____
_____
_____

25. When you anticipate(d) or met/meet with a difficult traffic situation did/do you have your hand/foot on the brakes:

Anticipation	Pre-Head Injury	Post-Head Injury
Always		
Often		
Occasionally		
Never		

SECTION D RESPONDENT_____ FOR OFFICE USE ONLY

PRE/POST HEAD INJURY
(Circle Appropriate)

Please answer the following questions by marking on the horizontal line the point which expresses most accurately your feeling(s):

Example : If you enjoy driving quite a lot you would mark it like this:

not at all ——————————/—— very much

26. In general how much would you say you enjoy driving?

not at all _____ very much

27. Do you think in general too much driving is a waste of time?

not at all _____ very much

28. In general do you mind being overtaken?

not at all _____ very much

29. When you are in a bad mood or irritated would you say that you drive aggressively?

not at all _____ very much

30. If another car overtakes you at a junction/cross-roads do you feel :

(a) Angry?

not at all _____ very much

(b) Anxious?

not at all _____ very much

(c) Indifferent?

not at all _____ very much

31. Does it worry you to drive in bad weather?

not at all _____ very much

32. Do you lose your temper when another driver does something silly?

not at all _____ very much

33. When, for whatever reasons, you try and do not succeed to overtake another car, do you usually feel :
(a) Frustrated?

not at all _____ very much

(b) Anxious?

not at all _____ very much

(c) Indifferent?

not at all _____ very much

34. Do you feel confident in your ability to avoid an accident?

not at all _____ very much

35. Do you think it is worthwhile taking risks on the road?

not at all _____ very much

36. Are you annoyed when the traffic lights change to red when you approach them?

not at all _____ very much

37. Do you usually make an effort to look for potential hazards when driving?

not at all _____ very much

38. Do you tend to overtake other vehicles whenever possible?

not_____very
at all much

39. How much would you agree that however well you drive an accident is possible because of other drivers' poor judgements?

not_____very
at all much

40. Do you find it difficult to control your temper when driving?

not_____very
at all much

41. Would you say that slow moving vehicles are a traffic hazard?

not_____very
at all much

42. When driving on a new road are you usually more tense than when the road is familiar?

not_____very
at all much

43. When you overtake another vehicle do you feel :
(a) In command of the situation?

not_____very
at all much

(b) Tense or nervous?

not_____very
at all much

(c) Satisfied?

not_____very
at all much

(d) Indifferent?

not_____very
at all much

44. Are you usually patient during the rush hour?

not_____very
at all much

45. When you come to negotiate a difficult stretch of road :
(a) Do you increase your concentration?

not _____ very
at all much

(b) Are you on the alert?

not _____ very
at all much

46. Does it annoy you to drive behind a slow moving vehicle?

not _____ very
at all much

47. Do you usually get bored during a motorway journey?

not _____ very
at all much

48. Do you feel more anxious than usual when driving in heavy traffic?

not _____ very
at all much

49. Driving makes you usually feel :
(a) Frustrated?

not _____ very
at all much

(b) Aggressive?

not _____ very
at all much

(c) Happy?

not _____ very
at all much

(d) Tired ?

not _____ very
at all much

50. Do you always feel ready to react in response to other drivers' unexpected manoeuvres?

not _____ very
at all much

51. Do you feel that driving a car gives you a sense of power?

not _____ very
at all much

52. When approaching a motorway contraflow system do you drive more carefully?

not _____ very
at all much

53. Do you find it difficult to maintain your concentration when driving?

not _____ very
at all much

54. In general, based on your entire driving experiences, do you consider that driving is a stressful activity?

not _____ very
at all much

ADAPTED DRIVING SKILL QUESTIONNAIRE

RESPONDENT_____

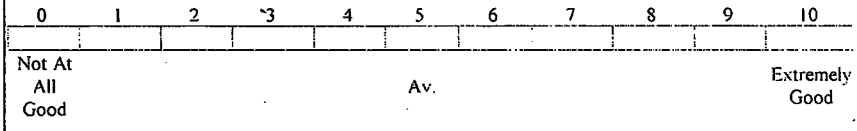
FOR OFFICE USE ONLY

PRE/POST HEAD INJURY
(Circle Appropriate)

SECTION A

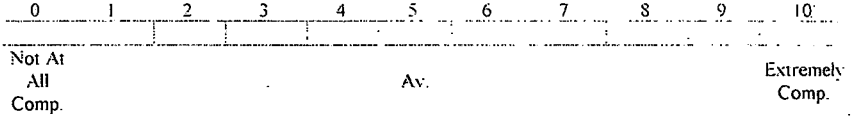
For the following questions you will be asked to rate your/the head injured person's driving skills in comparison to ALL DRIVERS IN THE UK.. You will be asked to do this twice, once for your rating of your/the head injured person's driving skills before the head injury and again for your rating of them now after the head injury. Please read the example below :

Example : If you felt that you/the head injured person was among the best drivers you know before/after the head injury, you would place a mark *in* the appropriate box, *not* on a line, like this

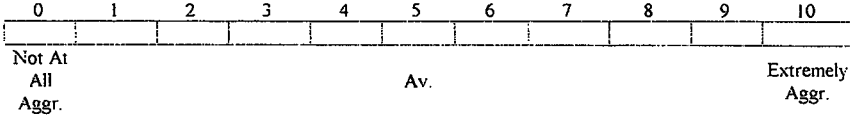


Please make the most accurate estimate you can, based on your general experience and impressions of other people.

