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The Role of Problem Solving in the Long Term Readjustment of Closed Head Injured Adults

by

Sandra J. Wolfe

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

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Date September 27, 1984

ABSTRACT

The hypothesis that problem-solving (P-S) deficits may be a significant contributing factor to the poor long term adjustment of young adults who have incurred a severe closed head injury (Boll, 1981; Miller, 1979) was examined in the present study. Twenty-six closed head injured (CHI) adults (coma & PTA > 24 hours, mean age = 27, mean IQ = 91) who had medically recovered (1-6 years post-trauma) and were residing in the community, were individually administered the WAIS-R and a battery of four P-S tasks. The battery included the Means-Ends Problem Solving Procedure, a measure of interpersonal P-S skill, which involved hypothetical everyday problem situations, and three tests of impersonal P-S ability; the Wisconsin Card Sorting Task, the Tower of Hanoi, and Syllogistic Reasoning. At the completion of each P-S task, subjects described their strategies. Adjustment level was assessed by subjects' self-evaluation using the Bell's Adjustment Inventory. Then psychologists reviewed interview data with each subject and a family member and rated the subjects on the Clinical Adjustment Index. Independent ratings on the 7-point likert-type scale produced a reliability coefficient of r = .94. Although the measure of adjustment was to be a linear combination of the two indexes, the Bell's Inventory was eliminated from most analyses. Self-evaluation of adjustment proved to be unrelated to Clinical Adjustment and to the linear combination of the four problem-solving measures.

Correlational analyses, using a step-wise regression technique, were employed to derive the relationships among the three variables-level of adjustment, impersonal P-S ability, and interpersonal

P-S skills. Once the major relationships were computed, a series of exploratory analyses was performed by dividing the sample into two groups based on various median splits. Chi Square procedures and group comparisons using primarily Hotelling's T^2 were calculated to indicate whether subgroups differed on a number of dimensions associated with their P-S ability, adjustment level, intellectual ability, and nature of their injury. Lastly, objective qualitative description provided additional information regarding critical issues such as metacognitive ability, individual differences, and task variables that could not be derived quantitatively.

The findings showed that the majority of the 21 subjects with low to high average intelligence were still unable to cope adequately with the demands of their home, work, and social environments. Further deterioration in adjustment level was predicted as they continue to fall behind their peers and experience more failures. However, the results failed to support the hypothesized systematic relationship between problem-solving and adjustment. Instead, intellectual ability proved to be the best predictor of adjustment. The measures purporting to assess problem-solving skills added little to our ability to predict level of adjustment beyond what is already known from conventional intelligence testing. However, the evidence did suggest that, with further development, two impersonal problem-solving measures, the WCST and Syllogistic Reasoning, may eventually enhance the clinician's ability to predict long term adjustment. Although P-S tasks are commonly part of assessment batteries and pressure is mounting to predict long term daily functions, clinicians need to refrain from basing prognostic statements on P-S tasks that intuitively appear to relate to adjustment but have

not been validated for this purpose.

The qualitative analyses repeatedly showed that CHI subjects could not accurately evaluate their own performance, failed to profit from feedback, and were unable to revise their strategy when demanded by increased task complexity. Such findings were interpreted as evidence of serious deficits in metacognitive processing. (Brown, 1978). Overall, the qualitative results strongly support Lezak's (1982) position that the daily living problems associated with limited executive functions need to become one of the major focuses of research and clinical work with severely closed head injured adults.

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I. Introduction

An increasing number of young adults incurring severe closed head injuries caused by acceleration-deceleration accidents are forced to cope with permanent cognitive impairments (Dye, Milby, Saxon, 1979; Eson, 1979; Eson, Yen, & Brouke, 1978; Jennett, 1975; Levin, Grossman, & Kelly, 1977; Lundholm, Jepsen, & Thornval, 1975; Miller, 1979; Smith, 1974; Thomsen, 1974). Even those who recover their basic intellectual abilities, as measured by intelligence tests, often prove unable to adjust adequately to the demands of their home, work, and social interactions (Eson, 1979; Miller, 1979), or otherwise fail to live up to their potential (Bond, 1983; Gjone, Kristiansen, & Sponheim, 1972; Jennett, 1975; Najenson, Mendelson, Schechter, David, Mintz, & Groswasser, 1974; Weddell, Oddy, & Jenkins, 1980). Secondary personality and emotional symptoms often develop and place the patient and the family under considerable stress which further interferes with the readjustment process (Boll, 1981; Cronholm, 1972; Oddy, Humphrey, & Uttley, 1978a; Rosenbaum & Najenson, 1976; Rosenthal, 1983).

Several preliminary studies have shown that residual higher level cognitive deficits, such as complex problem-solving (P-S), may be contributing significantly to the poor long term adjustment and deterioration in the mental health of closed head injured (CHI) adults (Boll, 1981; Dikmen & Reitan, 1977; Eson, 1979; Levin & Grossman, 1978; Lezak, 1976; Miller, 1979), although the relationship is not well understood. Exploration of psychosocial adjustment patterns have only recently been undertaken and are often unsatisfactory due to inadequate selection criteria, poor description of the patient characteristics, and insufficient outcome measures (McKinlay, Brooks, Bond, Martinage, &

Marshall, 1981; Oddy, Humphrey, & Uttley, 1978b). For several reasons, an understanding of the residual cognitive deficits that remain following closed head injury has also been slow in emerging (Brooks, 1974a, 1976; Levin et al., 1977; Mandleberg & Brooks, 1975). The traditional research approach has focused on the effects of localized lesions and these findings possess limited generalizability to persons with more diffuse damage (Mandleberg, 1976). The methodological tendency to use large heterogeneous groups consisting of cerebrovascular disease, head trauma, and degenerative diseases of the central nervous system has made interpretation of results for groups with specific types of brain dysfunction quite difficult and speculative (Black, 1973; Miller, 1970; Weddell et al., 1980). A further complication is that the few studies dealing with cognitive deficits associated with closed head injuries have generally been conducted in the early phases of recovery. However, outcome studies show that many of the initial impairments dissipate as the brain recovers and the patient learns to compensate (Miller, 1979). Yet it appears that the more global and less understood deficits, such as problem-solving (P-S), are proving quite resistive to spontaneous recovery, and continue to interfere with the readjustment process (Boll,1981). Also, deterioration in behavior involving higher intellectual functions, such as mental flexibility and abstract reasoning in complex impersonal and interpersonal P-S situations, has been noted to start a year post injury, seemingly due to further organic and metabolic changes (Lezak, 1976).

Research with other clinical populations where P-S is a critical issue, such as emotionally disturbed children, adolescents, and adults, has resulted in the gaining recognition of P-S as a significant variable

in mental health (D'Zurilla & Goldfried, 1971; Phillips, 1978). Yet even though a reduction in cognitive P-S (Lezak, 1976) and serious adjustment difficulties are accepted as major consequences of diffuse brain damage (Miller, 1979), there has been minimal research into the nature of the P-S deficit and its relationship to the adjustment process. This area of study has become even more complex with evidence indicating that impersonal, that is spatial or verbal P-S tasks, which have traditionally been used for diagnostic purposes with brain damaged individuals, assess very different skills than interpersonal P-S tasks which require a solution to hypothetical problems that occur in everyday life (Gotlib & Asarnov, 1979; King, 1980). Most importantly, a basic assumption regarding the relationship of P-S and brain injury is challenged by the suggestion that the ability to solve impersonal cognitive P-S tasks is unrelated to competency in solving real life interpersonal conflicts (Gotlib & Asarnov, 1979; Platt & Spivack, 1975a). Rather the evidence suggests that level of adjustment may be more related to one's skill at resolving interpersonal P-$ problems than laboratory-type P-S tasks that have no personal relevance. Further clarification of these issues would enhance our knowledge of the residual P-S deficits which may be affecting the adaptative functioning of the CHI person.

The study of metacognition offers another perspective for examining the relationship between P-S and level of adjustment. According to Brown (1978), metacognition, the knowledge or awareness of one's own cognitive strategies in problem situations, is the essence of intelligent and adaptive behavior. A growing theme in the literature concerning long term cognitive deficits following severe closed head

injury is that this population is unable to develop an efficient overall strategy when solving a variety of tasks. Most recently, Lezak (1983) claimed that the executive functions (or metacognitive processes) which are highly vulnerable to brain damage are "those capacities that enable a person to engage in independent, purposive, and self-serving behavior successfully" (p. 38). Therefore this neglected area of investigation must become a primary focus of researchers and clinicians working with brain injured adults (Lezak, 1982).

The qualitative approach which entails a detailed and systematic description of P-S strategies is necessary to derive deficits in metacognition. Such an approach illuminates a number of critical issues that cannot be adequately dealt with quantitatively (Simon, 1975). In the general cognitive P-S area, investigators who utilize this approach are beginning to account for differences in P-S ability in terms of the cognitive demands placed on the basic psychological processes, such as memory and perceptual skills, and are starting to stipulate task variables that can influence the acquisition of P-S skills (Glaser, 1978). The qualitative approach utilized in the present study provided much needed information concerning CHI adults' ability to adopt an effective overall strategy. Furthermore, questions such as whether the factors that contribute to P-S deficits are common among individuals across various tasks or vary with individual patients and the specific type of tasks were addressed through the qualitative method.

The more thorough understanding of P-S capability to be derived by the present study has significant positive ramifications in the applied field. Professionals working with CHI patients are confronted with the job of providing a comprehensive ability-deficit assessment which

predicts level of daily functioning and generates remediational recommendations (Heaton, Chelune, & Lehman, 1978). Unfortunately, most of the cognitive P-S measures that are predominately used in the decision-making process may provide insufficient or inaccurate information for practical prognostic statements (King, 1980). Any resulting misperceptions may aggravate the patients' and families' adjustment difficulties by placing inappropriate expectations on the patient (Boll, 1981; Heaton et al., 1978). Thus, increased understanding is necessary for improvement of assessment tools and development of future therapeutic and educational strategies. According to Jennett (1983) research into the efficacy of rehabilitation methods and tools is seriously lacking. Studies are needed not only to develop new assessment and rehabilitation techniques but also to evaluate current methods in order to discard ineffective ones. Although an understanding of the cognitive and behaviorial sequence of closed head injuries has recently improved, our ability to predict long term deficits and readjustment difficulties is very inadequate (Rosenthal, 1983). Consequently our intervention and rehabilitation programs are underdeveloped, which generally results in head injured persons remaining outside the mainstream of society.

The main objective of the present study was to determine the relationship of and interaction between P-S ability, including both impersonal cognitive and interpersonal components, and the level of adjustment achieved by CHI patients. Understanding this relationship is of particular significance since the majority of young CHI adults are entering into or are in the midst of a life stage that constantly demands complex problem-solving (Schaie, 1980).

The present study achieved the above objective by first assessing the impersonal cognitive P-S skill and the interpersonal P-S ability of individuals having medically recovered from a severe closed head injury of adult onset. Next, the relationship between impersonal P-S skills and interpersonal P-S capabilities was explored, and most importantly, the nature of the relationship between level of adjustment and both components of the P-S process was studied. The final step was to analyze qualitatively the P-S strategies adopted by CHI adults.

Definitions

Closed head injured (CHI) adult is used in "a broad sense, meaning that their primary mechanism of injury at the time of impact [caused by an acceleration/deceleration accident] was one of blunt trauma, rather than a penetrating injury"(Levin & Grossman, 1978, p. 720). As the study focuses on severe head injuries, the force will have been sufficient to result in a coma lasting over six hours and post traumatic amnesia over 24 hours. Post traumatic amnesia of 24 hours for a severe injury and over one week for a very severe injury is the generally accepted criteria for categorizing degree of brain injury (Jennett & Bond, 1975).

Post Traumatic Amnesia (PTA) "...refers to a period of variable length following closed head trauma during which the patient is confused, disoriented, suffers from retrograde amnesia and seems to lack the capacity to store and retrieve new information " (Schacter & Crovitz, 1977, p.151).

Coma, which is defined according to the Glasgow Coma Scale, must involve a concurrently inability to obey commands, to utter distinguishable

words, and to open ones eyes (Jennett, Teasdale, Galbraith, Pickard, Grant, Brackman, Avezaat, Muus, Minderhoud, Vecht, Heiden, Small, Caton, & Kurze, 1977).

Problem-solving (P-S) is considered to incorporate five interacting stages which include an overall P-S orientation, problem definition and formulation, generation of alternatives, decision making or the employment of transformation rules, and verification that the desired goal has been reached (Greeno, 1978; Heppner, 1978).

Impersonal and interpersonal problem-solving are terms created by some researchers in the applied study of P-S (i.e. Gotlib & Asarnov, 1979; Platt & Spivack, 1975a). The terms are used to differentiate between the skills necessary to solve problem situations or tasks that have no personal meaning for the problem-solver from skills necessary to effectively solve problems involving other people in everyday situations. The global P-S processes for both impersonal and interpersonal P-S are highly similiar (cf Heppner, 1978; Spivack & Shure, 1974). However, recent studies have shown a minimal relationship between performance on the two types of tasks and raises questions about the relationship of ability to solve impersonal P-S tasks to adjustment. In the present study, the Means-Ends Problem Solving procedure which involved hypothetical everyday problem situations was the measure of interpersonal P-S skill. Impersonal P-S ability was assessed by three verbal or spatial laboratory tasks; the Wisconsin Card Sorting Task, the Tower of Hanoi, and Syllogistic Reasoning.

Adjustment is considered to be the ability to deal effectively with ones home, work, and social environment. Adjustment in this context

"...connotes fitness, ability, confidence, experienced success in undertakings, realistic optimism, and sustained effort in dealing with ones physical and social environments " (Williams, 1979, p. 167). For the purposes of the present study, Bell's Adjustment Inventory and the Clinical Adjustment Index were used as two indices of adjustment.

II. Selected Review Of The Literature

A. Severe Closed Head Injuries

Epidemiology Severe closed head injuries of adult onset constitute one of the most complex health problems facing the injured persons, their family members, and rehabilitation teams (Rimel & Jane, 1983; Rosenbaum & Najenson, 1976). The principle causes are primarily products of our modern western society since motor vehicle accidents account for approximately 40% of head injuries and another 20% result from falls at home or in the work place (Annegers, Grabow, Kurland, & Laws, 1980). In Britain, Jennett (1979) estimates that nearly 1500 permanently disabled survivors of severe head injuries leave hospitals annually and that nearly half will never work again. As the average age of the survivors is 25 years and their life expectancy is another 40 years, the numbers become highly significant. Although people tend to be far more aware of spinal cord injuries, closed head injuries occur almost 10 times more frequently (Jennett, 1983). A recent epidemiological study of medical records from Minnesota during the years between 1935 to 1974 determined a mean annual age-adjusted rate for severe head injuries of 17 incidents for males and 6 incidents for females in every 100,000 persons (Annegers et al., 1980). Severe head injuries, which were defined by Annegers et al. as the presence of hematoma, brain contusion, and/or loss of consciousness for longer than 24 hours or post traumatic amnesia of at least 24 hours, were mostly concentrated in the 15 to 24 age range, especially for males. Extrapolating from these figures, a rough estimate of the number of severe head injuries a year in Alberta would be 500 cases. As approximately 80% of severe head injuries are caused by

acceleration/deceleration type accidents (Annegers et al., 1980), closed head injuries account for the vast majority of the severe head injuries. Furthermore, according to Annegers et al., the number of head injuries related to automobile and recreational accidents, such as collisions during horseback riding, football, and sledding, increased during the decade between 1965-1974 while all other categories remained stable or declined. Jennett (1975) maintained that the number of persons with permanent brain damage is growing due to increased survival rate because of a more advanced medical technology.

The most important fact from these statistics is that many young adults having incurred a severe head injury are attempting to cope for the rest of their lives with permanent physical and psychological disabilities (Thomsen, 1974). According to Jennett (1975, 1983), the psychological disabilities produce unique and complex adjustment problems for the head injured individual that differ significantly from the adjustment demands faced by persons with physical handicaps. Unfortunately, the nature of the disabilities caused by closed head injuries are often difficult to perceive and understand (Boll, 1981; Jennett, 1983). Hence society, including the injured person, their significant others, policy makers, and even at times professionals in the field, generally fail to appreciate the potential or lack of potential of the closed head injured (CHI) adult (Ron, Najenson, & Mendelson, 1977; Jennett, 1975).

Manifestations Even though a fully accepted medical definition remains to be determined, a coma lasting over 6 hours and a post traumatic amnesia (PTA) of over 24 hours are generally recognized as indicants of severe closed brain injury (Jennett & Bond, 1975; Jennett,

et al., 1977). Pathological changes in the brain tend to be bilateral (Mandleberg & Brooks, 1975), resulting from widespread, multifocal, and scattered brain damage (Brooks, 1974a; Eson et al., 1978, Jennett, 1983; Jennett et al., 1977; Miller, 1979). According to the Glasgow Coma Scale, a coma must involve concurrently an inability to obey commands, to utter distinguishable words, and to open the eyes (Jennett et el., 1977). Post traumatic amnesia

> "... refers to a period of variable length following closed head trauma during which the patient is confused, disoriented, suffers from retrograde amnesia, and seems to lack the capacity to store and retrieve new information" (Schacter & Crovitz, 1977, p. 151).

This interval has been shown to be a reasonably reliable retrospective index of severity of the head injury especially with acceleration/deceleration injuries (Jennett et al., 1977; Mandleberg, 1975) and to correlate highly with the degree of social, mental, and physical impairment (Bond, 1975), and to relate to long term outcome (Jennett, 1983). Post traumatic amnesia is considered to reflect the initial diffuse damage to the brain (Brooks, 1974a; Jennett, 1979) and has been related to later cognitive deficits such as memory (Brooks, 1974a) and learning (Brooks, Aughton, Bond, Jones, & Rizvi, 1983). Although PTA has been associated with the presence of negative personality change, it has not proven to be sensitive enough to predict extent or pattern of the change (Brooks & McKinlay, 1983). On the other hand, Brooks'(1974a) evidence suggested that neurological grades, which are often used to assess severity of injury and are based on specific neurological signs, are measuring focal damage which appears to be less

crucial in the cognitive functioning of CHI adults.

Due to the complexity of the brain as well as differences in the severity of the damage, injury to the brain manifests itself somewhat idiosyncratically once the person regains consciousness. Nevertheless, the immediate and direct impairments tend to be multiple as the injury effects, to varying degrees, the motor, cognitive, and emotional functioning of the individual. Physical disabilities can range from mild hemiparesis to profound hemiplegia (Romano, 1974), as well as such impairments as loss of voluntary movement and sensory discrimination. Concurrently, reduction in intellectual abilities such as impaired memory, concentration, communication disorders, and perceptual problems are typically found (Cronholm, 1972; Romano, 1974). In the initial recovery stage, the emotional sequelae directly associated with diffuse brain damage often incorporate emotional liability, increased fatiquability, reduced frustration tolerance, impulsivity, inappropriate affective reactions, and impaired social judgement (Cronholm, 1972; Gingras, 1979; Romano, 1974). Furthermore, as the individual attempts to cope with the disabilities, secondary personality and emotional symptoms, associated with premorbid status and grief reactions such as depression or denial, tend to develop (Cronholm, 1972; Gingras, 1979). The multidimensional aspect of a severe head injury often results in a general disability that is far more devastating than the sum of its component parts (Griffith, 1983).

Recovery The physical recovery process from a closed head injury is characterized by an enormous degree of uncertainty and variability (Jennett, 1972). Traditionally, the recovery period has been thought to be 3 to 5 years post injury (Lishman, 1973; Najenson et al., 1974).

Lishman (1973) speculated whether such a prolonged time course may be more related to reeducation of intact brain tissues taking over new functions rather than healing of the damaged brain tissue, suggesting that the adult brain possesses far more plasticity than previously thought. More recent evidence indicates that the actual recovery of cognitive functions primarily occurs in the first 6 months after the trauma, with only slight improvements thereafter (Bond, 1975; Bond & Brooks, 1976; Jennett et al, 1977). Changes noted after the first 6 months are attributed to the individual learning to compensate or adapt to their disabilities, including post injury psychosocial adjustment. Jennett et al. (1977) showed that physical recovery after the 6 month mark rarely was sufficient to change a patient's overall status. The assertion that the majority of cognitive recovery occurs within the first 6 months has been qualified by Eson at al. (1978) based on their clinical observations and cognitive assessments. As some of their patients achieved maximum recovery prior to 6 months while others demonstrated continuing recovery well past the 6 month mark, they claimed that the time course of recovery is quite variable and individual. Similiarly, when studying the long term psychosocial effects of severe head injuries for 58 patients, Hpay (1971) found that of the 24% who were judged to have made a full recovery, the vast majority (78%) had done so within 6 months and the rest within 2 years. Most recently, investigators have shown that CHI adults with no signs of recovery for 1 year can make substantial improvements in their intellectual, cognitive, social, and emotional functioning after becoming involved in an intensive cognitive rehabilitation program (Sbordone, 1984). Other factors influencing the eventual level of

recovery include depressive reactions, motivational deficits based in part on the original brain pathology, and long term readjustment to residual cognitive deficts (Lishman, 1973) and family reaction (Golden, 1978; Rosenbaum & Najenson, 1976). Group studies indicate that length of coma (Lundholm et al., 1975; Najenson et al., 1974), age (Jennett, 1972; Lundholm et al., 1975), and premorbid intellectual, emotional, and social status (Bond & Brooks, 1976; Jennett, 1972) all contribute significantly to the recovery level.

Long Term Adjustment The prognosis following a severe closed head injury is often considered favourable especially if long term adjustment is solely equated with resumption of employment. According to Oddy et al. (1978b), most outcome studies typically find 80-90% of CHI adults eventully obtain some type of work. In cases of a prolonged coma of over a month, the chances of working are reduced to 50%. However, in a 1 to 2 year follow-up study, Eson (1979) found that while the majority of 17 young adults with adequate and typical premorbid adjustment had recovered their basic adaptive/cognitive functions, none were able to successfully engage in school programs or to hold steady jobs. Their interpersonal relations with peers and adults also proved to be inept and stressful. Similarly, in Gjone et al.'s (1972) study, only 28 of 45 patients who were judged able to resume work, had in fact done so. Of 100 patients who had sustained either a closed head injury or penetrating head wound within the preceding 5 years, only 27% had full-time work while another 26% had secured part-time employment. The largest porportion, 37%, were not working (Ron et al., 1977). Najenson, Groswasser, Stern, Schechter, Daviv, Berghaus, and Mendelson (1975) studied for 6 months post injury the locomotor, intellectual,

communication, and behavioral recovery of 42 patients, of which 13 incurred blunt trauma and 29 sustained penetrating head wounds. In general, the patients demonstrated improvements on the Wechsler Adult Intelligence Scale (WAIS) as 24 had average or above average intelligence by the 6 month mark but the initial patterns of impairments, with visuo-motor perception being the most affected, remained relatively constant. In the subsequent follow-up two years later (Groswasser, Mendelson, Stern, Schechter, and Najenson, 1977), only 23 obtained work conforming to their ability level while 15 remained unemployed. By the 2 year mark only two more patients demonstrated average intelligence on the WAIS. In Hpay's (1971) study of 58 severely head injured adults, only 50% had returned to work by 5 years post injury and the majority of these expressed concern about work related difficulties. Another follow-up study conducted with patients who were 30 months post injury on the average determined that only 14 of 50 young adults with severe brain injury resulting from either a closed head injury or focal lesion had any type of job (Thomsen, 1974). In another study, 35 out of 97 patients who suffered major cerebral injury were not working at a level consistent with their functional capacity. Sixty-four percent of those capable of sheltered workshops and 36% of those able to do simple work were not so engaged, while only 15% in the professional category were not appropriately placed (Najenson et al., 1974). Bond and Brooks (1976) noted that brain injured persons who are members of professions and upper socioeconomic groups possess greater intellectual ability, broader ranges of social skills, and social support, than lower socioeconomic groups. Consequently, they more often obtain work that is consistent with their residual abilities relative to

their lower socioeconomic counterparts.