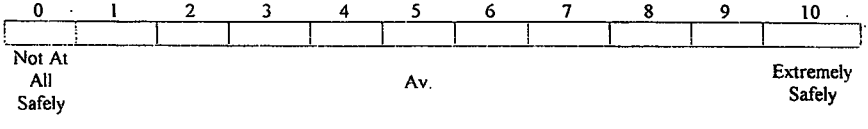
1. We would like to know how *competitive* you are/ the head injured person is, in relation to all other drivers



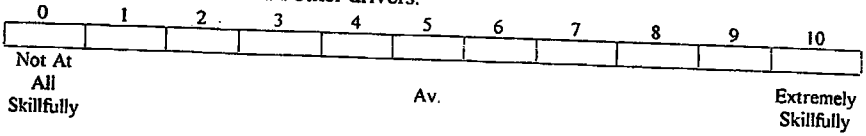
2. We would like to know how *aggressively* you /the head injured person drives, in relation to all other drivers :



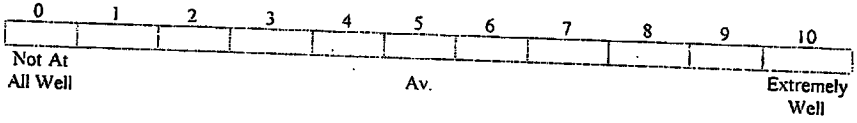
3. We would like to know how *safely you/the head injured person drive* or could drive a car, in relation to all other drivers :



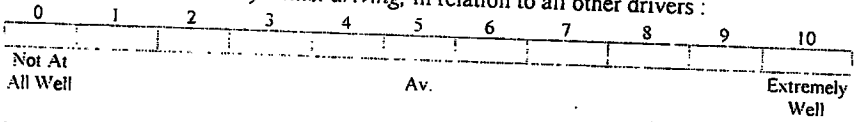
4. We would like to know what you think about how *skilfully you/the head injured person* drive or could drive , in relation to all other drivers:



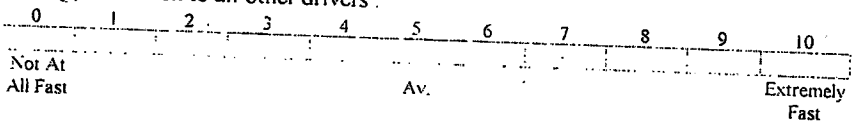
5. We would like to know how well you/the head injured person can *concentrate while driving*, in relation to all other drivers:



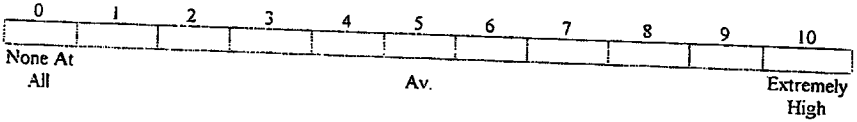
6. We would like to know how well you/the head injured person *plan(s) ahead (to avoid potentially dangerous situations etc.) whilst driving*, in relation to all other drivers :



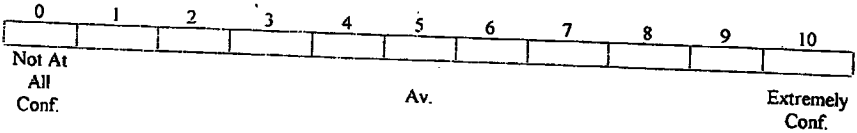
7. We would like to know *how fast your the head injured person's reaction times are whilst driving*, in relation to all other drivers :



8. We would like to know how much *stamina* you/the head injured person has whilst driving, in relation to all other drivers :



9. We would like to know how *confidently* you/the head injured person drive/s, in relation to all other drivers :



PRE/POST HEAD INJURY
(Circle Appropriate)

SECTION B

For the following questions you will be asked to rate how often you/the head injured person do the following behaviours whilst driving. You will be asked to make the rating twice, once for how you remember you/the head injured person drove before the head injured and again on how the person drives now after the head injury.

Please answer the following questions by marking on the horizontal line the point which expresses most accurately your judgement :

Example : If you hardly ever drive fast, you would mark it like this :

never _____ always

How often do you/the head injured person do the following whilst driving :

10.

drive with hands in the recommended position on steering wheel

never _____ always

11.

drive riskily

never _____ always

12.

drive as if taking a test

never _____ always

13.

brake without using the gears correctly

never _____ always

14.

drive when unhappy

never _____ always

15. drive too close to the car in front

never _____ always

16. startled by the behaviour of other drivers

never _____ always

17. forget to indicate

never _____ always

18. involved in near accidents

never _____ always

19. move from a stationary position smoothly

never _____ always

20. overtake

never _____ always

21. made nervous by driving

never _____ always

22. compete with other drivers

never _____ always

23. overtake only when road ahead completely clear

never _____ always

24.

steer out of hazard because of insufficient time to brake

never _____ always

25.

carry out unnecessary manoeuvres

never _____ always

26.

have difficulty in finding correct gear

never _____ always

27.

show intolerance of other drivers' mistakes

never _____ always

28.

have poor road positioning before, during, or after cornering

never _____ always

29.

attempt to accelerate when clutch disengaged

never _____ always

30.

show indecision at junctions

never _____ always

31.

driving style causes difficulty for other drivers

never _____ always

32.

tend to drive as if other traffic wasn't on the road

never _____ always

33.

are able to read the road

never _____ always

34.

use rear view mirror (r.v.m.)

never _____ always

35.

lose concentration whilst driving

never _____ always

36.

feel tired whilst driving

never _____ always

37.

are impulsive whilst driving

never _____ always

38.

misjudge own speed/the speed of other cars

never _____ always

39.

misjudge the space between own car and cars in front and the side

never _____ always

40.

find it difficult to park

never _____ always

Stoke Mandeville
Hospital NHS Trust

Buckinghamshire Health Authority

Aylesbury Vale Local Research Ethics Committee

Mandeville Road, Aylesbury
Buckinghamshire HP21 8AL
Telephone (01296) 315000
Direct Line: (01296) 316784

9 October 1995

PLM/jlk

Mr G J Newby M.A.
Trainee Clinical Psychologist
Isis Education Centre
Warneford Hospital
Warneford Lane
Headington
Oxon OX3 7JX

Dear Mr Newby

Re: Project NC636 - Driving After Head Injury: Self Versus Family Assessment

I refer to your application to the Local Research Ethics Committee for consideration of the above project. I am pleased to inform you that the Committee approves the project on ethical grounds on the understanding that:

i Any ethical problem, arising in the course of the project, will be reported to the Committee.

ii Any change in the protocol will be reported to the Committee.

iii A brief report will be submitted after completion.

Ethical approval by the Committee is not an authority to proceed. You are advised to discuss your proposal with all heads of departments and others who might be affected, particularly if there are financial and/or staffing implications.

Please note that your research may be subject to review annually by the Committee.

Yours sincerely

R M HILL
Secretary to Local Research Ethics Committee

c.c. Dr Andy Tyerman - Rayners Hedge

GLASGOW OUTCOME SCALE

1.0 DEATH

2.0 PERSISTENT COMA

3.0 SEVERE DISABILITY – NEED CONTINUOUS SUPERVISION OR HELP WITH MANY ACTIVITIES OF DAILY LIVING

3.5 SEVERE DISABILITY – CAN MANAGE ON OWN WITH CONSIDERABLE SUPPORT

4.0 MODERATE DISABILITY – SIGNIFICANT PROBLEMS WITH EITHER OCCUPATIONAL OR SOCIAL FUNCTIONING

5.0 GOOD RECOVERY – WITH RESIDUAL SYMPTOMS

5.5 GOOD RECOVERY – WITH NO SYMPTOMS

– APPENDIX 5 (a) (i) –

	HEAD INJURED		FAMILY		KOLMOGOROV-SMIRNOV Z-VALUES			
	PRE	POST	PRE	POST	PRE : POST		HI : FAM	
VARIABLE	MEAN (S.DEV)	MEAN (S.DEV)	MEAN (S.DEV)	MEAN (S.DEV)	HI	FAM	PRE	POST
Competiveness	5.33 (2.40)	3.06 (2.62)	6.47 (3.02)	4.06 (2.69)	0.94	0.67	0.63	0.73
Aggressiveness	4.33 (2.17)	3.44 (2.48)	5.01 (2.69)	3.78 (2.67)	1.1	0.43	0.63	0.86
Safetiness	7.22 (2.89)	6.22 (2.94)	8.29 (1.61)	6.72 (2.52)	0.64	0.85	0.83	0.6
Skillfulness	7.89 (1.23)	5.89 (2.61)	8.24 (1.25)	6.83 (2.04)	0.9	0.76	0.85	1.13
Concentration	7.83 (1.79)	5.5 (2.68)	8.35 (1.62)	5.89 (1.97)	0.74	0.69	0.73	0.93
Planning Ahead	7.67 (1.28)	6.22 (2.86)	7.47 (2.18)	6.72 (2.35)	0.58	0.68	0.72	0.67
Reaction Times	7.83 (1.47)	5.01 (2.50)	7.65 (1.69)	6.06 (2.67)	0.95	0.51	0.65	0.66
Stamina	7.89 (1.41)	5.44 (2.86)	8.01 (1.62)	4.78 (2.10)	1.02	0.71	0.83	0.66
Confidence	8.39 (1.20)	6.11 (3.12)	8.29 (1.05)	6.29 (2.61)	0.62	0.69	0.68	1.06