Absolute figures regarding resumption of employment have proven to be an insensitive index of recovery (Oddy & Humphrey, 1980; Weddell et al., 1980). These in depth examinations have revealed that many severely injured persons remained unemployed while a number did return to their former employment. However, many of those that returned could no longer cope with the demands which necessitated revising their responsibilities (Oddy & Humphrey, 1980; Weddell et al., 1980). Others in an haphazard fashion found suitable work while some floundered in inappropriate positions (Weddell et al., 1980).

Returning to work, however is not the sole indicator of overall adjustment. In Thomsen's (1974) study, most of the young injured persons (mean age = 26.8 years) did not realize the behavioral changes that their relatives found distressing although most reported feeling lonely as they had lost contact with old friends and were isolated in the home. Weddell et al. (1980) failed to support Thomsens's (1974) conclusion that social isolation results from lack of opportunity for social contact. Their results indicated that diminished social contact 2 years post injury was not related to isolation but rather to changes in the nature of their social interactions.

At 6 months post injury, Oddy et al. (1978b) found that approximately 20% of their 50 severely CHI patients were without any symptoms and had resumed their social activities, such as work, contact with friends, leisure activities, marital and family relations, parenting, and financial obligations. Yet a significant portion of their sample group complained of boredom which surprisingly seemed unrelated to resumption of work or leisure activities. At the same time, over a

third had not returned to work while another third had not fully resumed their leisure activities. In all, 68% of the patients were experiencing difficulties in some significant aspect of their lives at 6 months post injury. Oddy et al. (1978b) concluded that social problems were primarily the result of personality changes such as restlessness, irritability, and impatience. Interestingly, many patients were able to overcome emotional symptoms in order to return to work and resume social activities. Two years later, the most severly injured (PTA > 7 days) still had fewer social activities and more limited social life than before their accident (Oddy & Humphrey, 1980). The mild nature of the personality and cognitive changes meant that these factors had minimal influence on long term recovery (Oddy & Humphrey, 1980).

In their 6 month follow-up, Najenson et al. (1975) found that 25 of their 40 subjects exhibited behavioral abnormalities of varying severity, and of those with behavioral disturbances, 13 were unaware of their own disabilities. Since 7 out of the 10 patients who exhibited gross behavioral disturbances and lack of insight also had significant cognitive deficits, they concluded that the existence of residual cognitive deficits is a major obstacle to social and vocational readjustment. Their 2 year follow-up (Groswasser et al., 1977) determined that 14 out of the remaining 38 still possessed behavioral disorders and individuals lacking insight remained virtually unchanged. At that time, they postulated that behavioral disturbances, especially if accompanied by lack of insight, result in very poor social and vocational adjustment. Lundholm et al. (1975) found that 8 to 14 years after severe acceleration/deceleration head trauma resulting in coma lasting more than 7 days, all 30 individuals continued to demonstrate

some reduction in mental capacity but 50% were considered socially rehabilitated. An earlier study by Hpay (1971) with 58 severely head injured adults demonstrated that 21% had obvious social problems and another 14% were complete social outcasts due primarily to post traumatic personality changes. Overall, only 24% of Hpay's sample were judged completely recovered from the combined physical and psychological sequelae by 2 to 5 years post injury.

Given the original life threatening coma and the almost totally incapacitating initial impairments, it is understandable why the long term prognosis for severe CHI is viewed as more optimistic than originally thought (Hpay, 1971; Najenson et al., 1974; Oddy et al., 1978b; Panting & Merry, 1972). However, Jennett (1975) warned that the disappearance of marked neurological signs often deceptively leads to the conclusion of a good recovery and an underestimate of the long term consequences, even by rehabilitation experts. Miller (1979), after evaluating the major outcome studies, explained that it is premature to speculate on the average long term restitution. Interpretation of the results are hampered by the fact that studies differ substantially in their criterion for subject selection, subject characteristics, in follow-up time intervals, and outcome measures (Miller, 1979; Oddy et al., 1978b). Also, a number of studies simplistically and narrowly equated adjustment to securing employment (Jennett & Bond, 1975; Oddy et al., 1978b). Even so the accumulating body of research indicates that many adults having incurred a severe closed head injury have significant difficulty adjusting adequately to the demands of their home, social, and work environment (Eson, 1979; Gjone et al., 1972; Groswasser et al., 1977; Jennett, 1975; Miller, 1979; Thomsen, 1974). Furthermore, the

evidence strongly demonstrates that physical functions generally improve significantly and even if impairments remain, it is the cognitive and/or personality sequelae of diffuse brain injury that produce substantial problems for both the injured persons and their families, rather than physical deficits (Bond, 1983; Bond & Brooks, 1976; Hpay, 1971; Jennett, 1975; Lishman, 1973; Lezak, 1978; Najenson et al., 1974; Oddy et al., 1978a; Panting & Merry, 1972; Thomsen, 1974). Coping difficulties are exaggerated by the fact that this young and often male population is at an uncertain life stage when the sudden and unexpected accident occurs. Typically, the years between the ages of 20 and 30 are when young adults establish themselves financially and professionally, as well as begin their families.

Family Members At 6 months post injury, Oddy et al. (1978b) found no evidence of deterioration in family relationships for 50 CHI patients when compared to 35 patients with traumatic limb fractures. However, the researchers questioned whether spouses and family members would be able to sustain adequate and fullfilling relationships if the injured person continued to manifest their personality disorders. In fact the limited research on the impact of such an injury on the family suggests that by a year post injury, the family unit often starts to disintegrate as spouses no longer share activities or problem-solving (Malone, 1977; Rosenbaum & Najenson, 1976). At this stage, the young wives are faced with the reality of the situation and must begin the adjustment process as progress has slowed considerably, hopes for a full recovery have diminished, and support systems have begun to dissipate (Rosenbaum & Najenson, 1976). In his study with 56 severely CHI patients, Bond (1975) found that mental disabilities involving memory deficits and personality

changes, rather than physical handicaps, disrupted family cohesion. In a later study, relatives most often reported problems associated with emotional changes, poor memory, and subjective symptoms such as tiredness and slowness (McKinlay et al., 1981). As the first year post injury progressed, the relatives exhibited signs of decreasing capacity to tolerate or handle the negative personality changes (Brooks & McKinlay, 1983). Many spouses become disheartened when they recognize that persons with whom they are building their lives, are now significantly different persons; rather unpredictable and often disappointing.

The healthy spouse of the brain damaged adult often must deal with a number of debilitating emotional reactions such as depression, guilt, anger, and irritability (Lezak, 1978; Malone, 1977). Based on their findings with wives of 10 brain injured soldiers, 2 with closed head injuries and 8 with penetrating wounds, Rosenbaum and Najenson (1976) concluded that limitations in interpersonal skills of the injured person contributed to the depression of the spouse. The research by Oddy et al.(1978a) illustrated that the worst period of stress for the relatives was in the first month following the accident but 12 months post injury at least one quarter of the relatives were experiencing considerable chronic stress. The identified source for the stress was personality changes related to disorientation and verbal expansiveness. McKinlay et al.(1981) also demonstrated a connection between relatives' perception of mental and behavioral changes in the injured person and relatives' stress. The level of stress reported by family members once again proved to be constant by 3 months post injury. As well, the emotional strain on relatives of head injured adults was apparent in Panting and Merry's

(1972) patient review. At up to 5 years post injury, 61% of the relatives were using tranquillizers and sleeping pills that were not needed prior to the accident. Other negative symptoms manifested by spouses have proven to be an inadequate social life, neglect of job, children, and injured spouse, as well as physical and mental illnesses (Malone, 1977; Rosenbaum & Najenson, 1976). Thomsen (1974) and Panting and Merry (1972) concluded that the relationships between single head injured adults and their mothers were generally more satisfying than between married injured individuals and their spouses. To keep the family intact, female spouses were often forced to assume the traditional male role, to raise their children alone, and to become surrogate mothers to their former partners (Bond, 1983; Buxbaum, 1967; Lezak, 1978; Rosenbaum & Najenson, 1976). The family members' roles are made more burdensome by the fact that their reaction to the injured person can exacerbate existing dysfunctional behavior and even generate more emotional distress (Lezak, 1978; Rosenthal, 1983).

Despite the many problems facing the family of the injured person, there is clinical and research evidence indicating that the family establishes a more acceptable level of emotional equilibrium in the second year post injury (Bond, 1983; Oddy & Humphrey, 1980). During this phase, the family begins to view the person's disabilities more realistically, to disentangle themselves emotionally, and to develop more constructive and adaptive coping mechanisms (Bond, 1983; Weddell et al., 1980). Unfortunately, the reorganization within the family unit is not sufficient to dispel all of the serious adjustment problems.

Adjustment and Residual Cognitive Deficits The major findings from outcome studies indicate that CHI adults and their significant others

often experience disturbing changes in their lives that impede the readjustment process. Adjustment difficulties have proven to be multifaceted involving home, work, and social life (Lishman, 1973). Deterioration in interpersonal relationships and the mental health of the injured person and significant others are all too common aftermaths of closed head injuries. Some researchers attribute the inadequate readaptation of CHI adults primarily to personality/emotional disturbances (e.g. Groswasser et al., 1977; Mandleberg, 1976; Thomsen, 1974). Personality disorders are generally considered to be caused by physiogenic and psychogenic factors but the relative contribution of each factor remains illusive (Lishman, 1973). Furthermore, the personality orientation lacks clarity as the labels "personality", "psychiatric", "mental", or "emotional" are often used interchangeably and are poorly defined. Researchers vary considerably in whether their definitions incorporate all or just some of a broad range of changes related to intellectual, affective, and behavioral functioning (i.e. Lishman, 1973). For instance, in Bond's (1975) study, mental disabilities involved memory and personality factors and were correlated with loss of work capacity, leisure pursuits, and disruption of family cohesion. Jennett and Bond (1975) concluded that psychological symptoms involving personality changes or cognitive impairments create the most difficulties whereas signs of mental illness such as depression or anxiety rarely added to adjustment problems of head injured adults.

After reviewing the research on the psychological symptoms following head injuries, Dikmen and Reitan (1977) decided that the study of both the long term natural history of the emotional sequelae and the relationship between cognitive-intellectual impairments and emotional

dysfunction required further study. Therefore, the Minnesota Multiphasic Personality Inventory and an extensive battery of neuropsychological measures were administered to 27 adults admitted to neurosurgical wards with diverse types and severity of head injuries. Testing was conducted soon after the injury and repeated 12 and 18 months later. The subjects were divided into two subgroups designated impaired or normal/mild group based on their scores on a neuropsychological battery. The impaired group demonstrated greater emotional problems on the three testing occasions than the normal/mild group. The reduction in the number of the neurotic-like complaints with time was attributed to the recovery of other impairments such as cognitive deficits or adjustment to residual deficits. The authors concluded that

> "..."psychogenic mechanisms" are probably overused in explaining the difficulties experienced by head-injured patients. This tendency is fostered by focusing on neurological deficits that are likely to be absent in most cases of civilian head injuries, by overlooking posttraumatic cognitive-intellectual difficulties that are not easily detectable without neuropsychological examination, and by relying on background information that is largely based on select and biased samples of persons who have continuing medical, legal, and emotional difficulties" (Dikmen & Reitan, 1977, p. 493-494).

In another study focusing on behavioral sequelae similar conclusions were reached. Levin & Grossman (1978) administered a behavioral scale of psychopathology to 62 patients with closed head injuries of graded severity. Cognitive disorganization, motor retardation, emotional withdrawal, and affective disturbance were the

predominant behavioral dysfunctions and related to severity of the initial injury. The degree of behavioral disorder proved to correlate significantly with coma duration, an index of diffuse cerebral injury; hemiparesis and aphasia, two acute neurological deficits; the presence of EEG and CT abnormalities; and agitation during coma. No association between behavioral disturbances and mesencephalic injuries, hematoma, intercerebral hematoma, skull fractures, hemispheric lateralization, or focal injuries involving the temporal, orbitofrontal, or frontotemporal regions were derived. Levin and Grossman (1978) concluded that conceptual or cognitive disorganization may be one of the major underlying determinants of behavioral malfunctioning. As their patients had difficulties screening out irrelevant material, they speculated that behavioral dysfunctions are affiliated with a reduction in rate of processing as previously proposed by Gronwall and Sampson

third study, examining the emotional reaction to severe head injury, used the MMPI and relatives' perception on the Katz Adjustment Scale to compare acute patients (post-injury <6 months) and chronic patients (post-injury >6 months) (Fordyce, Roueche, & Prigatano, 1983). The results suggested that emotional distress worsens as time progresses which was attributed to increased understanding of their social problems and residual deficits. In contrast to Dikman & Reitan's (1977) finding that more impaired subjects showed greater emotional symptoms, level of emotional reaction proved unrelated to neuropsychological variables in this study.

In keeping with those studies linking emotional adjustment to cognitive impairments, other researchers maintain that subtle but higher

level residual cognitive deficits are at the root of the readjustment problems (Boll, 1981; Eson, 1979; Miller, 1979). Within this orientation, readjustment problems are multidimensional encompassing social functioning, interpersonal relationships, and mental health rather than solely neurotic emotional symptoms as investigated by Dikmen and Reitan (1977) and Levin and Grossman (1978). Although the eventual behavioral characteristics of the head injured person are produced by many interacting internal and external life influences, some significant aspects of the personality malfunctioning is considered to be the direct result of the residual cognitive deficits (Najenson et al., 1975; Rosenthal, 1983). Examination of the relationship of the residual cognitive deficits to the complicated psychosocial adjustment of severe CHI adults warrants further investigation but will necessitate, as Lishman (1975) explained, going beyond the orthodox models and approaches to this area. In an attempt to verify the cognitive position, research into the residual cognitive deficits stemming from severe closed head injuries has been reviewed in detail in the following section.

B. Residual Cognitive Deficits

As stated in the introduction, investigations of the cognitive sequelae of a closed head injury have been fraught with poor research design and methodological inconsistencies. Even studies dealing with only head injuries vary in whether the subjects are chiefly comprised of individuals with primarily focal damage caused by a penetrating head injury or diffuse damage from a blunt head injury (Mandleberg, 1976). Diffuse damage producing dead or damaged tissue alters far more aspects

of the brain status than clean penetrating injuries, including neurochemical and electrical functioning (Lezak, 1976). The after-effect of severe closed head injuries tends to result in far more extensive behavioral and functional consequences. As demonstrated by Black (1973), individuals incurring brain damage from a closed head injury were significantly more impaired on tests of memory and cognitive functioning than those with penetrating missile wounds. Other studies use non-representative samples of CHI persons by including a disportionately large number who required surgical intervention (e.g. Bond & Brooks, 1976; Mandleberg, 1975, 1976; Mandleberg & Brooks, 1975). Moreover, the fact that studies differ significantly in the severity of injuries, time from injury to testing, and criterion measures has lead to confusion and contradictions in results and interpretation (Miller, 1979).

Intellectual Impairments A series of studies on the relationship of closed head injuries and level of cognitive functioning have been conducted by a group of investigators from Glasgow. In the first study (Mandleberg & Brooks, 1975), the WAIS results of 40 severely CHI adults tested at 0-3 months, 4-6 months, 7-12 months, and over 13 months post injury were compared to the scores of a matched control group of 40 non-injured males. The findings indicated less initial deterioration and a more rapid and steady recovery level for verbal subtests (VIQ) than performance ones (PIQ). The rather unexpected result was that the intellectual abilities of the CHI adults, when compared as a group to their matched controls, eventually returned to normal levels, regardless of the severity of the injuries as defined by duration of PTA. In another study Mandleberg (1975) administered the the WAIS at 2 months post injury to two groups of matched CHI adults differing only in length

of PTA. As expected Group 1, whose members were still in the midst of the PTA stage as their mean PTA was 110 days, scored significantly lower than Group 2, whose members had recuperated from the PTA period since their mean PTA was 19 days. However, by the 18 month follow-up testing, the cognitive gap between the two groups had narrowed to such a degree that it was no longer significant. In general, the longer PTA seemed to be associated with a consistent but slight lowering of cognitive skills measured by the WAIS. During PTA, verbal skills proved to be somewhat intact, while even maintaining a low level of achievement on performance items was beyond the capabilities of the severely CHI individuals.

In his next study, Mandleberg (1976) analyzed WAIS scores of 51 CHI persons, systematically obtained at the same four time intervals as in 1975, and then the scores of an additional 98 patients tested at irregular intervals. By categorizing each sample into four subgroups based on severity of injury as defined by duration of PTA, it was found that VIQ level was only related to PTA at 3 months after injury. PIQ proved to be related to PTA at both 3 and 6 months and by 12 and 30 months, no relationship existed between duration of PTA and either VIQ or PIQ. During the same time period, Bond and Brooks (1976) assessed another 40 CHI adults, who incurred PTA of greater than 24 hours on the WAIS using the same test-retest method and similar time intervals. Their findings demonstrated that intellectual level recovers rapidly, often within the first 6 months and that later recovery appears to be associated with adaptation to residual deficits. Furthermore, the final level of intellectual recovery as measured by the WAIS proved to be achieved earlier for verbal than performance abilities.

From their research findings, the Glasgow investigators have generated hypotheses that have substantial implications for both the theoretical understanding of closed head injuries and the rehabilitation process. First, even though Mandleberg and Brook's (1975) sample contained a preponderance of individuals seeming to have primarily left hemispheric damage, their WAIS scores appeared more typical of individuals with right hemispheric insult. According to Mandleberg (1975) the differential effect of this type of injury on VIQ and PIQ could be attributed to a number of differences in the tasks. Some of the reasons that have been put forth to account for the consistently lower PIQ scores of CHI adults are the greater reliance on memory functions, the non-verbal characteristics, and the more complex nature of performance subtests. The Glasgow group support the position that performance subtests are substantially more structurally complex, involving the integration of various cognitive functions, while verbal subtests are considered to reguire simple, readily available responses (Bond & Brooks, 1976; Mandleberg & Brooks, 1975).

The widely accepted position that right sided damage soley produces visuospatial deficits while left sided injury effects verbal processes has been further qualified by Ben-Yishay, Diller, Gerstman, and Gordon (1970). In their study, 62 cerebral vascular accident (CVA) patients with left hemiplegia were given the standard form of the similarities and block design (BD) subtests from the WAIS to assess their competence level. Then all failed items were readministered using a series of cues ranging from minimal to maximal explicitness until the items were either passed or a complete failure to profit from the cues occurred. The data indicated that for right sided brain damage,

performance on BD, including competency level and results from cuing, is a highly sensitive index of impairment. The cuing procedure revealed subtle verbal conceptual deficits that were not apparent from scores on the standard administration of similarities because pre-injury verbal skills and education level masked their presence. The authors concluded that the evidence points out that previous experimental results may have been influenced by too simplistic verbal measures. Furthermore, a cross-validation study (Ben-Yishay, Diller, & Mandleberg, 1970) showed that BD competence is impaired for left hemiplegics as well. Hence Ben-Yishay, Diller, Gerstman, & Gordon (1970) maintain that the traditional right/left distinctions require reexamination using more sophisticated tasks measuring possibly higher level cognitive functions.

In a similar research vein, a few studies have examined the effects the location of the primary injury on the type of cognitive deficits incurred from a closed head injury. To ascertain the influence of site of impact on 77 adults with severe but uncomplicated closed head injuries who were then 10 to 20 years post-injury, Smith (1974) administered a number of subtests primarily from the WAIS and Wechsler Memory Scale. The right impact group manifested significantly greater deficits on both the verbal and visual spatial tasks. Rather than question the right/left distinction, the verbal deficits were interpreted to be the result of left hemispheric damage from the contrecoup injury. Even though matched in severity of injury and estimate of degree of contrecoup, the left impact group failed to show visual spatial impairments which one would have anticipated given their contrecoup. Smith attributed the differences between the left and right impact groups to the insensitivity of the measures used to assess

visuospatial deficits. In contrast to the Glasgow group, Smith (1974) claimed that the verbal subtests were more sensitive to brain damage than the performance ones. In Levin's et al. (1977) study, a higher percentage of aphasic patients who were assumed to have incurred primarily left hemispheric injuries demonstrated impaired facial recognition as compared to other CHI patients. However, their conclusion was on rather limited data as only eight aphasics and two non-aphasics from a total sample of 46 CHI patients performed within the defective range. As did Smith (1974), Levin et al. (1977) and Lezak (1979) concluded that cognitive abilities, generally ascribed to the cerebral hemisphere opposite to the hemisphere considered to have incurred the primary injury, are concurrently disrupted by closed head injuries, even when there are no apparent neurological indications. Teuber (1975) replicated findings that show that individuals with left hemispheric focal lesions resulting in dysphasia were particularly prone to poor performance on tasks requiring complex perceptual analysis, such as the hidden-figure test. Since his work is primarily with penetrating missile wounds, his results can not be accounted for by the presence of brain damage due to contrecoup. Considerablely more research into the applicability of the right/left distinction and the involvement of both hemispheres for CHI adults is required. The existing evidence suggests that the use of more sensitive and complex tasks may illuminate more clearly the nature of the cognitive deficits and the relative importance of diffuse and focal damage resulting from this type of injury.

The second major outcome of the Glasgow work is that the severity of the injury, as defined by duration of PTA, seems to have minimal effect on the long term cognitive recovery as assessed by the WAIS

(Mandleberg, 1976). This conclusion is in opposition to the traditional view that with increasing severity the risk of residual cognitive deficits grows progressively (Lishman, 1973). In accordance with the Glasgow work, Smith (1974) found no significant relationship between permanent cognitive impairments and duration of PTA, initial neurological condition, or age at the time of impact for persons incurring a closed head injury during adulthood. However, after comparing CHI individuals whose PTA was less than 7 days with a second group whose PTA was greater than 14 days, Brooks et al. (1980) concluded that PTA has a consistent association with cognitive deficits. Other indices such as duration of coma, signs of focal damage and age were unrelated to cognitive outcome. As the majority of subjects in their study were still in the first year post injury, the association of PTA to cognitive deterioration may weaken as time progresses. Lezak (1979), who assessed his subjects at four intervals over 3 years, found that severity of injury, PTA, was directly related to the severity of memory and learning deficit but that age failed to have the expected association. In other studies, length of coma (Levin et al., 1977; Dye, 1976; Dye et al., 1979) and pervasiveness of injury, meaning the involvement of both hemispheres and brain stem (Levin et al., 1977) have been associated with poor performance on a variety of cognitive tasks such as manipulatory tests from the Halstead-Reitan Battery and facial recognition tasks. Levin et al. (1977) stated that no single neurodiagnostic procedure or neuropsychological measure can serve as an adequate index of severity of injury. Early neurological difficulties, especially abnormal motor patterns, were judged by Dye et al. (1979) to be precursors to impaired cognitive functioning and even later

adjustment. As the evidence relating indices of severity to long term residual cognitive deficits remain clouded, further innovative research and replication studies are necessary before predictions on outcome can be made in the early recovery stage.