MEAN SUBJECT COMPARISONS OF HEAD INJURED DRIVERS' SKILLS TO OTHER DRIVERS (SECTION A ADSQ) (MEAN, S.DEV, KILMOGOROV-SMIRNOV VALUES)

– APPENDIX 5 (a) (ii) –

	HEAD INJURED		FAMILY		KOLMOGOROV-SMIRNOV Z-VALUES			
	PRE	POST	PRE	POST	PRE : POST		HI : FAM	
VARIABLE	MEAN (S. DEV)	MEAN (S. DEV)	MEAN (S. DEV)	MEAN (S. DEV)	HI	FAM	PRE	POST
Hands in recommended steering wheel position	55.44 (27.91)	60.67 (26.36)	57.06 (27.78)	56.94 (26.28)	0.89	0.88	0.69	0.64
Drive riskily	32.83 (27.71)	14.72 (20.07)	35.06 (24.64)	25.72 (25.46)	0.72	1.51*	0.89	1.55*
Drive as if taking a test	27.67 (19.78)	49.72 (22.26)	31.82 (24.11)	40.17 (31.06)	0.39	1.28*	0.58	0.52
Brake without using gears correctly	29.12 (23.91)	11.77 (11.83)	38.29 (26.81)	35.56 (28.81)	0.9	0.93	0.59	0.55
Drive when unhappy	45.44 (29.65)	47.72 (27.73)	62.12 (22.36)	49.06 (30.11)	0.85	0.73	0.49	0.7
Drive too close to car in front	30.89 (22.76)	15.56 (16.72)	41.71 (22.21)	30.06 (23.42)	0.7	0.86	0.59	0.8
Startled by behaviour of other drivers	46.39 (25.51)	52.78 (26.43)	26.35 (20.78)	39.17 (27.94)	0.79	0.91	0.76	0.36
Forget to indicate	16.44 (15.73)	16.33 (19.75)	23.24 (17.54)	27.39 (25.51)	1.02	1.21	0.98	0.92
Involved in near accidents	27.00 (19.82)	21.44 (23.13)	20.94 (11.87)	24.88 (24.12)	1.04	0.68	0.7	0.98
Move from stationary position smoothly	82.17 (16.69)	82.33 (17.00)	83.41 (10.30)	80.56 (15.98)	0.97	0.78	0.74	0.44
Overtake	57.11 (21.02)	51.67 (26.45)	67.59 (18.39)	47.5 (24.87)	0.74	0.52	0.64	0.51
Made nervous by driving	10.61 (11.86)	36.06 (31.39)	13.35 (13.39)	33.33 (27.74)	0.86	0.87	0.72	0.44
Compete with other drivers	32.44 (26.40)	9.44 (11.05)	39.59 (27.80)	26.67 (24.90)	1.03	0.84	1.2	0.95
Overtake only when road ahead completely clear	77.44 (19.07)	72.94 (23.55)	69.71 (25.17)	63.56 (22.74)	0.89	0.71	0.57	0.53
Steer out of hazard because of insufficient time to brake	39.00 (33.04)	33.44 (31.21)	42.35 (29.52)	28.28 (27.00)	0.5	1.19	0.56	0.64
Carry out unnecessary manoeuvres	11.33 (9.47)	21.28 (26.30)	18.06 (15.23)	25.11 (21.29)	1.08	1.28*	0.68	0.41
Have Difficulty in finding correct gear	8.71 (7.35)	16.65 (22.31)	13.69 (17.09)	11 59 (11.11)	1.26*	1.06	0.85	1.05
Show intolerance of other drivers' mistakes	37.39 (23.99)	46.44 (22.91)	55.12 (30.01)	52 22 (30.62)	0.74	0.85	0.68	0.51
Have poor road positioning before, during, or after cornering	13.28 (11.12)	20.33 (22.78)	19.77 (15.23)	23.06 (18.99)	1.01	0.9	0.47	0.74
Attempt to accelerate with clutch disengaged	7.77 (5.67)	14.29 (17.20)	11.75 (11.38)	12.35 (12.35)	1.11	0.54	0.69	0.82
Show indecision at junctions	11.94 (7.23)	26.83 (27.33)	15.12 (14.43)	30.50 (29.29)	1.07	1.09	0.64	0.76
Driving style causes difficulty for other drivers	17.22 (15.72)	23.56 (23.94)	23.77 (17.71)	29.94 (26.86)	0.96	0.65	1.01	0.67
Tend to drive as if other traffic wasn't on the road	17.67 (15.76)	10.72 (10.96)	28.35 (21.03)	20.78 (17.87)	1.07	0.97	0.81	1.09
Are able to read the road	76.33 (28.02)	70.83 (25.50)	76.47 (13.06)	65.94 (26.26)	0.49	0.91	0.97	0.5
Use rear view mirror	81.83 (15.63)	82.06 (22.51)	76.35 (14.30)	73.5 (23.17)	1.27*	1.43*	0.63	0.8
Lose concentration whilst driving	20.89 (22.72)	40.28 (29.41)	29.59 (25.47)	35.28 (24.06)	0.59	0.83	0.59	0.8
Feel tired whilst driving	26.33 (17.87)	43.61 (27.64)	28.94 (22.16)	46.17 (24.17)	0.47	1	0.5	0.83
Are impulsive whilst driving	31.72 (26.50)	35.78 (30.02)	42.94 (27.72)	31.06 (23.38)	0.88	0.99	0.88	0.75
Misjudge own speed/the speed of other cars	17.89 (13.03)	25.44 (28.34)	27.24 (19.82)	31.61 (25.07)	1.02	1.28*	0.58	0.77
Misjudge the space between own car and cars in front and the side	15.28 (10.75)	28.00 (27.328)	29.88 (22.77)	29.11 (24.84)	0.91	1.07	0.55	0.49
Find it difficult to park	8.83 (7.31)	25.5 (30.12)	15.06 (15.41)	27.39 (26.05)	0.97	1.01	1.02	0.81