The third conclusion from the Glasgow work is that the intellectual level of severely CHI adults gradually returns to normal (Mandleberg & Brooks, 1975). As the cognitive abilities measured by the WAIS often recover sufficiently to predict adequate daily living skills then it is speculated that cognitive impairments may not be crucial factors in overall recovery and adjustment for CHI adults. Instead, it is hypothesized that the significant residual changes negatively influencing adjustment are related to personality and stylistic modifications. Mandleberg (1976) postulated that "soft cognitive indices" such as reduced levels of arousal, poor concentration or attention, poor motivation, or disturbed memory are manifestations of inefficient cognitive style rather than lowered cognitive skills.

> "Stylistic changes might be reflected in speed of response, in persistence at a task, or other variables responsive to changes in task strategy, but such changes do not necessarily impair achievement" (Mandleberg, 1976, p.1007).

Mandleberg (1976) interpreted the series of papers by Ben-Yishay and his colleagues as supporting his position that residual cognitive deficits generally do not influence competence and adjustment. Early studies (Ben-Yishay, Diller, Gerstman, & Gordon,1970; Ben-Yishay, Diller, & Mandleberg, 1970) comparing left and right hemiplegics with normals showed that pathological and normal behaviour are a continuing, lawful, and quantifiable phenomena. In the first study on style of

performance (Ben-Yishay, Diller, Mandleberg, Gordon, & Gerstman, 1971), not one aspect proved to be exclusive to either brain damaged or normal persons except that the competence of the brain injured adults was significantly lower. Reasons for the lower competence of right hemiplegic patients were uncertain except that when failing they demonstrated reduced activity level. On the other hand, the poorer success rate of the left hemiplegic patients appeared to be associated with the fact that they produced the greatest number of constructional deviations, were the least active, and performed maneuvers more slowly than either the right hemiplegics or normals.

In a subsequent study (Ben-Yishay, Diller, Mandleberg, Gordon, & Gerstman, 1974), both individuals who incurred right and left hemiplegia from CVA manifested a tendency to shift to alternate quadrants of the block design items more frequently than normals although, in absolute terms, normals made more moves when failing. In their study, persistence was equated with an orderly and sustained effort to work in one segment of the design until successful while lower persistence was exhibited by the tendency to shift from segment to segment if not immediately successful. Within their framework, overall effort to complete a design was unrelated to level of persistence. Brain injured persons were found to be less persistent and remained so even after they were trained to the same competency level as the normals. Ben-Yishay et al. (1974) results differ from Mandleberg's (1976) in that the brain damaged persons demonstrated a lower competency level than the normals. The lack of motivation hypothesis, one interpretation offered by Mandleberg (1976) for residual deficits, is inconsistent with the fact that the the brain damaged individuals in the Ben-Yishay et al.(1974) study

maintained adequate effort throughout testing. Due to the finding that less persistent strategy continued after training, Ben-Yishay et al. concluded that ultimate success is dissociated from style, especially as retraining on Block Design generalized to cicumscribed daily living activities. However, their recommendation was that retraining should be multidimensional, including an emphasis on strategy. Thus, there seems to be some recognition that brain injured individuals may be capable of compensating for strategic deficits and that such deficits do influence level of success. Furthermore, with the brain injured sample, differences between right and left hemispheric patients in persistence suggested that assessment of stylistic changes are important for differential diagnosis and remediation even when competence level is similar.

After reviewing the Glasgow research, Miller (1979) cautioned against assuming that because IQ recovers to a level consistent with previous education and occupational history that CHI persons do not have permanent and debilitating cognitive impairments. Teuber (1975), in his work with penetrating head injuries, concluded that standard psychometric intelligence tests are relatively insensitive to certain behavioral outcomes of brain injuries.

> "It is simply bad logic, here as elsewhere, if one confuses absence of evidence (no apparent drop of performance on a particular test) with evidence of absence (no loss of intellectual function)" (Teuber, 1975, p. 166).

Miller (1979) stressed that more sophisticated research will eventually illuminate the nature of the residual cognitive deficits following severe closed head injuries, even when intelligence is assessed as

normal.

Other studies exploring residual deficits of closed head injuries, although some are admittedly less rigorous in their research design, have shown a variety of cognitive impairments remaining three years (Dye,1976) and even up to 20 years post-injury (Smith, 1974). Time from injury to testing has proven relatively unassociated with level of defective performance (Levin et al., 1977). Furthermore, Eson et al. (1978) maintained that the relationship between performance on a single intelligence scale, such as the WAIS, and adjustment has not been fully explored and probably will not be established. In contrast to the Glasgow group, Eson et al. (1978) concluded that on the basis of the results obtained on their newly devised ontogenetic assessment battery that cognitive impairments are primary outcomes of severe closed head injuries while personality malfunctioning is a derivative symptom. This position that subtle but significant intellectual impairments contribute to the more obvious emotional and behavioral disturbances was originally put forth by Goldstein in 1942 (Lishman, 1973).

In consonance with the Glasgow position, Eson's et al. (1978) initial work led to the conclusion that in the early recovery phases following a closed head injury performance on tasks requiring sequential ordering and visual scanning is impaired while verbal functions and activities relying on hemispheric specialization remain relatively intact. However, in their follow-up study with 17 young CHI adults with good premorbid adjustment histories, the researchers were rather startled to learn that those CHI adults who had recovered their basic cognitive abilities were unable to maintain employment, to meet the demands of school, and to develop mutually satisfying personal

relationships (Eson, 1979). Eson and his colleaques then approached the problem of inadequate adjustment from a cognitive perspective even though recovery of cognitive functions seemed sufficient for daily living, rather than turning to an explanation stressing personality factors as did Mandleberg (1976). Their original battery was viewed as able to track the recovery process for specific cognitive deficits but was not considered sensitive enough to the type of cognitive deficits that impede long term readjustment. Small group and case study approach revealed that the residual deficits one to two years post injury seemed to be associated with deficits in generative information processing as reflected in an inability to categorize events. Eson (1979) went beyond Gronwall and Sampson's (1974) stance that slowed information processing reduces work capacity and added that maintenance of attention, shifting of attention, and rule retention also interferes with daily functioning. Gronwall and Wrightson (1974) claim that even mildly head injured adults for a period of time post injury may inappropriately perceive reduced information processing capacity as a lack of concentration. A reaction time experiment (Miller, 1970) determined that a small group of five CHI who incurred their injury 3 to 12 months previously were significantly slower than a matched control group. The difference in speed was magnified as the task became more complex. As the findings were not explicable on the basis of either a motor or sensory deficit, Miller proposed a central disturbance involving retarded decision making and information processing abilities. Miller's conclusion appears consistent with Eson's (1979) that an instrument such as the WAIS may fail to measure the on-going and complex information processes which both researchers consider to be the root of the cognitive deficits resulting

from a severe closed head injury. A recurring theme seems to be that the long term deficits are associated with a failure of CHI adults to adopt an overall efficient strategy which hinders their ability to function at a satisfactory competence level. Further research to determine if deficits in information processing or higher level cognitive functions are permanent is one of the next steps in understanding the impact of closed head injuries on cognitive abilities.

Memory Impairments The quantitative literature on memory disabilities, one area of cognitive dysfunction that has been widely accepted as a outcome of closed head injury, especially in the initial PTA period, has been extensively reviewed by Schacter and Crovitz (1977) and Brooks (1983). As with other areas of research related to the cognitive sequelae of closed head injury, memory investigations provide inconsistent and equivocal findings. The usefulness and generalizability of the results are limited by differences in methods for measuring severity of injury, especially PTA; confounding variables such as age, restricted time range, and presence of focal damage; differing methods for assessment of memory functions in later recovery phases (Schacter & Crovitz, 1977); and inadequacies in commonly used clinical measures (Erickson & Scott, 1977). Lack of sufficient awareness of the theoretical and empirical status of experimental methods and models in memory research (Miller, 1979; Schacter & Crovitz, 1977) and a tendency to study memory in isolation from other cognitive abilities (Schacter & Crovitz, 1977) hinders interpretation and applicability.

The present concern is with the existence and nature of long term memory impairment as it influences performance in other cognitive domains. According to Schacter and Crovitz (1977) even the permanency

and ti[redacted]of memory malfunctioning remain questionable. Research by Broo[redacted]1974a, 1974b, 1975, 1976), Smith (1974), and Levin, [redacted]ossman[redacted]elly (1976) provide evidence for significant residual d[redacted]icits[redacted]le earlier studies reported by Schacter and Crovitz (1977) de[redacted]nstr[redacted]ed no significant memory deficit in the long term. After rev[redacted] the available literature, Miller (1979), Schacter and Crovitz (197[redacted] and Brooks (1983) all concluded that long lasting and relatively stabl[redacted]memory impairments exist although the nature of these deficits remai[redacted]somewhat speculative. Erickson and Scott (1977) explained that neurop[redacted]chological research has done more to illuminate the complexities of memor[redacted] than to provide answers. However, memory impairments are proving to be more serious than many other cognitive deficits (Brooks, 1983).

On[redacted]ain research by the Glasgow group appears to be the most rigorous, systematic, and sophisticated and thereby generating valuable information and hypotheses regarding memory functioning of the CHI person. Despite a general tendency to assume that PTA measures severity of injury, and that PTA correlates with memory deficits, the relationship is proving inconsistent and complex (Schacter & Crovitz, 1977). Brooks (1972, 1974a) initially maintained that the association is influenced by age with older patients demonstrating a significant correlation between duration of PTA and memory deficits that does not hold for younger patients. Based on his finding that poor decision making strategy was unrelated to PTA, he went on to propose a threshold effect whereby mild diffuse damage lead to a strategic deficit but a severe focal injury need not (Brooks, 1974a). On the other hand, Brooks (1974a, 1974b) concluded that the severity of injury determined by PTA

is indicative of diffuse insult to the brain and related to the degree of reduced memory capacity or the ability to store information. Neurological signs and skull fractures thought to be indicants of focal damage have been shown to be of minimum importance in memory functioning following a severe head injury (Brooks, 1974a, 1975, 1976). Brooks maintained that brain stem or midbrain damage would create deficits limited to input processes rather than the multifaceted deficits that have been found. Brooks (1974a, 1976, 1983) strongly contends that it is the presence of diffuse damage that is the crucial determinant of residual impairments and not the focal aspect of the injuries. Post traumatic amnesia, representing diffuse damage, was initiallly judged to be a significant prognostic sign (Brooks, 1972) which denotes a threshold level for efficient memory strategy and correlates with degree of reduced memory capacity (Brooks, 1976). In contradiction to his own position, Brooks (1975, 1976) later found that PTA failed to consistently relate to memory scores on a variety of diverse tasks but he did not examine the age variable as part of these studies. Furthermore, Brooks used very diverse measures of memory in his various studies but beyond the distinction between long and short term memory he failed to examine how these tests which may tap very different aspects of memory, such as storage or processing capacity, may interact with severity of injury. Overall, Brooks (1983) concluded that the greater the diffuse damage, the more serious the memory deficits, while the association between focal damage and memory deficit appears quite weak. A contrary interpretation was offered by Levin et al. (1976) as their evidence indicated that those CHI patients with signs of brain stem involvement and aphasia are more likely to manifest memory deficits.

However, in this study, the researchers compared individuals exhibiting no signs of coma with those unconscious for over two weeks. The former group may not have incurred an injury sufficient to pass the threshold proposed by Brooks (1974a).

In regards to the nature of the residual deficit, Brooks (1974a) found that on a continuous recognition test CHI adults, judged to have fully recuperated from the PTA stage, demonstrated a significant memory impairment when compared to a control group. The CHI adults demonstrated reduced memory capacity which was defined as ones efficiency in recognizing recurring designs in a sequence of 140 designs minus errors due to incorrectly identifying a new design as a recurring one. The error analysis determined that CHI adults made many more errors than the normals by failing to designate recurring stimuli. This finding was interpreted to mean that CHI adults employ a more conservative or cautious strategy. In a follow-up study using a technique to separate strategy from dysfunctional memory, Brooks (1974b) concluded that inefficient strategies and lowered memory capacity combined to reduce overall memory performance. Based on clinical observation, Eson (1979) stated that memory deficits are the result of inadequate internal strategies for processing information as well as difficulty constructing meaning for new experiences. Brooks (1975), using very severely injured patients, showed that disruption of short-term memory recovers relatively rapidly but that residual deficits occur in the transfer of information to a long term memory store, caused by diffuse rather than focal damage. In contradiction, Levin et al. (1976), using a small group comparison among three CHI groups differing in severity of injury, found impaired short-term memory over one year post-injury in the very severe

group.

In general, memory disabilities have been demonstrated to improve with time especially in the very early recovery stages but there is insufficient evidence to stipulate the time course (Schacter & Crovitz, 1977). The findings from Lezak's (1979) study of 24 CHI adults over a 3 year span demonstrated considerable variability in the initial performance level and recovery patterns on memory and learning tasks. Consistent improvement only occurred in the simplest immediate memory span and learning tasks and by 3 years post injury, further deterioration was noted on the most difficult tasks. On the other hand, Brooks (1976) found that memory deficits seem to stabilize at a low level within the first 6 months. Time from injury to memory testing has often proved immaterial past the 6 month point in the recovery process (Brooks, 1974a; Levin et al., 1976). Furthermore, Brooks' findings in 1975 indicate that different memory processes may recover at different rates. In his summary of memory outcome patterns, Brooks (1983) concurred with Lezak (1979) that the rate and extent of memory recovery is quite variable. Evidence also indicated that the final level and rate of return of memory function generally lags behind other functions. For instance, in 1976 Brooks speculated that intelligence, a more global and multidimensional function, may recover at a very different pace than memory functions per se. Unfortunately, the association of memory deficits to other areas of cognitive functioning for the CHI person is largely unknown. However, the evidence for residual memory deficits does caution researchers about the influence that memory can exert over performance on other cognitive tasks.

A recurring theme, both in the memory and more general cognition literature, is that an inability to develop an efficient strategy may be contributing to the lower competence levels exhibited by CHI adults on a variety of cognitive tasks. Memory may be especially vulnerable to the effects of a closed head injury because memory itself is a higher order cognitive process (Erickson & Scott, 1977). Lezak (1976) warns that a patients perception of memory deficits is sometimes objectively inaccurate. According to Teuber (1975), memory is a "catch-all' since many brain damage adults mistakingly believe their memory is inadequate when the source of their difficulties usually proved to be other types of impairments, such as lack of concentration. It is possible that other types of higher level cognitive impairments, such as strategic deficits, may be behaviorally manifested as a specific memory problem or misinterpretted by a naive observer as a specific memory deficit.

Considerable confusion and contradiction surround the nature of the cognitive deficits resulting from diffuse brain damage incurred after a severe closed head injury. Even though there is a paucity of research on residual cognitive deficits and level of adaptation, one consistent factor is that cognitive recovery is in many respects far greater than one would anticipate given the severity of the original injury (Lishman, 1973). The evidence suggests that impaired higher order intellectual functions and inadequate information processing strategies may reduce their ability to perform cognitive problems and daily activities. The information processing hypothesis appears to be a more sophisticated version of the conclusions derived by the pioneers in the field of brain damage, such as Goldstein and Reitan.

"Some after affects reflecting diffuse brain dysfunction are

common to most of these injuries. These include memory, attention, and concentration disabilities, impaired higher level and complex reasoning resulting in conceptual concretism and inflexibility and general response slowing " (Lezak, 1976, p. 153).

The evidence suggests that a more fruitful avenue of endeavour would involve an examination of the higher level or strategic cognitive functions and their relationship to the long term adjustment of the CHI person, rather than continuing to focus on more specific lower level cognitive skills that are apparent in the relatively early phases of the recovery process. A higher level strategic cognitive function that warrants further examination is problem solving . Problem solving skill is considered to be crucial in intelligent adaptative behaviour but standard intelligence tests fail to adequately assess these skills (Das & Malloy, 1981). Disruption of the P-S process has been associated with diffuse damage caused by closed head injuries (Boll, 1981).

Problem-solving and Brain Damage The preceding literature reveals a significant discrepancy between the poor adjustment level or competency of persons medically recovered from a severe closed head injury and their rather remarkable intellectual recovery. In general, their intellectual ability returns to an average level or to a level consistent with their premorbid functioning. The concept of P-S is judged by some to be the mediator between intelligence as defined by standard intelligence tests and competency level (Schaie, 1980). In fact, there does exist an historic relationship between P-S ability and organic brain dysfunction. Since the original work by Goldstein in 1939, deficits in complex reasoning and P-S have been considered to be a major

outcome of many forms of brain dysfunction (King, 1980; King & Snow, 1981). The findings by some experts on the effects of diffuse damage on higher intellectual deficits, poor decision making, and reduction in information processing (Eson, 1979; Miller, 1970, 1979; Lezak, 1976) seem to relate directly to the global process of P-S. Many of the residual deficits connected to closed head injuries and described in the previous section, such as poor concentration, attention, disturbed memory, and reduced response speed, have in fact been identified as significant dimensions of complex P-S (Schaie, 1980). Furthermore, Lezak (1976) maintains that while memory, concentration, and attentional deficits demonstrate significant improvement often within the first 6 months to 1 year post-injury, higher intellectual functions start to deteriorate after the first year presumably due to tissue scarring and metabolic changes. This deterioration is then reflected in a reduction in the CHI person's ability to handle not only complex cognitive tasks but also complicated social problems.

Initially, Goldstein (1939) and his colleaques concluded that brain damage impairs abstract reasoning in an all or none fashion as the injured person is only capable of functioning at a concrete level. Reitan countered Goldstein's qualitative argument with empirical data supporting the proposition that deficits in abstract reasoning are quantitative in nature rather than qualitative (Goldstein et al.,1969). In an attempt to resolve this controversy, Goldstein et al. demonstrated that both positions are correct depending on differential task and subject variables. Based on a total sample size of 30, representing ten different types of brain dysfunction, Goldstein and his colleaques maintained that IQ, education, and the presence of focal, diffuse,

static or progressive diseases did not distinguish between the group with a qualitative P-S impairment and subjects with quantitative deficits. Subjects were assumed to have a qualitative impairment if they were totally unable to perform the most simple abstract items. Individuals who successfully completed simpler items but failed the more complex abstract tasks were considered to show a quantitative deficit. The only subject characteristic that differentiated the types was age as the qualitative failers were substantially older than the quantitative failers. The task variable that proved to separate the two groups was complexity. However, those brain damaged individuals who were able to deal effectively with simple conceptual tasks but failed on more complicated tasks did tend to show incremental learning. Interestingly, after this original work establishing the significance of P-S in the recovery from various brain dysfunctions, and the preliminary understanding of the nature of this deficit, there has been minimal investigation into the P-S skills of brain damaged individuals in general. Direct research examining the relationship between diffuse damage caused by closed head injuries and P-S appear absent. However, several indirect lines of investigation, including the few studies dealing with P-S capability of heterogeneous groups of brain damaged adults, offer some clues into the nature of this relationship.

One of the few research papers in the 1970's focusing on P-S and brain damage was an attempt to clarify why left lesions produce less severe and consistent cognitive deficits than right-sided lesions. Reitan (1972) speculated that the verbal tasks used in psychological test batteries tapped abilities acquired throughout one's life and therefore, require little immediate P-S. Manipulatory tasks, such as

performance subtests from the WAIS, were viewed by Reitan as providing all the necessary information to solve the problem at the time of testing. Efficiency at solving the problems is therefore incorporated into ones scores. When verifying his hypothesis, he found that the Word Finding Test was very sensitive to the effect of cerebral damage in a group with heterogeneous cerebral lesions. Although Word Finding is a verbal test, Reitan postulated that it was the P-S aspect that produced the results, and that problems where missing elements must be discerned may be even more difficult than problems where all elements are present, as in the performance subtests. These results correspond with his earlier study where performance subtests from the WAIS were judged by three psychologists to be highly reliant on immediate P-S ability while verbal subtests were associated with experiential background (Matthews & Reitan, 1963).

In 1977, Finlayson's study with a sample comprised of a heterogeneous group of brain damaged persons reconfirmed Reitan's position that, in general, the effects of brain damage are more apparent on P-S measures than on tasks involving stored information. Educational level was found to influence more closely performance on stored information tasks than P-S measures. In keeping with this line of research, King and Snow (1981) determined that two widely employed clinical measures to assess P-S skills were only modestly related to each other. Yet their heterogeneous sample of brain damaged individuals experienced considerably more difficulty on both tasks than normals. In this study, age and education though proved to be contributing factors to the performance level of the brain damaged group on both measures but not for the control group. The findings by Caramazza, Gordon, Zurif and

DeLuca (1976) that CVA patients with right sided damage and no obstensible linguistic disabilities demonstrated impaired verbal P-S lends further support that the P-S dimension is highly susceptible to cerebral dysfunction. Similarly, in an earlier study by Scott and Phelan (1969) CVA patients incurring widely diffuse damage proved less adept and efficient than normals on a P-S task requiring categorization. The patients were also less aware of the optimal strategy.

Another area of research associated with P-S and brain dysfunction that warrants comment but is not a primary focus of the current paper is the quest for localizing higher intellectual functioning within the brain. In general, higher level cognitive abilities, such as the selection and regulation of plans or P-S, have been ascribed to the frontal lobes (Das, Kirby, & Jarman, 1975; Luria, 1966), particularly in the dorsolateral region (Shallice & Evans, 1978). A number of studies have demonstrated that persons with dominant frontal lobe lesions perform significantly more poorly than normals and groups with lesions in other areas of the brain on a task judged to measure complex P-S (Drewe, 1974; Heaton, 1981; Milner, 1963; Nelson, 1976; Robinson, Heaton, Lehman, & Stilson, 1980). Interestingly, the more recent research has determined that this P-S task can not discriminate between focal frontal lesions and diffuse damage as the diffusely injured group's performance was very similar to the focal group's on this task, the WAIS, and the Halstead Reitan Battery. The position that the frontal lobes are at least in part responsible for higher level cognitive functions is strengthened by the fact that intelligence, as measured by standard tests, has proven relatively unaffected by severe frontal lobe damage (Shallice & Evans, 1978). To enhance the verification of the role

of the frontal lobe, Shallice and Evans (1978) employed a test of cognitive estimation unrelated to general intelligence but which incorporated a number of P-S aspects, such as comprehending the problem, selection of a plan, implementation, and verification prior to answering. As the anterior lesioned group performed significantly worse than the posterior group, the findings were interpreted as supporting Luria's (1966) position. Furthermore, a complex group of maladaptive behaviors including lack of goal-directed behavior and poor judgment have been attributed to frontal lobe dysfunction (Rosenthal, 1983). It must be cautioned that considerable controversy and ambiquity surrounds the physiological and neuropsychological findings regarding the role of the frontal lobe (Wolfe, 1976). For example, Lezak (1976) claims that higher level cognitive functions such as P-S, involve a variety of neurological subsystems which defy localizition and tend to be especially sensitive to diffuse brain injury.