ADSQ VISUAL ANALOGUE DATA (MEAN, S.DEV., KSM Z-VALUES; * p< .10)

- APPENDIX 5 (a) (iii) -

	HEAD INJURED		FAMILY		KOLMOGOROV-SMIRNOV Z-VALUES			
	PRE	POST	PRE	POST	PRE : POST		HI : FAM	
VARIABLE	MEAN (S. DEV)	MEAN (S. DEV)	MEAN (S. DEV)	MEAN (S. DEV)	HI	FAM	PRE	POST
Enjoy driving	81.94 (24.17)	59.11 (31.97)	78.53 (23.83)	62.06 (34.66)	0.85	1.02	0.68	0.64
Too much driving is a waste of time	31.61 (28.91)	29.06 (29.51)	24.82 (25.30)	29.06(27.47)	1.28*	0.81	0.68	0.55
Mind being overtaken	30.28 (28.50)	24.72 (22.09)	35.47 (23.47)	40.78 (29.46)	0.58	0.52	0.58	0.81
Bad mood or irritated : drive aggressively	40.39 (29.00)	30.17 (23.39)	46.71 (28.28)	36.72 (24.19)	0.48	0.97	0.6	0.54
Overtaken at crossroads/function feel								
Angry	48.06 (29.34)	34.17 (26.58)	47.77 (22.21)	44.33 (28.69)	0.73	0.45	0.41	0.58
Anxious	32.28 (25.38)	42.67 (32.63)	28.59 (21.03)	35.11 (21.24)	0.75	0.32	.46	0.5
Indifferent	53.22 (29.44)	38.33 (28.31)	44 (22.41)	41.94 (24.94)	0.53	0.52	0.73	0.55
Worry to drive in bad weather	30.61 (29.39)	47.28 (33.21)	16.53 (14.68)	41.56 (30.69)	0.45	0.93	0.51	0.51
Lose temper when another driver does something silly	53.89 (24.38)	56.94 (30.76)	45.53 (27.10)	51.33 (29.39)	0.59	0.59	0.51	0.44
Try and do not succeed to overtake another car, usually feel :								
Frustrated	39.00 (25.89)	43.28 (28.04)	47.35 (24.87)	41.61 (24.87)	0.86	0.59	0.7	0.43
Anxious	23.72 (19.34)	43.00 (30.36)	27.41 (24.39)	30.83 (25.70)	0.92	0.84	0.55	0.57
Indifferent	45.83 (26.59)	42.83 (25.80)	33.77 (19.48)	35.61 (18.97)	0.98	0.92	0.69	0.55
Feel confident in ability to avoid an accident	77.72 (20.29)	64.00 (34.18)	80.82 (13.49)	63.17 (25.79)	0.88	1.07	1.06	0.87
Worthwhile taking risks on the road	24.06 (26.01)	20.56 (28.79)	35.88 (29.63)	16.33 (16.13)	0.97	0.73	0.7	1
Annoyed when traffic lights change to red when approach	44.67 (24.36)	42.67 (30.17)	50.59 (24.07)	43.17 (23.17)	0.7	0.83	0.48	0.99
Usually make an effort to look for potential hazards	70.56 (27.38)	80.11 (21.35)	68.41 (17.21)	72.00 (21.67)	0.92	1.01	0.46	0.75
Tend to overtake other vehicles whenever possible	55.44 (28.27)	38.94 (29.80)	55.47 (25.10)	35.22 (24.23)	0.51	0.93	0.62	0.88
However well drive an accident is possible because of other drivers' poor judgements	83.72 (17.36)	82 (23.62)	73.71 (16.22)	78.5 (18.09)	1.21*	0.57	1	0.68
a Difficult to control temper when driving	30.61 (23.07)	43.39 (31.89)	37.59 (20.04)	42.44 (22.12)	0.81	0.86	0.63	0.62
Slow moving vehicles are a traffic hazard	66.67 (24.5841)	56.33 (33.20)	59.41 (24.34)	60.44 (21.48)	1.26*	0.97	0.76	0.41
New road, usually more tense then when the road is familiar	35.06 27.273)	58.11 (32.51)	32.06 (23.05)	52.33 (21.66)	0.68	0.55	0.52	0.55