Conclusions The Glasgow group's investigation of the cognitive deficits measured by repeated administrations of the WAIS following a severe closed head injury can be reconsidered in light of the findings regarding P-S and brain damage. Their hypothesis that PIQ is more vulnerable to CHI than verbal subtests due to the more complex nature of the task can be expanded to integrate the findings that performance subtests have a P-S component not found in Verbal subtests. It may, in part, be the P-S aspects of the performance subtests that are contributing factors to the significant difficulty experienced by the patient. However, the Glasgow group did find that PIQ, although more gradual than VIQ, did eventually return to a normal level that was relatively consistent with premorbid educational and occupational

history. The performance subtests, which were not intended to be a measure of P-S, may be inadequate for assessing the subtle and complex P-S deficits that remain following the medical recovery from a closed head injury. Shallice and Evans (1978) speculate that

> "... even conventional intelligence tests, where a series of problems of the same type is presented with gradually increasing difficulty, seem to demand the use of relatively routine even though complicated cognitive operations" (p. 301).

Sophisticated P-S capability, which has been proposed as the essence of intelligent behavior, is generally considered to be relatively untapped by standard IQ tests (Das & Malloy, 1981). In further support of the position that IQ tests fail to measure P-S capability, Corder and Corder (1974) demonstrated that performance on concept learning tasks involving flexibility of approach is not significantly related to IQ for individuals with average to superior intellectual ability. However, Shallice and Evans (1978) caution that the dissociation between IQ and P-S requires far more investigation, especially as it relates to brain dysfunction.

As P-S deficits have long been recognized as a consequence of brain damage and considered important in daily living, tasks purporting to measure cognitive P-S have been given a dominant place in neuropsychological batteries (King & Snow, 1981). Increasingly, clinicians are being called upon to make prognostic statements and remediation recommendations based on the results of these tests (Boll, 1981). In spite of this, only one unpublished study examining the relationship between performance on P-S assessment tasks and a measure of interpersonal P-S (King, 1980) and none examining the impact of P-S

deficits on adjustment could be located. In the King study, both impersonal and interpersonal P-S tasks distinguished the brain damaged group from the normals but interpersonal P-S proved to be dissociated from impersonal skills. The impersonal P-S measure predominately used in the decision making process affecting the rehabilitation of brain damaged individuals was judged to provide insufficient or inaccurate information for practical prognostic statements. Support that P-S deficits effect level of adjustment though can be gleaned from research into P-S and mental health with other populations.

C. General Problem-Solving Literature

Problem-solving has been a significant focus of inquiry within psychology for many years (Heppner, 1978) although the general area of P-S is rather overwhelming as it lacks a cohesive theory and set of paradigms (Erickson & Jones, 1978), thereby creating a somewhat chaotic body of literature (Coates, Alluisi, Morgan, 1971). The classic Gestalt view of P-S emphasizing response discovery, insight, and restructuring led to the traditional conception that P-S is an "... activity that takes place in an unfamiliar context when a motivated person is initially unsuccessful in achieving some goal" (Erickson & Jones, 1978, p. 62). Since then, three major frameworks focusing on information processing, metacognition, and applied research have evolved using both impersonal and interpersonal tasks. These frameworks have directed P-S research and thereby increased understanding of this highly complex strategic ability.

In order to provide a detailed description of the psychological process involved in P-S, an information paradigm stressing search,

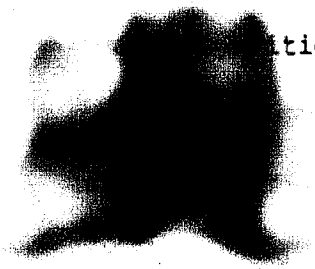
discovery, and strategy was advanced (Erickson & Jones, 1978). The task of accounting for observed human behavior resulted in the development of computer programs (Simon & Newell, 1971) and mathematical models (Greeno, 1978). Effective P-S is considered to be the product of a successful search where the problem solver employs an appropriate sequence of transformation rules, chosen from an array, to change the initial situation into the desired goal (Greeno, 1978).

> "Psychological analyses of problem solving now attend to the nature and organization of component processes that interpret information, set goals, and select among available actions in the process of solving the problem" (Greeno, 1978, p. 15).

Greeno integrated three significant concepts that have emerged from the research into an information processing paradigm described as means-end analysis. This analysis is a future oriented approach (Erickson & Jones, 1978) where the problem solver, by comparing the initial state to the desired goal, identifies differences. After setting subgoals, the problem solver reduces the discrepancies through various maneuvers until the major goal is reached. A second important factor that facilitates the general P-S process by removing the initial ambiquity (Erickson & Jones, 1978) is that of overall planning. In the initial phase of P-S, after the essential features of the problematic situation and final goal are examined, a plan is generated to remove the basic differences prior to dealing with the details. Finally, memory has been identified as the third major component since information must be stored as one progresses through the problem, although focusing on patterns within a P-S task can largely reduce the necessity for memory storage (Simon, 1975).

Due to the adaptibility of the human organism, the P-S process, beyond the few major characteristics outlined, has proven more variant than originally conceived. The process represents an interaction between subject characteristics and the demands of the task environment (Simon & Newell, 1971). Individual strategic approaches are possible where a number of routes to achieve the final state exist (Erickson & Jones, 1978). The increased understanding of P-S and its variant nature has facilitated the development of tasks that allow for the specification of the various maneuvers employed by the individual problem solver and the resulting demands on psychological processes. For instance, transformation problems, such as the Tower of Hanoi, provide an excellent mechanism for evaluating means-ends strategy since they provide well-defined initial and final conditions (Erickson & Jones, 1978).

Metacognition, a recent branch of cognitive psychology, offers an even greater understanding of human P-S capabilities. According to Brown (1978) metacognition, the intelligent evaluation and control of ones own actions subsumes the general P-S skills just described. Within this framework, the major focus becomes knowledge about ones own cognitive process. Self-introspection or conscious executive control of ones basic cognitive processes is considered the highest form of intelligent behavior as it implies knowledge of when to utilize various cognitive skills in order to achieve ones goals. Furthermore, Brown maintains that at this higher or strategic level of intellectual behavior, boundaries



tional cognitive domains dissolve allowing for more

oaches to the cognitive functioning of designated

his strategic level, memory functioning is judged to be

inseparable from other intelligent behavior such as P-S since both involve "... predicting, checking, monitoring, reality testing, and coordination and control of deliberate attempts to learn or solve problems" (Brown, 1978, p. 78). Brown proposes that the division between P-S and metamemory

> "... reflects the state of the art rather than any conviction that the metacognitive skills involved in intelligent control of ones actions while memorizing are necessarily different from those involved in any other problem solving situation, whether experimentally induced or naturally occurring" (p. 77).

Furthermore, metacognition has been associated with daily living by Brown since validating ones conclusions against common-sense reality is applicable whether performing a math problem, fixing a machine, or handling an interpersonal conflict.

Problem-Solving and Adjustment A second orientation toward P-S, arising from the more applied fields of industry, education, and psychology, focus on a model for effective P-S performance using more practical although still impersonal tasks. Within this framework, it is generally accepted that P-S incorporates five interacting stages which include an overall P-S orientation, problem definition and formulation, generation of alternatives, decision making, and verification (Heppner, 1978). Combining the research regarding applied P-S with the recognition that during the course of daily living persons are confronted with numerous incidents requiring effective P-S has produced a new theoretical concept of mental health. The ability to effectively solve complex problems has been acclaimed as a significant characteristic of a competent and emotionally healthy person (D'Zurilla & Goldfried, 1971;

D'Zurilla & Nezu, 1982; Phillips, 1978; Schaie, 1980; Scott & Phelan, 1969). D'Zurilla and Goldfried (1971) and later Horowitz, Weckler, and Doner (1983) suggested that persons who are unable to resolve important problematic situations because of ineffective P-S methods experience disturbed and undesirable behaviours such as anxiety, depression, and additional difficulties. D'Zurilla and Goldfried (1971) maintained that considerable individual differences in P-S capability exist and that P-S incorporates both cognitive strategies and a self-control component to enhance ones competency.

Most supporting evidence for the association of P-S to mental health has been extrapolated from studies utilizing impersonal cognitive tasks (i.e. D'Zurilla & Goldfried, 1971). As discussed previously, other evidence suggests that impersonal cognitive P-S tests tap very different abilities from interpersonal P-S tasks (Gotlib & Asarnov, 1979; King, 1980; Spivack & Shure, 1974). Therefore the concept of effective impersonal P-S being a significant condition of mental health has been revised to the position that healthy adaptation is the sequelae to developing effective interpersonal P-S skills (Shure & Spivack, 1978; Spivak, Shure, & Platt, 1981).

Within this revised orientation, poor problem solvers are viewed as often overpowered by their environment because, in part, their means-end thinking is limited and restricted. Similar to D'Zurilla and Goldfried's (1971) position, the resulting repetitive failure to adequately satisfy their needs and to resolve their interpersonal conflicts are hypothesized to lead to a variety of types and severity of maladaptive behaviors, including an inability to successfully fullfill important life roles (Shure & Spivack, 1972). Interpersonal P-S,

comprised of sensitivity to, and articulation of the problem, generation of options and alternatives to handle the problem, visualization of the sequential steps and obstacles within a plan of action, and awareness of the consequences of a particular action (Spivack & Shure, 1974) as well as appropriate timing (Spivak et al., 1981), appear to be very similar to the P-S components described by Heppner (1978). In order to more systematically study interpersonal P-S and its relationship to adaptation, the Means-End Problem Solving Procedure (MEPS) was devised to assess a persons ability to articulate in a logical and systematic fashion the means to achieve a desired goal when confronted with a social need (Platt & Spivack, 1975a). The subsequent research has demonstrated that the two primary elements consistently related to mental health are the spontaneous generation of options and the visualization of sequential steps and obstacles (Platt, Siegel, & Spivack, 1975; Platt & Spivack, 1973, 1975a; Platt, Spivack, Altman, Altman, & Peizer, 1974).

A series of studies on the relation of interpersonal P-S to adjustment determined that groups judged to be ineffective problem solvers, such as adult psychiatric inpatients (Platt & Spivack, 1972a, 1972b, 1974; Platt et al., 1975; Siegel, Platt, & Peizer, 1976), institutional juvenile delinquents (Platt et al., 1974; Siegel et al., 1976), emotionally disturbed children (Shure & Spivack, 1972), and depressed university students (Gotlib & Asarnov, 1979) have been shown to possess less efficient interpersonal P-S skills relative to their respective normal peers. Normals and psychiatric inpatients have been found to share a similar frame of reference regarding appropriate solutions but to differ in ability to spontaneously generate options

(Platt et. al.,1975). Furthermore, interpersonal P-S has proven in a number of studies to be relatively independent of intelligence, given a minimal level of basic ability (Platt & Spivack, 1975b). Preliminary data indicates that effective P-S is not contingent on socioeconomic status and that culturally disparate normal females agree on the ways to reach goals (Platt & Spivack, 1974). Hence considerable evidence has been determined to link deficient P-S skills with inadequate adjustment and poor mental health. The nature of the P-S deficits remains somewhat unclear due to the recent findings that impersonal and interpersonal P-S tasks measure diverse abilities.

D. Conclusions

The conclusions from all three P-S frameworks, including studies in the field of information processing, metacognition, and more applied research, has significant implications for studying P-S impairments and their relationship to the adjustment process of persons incurring severe closed head injury. The information processing paradigm with its thoroughly investigated tasks offers the opportunity for a more detailed and explicit understanding of the nature of the P-S deficits including the demands placed on the component psychological processes and their organization. In contrast the metacognitive position stresses the study of the overall strategic approach which may be impeding the utilization of a number of the lower level cognitive skills. It is plausible that one of the significant residual deficits resulting from a severe closed head injury may be a general disruption of higher level or strategic cognitive functioning rather than lower level cognitive and memory deficits. Closed head injured persons may possess the necessary

component cognitive skills to handle both impersonal and interpersonal P-S situations but lack awareness of when to use the skills and/or how to orchestrate the various subskills into one integrated approach. Given the association between metacognition and level of daily functioning, it may prove that ones awareness of the P-S process will account, to some extent, for the generally poor long term adjustment of many CHI persons in spite of their remarkable intellectual recovery. The finding that those individuals who are unable to realistically evaluate themselves often demonstrate the poorest overall adjustment lends further credance to this position. Lezak (1976) maintains that inadequate adjustment is the consequence of behavioral deterioration stemming from impairments in higher levels of intellectual activity combined with diminished self-control.

The more applied orientation to P-S provides the link between P-S skills and adjustment missing in the literature on brain damage. Most importantly, a basic assumption regarding the relationship of P-S and brain injury is challenged by the evidence that the ability to solve impersonal cognitive P-S tasks is unrelated to both competency in solving real life interpersonal conflicts and level of mental health. As stated in the introduction further clarification of these issues would enhance our knowledge of the residual P-S deficits which may be affecting the adaptative functioning of persons medically recovered from a severe closed head injury.

III. Method

A. Rationale, Hypotheses, and Research Questions

Severe closed head injuries of adult onset, caused by acceleration/deceleration accidents, constitute one of the most complex and devastating health problems of our modern society. The accumulating body of research has indicated that many CHI adults have significant long term difficulties coping with the demands of their home, social, and work environment (Eson, 1979; Gjone et al., 1972; Groswasser et al., 1977; Jennett, 1975; Miller, 1979; Thomsen, 1974; Weddel et al., 1980) and that their family members experience considerable debilitating chronic stress (Boll, 1981; Oddy et al., 1978a; Rosenbaum & Najenson, 1976).

Several preliminary studies have shown that residual higher level cognitive deficits, such as problem-solving, may be one of the major underlying causes of poor long term adjustment and deterioration in the mental health of severe CHI adults (Boll, 1981; Dikmen & Reitan, 1977; Eson, 1979; Levin & Groswasser, 1978; Miller, 1979). While the relationship between problem-solving and adjustment remains poorly understood, problem-solving deficits appear to play a major role in adjustment in spite of an otherwise remarkable cognitive recovery.

Many of the initial post-injury cognitive impairments dissipate as the brain recovers and the patient learns to compensate (Miller, 1979). For instance, in the early phases of recovery, CHI adults demonstrate deficits on standard intelligence tests with their most serious difficulties occurring on performance items, regardless of the side of the primary insult. Gradually, their intellectual performance returned

to normal or to levels consistent with premorbid functioning (Mandleberg & Brooks, 1975). Our ability to predict the recovery pattern and extent of residual deficits, though, is inadequate. The evidence supporting a relationship between PTA, an index of diffuse damage which is considered to be the crucial factor in determining the severity of the injury, and long term cognitive recovery is inconsistent (e.g. Brooks et al., 1980; Mandleberg, 1976). Other injury factors such as duration of coma and focal damage as well as personal chacteristics such as age and education are proving to have no systematic association with cognitive recovery patterns (Brooks et al., 1980).

The concept of problem-solving has been proposed as a mediator between intelligence, as defined by standard intelligence tests, and competency level (Shaie, 1980), and is considered to be crucial in intelligent adaptive behavior (Das & Malloy, 1981). Furthermore, problem-solving deficits have been associated with diffuse cerebral damage resulting from closed head injuries (Boll, 1981; Lezak, 1976). Other residual deficits connected to closed head injuries, such as poor concentration, inadequate attention, disturbed memory, and reduced response speed, also have been identified as significant dimensions of complex P-S (Schaie, 1980).

Clues to the missing link between P-S deficits and the readjustment process of CHI adults were drawn from two distinct inter-related orientations to the study of cognition and problem-solving. First, the information processing approach to problem-solving has resulted in the development of laboratory type tasks that provide detailed understanding of P-S skills. Secondly, within the more applied orientation, the ability to effectively solve complex

problems has been acclaimed as a significant characteristic of a competent and emotionally healthy person (D'Zurilla & Goldfried, 1971; Phillips, 1978; Schaie, 1980). Due to more recent findings that impersonal P-S instruments measure different abilities from interpersonal P-S tasks, the definition of healthy adaptation has been redefined by some to stress the development of effective interpersonal P-S skills (Shure & Spivack, 1978). Thus, level of adjustment or adaptive functioning may be more contingent upon one's ability to effectively resolve problems of an interpersonal nature, problems that occur in everyday life events, than it is to the more narrowly defined, laboratory type tasks involving spatial or verbal problem-solving that do not have a personal referent.

Studies of metacognition offer another plausible link between problem-solving and level of adjustment. According to Brown (1978), metacognition, the intelligent evaluation and control of ones action, subsumes general P-S skills and is very much related to daily living. Closed head injured adults may possess the necessary component cognitive skills to handle both impersonal and interpersonal P-S situations but lack the awareness of when to use the skills or how to orchestrate the various subskills into an integrated strategy.

In order to increase our knowledge of the residual cognitive deficits resulting from a severe closed head injury, the present study considered each of these perspectives in an in-depth examination of a group of closed head injured adults, their intellectual abilities, their problem-solving skills and awareness of the strategies they used, and their level of adjustment in the home, at work and in the community. Most importantly, the study went beyond determining the nature of P-S

deficits to explore the relationship of both impersonal and interpersonal P-S skills to the long term adjustment of CHI adults. A sound understanding of the relationship between residual cognitive deficits and adjustment is crucial for improving assessment tools and developing therapeutic and educational strategies. Thus, the following hypotheses and research questions were generated.

Major Hypotheses

Although it was difficult to formulate specific hypotheses, due to the exploratory nature of the study, certain directions in results were specified.

1. It is expected the CHI adults will demonstrate deficiencies on the two normed measures of problem-solving, Means-Ends Problem Solving Procedure and the Wisconsin Card Sorting Test, and that these deficiencies will be relatively unassociated with FSIQ, VIQ, and PIQ from the WAIS-R by one year post injury.
2. It is anticipated that level of adjustment will covary with their level of interpersonal P-S skills.
3. It is hypothesized that level of adjustment will be unrelated to ability to solve impersonal P-S tasks.
4. All measures of impersonal P-S whether verbal or nonverbal are expected to be highly correlated with each other but uncorrelated with the measure of interpersonal P-S skill.

Research Questions

These additional questions were addressed through exploratory analyses to clarify the role various factors have in the long term

readjustment process, and in the recovery of intellectual ability and problem-solving skills following a closed head injury.

1. a) Is the relationship between impersonal P-S and adjustment different for a group of proficient impersonal cognitive problem-solvers than for a group of inefficient impersonal problem-solvers?

   b) Do high and low ability impersonal problem-solvers differ in their level of adjustment?

2. a) Does the relationship between interpersonal P-S skill and adjustment change if the group is comprised of effective or ineffective interpersonal problem-solvers?

   b) Do effective and ineffective interpersonal problem-solvers differ in their level of adjustment?

3. After one year post injury, does the length of time following the injury continue to influence level of adjustment, impersonal P-S ability, and/or interpersonal P-S skills?

4. Do fast or slow impersonal problem-solvers differ in their level of competency on impersonal P-S tasks?

5. Is the location of impact or focal neurological signs related to adjustment level, impersonal P-S skills, and/or interpersonal P-S ability?

6. Does the nature of the injury, more specifically duration of coma, length of PTA, and complications, influence the three variables, adjustment, impersonal P-S skills, and/or interpersonal P-S ability?

7. Do factors such as age and education relate to level of adjustment, inpersonal P-S skills, and/or interpersonal P-S ability?

8. a) Do CHI adults demonstrate a significant discrepancy between their

VIQ and PIQ on the WAIS-R by one year post injury?

b) Do CHI adults with diverse patterns on the WAIS-R differ significantly in their level of adjustment, interpersonal P-S skills, and/or impersonal ability?

Descriptive Questions

The remaining questions served as guidelines for the qualitative analyses so that the metacognitive ability of head injured adults could be examined in detail.

1. Do CHI adults adopt an overall strategy on all or some of the P-S tasks?
2. Are CHI adults aware of the strategies they employ to solve impersonal and interpersonal P-S tasks?
3. What specific strategies did the CHI adults use on various P-S tasks? What were the demands placed on the component cognitive skills by the chosen strategies?
4. Are P-S deficits and strategies common among individuals across tasks or do they vary with individuals and the specific type of task?

B. Sample

Twenty-six subjects, 19 males and 7 females who were between the ages of 19 and 37 years at the time of their participation in the study, were selected from the medical records at a local rehabilitation hospital. Each subject was contacted by letter and then by telephone after permission to do so was given by their personal physicians. The subjects were between the ages of 17 and 34 years when they incurred a

severe closed head injury from an acceleration-deceleration accident. All subjects met the following three selection criteria. First, 1 to 6 years prior to this study, all the subjects had been involved in a vehicular or industrial accident involving a blunt head injury, where their heads were thrust forward and then abruptly stopped. Second, the force was sufficient to result in a coma lasting over 6 hours with posttraumatic amnesia over 24 hours, as determined by the subjects' medical records. Posttraumatic amnesia of 24 hours for a severe injury and over 1 week for a very severe injury, is the generally accepted criteria for categorizing degree of brain injury (Jennett & Bond, 1975). A further selection criteria was that all subjects were residing within the community, as opposed to a medical care centre at the time of their involvement in the study. An effort was made to derive a representative sample by including both individuals who had incurred complicated injuries (i.e. those with neurological focal signs and/or those having had surgical intervention) and persons with uncomplicated injuries. Precise group characteristics are reported in the results section.

C. Procedure

The present research, which was a study of individual differences within a group of CHI persons, employed correlational analyses to determine the relationships among the three variables-level of adjustment using the Clinical Adjustment Index and Bellis Adjustment Inventory; impersonal P-S ability measured by Wisconsin Card Sorting Test, Syllogistic Reasoning and Tower of Hanoi; and interpersonal P-S skills using the Means-Ends Problem Solving Procedure. Data collection was accomplished by individual assessments of the 26 subjects who were

given a participation fee. Each subject was administered the WAIS-R and Bell's Adjustment Inventory. Four P-S tasks, described below, were given according to the instructions outlined in the appendices. At the completion of each P-S task, the subject was asked to describe his/her strategy. The 5 hours of testing was conducted in two sessions with one 15 minute break during each occasion arranged at times convenient for individual subjects. In order to formulate clinical impressions of adjustment levels, a psychologist interviewed each subject for 1 1/2 hours and held a second 1 1/2 hour interview with the subject's significant other, such as a parent or spouse, at a time and place that was convenient for the interviewee. The structured interviews focused on the subjects' and their significant others' perception of the subjects' functioning at home, at work, and in the community.

D. Measures

Adjustment Measures

Clinical Adjustment Index. Since the adjustment difficulties of CHI adults have proven to be multidimensional, affecting work, family, and community involvement, the primary adjustment measure chosen for the present study also incorporated a number of facets. Clinical assessment by a trained mental health practitioner is one of the most common and well recognized methods of determining level of adjustment and mental health. Dikmen and Reitan (1977) concluded that clinical insight needs to be operationally defined, quantified, and subjected to systematic investigation in order to increase understanding of the post traumatic adjustment sequelae of head injuries.

The first measure, then, was a newly devised Clinical Adjustment Index (see Appendix A). This index is a 7 point likert-type scale designed to rate a clinician's subjective impressions of a client's ability to handle the demands of work, family, and social situations. The clinician derives three scores by comparing clinical impressions to a set of scoring criteria in each category. The subscores were combined to provide an overall index of adjustment which was used in the statistical analyses.