When overtake another vehicle, feel :								
In command of the situation	78.39 (19.42)	61.83 (28.34)	78.88 (12.74)	69.06 (22.14)	0.95	0.78	0.58	0.54
Tense or nervous	22.89 (24.85)	39.83 (30.80)	21.29 (21.34)	29.33 (22.37)	0.94	1.29*	0.97	0.9
Satisfied	58.61 (27.58)	46.39 (26.48)	66.82 (18.45)	56.44 (20.14)	0.87	0.65	0.57	0.64
Indifferent	44.56 (23.70)	44.83 (24.68)	30.00 (18.38)	36.22 (20.52)	1.17	0.7	0.77	0.69
Usually patient during the rush hour	54.44 (26.77)	58.67 (28.71)	45.41 (25.50)	51.83 (24.49)	0.66	0.93	0.85	0.49
Increase concentration	75.56 (21.02)	86.39 (14.07)	73.41 (13.08)	73.50 (16.82)	0.59	0.85	0.61	0.48
On the alert	76.50 (15.99)	80.33 (21.59)	77.71 (13.17)	73.50 (19.13)	0.91	0.72	0.75	0.91
Annoy to drive behind a slow moving vehicle	51.00 (30.76)	51.06 (30.96)	69.47 (23.21)	56.67 (27.01)	1.46*	0.65	0.73	0.75
Usually get bored during a motorway journey	43.61 (31.88)	41.28 (26.86)	44.24 (28.97)	47.89 (26.76)	0.72	0.71	0.59	0.57
Feel more anxious than usual when driving in heavy traffic	44.06 (28.48)	57.06 (30.54)	34.18 (23.83)	46.11 (23.85)	1	0.63	0.32	0.61
Driving makes usually feel :								
Frustrated	22.67 (17.50)	30.22 (26.79)	20.65 (16.79)	32.06 (25.84)	1.15	0.98	0.77	0.86
Aggressive	29.17 (16.34)	25.56 (22.78)	34.71 (21.01)	37.28 (23.04)	0.65	0.87	0.5	0.6
Happy	57.44 (27.89)	52.44 (30.72)	60.06 (21.66)	56.33 (28.12)	0.76	0.58	0.47	0.37
Tired	37.89 (24.31)	43.00 (31.39)	20.47 (13.39)	47.72 (23.75)	0.72	0.56	0.47	0.47
Always feel ready to react in response to other drivers' unexpected manoevres	75.00 (24.77)	74.78 (25.36)	77.18 (23.43)	67.67 (19.99)	0.99	0.7	0.67	0.76
Feel driving a car gives a sense of power	43.67 (33.57)	32.33 (29.56)	47.29 (28.78)	35.00 (27.45)	1.26*	0.74	0.89	0.91
Drive more carefully when approaching a motorway contraflow system	71.44 (24.06)	81.61 (14.61)	66.00 (16.69)	77.28 (12.42)	1.23*	0.9	0.61	0.64
Difficult to maintain concentration when driving	19.61 (18.13)	41.61 (33.48)	22.41 (16.76)	46.56 (23.87)	1.02	0.78	0.78	0.77
Based on entire driving experiences, consider driving is stressful activity	36.44 (25.63)	46.61 (34.20)	36.24 (26.35)	43.83 (28.57)	0.92	0.75	0.62	0.42

ADBI VISUAL ANALOGUE SUBJECT RATINGS OF HEAD INJURED DRIVERS' BEHAVIOURS (MEAN,S.DEV., KSM Z-VALUES;*<P.10)

_ APPENDIX 5 (a) (iv) -

	KOLMOGOROV-SMIRNOV Z-VALUES			
	PRE : POST		HI : FAM	
VARIABLE	HI	FAM	PRE	POST
Annual Mileage	0.84	1.03	0.71	0.81
Time Post Injury	N/A	N/A	N/A	1.82*
Time Resumed	N/A	N/A	N/A	0.03
Time driving	0.5	1.23*	0.95	1.1
Total Mileage	0.82	0.88	0.68	1.29*
No. Accidents	1.43*	1.93*	2.01*	1.44*
Miles per Accident	0.45	0.63	0.55	0.84
Accident Rate	1.1	0.83	0.9	1.3*