Scale development consisted of an initial draft based on Williams' (1979) criteria of competence as well as clinical and theoretical knowledge of the adjustment difficulties confronting brain injured persons and other clinical populations. The instrument then underwent five separate revisions by five psychologists who had 2 to 20 years of experience in assessment and psychotherapy with diverse clinical populations. Each psychologist reviewed, criticized, and made suggestions regarding the instrument. Next, two psychologists were trained to use the scale by rating five persons using structured taped interviews. They discussed any difference until agreement was reached. The psychologists then rated 14 unfamiliar clients with a variety of adjustment problems including child custody disputes, vocational concerns, and child abuse. These clients had been assessed by three psychologists in private practice who had no knowledge of the scale at the time of the assessments. The ratings were based on written psychological reports that contained each client's history, psychometric test results, and the assessing psychologist's conclusions. An interrater reliability coefficient of .9 was achieved by using a Pearson Product Moment Correlational analysis. This result compared favorably

with those reported in other studies using a similar procedure (cf. Bryant, Trower, Yardley, Urbieta & Letemendia, 1976).

In the present study, the two trained psychologists rated each subject on the scale after listening to an hour and half taped interview with the subject and another taped interview with a significant other. All the interviews had been conducted independently by one other psychologist using the structured interview format outlined in Appendix G. To ensure consistency among raters, transcripts from a random sample of 10 of the 26 subjects and their significant other were rated by both psychologists. An interrater reliability coefficient of .94 was computed using the Pearson Product Moment Correlation.

Bell's Adjustment Inventory. Bell's (1962) Adjustment Inventory-Adult Form was used to assess the subject's subjective impression of his/her own adjustment level (see Appendix B). This self-administered inventory consists of 160 items to which the respondent answers "Yes, No, Uncertain". The manual provides norms for five levels of adjustment based on a representative sample of adults ranging in age from 20 to 50 years. The instrument has been widely used clinically, and in research in order to discriminate between well-adjusted and poorly-adjusted individuals. The test has proven to be highly reliable with an odd-even reliability coefficient of .94 for the total score and coefficients ranging between .91 to .81 for the five sub-categories (for reviews see Buros, 1975). The measure used for statistical purposes in the present study was the total adjustment score. An overall score for adjustment was calculated from the scores for four separate categories including home, health, social, and emotional health. The occupational score was not included as only 6 of

26 subjects were employed.

Interpersonal P-S Measure

Means-Ends Problem Solving Procedure. The Means-Ends Problem Solving Procedure (MEPS), a test devised to assess a person's ability to generate appropriate and effective means in order to achieve the desired goal when confronted with a problem situation and an aroused need (Platt & Spivack, 1975a), served as the measure of interpersonal P-S skills (see Appendix C). With a psychiatric population, the MEPS has been shown to measure a single underlying dimension (Platt & Spivack, 1975b), and to have test-retest reliability coefficients ranging from .43 to .64, with an odd-even coefficient of .82 (Platt & Spivack, 1975a). Construct validity has been established by consistent findings that a variety of psychiatric groups (Platt & Spivack, 1975a) and depressed university students (Gotlib & Asarnov, 1979) possess less efficient real-life P-S skills than their normal peers.

The MEPS, a test comprised of seven hypothetical real-life situations, requires the respondent to complete each story by making a middle that connects the beginning and the end. The subjects are asked to make up the middle of the story by imagining the situation and then they are to describe the actions that could be used to successfully handle the situation. Answers were tape recorded and then transcripts were independently scored by one of two trained raters according to the criteria specified in the manual (Platt & Spivak, 1975a; Spivak, Shure & Platt, 1981). The scoring system provided six scores: (a) number of relevant means, (b) number of enumerations, (c) number of obstacles, (d) total number of irrelevant means, no means, and no answers, (e)

relevancy ratio (a/a+d), and (f) time. The total MEPS score, which includes items (a), (c), and (f), was used in the statistical analyses and the remaining scores were examined in the qualitative analyses. An interrater reliability of .98 was derived by correlating the independent assessments of the two raters on a random selection of 10 transcripts. The raw scores of the two raters were averaged when discrepancies occurred. In order to objectively verify the presence of interpersonal P-S deficits, the group means for (a) and (e) were compared to the norms provided in the manual.

For the purposes of the qualitative analysis, the subjects were asked for reasons for choosing their solutions to stories 1, 2, 3, 4, and 5 after answering all questions. These stories were chosen because the responses of psychiatric patients and normals have proven to differ very significantly in their content (Platt & Spivack, 1974). The subjects' responses and strategies from these five stories were scored by both raters and compared to the existing literature on the following dimensions: (a) logical rationale (Platt et al., 1975), (b) elements of introspection prior to taking action (Platt & Spivack, 1974), and (c) content categories (Platt & Spivack, 1974, 1975a).

Impersonal Cognitive P-S Measures

Wisconsin Card Sorting Test. The Wisconsin Card Sorting Test (WCST), developed by Berg (1948) to assess "abstract behavior" and "shift of set", was one measure of impersonal cognitive P-S (see Appendix D). The WCST is considered to be a complex P-S measure involving the ability to form concepts based on response feedback, to maintain response sets, and to shift sets (Lezak, 1976). It has the

advantage of being scored objectively and providing quantitative results (Heaton, 1981; Milner, 1963), while also being amenable to qualitative analysis as sources of difficulty can be identified (Berg, 1948; Heaton, 1981). Furthermore, it has been used extensively in clinical practise as a measure of P-S ability (Heaton, 1981; King & Snow, 1981) and in research where it has proven able to discriminate between brain damaged and nonbrain damaged persons (Heaton, 1981; King & Snow, 1981) and between frontal and nonfrontal focal brain injuries (Heaton, 1981; Milner, 1963; Robinson et al., 1980) but unable to distinguish between focal frontal lesions and diffuse cerebral injury (Heaton, 1981; Robinson et al., 1980).

The WCST consists of four stimulus cards whose figures differ in color, form, and number of elements (a red triangle, two green stars, three yellow crosses, four blue circles). The subject is required to sort 128 response cards which vary on the three dimensions into categories based on feedback regarding correctness of choice. Once the subject achieves 10 consecutive correct choices, the category changes without warning. In the present study, the subject continued to sort until all 128 cards were used (King & Snow, 1981) rather than Milner's (1963) method of discontinuing after the completion of six categories. The former method enabled a broader range of possible scores. In order to maintain standardization, the instructions and scoring procedures by Heaton (1981) were followed (see Appendix D). For the main statistical analysis, the measure used was the total number of errors. The number of errors was calculated for each category and added over the total number of categories to constitue the total number of errors.

For the purposes of the quantitative analysis, a number of other measures from the WCST were derived. Presence of a cognitive P-S deficit was assessed by comparing subjects' scores with two cut-off scores. A deficit was indicated by a perseverative response score of greater than 18 and a perseverative error score greater than 13 (Heaton, 1981). Perseverative responses were determined by using Heaton's definition since it permits greater diagnostic accuracy.

> "A perseverative response is defined as one that would have been correct in the previous stage ... The first exception to this definition of perseveration is that it is also possible for the patient to make perseverative responses before he/she has completed one category. Once the patient has made the first incorrect unambiguous response in stage one, that sorting principle will be the one to which he/she can perseverate to in the first stage.
>
> Our second exception to the traditional scoring of perseveration is rather complicated. It is possible for the "perseverated-to" principle to change within a single stage of the test if the patient makes three unambiguous incorrect matches in succession according to another principle ..." (Heaton, 1981, p. 22).

As all perseverative responses are not errors, perseverative errors are considered to be those perseverative responses that are also errors and the score for nonperseverative errors was determined by subtracting total number of perseverative errors from total number of errors scored on the test. Using Heaton's scoring procedure the following major scores were calculated: total number of errors, total number of correct responses, number of categories, perseverative responses, perseverative errors, and nonperseverative errors. Five more descriptive WCST measures were also computed: percent of perseverative errors, two scores of conceptual ability, failure to maintain set score, and finally Heaton's "learning to learn" score. Furthermore, the response pattern represented by their sorting decision and the time taken to complete the task were recorded. At the completion of the task,

each subject was asked to explain the purpose of the task, to state the rules or strategies they were applying, and to describe what the examiner was doing. Their comments and response pattern permitted a descriptive comparison between their cognitive P-S capabilities and Berg's (1948) proficiency levels.

Tower of Hanoi. The Tower of Hanoi puzzle (see Appendix E), which requires the person to reconstruct a pyramid of graduated sized disks by moving one at a time to one of the two alternative positions without ever placing a disk on top of one smaller than itself, functioned as a second measure of impersonal cognitive P-S. This task has been used widely in general P-S research and in studies examining a variety of components of the P-S process (Simon, 1975). The problem can be solved by four major strategies that place differing demands on perceptual processes, as well as long-term and short-term memory (Simon, 1975). The minimum number of moves for a solution is 2^n-1, where n is the number of disks. In the present study, the three, four and five disk problems which require a minimum of 53 moves were used, and the total number of moves for the three problems was the measure.

For the qualitative analysis, the exact sequence of responses was recorded. The time to complete the entire task was also calculated. Each subject was asked to describe his/her strategy. This information allowed for examination and comparisons of individual profiles within the group.

Syllogistic Reasoning. A Syllogistic Reasoning task served as a measure of verbal impersonal P-S skills (see Appendix F). A syllogism consists of two premises or statements which describe a relationship between three terms. The information must be combined to determine if the conclusion about the non-adjacent terms is logical (Sternberg,

1979). For example, Mary is taller than Sue; Sue is taller than Joan; Conclusion: Mary is taller than Joan. This well-recognized complex P-S task (Heemsbergen, 1980; Quinton & Fellows, 1975; Vinacke, 1974) is one of the most systematically studied reasoning tasks in psychology (Sternberg & Turner, 1978). Considerable research has focused on determining the nested subskills and strategies used in solving the three-term series problem (Sternberg & Turner, 1978). Furthermore, syllogistic reasoning tasks have been used as a measure of transitive inferences in such diverse research areas as differential, cognitive, and developmental psychology (Sternberg, 1980). According to Sternberg (1979), syllogistic reasoning is an excellent task to study the nature of mental abilities as performance is quantifiable; reliability coefficients across item types and across subjects have been found to consistently exceed .90, and the task has been demonstrated to possess construct and empirical validity. Furthermore, Vinacke (1974) stated that syllogistic reasoning requires four general processes: determination of the requirements, information collection, evaluation of information, and verification of the conclusion. These processes are quite similar to those considered to be involved in P-S from the information processing and applied perspectives. Also, a syllogistic reasoning task proved sensitive to the disruption of verbal P-S skills of a small group of right hemispheric patients with no apparent linguistic difficulties (Caramazza et al., 1976). The P-S skills required to successfully complete syllogisms are judged to be necessary for numerous comparisons and decisions made in everyday life (Sternberg, 1980). Lastly, syllogistic reasoning shared a verbal component with the interpersonal task used in the present study. The use of a verbal

impersonal and interpersonal tasks allowed for an examination of the issue of whether the verbal or nonverbal nature of these tasks is the factor that accounts for differences in performance levels rather than differences in the component P-S skills.

The actual test used in the current study was developed by Heemsbergen (1980) based on Sternberg's (1979) 32 categorical syllogisms and Hunter's (1957) four basic premise structures. The subject is given two premises and the conclusion and then specifies if the conclusion has been logically derived from the premise by circling " True or False." The first problem set contains eight items that are presented in their natural or isotropic order (cf. previous example). Isotropic order means that the two linked premises contain the same relation and that the last term of the first premise is the first term of the second premise (Hunter, 1957). In order to restructure the problem to its isotropic form, the second problem set requires reordering of the premises (e.g., Susan is taller than Ann; Jane is taller than Susan-to-Jane is taller Susan; Susan is taller than Ann). The third set specifies the relation by using opposite adjectives such as taller and shorter and therefore involves a conversion (e.g., Ann is taller than Alice; Susan is shorter than Alice-to-Ann is taller than Alice; Alice is taller than Susan). The last problem requires both a conversion of the adjectives and a reordering of the premises (e.g., Peggy is taller than Susan; Peggy is shorter than Becky-to-Peggy is taller than Susan; Becky is taller than Peggy-then-Becky is taller than Peggy; Peggy is taller than Susan). The problem sets were administered in sequence from simplest to most difficult in order to facilitate the subjects developing an effective strategy and to promote awareness of the need for revisions in

strategies. The measure for the main statistical analysis was the total errors on all four sheets.

For the purposes of the qualitative analysis, the time per sheet, total time, and errors per sheet were computed. After completing each sheet, the subjects were asked to explain their strategy and at the end of the overall task to specify which strategy they considered the most effective. This information allowed for a comparison with Quinton and Fellows' (1975) major strategies, thinking and perceptual. Also, recording of their strategies helped determine if CHI adults use the variations within the major stategies and change their reliance on certain strategies as the demands of the task vary.

IV. Results and Discussion

A. Group Characteristics and Test Performance

Analyses of the demographic data substantiated that all 26 subjects had incurred their injuries 1 to 6 years prior to their assessment with the majority falling within a time frame of 2 years 1 month to 4 years 0 months. Twenty-two subjects had been involved in motor vehicle accidents, 3 subjects had fallen in industrial or recreational mishaps, and the remaining subject had his head struck by a large moving blunt object. Determining the exact length of their coma and PTA proved impossible due to incomplete medical records. Estimates of both coma and PTA were based on the accounts provided by family members and/or the injured person as well as the medical records. The length of coma varied from 1 to 49 days while PTA ranged from approximately 1 to 62 days. The medical records indicated that 12 subjects had right-sided damages, 7 subjects exhibited signs of left focal damage; and 4 subjects had no focal signs. The remaining 3 subjects were described as receiving bilateral frontal injuries without focal signs. The medical records indicated that 10 of the 26 subjects had definite frontal lobe involvement but the evidence was inconclusive for the other 16 subjects. Nineteen subjects were considered to have complicated injuries since they demonstrated focal signs or had surgical intervention while 7 subjects incurred uncomplicated injuries.

Overall, the group proved relatively well educated with only the 2 oldest subjects having quit school at the completion of grade 8. Six other subjects left school at the end of grade 10. Another 9 subjects completed either grade 11 or 12 and 3 more received their grade 12

matriculation. Apprenticeship programs had been successfully undertaken by 5 subjects prior to their accidents. Six subjects possessed some college or university, although of these, only 1 subject graduated from university and another finished 1 year of college post-trauma.

Although the majority had a skilled trade or profession, only 6 or 23% of the subjects were gainfully employed at the time of their participation in this study. Of these 6 subjects, 1 person terminated within weeks of his interview for inadequate work performance, a second was dependent on friends in order to fulfill his commitments, and a third was only holding down part-time temporary work. Therefore, only 3 or 12% could be considered as achieving regular and ongoing full-time employment with 2 of these 3 subjects having suffered the least severe injuries. Two of the female subjects were full-time homemakers but one needed supervision to care for her children and to complete household responsibilities. Eleven or 42% were not employed nor was there any indication of them obtaining employment in the near future. Furthermore, this subgroup was not involved in any type of educational, training or therapeutic program. Four other subjects were actively involved in educational programs, with 1 woman in the process of failing her course at a local community college, another needing to repeat one of his two upgrading courses, and a third unable to settle into the program. The remaining student appeared to be doing satisfactorily in his computer programming course for the physically handicapped but he wondered if he might be asked to leave because of a poor attitude toward being with the handicapped. One subject was immersed in an intensive physical therapy program. Two others had just commenced a life skills program but 1 subject had already experienced significant problems.

At the time of the interview, 6 subjects were married and 1 was maintaining a long term common-law relationship. One or both partners from six of the relationships acknowledged serious conflicts or disappointments in their marriage. Only one marriage was described by both partners as stable and satisfying. Three of the married subjects did so after the accident. Of these three marriages, one marriage failed within the first year, the second couple separated but were attempting a reconciliation, and a third couple had discussed separation. Another 6 subjects were divorced or separated at the time of the interview and only one separation occurred prior to the accident. The other 5 subjects experienced marriage breakdown after their accident, but 4 of these couples admitted substantial marital conflict before the trauma. As a result of the accident one young woman was widowed. The remaining 12 or 45% were single at the time of their accidents and have remained so. Their histories illustrated that none of these young persons have been involved in an intimate relationship since their accident and only 5 subjects trying to actively pursue an intimate relationship by dating.

Alcohol or drug problems that originated prior to the accident were reported by 4 subjects. Three would now be considered occasional binge drinkers who had not had an episode in well over a week prior to their participation and the other had not drank heavily for several years. None of these were judged chronic and heavy enough drinkers to have their drinking interfere with their performance. Reports from subjects indicated that symptoms of alcoholism at times were confused with the outcome of severe brain damage.

Review of their life histories suggested that only 3 subjects appeared to be functioning reasonably well in one of the three major

life spheres. Only 1 subject seemed to be doing well at home, work and socially. Another appeared to be functioning satisfactorily at work, and adequately socially but experiencing marital problems. The third was coping with her clerical position but feeling quite lonely socially and desperately searching for an intimate relationship.

The adjustment level for each subject was assessed by one of two psychologists using the Clinical Judgement Index which measures level of adjustment at work, home, and socially ($\bar{X}$ = 8.1, Sd = 2.9). The total score on this scale can range from 3 to 21 with an average adjusted person expected to achieve a minimum score of 12. Only 2 of the 26 subjects were judged to be at the average adjustment level and another 3 subjects were placed within the low average adjustment category. Twelve subjects were rated as poorly adjusted and the remaining 9 were considered to be very poorly adjusted. The high first order correlations which ranged from .79 to .94 among the three subscales of Clinical Adjustment Index illustrated that adjustment difficulties tended to occur in all three major life areas for this group. On the whole, the group perceived themselves as better adjusted than the psychologists assessed them. Total Scores from the Bell's Adjustment Inventory ($\bar{X}$ = 33.2, Sd = 17.3) placed 1 person in the excellent category, 7 in the high average range and 9 in average adjustment category. Two subjects viewed their adjustment as unsatisfactory while 7 subjects ended up in the very unsatisfactory category.

Basic intellectual ability was measured by administering the full WAIS-R. The mean FSIQ for this closed head injured sample proved to be approximately nine IQ points below the average for the WAIS-R standardized sample ($\bar{X}$ = 90.7, Sd = 12). Eleven or 42% of the sample

achieved scores in the average to above average IQ range. The dull normal subgroup consisted of 10 subjects or 38%. The performance of 4 of the remaining subjects yielded them scores in the borderline mentally deficient category, while the last subject proved to be functioning on the border of retarded to borderline mentally deficient category. By 1 year past injury, only 4 subjects, 3 subjects who had right and 1 subject who had left focal damage, demonstrated a statistically significant (15 FSIQ points) discrepancy between their VIQ and PIQ in favour of a higher VIQ. Two individuals who had no focal signs had PIQ scores that were approximately 15 IQ points above their VIQ scores. Not one subject had a discrepancy greater than 20 IQ points in either direction. Overall, 20 or 77% of subjects possessed no significant differences between their performance and verbal scores.

Quantitative deficits in problem-solving skills were derived from the scores on the two normed P-S tasks, the MEPS ($\bar{X}$ = 8.6, Sd = 6.5) and the WCST ($\bar{X}$ = 42.8, Sd = 22.7). Using the MEPS norms (Platt & Spivak, 1975a), 9 subjects or 35% of the group were categorized as possessing normal interpersonal P-S skills while 17 subjects or 65% demonstrated deficiencies. Using Heaton's (1981) cutoff scores of 18 perseverative responses on the WCST, 10 subjects or 38% were classified as normal while 62% were found to be in the brain damaged category. Only 5 subjects or roughly 20% were placed in the normal range on both clinical measures. The mean score on the Tower of Hanoi, a research instrument, was 127.04 moves (Sd = 42.1), even though the task can be completed in 53 moves. The group's performance on the Syllogistic Reasoning Task, the second research instrument, resulted in a mean of 9.77 and standard deviation of 8.9.

B. Main Analysis

Procedure and Predictions In order to simultaneously assess the relationships among the six measures, a canonical correlation was performed. The one set of criterion variables were the scores derived from the two measures of adjustment. The second set of predictor variables included the total score from the MEPS as the measure of interpersonal P-S skill and the scores assessed from the three impersonal cognitive P-S tasks. Individual correlations, both with and without the effects of IQ partialled out, were also computed. Contingency tables were used to visually demonstrate each significant relationship derived from the preceding analyses.

Moderate to high correlations between the two measures of adjustment, the Clinical Adjustment Index and Bell's Adjustment Inventory, and the measure of interpersonal P-S skills from the MEPS were anticipated. The three measures of impersonal P-S, the Tower of Hanoi, WCST and Syllogistic Reasoning, were expected to be positively correlated amongst themselves. Random relationships, demonstrated by zero to low correlations, were predicted among the two indices of adjustment and the three measures of impersonal P-S. Finally, nonsignificant correlations among the scores for the interpersonal and impersonal P-S tasks were anticipated.

C. Findings

The analysis produced a moderate canonical correlation, based on the best weighting system, that approaches but does not reach significance ($Rc=.62$, $p=.12$, See Table 1). Thus there was no significant relationship between adjustment, as measured by a linear combination of

the two criterion variables, and a linear combination of the four problem solving measures.

The two criterion variables were selected based on the assumption that the two measures would be highly correlated. Self-assessed adjustment (Bells Adjustment Inventory) and clinically assessed adjustment (Clinical Adjustment Index) were seen as assessing two aspects of the construct, adjustment. Although there was a slight tendency for some of those subjects whom obtained a higher rating of adjustment by the clinicians to also view themselves as better adjusted by scoring low on the Bells, the correlation between the two measures was low and nonsignificant ($r=-.29$, $p=.08$, see Table 2). This finding suggested that for CHI individuals, self-perception of adjustment level may be largely unrelated to assessment of adjustment by mental health care professionals.

Due to the nonsignificant relationship between the two criterion variables, a multiple correlation with the Bells as the sole criterion variable was performed and then the procedure was repeated with the Clinical Adjustment Index as the only criterion variable. To better understand the contribution of each predictor variable, multiple correlations were calculated using a forward [illegible]-wise regression technique (see Tables 3 & 4). In this proce[illegible] each predictor variable is systematically and individually added to the calculation of the multiple correlation. The first predictor variable entered has the highest individual correlation with the criterion variable and the remaining variables are entered in order based on their partial correlation with the criterion i.e., after the effects of those variables already in the equation are removed.

As was expected, the overall multiple correlation was nonsignificant (Rm=.35, F=.75, p=.57, see Table 3) when the Bells was used as the single criterion variable. This finding indicates that for CHI adults there is no relationship between self-perceptions of adjustment and the linear combination of the four measures of problem-solving. Therefore, Bell's Adjustment Inventory has been eliminated from further discussion in the results.

With the Clinical Adjustment Index as the criterion variable, the analysis produced an overall multiple correlation of .57 (F=2.5, p=.07) which represents approximately 32% of the variance in the criterion variable (see Table 4) accounted for by the combined predictor variables. In order to verify which of the predictor variables added the statistically significant portion to the variance, the regression analysis was conducted that limited the inclusion of the predictors to those that make a significant contribution to the shared variance at the 95% level when combined with the other predictors. Syllogistic Reasoning was entered first since it has the highest first order correlation with Clinical Adjustment (r=-.51, p<.01, see Table 2) and accounted for 26% of the shared variance. The predictor variable, Syllogistic Reasoning, also proved to be significantly correlated with the other three predictor variables (see Table 2). When predictor variables are highly correlated, they tend to account for the same variance in the criterion rather than predicting new components which reduces the chances of their contributing in a significant manner to predicting the criterion. This was found to be the case in the present analysis as the contribution of the three predictor variables to the variance in the criterion variable was nonsignificant.