KILMOGOROV-SMIRNOV Z-VALUES OF ACCIDENT INFORMATION

*p< .10

	SCALE A (TOTALS : SECTION A ADSQ)				SCALE B (TOTALS : ORIG. VAS DATA ADSQ)				SCALE C (TOTALS : HI. VAS DATA, ADSQ)				SCALE D (TOTALS : VAS DATA, ADBD)			
CODE	HEAD INJURED		FAMILY		HEAD INJURED		FAMILY		HEAD INJURED		FAMILY		HEAD INJURED		FAMILY	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
12	22	17	13	18	578	143	828	1067	131	46	137	245	1264	884	1781	1604
61	30	21	35	45	950	618	941	863	109	212	262	362	1505	1263	1502	1187
36	24	32	34	41	841	692	792	678	149	147	200	167	1809	1773	1608	1431
40	37	40	32	28	1211	767	731	582	195	166	153	152	2122	1921	1630	1670
9	11	32	24	18	695	598	605	481	153	91	67	93	1589	1642	1018	1204
104	27	73	9	51	528	1138	780	835	98	488	156	192	1134	2495	1587	2568
71	24	49	35	30	699	671	1158	1341	140	268	371	397	974	1628	2013	1987
93	29	22	18	28	588	301	733	729	108	73	125	95	1266	1161	1303	1453
27	33	28	25	18	533	475	588	398	91	146	31	76	1610	1622	1302	1215
117	21	34	N/A	24	480	504	N/A	501	90	174	N/A	153	1530	2020	N/A	1715
70	37	38	24	57	563	460	696	875	75	233	190	199	1773	1720	1874	2114
62	17	24	23	38	N/A	N/A	N/A	N/A	32	62	115	141	949	619	1083	1305
115	12	35	7	25	806	763	737	706	152	122	166	128	1681	1697	1716	2009
123	17	49	12	38	412	708	390	608	32	108	139	148	1538	1444	1237	1813
99	28	25	17	17	764	644	518	535	176	76	119	137	1626	1669	1209	1323
116	37	66	38	52	596	1137	869	1089	183	419	299	381	1833	2225	1809	2052
43	17	72	14	60	598	922	882	1181	134	514	123	244	2029	2203	1656	1546
24	14	63	18	48	914	876	667	846	129	230	299	301	1663	1891	1344	1657
MEAN	24.28	40	22.24	36.44	691.53	671.06	744.69	783.24	120.94	198.61	173.65	200.61	1549.72	1659.83	1510.02	1658.8
S.DEV.	8.56	18.01	9.85	14.7	203.05	261.79	179.68	266.57	46.32	142.35	88.59	100.24	327.68	467.92	289.97	377.31

RAW SCALE SCORES FROM INDIVIDUAL SUMMED RATINGS

BACKGROUND VARIABLE		HI (N)		FAM. (N)		CHI-SQUARE VALUES			
		PRE.	POST	PRE.	POST	PRE: POST		PRE-INJ.	POST-INJ.
						HI	FAM	HI:FAM	HI : FAM
Type of road	Minor	3	7	5	6	1.25	0	#0.24	0
	Major	15	11	12	12				
Freq. of Driving	< Everyday	2	7	2	7	#2.37	#2.10	#0.00	0
	Everyday	16	11	15	11				
Use of Alt. T/S	None/v. little	8	10	8	7	0.11	0.02	0	0.45
	Some extent	10	8	9	11				
Driving in L'style	None/v. little	4	5	2	7	#.00	2.1	#0.14	0.13
	Quite a bit	14	13	15	11				
Avoid Driving	None/v. little	15	12	16	13	#0.59	1.61	#0.22	0
	Quite a bit	3	6	1	5				
Driving Convictions	Yes	7	4	2	2	0.52	0	0.23	2.92
	No	11	14	16	10				
Changed Driving Style	None/v.little	N/A	9	N/A	5	N/A	N/A	N/A	0.81
	Quite a bit	N/A	9	N/A	12	N/A	N/A		
Listen Radio/Tape	None/v. little	3	7	4	7	1.25	0.38	#0.00	0
	Quite a bit	15	11	13	11				
Traffic, Switch Radio/Tape Off	Occ./v. little	18	15	16	15	#1.45	#0.22	#0.00	#0.00
	Some Extent	0	3	1	3				
Tired, Take a Break	Yes	9	12	10	14	0.46	0.71	0.03	0.14
	No	9	6	7	4				
Take Refreshment	Yes	8	10	9	12	0.11	0.23	0.03	0.12
	No	10	8	8	6				
Think Most Drivers Drive Too Fast	None/v. little	10	1	10	2	8.38***	6.84**	0	0
	Some Extent	8	17	7	10				
In Hurry, Drive near Car in Front	Never	4	10	4	6	2.9	0.07	#0.00	1.01
	Some Extent	14	8	13	12				
Traffic Jams:									
Irritated	Yes	7	8	9	10	0	0	0.24	0.11
	No	11	10	8	8				
Angry	Yes	1	3	5	3	#0.60	#0.24	#2.02	0
	No	17	15	12	15				
Anxious	Yes	3	4	4	6	#0.00	#0.07	#.01	0.14
	No	15	14	13	12				
Relax	Yes	8	9	6	6	0	0	0.04	0.46
	No	10	9	11	12				
Other	Yes	3	2	1	2	#.00	#.00	#0.22	0
	No	15	16	16	16				
Worried, Do Not Concentrate	Never/Occ.	9	8	9	7	0.03	0.24	0	0
	Some extent	8	10	8	11				
Distractable	None/v. little	17	11	16	13	#4.02*	#1.61	#0.00	0.13
	Some extent	1	7	1	5				
Flashed Lights/Use Horn	Seldom/Never	16	13	11	14	#0.71	#0.23	#1.69	#0.00
	Some extent	2	5	6	4				
Sworn/Remonstrate	Seldom/never	15	14	12	12	#.00	0.00	#0.24	0.14
	Some extent	3	4	5	6				
Anticipation	Never/occ	11	10	11	8	#0.00	#0.33	#0.01	#.00
	Freq./v.oft	7	8	5	9				

CHI-SQUARE VALUES OF LICKERT DATA FROM SECTIONS A-C OF ADBI (CONVERTED INTO BINARY CHOICE DATA)

*** p< .05, ** P< .01, *** p <.001; # FISHER'S EXACT T-TEST USED TO CALCULATE p-VALUE**

CODE	TIME DRIVING (YEARS)				TOTAL MILEAGE (EST. ANN. MILES xT. DRIVING)				NO. OF ACCIDENTS RATER				MILES PER ACC. (TOT. ANN. MILES/NO.ACCS)				ACC. RATE (NO.ACCS/TIME DRIVING)			
	H.I.		FAMILY		H.I		FAMILY		H.I		FAMILY		H.I.		FAMILY		H.I.		FAMILY	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
	N=18	N=16	N=15	N=17	N=17	N=15	N=13	N=13	N=17	N=18	N=16	N=16	N=16	N=17	N=16	N=12	N=17	N=17	N=16	N=16
12	5	3.98	6	3.75	250000	198958.3	150000	93750	2	0	1	2	125000	0	150000	46875	0.4	0	0.17	0.53
61	2	3	3	2.92	50000	75000	45000	23333.33	4	1	2	1	12500	75000	22500	23333.33	2	0.33	0.67	0.34
36	2.75	4.25	3	4	68750	106250	13500	18000	2	2	2	1	34375	53125	6750	18000	0.73	0.47	0.67	0.25
40	7.25	D/K	6	0.75	145000	D/K	180000	18750	2	0	6	1	72500	D/K	3000	18750	0.28	0	1	1.33
9	11	D/K	D/K	19.75	55000	D/K	D/K	79000	0	0	0	0	D/K	0	0	D/K	0	0	0	0
104	8.5	2	8.75	2.25	353600	83200	175000	22500	0	0	0	0	0	0	0	0	0	D/K	0	0
71	30	4	27.97	1.58	D/K	D/K	139583	1583.33	0	0	1	0	D/K	0	139583	80.78	0	0	0.04	0
93	32.83	0.67	28.83	0.67	656667	13333.33	720833	6666.67	2	0	0	0	328333.35	0	0	0	0.06	0	0	0
27	5	0.67	4	0.75	150000	20000	80000	D/K	2	0	3	0	75000	0	26666.7	D/K	0.4	0	0.75	0
117	0	19.75	D/K	D/K	0	395000	D/K	D/K	D/K	1	D/K	D/K	0	395000	D/K	D/K	D/K	0.05	D/K	D/K
70	30.17	1.58	28	1.75	452500	23750	D/K	D/K	0	0	0	0	0	0	0	D/K	0	0	0	0
62	31	1.92	28	1.5	558000	34500	140000	6000	0	0	0	0	0	0	0	0	0	0	0	0
115	11.97	1.06	D/K	1.08	536250	47812.5	D/K	D/K	1	1	D/K	D/K	536250	47812.5	D/K	D/K	0.08	0.94	D/K	D/K
123	20.92	1.58	20.97	1.83	20916.7	1583.33	16733.3	12833.33	0	0	0	0	0	0	0	0	0	0	0	0
99	10.5	0.33	8.58	1.25	105000	3333.33	171667	D/K	0	0	1	1	0	0	17166.7	D/K	0	0	0.12	0.8
116	5.83	8.5	6	8.5	58333.3	85000	72000	42500	2	3	0	1	29166.67	4250	0	14166.67	0.34	0.35	0	0.35
43	3	5	0	5.12	1500	2500	D/K	10333.33	0	2	0	3	0	2500	0	3444.42	0	0.4	0	0.58
28	5	23.84	7	23.83	175000	834166.7	350000	119166.7	3	0	1	1	58333.33	0	350000	119166.7	0.6	0	0.14	0.04

RAW PRE AND POST INJURY DRIVING EXPERIENCE AND ACCIDENT RATES