First Order Correlations To further understand of the relationships among the variables, the individual correlations were examined (see Table 2). As stated earlier, a moderate to high correlation between adjustment and interpersonal P-S skill was anticipated. Although the magnitude of the relationship was less than hypothesized, the analysis determined the expected significant correlation between the two measures ($r=.40$, $p=.02$). As predicted, the three measures of impersonal P-S skills, the Tower of Hanoi, WCST, and Syllogistic Reasoning, were significantly and positively intercorrelated (see Table 2). Next, random relationships demonstrated by zero to low correlations, were expected between the indices of adjustment and the three measures of impersonal P-S, and between the scores for the interpersonal and impersonal P-S tasks. However, the intercorrelations only partially confirmed these expectations. Syllogistic Reasoning, one of the impersonal P-S measures, was found to have the highest correlation with the Clinical Adjustment Index ($r=-.51$, $p<.01$) rather than the interpersonal P-S measure, the MEPS. Contrary to expectations, Syllogistic Reasoning proved to be significantly related to the MEPS ($r=-.44$, $p=.01$). As was anticipated, the correlations between each of the other two measures of impersonal P-S and Clinical Adjustment were nonsignificant and as well they proved to be unrelated to the MEPS.

The initial results suggested that for CHI adults, level of adjustment is partly related to their cognitive P-S skill. The pattern of intercorrelations showed that adjustment may be related to a combination of interpersonal and impersonal P-S skill rather than just interpersonal P-S as stated in earlier research. Furthermore and again, in contradiction to previous research, interpersonal P-S and impersonal

P-S skills do not seem to be two completely independent cognitive skills but rather share some common skill dimensions. The verbal intellectual nature of Syllogistic Reasoning and the MEPS is one common aspect which may have produced a significant correlation between the two. The verbal component was absent in the other P-S tasks that were not correlated with the MEPS.

First Order Correlations with the Effects of IQ Partialled Out The intercorrelation matrix of all variables including Verbal IQ (VIQ), Performance IQ (PIQ), and Full Scale IQ (FSIQ), indices of the WAIS-R, demonstrated that intellectual ability is a crucial factor for this patient group. Each index proved to be highly correlated with Clinical Adjustment and all four predictor variables (Table 5).

In order to better understand the influence that FSIQ is exerting on the relationship between adjustment and P-S skill, a partial correlation was conducted to remove the effects of IQ from all individual correlations. The outcome of this procedure was to change the pattern of intercorrelations substantially (see Table 6). The criterion variable was no longer significantly correlated with any of the predictor variables although the correlation between the Clinical Adjustment Index and WCST was approaching significance ($r=.31$, $p=.07$). Syllogistic Reasoning, which previously had the highest first order correlation with Clinical Adjustment, was reduced to a near zero correlation ($r=.008$, $p=.49$). In fact, it had the lowest correlation with Clinical Adjustment. This finding suggests that Syllogistic Reasoning was the second best measure of general intellectual ability after the WAIS-R. The correlation of the MEPS with the Clinical Adjustment Index also declined to near zero, indicating that the original correlation

could be considered as being based on intellectual ability.

Removal of the effects of FSIQ also resulted in the elimination of the significant correlations among the three impersonal P-S tasks (see Table 6). All three measures appear to tap general intellectual ability rather than share common P-S components. The significant relationship between the two verbal P-S measures also disappeared, suggesting that a third variable, general intellectual ability, was the basis for that relationship.

To further clarify the role of IQ, the multiple correlation, using Clinical Adjustment as the criterion variable, was repeated with FSIQ added as the fifth predictor variable (see Table 7). The inclusion of IQ substantially increased the overall multiple correlation to .73 ($F=4.77$, $p<.01$), accounting for 55% of the variance in the criterion variable. Full Scale IQ, since it had the highest correlation with Clinical Adjustment, was entered first and accounted for 47% of the variance ($Rm=.7$, $F=23.1$ $p<.01$). The remaining four predictors failed to meet the criterion for inclusion which indicates their contribution to the shared variance in the criterion variable is nonsignificant in the context of FSIQ.

General intellectual ability proved to be the best single predictor of adjustment for this CHI group whose FSIQ ranged from 68 to 113 ($\bar{X} = 90.7$, $Sd = 12$). Furthermore, it appears that knowledge of their P-S skill, whether interpersonal and impersonal in nature, adds little to our ability to predict their level of adjustment once their intellectual ability is established. All P-S measures proved to be significantly correlated to FSIQ when IQ level was not restricted. Once the effect of FSIQ was removed, the P-S tasks did not adequately

differentiate members of this group. This does not mean that if IQ range was restricted the predicted relationships might not yet materialize but does indicate that in a clinical setting where intellectual ability is naturally free to vary, the P-S measures appear to have limited prognostic value at this time.

Removal of Lower IQ Subjects The current sample was representative of a clinical population of CHI adults. Hence, there were no restrictions placed on participants regarding their basic intellectual ability. However, it was apparent that there existed an extreme subgroup whose IQ level was assessed as falling in the borderline to mentally deficient range. These individuals may be unduly influencing the relationships under exploration by over stressing the role of intellectual ability. For these subjects, IQ level may be a far greater factor in both adjustment and P-S capacity than for those with more average intellectual ability. Individuals with below average intelligence will perform very poorly on the majority of cognitive tasks and probably exhibit reduced ability to cope with complex demands of daily living. Therefore 5 subjects with the lowest FSIQ were eliminated, reducing the sample to 21 subjects whose FSIQ ranged from 81 to 113 ($X=94$, $Sd=10.4$). The series of correlational analyses was then recalculated without this extreme subgroup.

The new multiple correlation with Clinical Adjustment as the sole criterion variable and the four P-S measures as the predictor variables resulted in a substantially higher overall multiple correlation ($Rm=.81$, $F=7.5$, $p<.01$, see Table 8). The combined predictor variables now accounted for approximately 65% of the variance in the criterion which represents a substantial increase over the 32% that was accounted for

originally. Syllogistic Reasoning continued to have the highest individual correlation with the criterion ($r=-.78$, $p<.01$, see Table 9). The magnitude of the individual correlations of the remaining predictor variables decreased slightly. The MEPS still had the second largest correlation ($r=.39$, $p=.04$), the Tower of Hanoi came next ($r=-.14$, $p=.27$) and the WCST had a near zero correlation ($r=.02$, $p=.46$).

The regression analysis, which limits the inclusion of the predictors to those that make a significant contribution to the variance in the criterion variable, entered Syllogistic Reasoning first as it had the highest individual correlation. The use of the multiple correlation only resulted in a gain of .03 over the first order correlation between adjustment and Syllogistic Reasoning. Once again the three remaining predictors failed to meet the criterion for inclusion indicating that their contributions are nonsignificant. Removal of the subgroup with low intellectual ability substantially increased the magnitude of the correlations indicating that the low IQ of the extreme group had previously been suppressing the multiple correlation. However, the pattern of the correlations between each predictor variable and the criterion variable and the relative contribution of each to the variance in the criterion variable remained virtually the same.

The multiple correlation with FSIQ as the fifth predictor variable was then repeated. The overall multiple correlation was once again strengthened ($Rm=.87$, $F=9.7$, $p<.01$) and now over 76% of the variance in the criterion variable was accounted for by the combined predictors (see Table 10). The one notable change was that Syllogistic Reasoning had a marginally higher individual correlation with clinical adjustment ($r=-.78$) than FSIQ ($r=.74$). Therefore, the regression analysis entered

Syllogistic Reasoning first and the other four predictor variables failed to meet the criterion for inclusion. As Syllogistic Reasoning and FSIQ still do not add separate components to the variance in the criterion variable, it appears that general intellectual ability remains the major factor in predicting long term adjustment.

The influence of the extreme low IQ was apparent in the changes in the individual intercorrelations among all the variables (see Table 9). Syllogistic Reasoning ($r=-.78$, $p<.01$) and the MEPS ($r=.39$, $p=.04$) continued to be significantly related to Clinical Adjustment but the two predictor variables were no longer significantly correlated with each other ($r=-.27$, $p=.12$). The correlation among the three impersonal P-S tasks became nonsignificant indicating that the low IQ subgroup had been unduly influencing them. Full Scale IQ was found to be still playing a crucial role as the Clinical Judgement Index ($r=.74$, $p<.01$), the MEPS ($r=.5$, $p<.01$), Syllogistic Reasoning ($r=-.6$, $p<.01$), and Tower of Hanoi ($r=0.36$, $p=.05$) proved to be significantly correlated with FSIQ. The exception was the WCST ($r=-.26$, $p=.13$). The removal of the lower IQ group reduced the correlation between FSIQ and Syllogistic Reasoning from -.74 to -.60 but the moderate correlation demonstrated that they continue to be related to a substantial degree.

The partial correlation which controlled for FSIQ resulted in the correlation between the interpersonal P-S measure, the MEPS, and the Clinical Adjustment Index dropping to near zero ($r=.02$, $p=.47$, see Table 11). The relationship between these two variables appears to be an artifact of their relationship with intellectual ability. On the other hand, Syllogistic Reasoning continued to be significantly related to Clinical Adjustment ($r=-.62$, $p<.01$). As well, the correlation between

the Clinical Adjustment Index and WCST was found to be approaching significance (r=.33, p=.08). These two impersonal P-S tasks appear to have some components that relate to adjustment and are relatively independent of FSIQ and each other (r=.05, p=.4).

Although Syllogistic Reasoning and, to a lesser degree, the WCST seem to possess independent components that relate to the adjustment of CHI adults, the regression technique for obtaining a multiple correlation demonstrated that these components do not contribute significantly to our ability to predict adjustment. Overall, the analysis showed that intellectual ability, as best measured by the WAIS-R, is the major factor in predicting long term adjustment for CHI adults (see Table 12). The results do suggest that, with further development the two impersonal P-S tasks may add to clinicians' understanding of long term adjustment beyond what is gleamed from a general intellectual assessment.

D. Major Hypotheses

Hypothesis 1 It was expected that the CHI adults would demonstrate deficiencies on the two normed measures of problem-solving, MEPS and WCST, and these deficiencies would be relatively unassociated with FSIQ, VIQ, and PIQ derived from the WAIS-R by one year post injury.

FINDING The first half of the hypothesis was confirmed as the vast majority of CHI adults did demonstrate deficiencies on one or both of the normed P-S measures. These two tasks, the MEPS and WCST, provided norms and cutoff scores so that the presence or absence of P-S deficits could be determined. Using the MEPS norms (Platt & Spivack, 1975a), 9 subjects or 35% of the group were categorized as possessing normal

interpersonal P-S skills while 17 or 65% fell below the norms. Using Heaton's (1981) cutoff score of 18 perseverative responses on WCST, 10 subjects or 38% were classified as normal while 62% were found to be brain damaged. Only 5 or roughly 20% were placed in normal range on both measures.

The data failed to confirm the second part of the hypothesis, even when those individuals with below normal IQ were eliminated from the sample (see Table 9). With the exception of WCST, all the P-S measures were significantly related to FSIQ and PIQ. In general, the P-S tasks' associations with VIQ were more variable. The verbal interpersonal measure, the MEPS, was moderately correlated with VIQ ($r=.52$, $p<.01$) and also significantly related to PIQ ($r=.39$, $p=.04$). The Tower of Hanoi was not significantly correlated with VIQ. Syllogistic Reasoning, the verbal impersonal P-S task, proved to have a higher correlation with PIQ ($r=-.63$, $p<.01$) than VIQ ($r=.45$, $p=.02$) although both were significant. The WCST was the only one that was found to be independent of IQ for those severely CHI adults whose intellectual scores fell within the average to dull normal range. The analysis also determined that for the MEPS, the interpersonal P-S task, its relationships with Clinical Adjustment and Syllogistic Reasoning were a function of its correlation with intellectual ability rather than its interpersonal P-S components.

Hypothesis 2 It was anticipated that level of adjustment would covary with level of interpersonal P-S skill.

FINDING The initial analysis did determine that level of adjustment was related significantly to level of interpersonal P-S skills. However, further analysis revealed that this relationship was a function of the interpersonal P-S task's association with intellectual

ability. Once the effect of FSIQ was removed, the correlation between Clinical Adjustment and interpersonal P-S was reduced to zero, indicating that their previous relationship was the product of both variables being significantly correlated with intelligence.

Hypothesis 3 It was hypothesized that level of adjustment would be unrelated to ability to solve impersonal P-S tasks.

FINDINGS The evidence from the present study failed to confirm the third hypothesis. Overall, the results repeatedly pointed out that level of adjustment has a far greater association with general intellectual ability than with interpersonal or impersonal P-S skills. However, in the final analysis when FSIQ was controlled for and those subjects with below normal intellectual ability were eliminated, Syllogistic Reasoning was significantly related to level of adjustment. Furthermore, the correlation between WCST and level of adjustment was found to be approaching significance and independent of FSIQ. However, the evidence indicated that neither task is contributing significantly to our ability to predict adjustment beyond what is gained from a general intellectual test, such as the WAIS-R. The two impersonal P-S measures seem to have some components that are associated with adjustment level while also being independent of intelligence but they do not adequately differentiate among CHI adults. Further task development and greater refinement of the variable, 'adjustment', need to be accomplished if the tasks are to have clinical value as prognostic tools. General intellectual ability remains the best predictor of long term adjustment with the two impersonal P-S tasks holding some promise with future development.

Hypothesis 4 All measures of impersonal P-S whether verbal or nonverbal were expected to be highly correlated with each other but uncorrelated with the measure of interpersonal P-S skill.

FINDINGS The initial analysis offered support of the fourth hypothesis, but more indepth examination revealed that the relationships were a function of general intellectual ability. Once the extreme low IQ subjects were eliminated, the three impersonal P-S tasks were uncorrelated. Preliminary evidence indicated that the interpersonal P-S measure was related to the impersonal verbal P-S task. Again it was demonstrated that IQ was the mutual link between these two tasks. The lack of association among the P-S tasks indicates more work is needed to isolate relevant P-S components.

E. Exploratory Analysis

Once the major relationships were derived, exploratory analyses were conducted in order to provide tentative answers to the following questions and to generate more specific hypotheses. In this exploratory phase, the analyses are not independent of each other or the main analysis. The same configuration of data points from one sample were employed in all the analyses. Futhermore, the less conservative significance level of .10 was used since the small sample size would reduce the power of the statistical tests. Winer (1971) maintained that "too much emphasis has been placed on level of significance of a test and far too little emphasis upon the power of the test" (p.13), particularly in exploratory work. The .05 and .01 levels of significance are the most common but are mostly a matter of convention (Hinkle, Wiersma, & Jurs, 1979; Winer, 1971). Winer recommended that if the power

of the test is likely to be low under the usual significance levels and when type 1 and type 2 errors are of approximately equal importance, higher levels of significance can be more appropriate.

The Bell's Adjustment Inventory and the Tower of Hanoi were not included in the exploratory analysis, for the most part, as neither test contributed to the major relationships in the main analysis.

Question 1(a). Subgroups based on Impersonal P-S Skill

Do the relationships between impersonal P-S and adjustment differ as a function of group membership derived from a median split on the total number of errors first on the WCST, then on Syllogistic Reasoning, and finally on the Tower of Hanoi. Each of the three median splits produced two groups who are considered high and low in their impersonal P-S ability for each particular task. A series of Chi Square procedures which treated all members in the same group as having the same scores was used to deal with the question of presence of subgroups.

The Chi Square Analysis using the two levels of impersonal P-S ability, based on a median split on the WCST, and using high and low adjustment groups, defined by a median split on Clinical Adjustment, produced a significant corrected Chi Square of 5.54 ($df=1$, $p<.02$). The results infer the existence of two subgroups of high and low skilled impersonal problem-solvers who differ in the degree of their relationship to adjustment (see Table 13). The group with higher impersonal P-S ability, based on the WCST, appear to be higher on the adjustment scale while those defined as low ability impersonal problem-solvers were found to be on the lower end of the adjustment scale.

No significant relationships materialized between the high and low ability impersonal problem-solvers, based on the median split on WCST and those considered low and high ability impersonal problem-solvers based on median splits on Syllogistic Reasoning (corrected X^2=1.39, df=1, p>.10) and the Tower of Hanoi (corrected X^2=.62, df=1, p>.10). As was expected from the earlier product-moment correlations, the Chi Square analysis demonstrated a significant relationship between two levels of impersonal problem-solvers derived from a median split on Syllogistic Reasoning and the two levels of Clinical Adjustment (corrected X^2=7.58, df=1, p<.01). The present analysis supports the position that those CHI individuals performing well on Syllogistic Reasoning Tests are better adjusted than those with poorer scores.

When the two levels of impersonal problem-solvers were derived from a median split on Tower of Hanoi, no significant relationship was found (corrected X^2=61, df=1, p>.10).

Question 1(b). Differences in Adjustment for Subgroups

Do the two groups, high and low ability impersonal problem-solvers determined by the above median split differ significantly in their level of adjustment? Two t-tests were employed to compare the group scores first from WCST and then from Syllogistic Reasoning on the Clinical Adjustment Index.

The adjustment levels for the two groups, high and low ability impersonal problem-solvers based on WCST were not significantly different (t(24)=1.48, p>.10, see Table 14). On the other hand, the adjustment levels for the high and low impersonal problem-solvers based on their performance on Syllogistic Reasoning Task were shown to be significantly different (t(24)=3.19, p<.01, see Table 14).

The statistical properties demonstrated by the Chi Square procedures and t-tests lend support to the conclusion in the main analysis. With further task development and the greater refinement of the variable, adjustment, the two impersonal P-S tasks, WCST and Syllogistic Reasoning, may have clinical value as prognostic tools.

2. Subgroups based on Interpersonal P-S Skill

Does the relationship between interpersonal P-S and adjustment vary as a function of group membership derived from a median split on the Total Score from the MEPS, the measure of interpersonal P-S ability? Do the high and low interpersonal P-S groups differ significantly in their level of adjustment? To examine these questions the data analyses described in part (1a) and (1b) were repeated.

The Chi Square Analysis, with high and low interpersonal P-S groups based on the median split on the MEPS and with high and low adjustment groups, derived from median split on Clinical Adjustment Index, resulted in a nonsignificant corrected Chi Square of .62 (df=1, $p>.10$). Therefore, the relationship between interpersonal problem-solving and adjustment did not vary as a function of group membership (see Table 15).

The t-test produced a nonsignificant result ($t(24)=1.05$, $p>.10$) which determined that the high and low interpersonal P-S groups did not differ significantly in their level of adjustment (see Table 16).

Question 3. Length of Time from Injury

Do the two groups, based on a median split on the length of time from injury, differ significantly on any or all of the three variables: adjustment level, impersonal P-S, and interpersonal P-S

ability. This question was explored by using a Hotelling's T^2 on the group scores for the four dependent measures; Clinical Adjustment Index, MEPS, WCST, and Syllogistic Reasoning.

The median split on the time from injury produced one group whose members were less than or equal to 3 years 6 months from their injury date and a second group whose time from injury ranged from 3 years 7 months to 6 years 11 months. The two groups did not differ significantly in their adjustment level, their impersonal P-S skills, and interpersonal P-S ability ($F(4,21)=1.51$, $p>.10$, see Table 18).

Question 4. Impersonal P-S Efficiency

Do the two groups, fast and slow impersonal cognitive problem-solvers determined by a median split on the length of time to complete the Tower of Hanoi, differ on their impersonal cognitive P-S proficiency? This question was dealt with by using a MANOVA to simultaneously compare the group mean scores from the Tower of Hanoi, WCST, and Syllogistic Reasoning.

The MANOVA produced a significant F value ($F(3,14)=2.81$, $p<.1$). Examination of the univariate F tests derived a significant F value for the Tower of Hanoi ($F(1,21)=5.5$, $p<.05$) while the differences in the means of the other two variables, WCST, and Syllogistic Reasoning, produced nonsignificant F values (see Table 17). Those subjects taking less time to complete the Tower also made fewer extraneous moves, suggesting they may have developed a strategy before embarking on the task. Those individuals who required more time and made significantly more moves appeared to approach the task in trial-and-error fashion.

Question 5. Focal Damage

Do two groups with indications of anterior and posterior focal

damage differ significantly on any or all of the three variables: adjustment level, impersonal P-S skills, and interpersonal P-S ability? This question was to be addressed by using a Hotelling's T^2 on the group scores for the four measures.

Question five could not be answered as the medical records failed to provide definite indications of anterior and posterior focal damage. As was anticipated, the damage and type of injury incurred by the subjects meant that for the majority the insult encompassed many areas of the brain including the anterior and posterior portions simultaneously.

Question 5.(b) Impact

Do the three groups, defined by indications of right and left hemispheric impact sites and no indication of specific hemispheric involvement differ significantly on any or all of the three variables; adjustment level, impersonal P-S skills, and interpersonal P-S ability. This question was addressed by using a 1-way MANOVA on the group scores for the four measures.

As the multivariate test of significance resulted in a nonsignificant F ($F(4,21)=.93, p>.10$), the three impact site groups were found not to differ significantly on any of the three variables (see Table 22).

Question 6(a). Coma

Do the two groups, derived by a median split on an estimate of length of coma differ significantly on any or all of the three variables. Hotelling's T^2 on the group scores on the four measures; Clinical Adjustment Index, MEPS, WCST, and Syllogistic Reasoning was again utilized to answer this question.

The median split produce one group whose members were judged to have incurred comas ranging from approximately 1 to 14 days and a group whose length of coma ranged from 15 to 61 days. The two groups based on length of coma did not differ substantially on any of the three variables ($F(4,21)=.81$, $p>.10$, see Table 20).

Question 6(b). Post Traumatic Amnesia (PTA)

Do the two groups, derived by a median split on an estimate of length of PTA, differ significantly on any or all three variables. A MANOVA was computed to simultaneously compare the group scores from the Clinical Adjustment Index, the MEPS, WCST, and Syllogistic Reasoning. A series of Chi Squares was also calculated to determine if there were any significant relationships between length of PTA and high and low scores on the tests for the three variables.

The median split resulted in one group whose members were assessed as having had a PTA from 1 day to less than 2 months. The second group's members were judged to have a PTA longer than 2 months. The MANOVA produced a multivariate F value ($F(4,21)=1.18, p>.10$) indicating that the two groups, based on length of PTA, did not differ significantly on any of the four measures (See Table 21). The series of Chi Squares analyses did not determine any significant relationships between length of PTA and the four measures; Clinical Adjustment Index (corrected $X^2=.61, df=1, p>.10$), MEPS (corrected $X^2=.0$, $df=1$, $p=1$), WCST (corrected $X^2=.0$, $df=1$, $p=1$), and Syllogistic Reasoning (corrected $X^2=1.39$, $df=1$, $p>.10$).

Question 6.(c) Complicated/Uncomplicated Injuries

Do the two groups, defined as having complicated or uncomplicated injuries, differ significantly on any or all of the three variables? This question was answered by employing Hotelling's T^2 procedure.

The Hotelling's T^2 procedure determined a nonsignificant T^2 (T^2=1.88, $F(4,21)$=.41, $p>.10$) There was no indication that the group considered to have complicated injuries due to presence of focal signs or surgical intervention differed on any of the three variables from those with uncomplicated injuries (see Table 23).

Question 7.(a) Age

Do the two groups, determined by a median split on age, differ on any or all of the three variables: adjustment level, impersonal P-S, and interpersonal P-S ability? This question was addressed again by using Hotelling's T^2 on the group scores for the four measures; Clinical Adjustment, MEPS, WCST, and Syllogistic Reasoning.

The members of group one ranged in age from 19 to 26 years while those forming the second group from 27 to 37 years. The resulting T-Squared (T^2=1.23) proved to be nonsignificant ($F(4,21)$ =.27, $p>.10$). Therefore, age did not affect level of performance on the tasks (see Table 19).

Question 7.(b) Education

Do the three groups, based on dividions in education, differ significantly on any or all of the three variables. A MANOVA was computed to simultaneously compare the group scores from the Clinical Adjusment Index, the MEPS, WCST, and Syllogistic

Reasoning. A series of CHI Squares were also utilized to determine if there was any significant relationships between education groups and high and low scores on the tests for the three variables.

The divisions in education created Group One whose 6 members all possessed some college or university training. Group Two's 10 members all completed Grade 12 with 3 subjects obtaining their Grade 12 matriculation, and Group Three had 10 subjects whose education level ranged from the completion of grade 8 to grade 11. The test of significance produced a nonsignificant F value $F(8,40)=1.31$, $p>.10$) (see Table 24). The three education groups were therefore found not to differ significantly on any of the three variables. The individual Chi Squares demonstrated that there was no significant associations between level of education and level of clinical adjustment ($X^2=4.6$, df=2, $p>.10$), and level of interpersonal P-S ($X^2=4.3$, df=2, $p>.10$), and level of impersonal P-S ability based on WCST ($X^2=1.07$, df=2, $p>.10$) or based on Syllogistic Reasoning ($X^2=.52$, df=2, $p>.10$), see Table 24). Thus, education is not a major factor affecting the three variables under study.

Question 8. Discrepancies between VIQ and PIQ

Do the three groups, defined as high VIQ and low PIQ, high PIQ and low VIQ, and no significant discrepancy, differ on any or all of the three variables? The question was to be handled by performing a 1-way MANOVA to simultaneously compare the group scores for the four measures.

This question could not be dealt with as the sample could not be divided into three groups, defined as high VIQ/low PIQ, high PIQ/low

VIQ, and no significant discrepancy. When the statistically significant 15 point discrepancy was used as the criterion, twenty subjects exhibited no significant differences. Four subjects were placed on the high VIQ/low PIQ category while only 2 subjects fell in the high PIQ/low VIQ group.

F. POST-HOC EXAMINATION OF INTELLECTUAL ABILITY

The main analysis indicated that general intellectual ability is a crucial variable in predicting long term adjustment for CHI adults and is correlated with both impersonal and interpersonal P-S ability. Therefore, it was decided to perform further exploratory analyses to increase our understanding of the role of IQ. For this phase, the full sample was divided into two groups differing in intellectual ability. The high FSIQ group's 11 members had average to above average FSIQ scores (FSIQ>90). The low group consisted of 15 persons in the low average to borderline categories (FSIQ<89). All analyses were then repeated with the five extreme low FSIQ persons eliminated as earlier results showed that this minority unduly affected some of the relationships among the variables. Only if the latter analysis differed substantially from the full sample ones were they reported.

1. Differences between FSIQ Groups

Do the two FSIQ groups differ significantly on any or all of the three variables. A MANOVA to simultaneously compare the group means on the four measures, Clinical Adjustment Index, MEPS, WCST, and Syllogistic Reasoning was used.

Using the full sample, the MANOVA produced an overall significant F value ($F(4,21)=5.11, p<.01$). The univariate F-tests demonstrated

significant F values for all measures; Clinical Adjustment ($F(1,24)=11.24$, $p<.01$); MEPS ($F(1,24)=3.35$, $p<.1$); WCST ($F(1,24)= 5.46$, $p<.05$); and Syllogistic Reasoning ($F(1,24)=11.85$, $p<.01$). Those with average intellectual ability performed better on all three variables than those in lower FSIQ group (see Table 25).

When the extreme low FSIQ subjects were deleted from the sample, the test of significance yielded a lower but still significant overall F value ($F(4,16)=3.46$, $p<.05$, see Table 26). The univariate F-tests produced significant F values for two of the measures; Clinical Adjustment Index ($F(1,19)=8.68$, $p<.01$) and Syllogistic Reasoning ($F(1,19) =8.92$, $p<.01$). These differences reconfirmed that intellectual ability is a pertinent factor in determining the outcome on these two measures. Elimination of low IQ subjects meant that the two groups no longer differed significantly on their means scores from the MEPS ($F(1,19)=1.09$, $p>.10$) and WCST ($F(1,19)=2.58$, $p>.10$). The results indicated that for CHI adults within the low to average IQ ranges, their performance on these two tasks did not differ as a function of IQ.

2. Relationships between FSIQ and Demographic Factors

Does IQ level have any significant relationship to the major demographic factors (Time from Injury, age, complicated/uncomplicated, coma, impact site, education and PTA)? A series of individual Chi Square analysis was employed to establish these relationships.

For the full sample, the series of Chi Square analyses did not show any significant relationships between the level of intellectual ability and the major demographic factors (see Table 27). The deletion of the extreme low FSIQ subjects did not substantically change any of

the Chi-Squares (see Table 28).

3. Median Splits on Demographic Factors

Do groups devised by a series of median splits based on the major demographic factors differ significantly in their FSIQ scores. t-tests and 1-way MANOVAS were employed to compare group scores on the measure of FSIQ.

The t-tests for comparing the two groups derived from age ($t(1,24)=.32$, $p>.10$), length of PTA ($t(1,24)=.65$, $p>.10$), and for the complicated/uncomplicated groups ($t(1,24)=-.67$, $p>.10$), yielded nonsignificant results. The ANOVAS comparing the mean FSIQ scores for the three groups derived by education ($F(2,23)=1.8$, $p>.10$) and the three groups based on impact site ($F(2,23)=.09$, $p>.10$) also revealed no significant differences (see Table 29). The deleted sample failed to make any noteworthy changes in these results (see Table 30).

The t-test comparing the mean FSIQ scores for the two groups with differing length of time from injury produced a significant result ($t(1,24)=-1.86, p<.1$). The group whose subjects incurred their injuries less than or equal to 3 years 6 months ago had significantly lower mean FSIQ score than the group whose members' injuries occurred more than 3 years 6 months ago. The t-test comparing the FSIQ scores of two groups differing in length of coma also resulted in a significant t value ($t(1,24)=2.04, p<.05$). Group one whose members were judged to have incurred comas ranging from 1 to 14 days, had a significantly higher mean FSIQ score than group two whose length of coma ranged from 15 to 61 days (see Table 29).

Four of the 5 lowest IQ subjects proved to be in the groups whose injury occurred less than 3 years 6 months ago. Their removal resulted

in an nonsignificant result ($t(1,19)=-1.07, p>.10$, see Table 30). Furthermore, the 5 lowest IQ subjects were all in the group whose members incurred the longer comas. Their eliminations again produced a nonsignificant t value ($t(1,19)=1.09, p>.10$). The findings suggest that severest injuries resulting in prolonged coma produce the greatest deficits and their recovery time may be longer. In contrast, those CHI adults whose FSIQ is in the average range by one year post injury, time from the accident and length of coma appear unassocciated with FSIQ scores.

G. Qualitative Analysis

What strategies did the subject use to solve each of the problem-solving tasks? To answer this question, each individual measure was examined in detail in an attempt to identify trends and characteristics. As was discussed previously, the qualitative approach which studies P-S in the context of certain subject-task domains, is necessary to further our understanding of human behaviour. This approach deals with a number of vital issues that cannot be adequately dealt with quantatively (Simon,1975). For instance, the detailed and systematic description of strategies is beginning to account for differences in P-S ability in terms of the cognitive demands placed on the basic psychological processes that are the prerequisites for P-S (Glaser,1978). Furthermore, the qualitative analysis stresses the examination of the overall strategic approaches or the metacognitive processes, which if faulty, may hinder the productive utilization of lower level cognitive skills. Metacognition, the knowledge of ones own cognitive strategies in P-S situations is considered the essence of

intelligent behavior (Brown, 1978). Wherever possible, the qualitative analyses for the CHI adults were compared to previous research with other samples.

Means-Ends Problem-Solving Procedure The MEPS was devised to assess a person's ability to generate appropriate and effective means in order to achieve the desired goal when confronted with a problem situation and an aroused need (Platt & Spivack, 1975a). For this task, each subject was given the beginning and outcome of seven hypothetical real-life situations and was asked to describe the actions (means) that could be used to effectively handle each situation.

1. Comparison of each subject's average number of relevant means and their relevancy ratio with the MEPS norms (Platt & Spivack, 1975a) showed that 17 subjects or 64% fell in the impaired category on both indices. The 9 remaining subjects or 36% were assessed as within the normal range. A post-hoc Chi square procedure illustrated that those rated as normal on the MEPS were significantly more adjusted than those subjects assessed as impaired ($X^2=4.06$, $df=1$, $p<.05$).

2. The content of the CHI subjects responses to stories 1,2,3,4, and 5 were categorized according to the major themes provided by Platt and Spivack (1975a). Using the Chi Square procedure, the proportion of thematic responses given by CHI adults were compared to the proportions given first by normal controls and then by the psychiatric patients for the mean categories designated by Platt & Spivack (1974). The comparisons examined the qualitative differences in the content of the responses to common life problems among the three groups; normal controls, psychiatric patients, and CHI adults. The procedure tested the

hypothesis that the three groups have different methods of solving common life problems. The CHI adults' choices of responses were significantly more similar to the controls than the psychiatric patients for four out of the nine mean comparisons described in Table 31. For two comparisons, the CHI subjects' frequency rate of giving a particular response proved similar to the psychiatric group. One comparison indicated that CHI group was significantly different from both normals and psychiatric patients. For one story, their frequency rate of giving two mean categories fell between both the controls and patients leading to nonsignificant results.

Although 65% of the CHI sample experienced difficulty conceptualizing relevant interpersonal means-end thinking, the content of their thinking, when relevant, was more similar in quality to normals than psychiatric patients. However, no clear pattern emerged since they were more likely than even normals to include in their stories an element of thinking prior to taking action. On other occasions, their stories incorporated many more responses that reflect taking immediate and concrete action. These findings suggested that CHI adults may be an unique group whose quality of responses fluctuate. Further research may prove that the responses vary in accordance with the nature of the story. Stories associated with old learning or experience may result in very different kinds of responses than those elicited by stories considered novel by CHI adults.

3. Examination of the response pattern on the MEPS demonstrated that, on the average, only 54% of the subjects were able to provide at least one relevant means per story (See Table 32). Even though another 40% gave responses to each story, their answers were rated as either

containing no means or irrelevant ones. Six percent of the sample gave no response to each story. For the most part, the CHI subjects were found to be unaware of obstacles that might hinder their achievement of designated goals. The concept of time required to reach solutions to problems was only incorporated by a small minority of the subjects. Furthermore very few elaborated on their means of achieving their goals. The presence of introspection, defined as giving thought prior to taking action, varied depending on the situation. Overall, CHI adults tended to elicit action means as the protagonist performed an action rather than passively waiting for someone else to take the initiative.

The preliminary evidence suggested that CHI adults are deficient in their cognitive ability to focus on relevant and salient aspects of interpersonal P-S situations. They also seem unaware of potential obstacles or the need for a suitable amount of time to pass for change to occur. On the other hand, the data indicated that some CHI adults possess some adaptive understanding of problematic social situations as they cognitively realize the importance of planning and taking the initiative in social situations.

4. The strategies given for the first five stories were evaluated for the presence of a logical rationale by two psychologists in order to compare the findings with Platt, Siegal, and Spivack's (1975) conclusions. Logical rationale for the purpose of the present study was defined as demonstrating some general knowledge and understanding of human behaviour. For a rationale to be considered valid and coherent, there had to be agreement between the two psychologists. If no valid rationale was derived, the psychologists identified what each subject was doing instead.

Platt et al., (1975) claimed that in all situations, normals are more able to provide a valid rationale for having chosen a particular course of action than psychiatric patients. The present analysis demonstrated that CHI adults had difficulties similar to the psychiatric patients who could not provide an adequate rationale (see Table 32). No logical rationale could be derived for all five stories of 14 subjects or nearly 60% of the sample. When asked for their rationale these subjects were often confused, told stories from their past, reiterated their original stories, justified their choices or gave social cliches. Eight subjects gave one logical rationale as the majority knew that they must take the initiative to meet new people. Only two subjects provided a logical rationale for two stories while one subject demonstrated a sound understanding of human behavior by giving four valid and coherent rationales for the five stories. Unfortunately, a direct statistical comparison could not be made between the present findings and Platt et al.(1975) results due to the lack of data in their study. Overall, the results indicate that CHI adults experience great difficulty explaining why they chose a course of action. They seem to be deficient in their ability to monitor and evaluate their own behavior.

Summary. The qualitative anaylsis of the MEPS demonstrated that the majority of CHI adults are impaired in their ability to generate relevant means to achieve their desired goal when confronted with a problematic situation. Caution needs to be exercised when interpreting the findings as the main analyses indicated that general intellectual ability, rather than interpersonal P-S cognitive skill, may be contributing substantially to this deficit, and the significant relationship between adjustment and performance on the MEPS. However,

the qualitative examination did reveal a number of areas warranting further research. The content, quality, and frequency of their responses suggest that CHI adults may be different from both normals and psychiatric patients. Furthermore, for CHI persons who learned social behaviour prior to their accident, their ability to cognitively handle problematic life situations may depend on whether the situations are novel or related to past experience. Their tendency to rely on past experience and social cliches for direction may be detrimental in novel situations where flexible and innovative approaches are needed. The current evidence demonstrated that CHI adults have difficulty focussing on important aspects of the problem, recognizing potential obstacles that may interfere with achieving their goals, and appreciating the role of time in interpersonal P-S situations. To further compound their deficiencies, CHI adults seem to have problems monitoring and evaluating their behavior. This finding suggested a breakdown in their metacognitive processing which requires the higher level skill of introspection concerning ones own performance (Brown, 1978).

Wisconsin Card Sorting Test The WCST is considered to be a complex P-S measure involving the ability to form concepts based on response feedback, to maintain response sets, and to shift sets(Lezak, 1976). Each subject was presented with four stimulus cards that differed in number, colour, and form. They sorted the 128 response cards which varied on the same three dimensions into categories based on feedback regarding the correctness of their choices. The categories changed without warning when the subject achieved the criterion of ten consecutive correct choices.

1. The first cutoff score provided by Heaton (1981) placed 18 subjects, who had greater than 18 perseverative responses, in the brain damage category with indications of frontal lobe involvement while the 10 remaining subjects were categorized as normal. The second cutoff score based on perseverative errors resulted in only 8 subjects in the normal range, 1 in the brain damaged category and 17 in the range denoting focal frontal lobe involvement.

For descriptive purposes, Heaton (1981) also presented the following five special WCST scores. Calculation of percent of perseverative errors revealed that for 9 subjects, their perseverative errors were less than 10% of their total responses. Percentage of perseverative errors for the majority, nearly 60% of the subjects, ranged from above 10% to about 30% of their total responses. The perseverative errors of 1 subject equalled 35% of his total responses and another subject proved extremely perseverative as his perseverative errors comprised 70% of his total number of responses.

According to Heaton (1981), the number of trials to complete the first category provides an indication of initial conceptualization before shift of set is required. The initial conceptualization was not particularly problematic for 21 of the 26 subjects as they all successfully completed the first category within 10 trials of the minimum. The 5 remaining subjects did have great difficulty with initial conceptualization and three of them never completed the first category. The second conceptualization score is the percent of conceptual level responses which is considered to reflect some insight into the correct sorting principle throughout the task. The subjects' scores on this scale varied substantially from 2% to 88% suggesting considerable

individual differences.

Heaton's (1981) "failure to maintain set score is the number of times in the test that the patient makes five correct responses in a row but fails to complete the category" (pg. 24). Ten subjects in the present study more than once demonstrated definite insight into the correct sorting principle by achieving five consecutive correct responses but nevertheless were inconsistent in their use of the correct strategy. Finally, Heaton's "learning to learn score reflects the patient's average change in efficiency across the successive stages of the WCST" (pg 24). A positive learning to learn score suggests improved performance across successive categories, presumably due to learning. Of the 26 subjects, 4 subjects had such poor performance that this score could not be calculated and 13 received negative scores indicating that 65% experienced difficulty profitting from the feedback.

2. Determining where the majority of errors occurred (at the beginning of the task, after each category change, or in the middle of an ongoing category) for individual subjects helped clarify if impairments are associated with an inability to form concepts, to shift sets, or to maintain categories (Lezak, 1976). The 8 subjects who were consistently placed in the normal range were not included in this calculation although all of them made the majority of their errors after each category change. The errors of the remaining subjects proved to be divided among the three locations with some subjects having difficulty in more than one area. Problems shifting set were the most common as 10 of the 18 impaired subjects made the majority of their errors after each category change. For 4 subjects, difficulty arose when trying to form the original concept since their errors primarily occurred at the

beginning of the task. The last 4 subjects experienced problems maintaining categories as most of their mistakes were in the middle of ongoing categories.

3. Combining the information on the location and frequency of errors with the subject's understanding of the task permitted the categorization of the subjects into Berg's (1948) three proficiency levels. On the basis of his undergraduate sample's quantitative performance and their verbal reports of their understanding of the the task, Berg (1948) derived three groups of differing skill levels. Members of Berg's Group A classified only by the three correct rules (color, form, and number), realized that the examiner shifted after a certain number of correct responses, made a maximum of three errors by the last three categories and completed the task in 15 to 20 minutes. Not 1 member of the CHI sample was placed in Group A, even if their scores were adequate. Their inability to describe what they and the experimenter were doing throughout the task prohibited their inclusion in this highest level. Half of the present CHI sample were placed in Group B, where the members demonstrated greater variability in their hypotheses, made unique errors in the middle of the task, could not verbalize accurately what was involved in the task, and/or demonstrated a strong tendency to perseverate. By the end of the task all those in Group B had established the correct three sorting principles (color,form, and number). The remaining 13 subjects were placed in Group C as they demonstrated extreme perseveration and variability. In accordance with Berg's findings, some of these CHI adults persisted throughout most of the task in trying to find one underlying principle, failing to appreciate that three principles were involved. The

classification system made it very apparent that the CHI adults were quite deficient in their ability to describe their own behavior and what was happening around them, even if their scores demonstrated a good understanding of the task demands.

The average time for task completion for each subject at each proficiency level was calculated to examine if time was associated with proficiency. A post hoc t-test showed that Group B whose members made less errors also required significantly less time than Group C ($t=2.11$, $df=24$, $p<.05$).

4. To determine further if subjects learn from previous experience, a learning curve was plotted for each subject by recording the frequency of errors at the beginning, middle, and end. The task of sorting 128 cards was divided into four parts, each containing 32 choices. The average number of errors, corrected for differences in the number of category shifts made, in each part, was plotted. Failure to learn was indicated by a relatively horizontal line, irregular pattern, or upward slope between each of the four parts. A downward slopping curve or no errors after correction denoted that subjects benefited from previous errors and feedback.

Examination of the learning curves (See Table 33) showed that 9 of the CHI adults profitted from the feedback. Seven of those were part of the 8 subjects rated as normal according to the two cutoff scores. Only 2 of the impaired subjects appeared to have benefitted by the feedback as their error scores progressively lowered. Failure to learn was evident from the learning curves of 17 subjects. Of these, 4 seemed oblivious to the feedback as their error rate remained constant. Another 6 subjects performed erratically while 7 individuals' performance

deteriorated as the task progressed.

Summary. The detailed examination of the WCST profiles indicated some general trends in the inadequate P-S strategies manifested by nearly 70% of the CHI adults. The high perseveration scores by over two thirds of this sample confirmed the findings in earlier work (Heaton, 1981, Robinson et al., 1980) that the quantitative performance of individuals with diffuse cerebral injury is indistinquishable from persons with focal frontal lesions. In the present sample, 10 subjects have medically confirmed frontal lobe involvement and an indeterminate number of the remaining 16 may have incurred some damage to this area as well as other regions of the brain.

Qualitatively, the largest portion of the errors followed category changes indicating that shifting set created the greatest difficulty for these CHI adults. As those CHI adults with normal scores also made most of their errors after a category change, deficient performance did not seem due entirely to unique problems but rather to a tendency to make more of the same type of errors exhibited by persons with normal scores. This tendency demonstrated a quantitative as opposed to a qualitative difference between subjects rated as "normal and impaired". Categorizing the errors revealed two other subgroups within the sample. One subgroup experienced their most serious problems with initial cenceptualization and the other had difficulty maintaining the correct strategy. The two indices, the learning to learn score by Heaton (1981) and the learning curves, demonstrated that those with impaired performance did not profit from feedback as their errors failed to progressively decrease. Proficient problem solvers required less time to complete the task than those rated as less skillfull, suggesting the presence of a strategy and

the ability to profit from past experience reduces the time to solve complex problems. All the CHI adults were impaired in their ability to verbalize their understanding of the task, their own behavior and that of the experimenter, even if their performance demonstrated a good understanding of the task demands. The finding adds support to the hypothesis that CHI adults are quite deficient in their ability to monitor and evaluate their own and other's behavior. This trend on both the WCST and the MEPS suggested that a residual outcome of a severe closed head injury may be reduced metacognitive processing.

Tower of Hanoi The Tower of Hanoi has been widely used to derive the component skills and strategies in the P-S process (Simon, 1975). The three puzzles, using three, four, and five disks, required each subject to reconstruct the three pyramids of graduated sized disks. The rules stipulated that each disk must be moved independently to one of the alternative pegs without ever placing a larger disk on top of a smaller one.

1. Comparisons and groupings of the individual response profiles were performed to help clarify the issue of whether CHI persons share a common inefficient P-S strategy or whether impairments are reflected as individual variations in strategies. Seven subjects accurately perceived that the initial sequence varied depending on the number of disks. The majority, 15 subjects, were judged unaware of the importance of the initial sequence to achieving the goal as they either started all three problems in exactly the same manner or varied the starting sequence indiscriminately. Those that correctly varied their initial sequence made significantly less moves ($t=4.95$, $df=20$, $p<.01$) than those judged

unaware. Three subjects seemed to set subgoals, defined as building subunits on appropriate pegs and consistently moving in the correct direction after achieving the subgoals. The performance of another 12 subjects suggested they were attempting to build subgoals but unable to develop a logical strategy to achieve them. After reaching each subgoal, these individuals reverted to random movements and direction. Three subjects moved randomly throughout the task until, in a haphazard fashion, they solved the problem. Perseveration was problematic for 4 subjects who repeatedly became locked into loops. Only 1 subject demonstrated the ability to quickly and systematically correct herself after making an error. Overall, the analysis of sequence of individual moves indicated that impaired performance was primarily due to individual variations in strategies. A few common trends in errors were apparent including the inability to detect relationships between the start and the finish, perseveration, inability to systematically achieve subgoals, and difficulty correcting errors efficiently.

2. The descriptions of strategies given by each subject were rated by two psychologists according to the four strategies provided by Simon (1975). Simon's rote strategy involved mentally learning the correct sequence of steps prior to execution. Persons using his move-pattern approach paid little attention to the actual problem but rather cycled the disks through the pegs in a particular order. The goal-recursion strategy entailed breaking down each problem into small subgoals. Individuals utilizing the perceptual strategies developed a repetitive sequence of moves to free the largest disk. The two psychologists independently examined all of the subjects' verbal descriptions of their strategies for each problem and rated them according to the presence of

the major characteristics of Simon's strategies. The psychologists then compared ratings and for the few discrepancies, agreement was reached through discussion. It was anticipated that hypotheses could be generated from this information regarding the relationship between specific strategies and the perceptual and memory demands of the task.

Review of the subjects' strategies demonstrated one further time that this group has great difficulty verbalizing their understanding of their own behavior. The responses of 20 subjects were judged as confused for all three components. Logical strategies were stated by 6 subjects and of these only 2 provided coherent strategies for all three pyramids. A t-test demonstrated that the group of 6 subjects who gave a logical strategy for at least one problem performed significantly better than those 17 subjects who could not ($t=2.65$, $df=21$, $p<.05$).

Simon's (1975) perceptual strategy, which involved a repetitive sequence of moves to free the largest disk, was used most frequently by 4 subjects. Furthermore, those that reported the perceptual strategy found it useful for all three problems. The perceptual strategy required repeated perceptual tests but has the advantage of not increasing the demands on short term memory as the task complexity increases. The rote strategy, which involves mentally learning the correct sequence of steps prior to execution, was utilized by 2 subjects. However, they only reported using the rote strategy for the three disk problem. Its limited use may be related to the fact it requires learning a different sequence for each specific number of disks, and demands that a great deal of information be committed to memory. The preliminary data suggests that the perceptual strategy may be the most useful for CHI adults because it places minimal demands on short-term memory. Overall, the analysis of

strategies demonstrated once again that the majority of CHI adults either fail to develop a strategy or can not verbalize their thinking process.

3. The previous examination in the exploratory analysis of the association of speed and skill demonstrated that the two groups, derived from a median split on time to complete the Tower, differed significantly in their scores on the Tower of Hanoi ($F(1,21)=5.5$, $p<.05$, see Table 17). It was hypothesized that those subjects who took less time and made fewer moves may have developed a strategy, whereas those who required more time and made significantly more moves may be approaching the task in a trial-and-error fashion. In general, the evidence added further support to the position that more proficient problem-solvers need less time to complete P-S tasks.

To further explore the role of time, a ratio of the number of moves over the time to complete each problem was computed for each subject. A t-test for related measures showed that the subjects made more moves per minute on the 3-disk problem than the 4-disk one ($t=3.92$, $df=22$, $p<.01$). Moves per minute stabilized when the ratio for the 4-disk and 5-disk were compared ($t=-.29$, $df=22$, $P>.1$). It appears that for the first problem, the subjects rather efficiently arrived at their solution but slowed down when confronted with the more difficult tasks.

Summary. Although, the evidence to date indicated that the impaired performance of CHI adults was primarily due to individual variations in strategies, a few common trends in errors warrant further study. As a group, the subjects demonstrated problems detecting the relationships between the start and the finish, perseveration, difficulty systematically achieving subgoals and were inefficient when

correcting errors. An assessment of their descriptions of their own strategies demonstrated again that the majority of the CHI adults either failed to develop a strategy or could not verbalize their thinking process. This finding stengthened the hypothesis that CHI adults experience severe difficulties monitoring and evaluting their own and other's behavior and thus they appeared to have residual deficits in their metacognitive processing. The initial data also suggested that for CHI adults a perceptual strategy that places minimal demands on short term memory may be the most useful for cognitive transformation tasks. As with the other tasks used in this study, the more skillful problem-solvers in the group required less time to complete the task. Furthermore, the CHI adults tended to slow down when initially confronted with difficulties rather than act impulsively. However, slowing down did not necessarily result in improved performance. Their poor performance in general indicated that they either do not spend sufficient time developing a strategy prior to taking action or are unable to develop an adequate plan, even if they take ample time.

Syllogistic Reasoning The Syllogistic Reasoning task is a well-recognized complex P-S measure that frequently has been used to determine subskills and strategies involved in the P-S process (Sternberg & Turner, 1978). Each syllogism consisted of two statements that described a relationship between three terms. The subjects had to combine the information to decide if the conclusion about the non-adjacent terms was logical. Each subject was required to complete four problem sets of increasing difficulty with eight syllogisms per problem set.

1. Graphs of individual profiles (see Tables 34 and 35) and the group means for errors and time per problem set were used to determine if performance steadily declined as task difficulty increased or whether CHI adults developed more efficient strategies when demanded by the task. Examination of the profiles revealed that 10 of the 23 subjects who completed all four sections performed at a constant level as they made about the same number of errors per difficulty level. The error profiles of 7 subjects were U-shaped indicating that they made most of their errors on the easiest and most difficult problem set. The performance of 2 subjects improved steadily as the task progressed while for 2 others their performance progressively deteriorated.

Time appears to have been a major determinant in level of performance as 12 subjects' time increased as the task became more [illegible]. The finding suggests that rather than developing a more [illegible] strategy the CHI adults spent more time solving the individual p[illegible]s. The second and fourth problem set consumed the greatest amount of [illegible]e indicating the subjects put considerable effort into these two di[illegible]culty levels, presumably because the subjects perceived these two set[illegible] as the most difficult. Time remained generally constant across the fo[illegible] problem sets for 6 subjects. Comparison of their time and error profile demonstrated that 4 of these had low error rates on all four difficu[illegible] levels. The fifth person had a very high time and error rate across al[illegible] levels while the sixth person guessed at each item. It is postulated that those with low and constant time and error rate may be the subgroup who developed an efficient strategy for solving these types of problems.

To demonstrate if error rate and amount of time changed significantly from one difficulty level to the next, t-tests for related measures were used. The first t-test showed that the subjects made significantly fewer errors on problem set two than on one ($t=2.73$, $df=22$, $p<.02$), even though the second set was more difficult. The decrease in error rate corresponded to a significant increase in the amount of time required to complete the second problem set ($t=2.5$, $df=22$, $p<.05$). There were no significant differences in either error rate or time when the results of the second and third problem set were compared. When the subjects' responses from set three and four were analyzed, it was found that they made significantly more errors on four ($t=2.54$, $df=22$, $p<.02$) while also requiring significantly more time to complete the last sheet ($t= 3.86$, $df=22$, $p<.001$). The analyses suggested that on the whole the CHI group experienced difficulty revising their strategy as task difficulty increased.

In order to explore if subjects making fewer errors required less time, the sample was divided by a median split on number of errors. Comparison of the group means for time indicated that the more proficient problem-solvers needed less time to complete the task ($t=2.81$, $df=22$, $p<.05$).

2. The strategies described by the subjects were grouped by two psychologists according to Quinton and Fellows' (1975) major strategies. According to Quinton and Fellow's (1975) findings, common strategies for this task fall into two categories, thinking and perceptual. The thinking strategy first entails reading and thinking about the meaning of both premises and then the person must use either the series formation or elimination strategy. The former requires forming a mental

series of the three terms while the latter's prime feature was a process of elimination. Quinton and Fellow also derived two sophisticated perceptual strategies that do not seem to necessitate any obvious reasoning process but rather involve the recognition that the placement of the names in the statements directly relate to the conclusion. Due to the lack of details in the response of CHI adults, the strategies could not be divided into the various subcategories within the perceptual strategies.

In order to generate hypotheses regarding CHI adults' strategies such as whether strategies varied across item types and individuals, the percentage of subjects falling into the main categories were calculated. Of the total sample, 23% were either unable to provide an account of their strategy or their comments were assessed as confused and illogical. Another 42% stated that they read the problems and thought about the relationships but could not go on to explain how they used the information to solve the problem. As Quinton and Fellows' thinking strategies involved either forming a mental image or providing a systematic process of elimination, this 42% of CHI adults failed to qualify for the thinking category. The series formation thinking strategy was given by 23% of the subjects as their primary method of solving the problem. However, these subjects did not abandon this arduous approach in preference for the more efficient, sure, and effortless perceptual strategies as the majority of Quinton and Fellows' undergraduate sample did. In fact the sophistication of a number of CHI adults' strategies deteriorated with increased task complexity as for instance their comments indicated they changed from the series formation strategy to a confused state. A perceptual strategy that involved

recognizing that the physical position of the names in the statements related to the conclusion was used consistently by 1 CHI subject. Two others inconsistently employed either the perceptual or series formation strategies for various difficulty levels. None of the 3 subjects using the perceptual strategies were able to articulate the details that Quinton and Fellows' subjects reported. Overall, the CHI adults who were able to verbalize a strategy relied far more heavily on a verbal thinking approach rather than the more sophisticated perceptual strategies. Furthermore, they presented as rather inflexible in their thinking since the vast majority failed to go on to develop a more productive strategy as demanded by the task complexity. Only three subjects discovered even a simple perceptual strategy and two did not use the method consistently as task difficulty increased.

3. The subjects were divided into two groups according to their strategic approaches. The first group consisted of 6 subjects rated as confused and the 11 who were unable to verbalize a specific strategy. The 3 subjects who failed to complete the task were eliminated from this group. The second group was comprised of the 9 subjects who were assessed as providing logical strategies. A t-test was computed to test the directional hypothesis that the group able to verbalize a coherent strategy would make significantly less errors than the confused or non-specific group. The one-tailed t-test demonstrated that those CHI adults able to verbalize a logical strategy were significantly more proficient on this task ($t=2.074$, $df=22$, $p<.05$).

Summary. Examination of the individual profiles suggested that most of the subjects did not develop more efficient strategies but rather spent more time solving the more complex problems. This was

consistent with the previous findings that when confronted with more complex tasks most CHI adults do not act impulsively. In the initial phase, investing more time in the individual items was productive as their error rate decreased. However, on the last level, even though time increased so did the number of errors. A small subgroup, roughly 15% of the entire sample, became more proficient as the task complexity increased. As with the previous tasks, it was found that the more skillful problem-solvers required less time to complete the task.

The individual profiles and statistical comparison of the results from the four problem sets demonstrated that CHI adults fail to revise their strategy. Further support for the position that CHI adults are rather inflexible in their reasoning was gained from their descriptions of their strategies as not one subject progressed systematically from the arduous verbal strategy to the more sophisticated but less effortful perceptual strategies. The majority could not even verbalize their strategy or had in fact failed to develop one, again pointing out the difficulty this group has monitoring and evaluating their own behavior. Furthermore, the evidence suggests that their limited ability to develop and/or verbalize strategies hinders their effectiveness as problem-solvers. Overall, the analyses of the verbalization of the subjects' strategies on all four P-S tasks revealed significant deficiencies in their metacognitive processing. This deficit seemed to reduce their performance, even if they possessed the lower level component skills.

V. Conclusions

A. Long Term Adjustment

The findings of this study strongly supported the first major premise of poor long term adjustment for CHI adults. Twenty-one of the severely head injured persons under consideration had recovered their basic intellectual ability, as measured by a standard intelligence test, to a sufficient degree that should have enabled them to cope adequately with the demands of their home, work, and social environments. The majority, though, demonstrated quite significant adjustment problems that appeared to permeate the three major life areas rather than being confined to one sphere. In a similar vein, Klonoff and Costa (1984) studied the quality of life of 83 CHI patients who were 2 to 4 years post-injury by examining ratings by significant others on the Katz Adjustment Scale. As their results indicated enduring emotional and social dysfunction, they postulated that maladjusted behavioral symptoms are chronic or even permanent outcomes of closed head injuries.

The resilience and strength of these individuals and their significant others, though, proved to be very impressive. It appeared that by 1 to 2 years post-injury, most families of the CHI adults had developed some adaptive and realistic methods of dealing with their situation, which is consistent with Weddell et al.'s (1980) findings and Bond's (1983) clinical impressions. By this stage, signs of disruption disappear (Oddy & Humphrey, 1980), presumably because a new level of emotional equilibrium is established which allows them to solve ongoing problems (Bond, 1983). However, Klonoff & Costa (1984) found an interesting discrepancy in the reports of relatives. The significant

others acknowledged the CHI adults' serious emotional and social problems. They then rated the injured person's social roles and leisure activities as well as their own expectations and satisfaction with the patients as normal or better than normal. The authors hypothesize that the relatives were coping by relying on denial to promote the socially desirable image of being sympathetic and understanding toward the injured person.

Unfortunately, examination of their life circumstances suggested that for many of these young people further deterioration in their adjustment level will occur as time progresses. It is judged that the accumulative effect of their existing adjustment problems over time will create even greater distress and more debilitating emotional reactions for the injured individuals and possibly their family members. One young man explained that prior to his accident he never thought about rejection or failure but after five years of unexpected failures, he anticipates problems both in work and interpersonal situations for reasons he cannot fully comprehend. According to Fordyce, Roueche, and Prigatano (1983), more serious emotional reactions and social withdrawal become apparent in the chronic phases as injured persons' awareness of their residual deficits and inadequate social skills gradually increases. "The unfortunate consequence of adapting to head injury is the disquieting realization that the remainder of one's life will be a difficult struggle" (Rosenthal, 1983, p. 202). Severe closed head injured adults must learn to cope with a vast variety of enduring life changes including reduced physical ability; social, familial, and economic dependency; diminished social relationships; and lower vocational productivity that often results in feelings of impotency and

low self-esteem (Rosenthal, 1983).

The present data illustrated that for CHI adults, the general adjustment course may be an inverted U-shaped pattern. Their level of adjustment gradually ascends but seems to plateau just prior to achieving full and satisfying independence and then tragically declines as they experience repeated failures in the psycho-social aspects of their lives. The time frame varied for each individual, but with the continued support of their families, they made tremendous recoveries given their almost totally incapacitating initial impairments. With the exception of the most severely injured, recovery continued until the person could function almost independently, with many procuring employment or enrolling in some type of educational or training program. Then, the long term problems gradually revealed themselves as most were unable to successfully hold a job or finish a training program. Furthermore, they demonstrated significant problems maintaining friendships and intimate relationships. The pattern seems to concur with Eson's (1979) findings. Two years post-injury the majority of his young sample had recovered their basic adaptive/cognitive functions but none were able to successfully engage in school programs, to hold steady jobs, or to maintain mutually satisfying personal relationships. One subgroup of 12 young single persons in their late teens and early twenties at the time of their accident most clearly exemplified this pattern as not one individual, even though some had above average intelligence, had progressed to the next life stage of securing steady employment and settling into a career while interpersonally forming an ongoing intimate relationship. There was no evidence of this pattern changing in a positive direction in the near future. As they fall

further behind their peers and experience more failures, it appears probable that their social, emotional, and employment retardation will become even more evident in the years to come.

B. Adjustment and Residual Cognitive Deficits

Findings from this study also strengthened the position that it is the cognitive sequelae of diffuse damage, involving higher level residual cognitive deficits, that cause substantial adjustment difficulties for both the injured persons and their families (Boll, 1981; Eson, 1979; Miller, 1979; Rosenthal, 1983). Poor adjustment was judged to be primarily a by-product of the residual cognitive deficits (Najensen et al., 1975). Furthermore, it was considered false to conclude that just because IQ recovers to a level consistent with premorbid functioning that CHI persons do not have permanent and debilitating cognitive impairments (Miller, 1979; Tueber, 1975). Therefore, it was proposed that if higher level residual deficits are at the root, CHI adults would generally demonstrate multidimensional readjustment problems while also having significant higher level cognitive deficits. In fact, the majority of the sample with average intelligence were found to have serious adjustment problems involving their social functioning, interpersonal relationships, mental health, and vocational performance. Also the CHI subjects were deficient in their P-S capacity and more importantly, they proved quite inept at self-evaluation both personally and cognitively. Their self-assessment of their adjustment levels and emotional health failed to concur with that of the psychologists. On the cognitive tasks, they repeatedly demonstrated a breakdown in metacognitive processing as they were

deficient in their ability to monitor and evaluate their own behavior. Metacognition, the higher level skill of introspection concerning one's own performance (Brown, 1978) appeared to be lacking in this group. Disruption in executive functions or metacognitive processing reportedly manifests itself globally as it influences all behavior (Lezak, 1983).

The current results suggest that higher level cognitive deficits, encompassing personal and cognitive self-evaluative skills, directly produce some aspects of the poor adjustment and behavioral dysfunction exhibited by this population. The disruption of their executive and integrative cognitive functions seems to hinder their capacity to satisfactorily fulfill their life roles. But adjustment is affected by more than just executive cognitive functions. One must also consider important life influences, such as coping mechanisms, financial status, family support, premorbid functioning, emotional resources, and the reactions of those persons who encounter the head injured adult (Rosenthal, 1983). The complexity of the adjustment process becomes even more apparent with the recognition that these life influences do not operate in isolation. Nevertheless, the present results do suggest that efforts to clarify the relationship between levels of metacognitive processing and adjustment, and in particular, to understand the effects of the disruption of executive cognitive skills in the long term readjustment of CHI adults would be quite valuable.

C. Problem-Solving and Adjustment

The majority of the severely CHI subjects in the present study revealed the expected substantial discrepancy between their poor adjustment level and their cognitive recovery. Previous research had

indicated that more global and less understood cognitive deficits are quite resistive to spontaneous recovery and interfere with the readjustment process (Boll, 1981). Therefore, the concept of problem-solving which is thought to be crucial in intelligent adaptive behavior was proposed as the mediator between intelligence, as defined by standard intelligence tests, and competency level (Schaie, 1980). However, the present study failed to derive a systematic relationship between problem-solving and adjustment that was independent of intelligence. Even when analyses were restricted to subjects with average intelligence, the expected dissociation between IQ and P-S failed to materialize. Most importantly, a strong linear relationship between adjustment level and intelligence, as measured by the WAIS-R, was evident. General intellectual ability was the best predictor of adjustment and measures purporting to assess problem-solving skills added little to our ability to predict level of adjustment beyond what is already known from conventional intelligence testing. The present results raise questions about the rather common position that there is a limited relationship between performance on a single intelligence scale, such as the WAIS-R, and adjustment, even though it has not been fully investigated (Eson et al, 1978). If it is impairment in ongoing and complex information processes that are at the root of the cognitive deficits resulting from a severe closed head injury (Eson, 1979; Miller, 1970), then the results indicated that, in fact, the WAIS-R assessed these deficits more thoroughly than the P-S measures under consideration.

Unfortunately, conventional tests of intelligence produce levels of overall cognitive functioning that only pertain very generally to the

injured person's long term capacity to handle life's demands (Bond, 1983). Furthermore, clinical neuropsychological assessment batteries possess poor ecological validity (King, 1984). Because there is a weak relationship between assessment instruments and aspects of day-to-day functioning, the tests contribute little information for rehabilitation planning (Sbordone, 1984). The clinician is then left with insufficient information from which he/she is asked to derive realistic expectations for individual CHI adults. The present results strongly demonstrate that clinicians need to be very cautious about basing prognostic statements on tests that intuitively appear to relate to adjustment but have not been validated objectively. Problem-solving tasks which have been given a dominant place in assessment batteries because P-S deficits have long been recognized as a consequence of brain damage and are considered important in daily living have proven (King & Snow, 1981), in this case, to have limited ecological validity. The present findings concur with King's (1980) contention that P-S measures provide inadequate information to be used in the assessment decision-making process. The poor prognostic value of P-S tests needs to be stressed as the resulting misinterpretation can aggravate the patients' and families' adjustment problems by creating unrealistic expectations. Inappropriate expectations interfere with coming to terms with the long term disabilities which impedes the development of practical courses of action to deal with the person's new status (Jennett, Snoek, Bond, & Brooks, 1981).

The need for objective measures that can assist with differential diagnosis for predicting level of long term adjustment for this population remains. For clinicians increasingly are being expected to

derive prognostic statements and remediation recommendations based on the results of these types of cognitive tests (Boll, 1981). In fact, many inadequately validated instruments are frequently being used to predict "real life" outcomes (King, 1984).

According to Rosenthal (1983), there are no adequate instruments to assess behavioral alterations in CHI adults and to predict their long term consequences. Bond (1983) maintains that current long term outcome tools only assess individuals' prognosis in very broad categories, especially when attempting to predict overall reintegration into the community. These deficiencies, in turn, hinder the development of resocialization programs that can assist the person to establish a new and satisfactory role within their family, work, and community environments. Such programs are crucial to modify the primary maladjusted behaviors that are directly attributed to the brain insult and to minimize the secondary emotional reactions that are currently resulting from poor reintegration into the community (Rosenthal, 1983). The common practise of delaying assessment of outcome to months and years post injuries when indices are very apparent, results in missing prime therapeutic opportunities to help individuals compensate for, and adjust to, deficiencies (Bond, 1983). Furthermore, this practise can result in clinicians espousing optimism for significant improvements for much longer than is realistic (Jennett et al., 1981). Families become frustrated and embittered when finally they realize they must continue to cope with problems that they originally thought would disappear. Their belief is primarily based on early vague statements by experts suggesting spontaneous improvement for up to 2 years post injury (Bond, 1983).

D. Interpersonal Problem-Solving and Adjustment

The more recent position that healthy adaptation relates to effective interpersonal P-S skills rather than impersonal problem-solving was another area of exploration. The terms are used by some researchers to differentiate between the skills necessary to solve laboratory-type tasks that have no personal relevance for the problem-solver from skills necessary to effectively solve problems involving other people in every day situations. The adherents of the perspective stressing the importance of interpersonal P-S skills claim that poor problem-solvers are overpowered by their environment. These individuals repeatedly fail to adequately satisfy their needs and to resolve their interpersonal conflicts which appears to result in the inablity to successfully fulfill important life roles (Shure & Spivack, 1972; 1978). Intuitively, it would seem that the interpersonal P-S task, the MEPS, which was devised to assess a person's ability to articulate in a logical and systematic fashion the means to achieve a desired goal when confronted with a social need (Platt & spivack, 1975a), should directly relate to the level of adjustment that was achieved by the individuals in this sample. Initially, this position received support as level of adjustment was significantly related to level of interpersonal P-S skills. Further analyses, though, demonstrated that this relationship was a function of the interpersonal P-S task's association with intellectual ability. Once the effects of FSIQ were removed, the correlation between clinical adjustment and interpersonal P-S was reduced to near zero. Although interpersonal P-S, as measured by this instrument, has been found in a number of studies to be relatively independent of intelligence, given a minimum level of basic ability

(Platt[illegible], 1975b) this was certainly not the case with this sample[illegible]lts. On the whole, those CHI adults with average [illegible]telle[illegible]ility posssessed less skill at solving cognitive [illegible]rperi[illegible] P-S situations than the average non-injured person. H[illegible]ver, this deficiency did not systematically relate to adjustment onc[illegible] t[illegible] influence of IQ was removed.

[illegible]cently, researchers in the area of social learning are ques[illegible]ning the validity of the MEPS, especially as it is based solely on on[illegible]element of a complex process (D'Zurilla & Nezu, 1982). After reviewing existing literature, D'Zurilla and Nezu (1982) suggested that the spontaneous generation of means may be more a measure of the quantity and quality of a person's social response repertoire or possibly an index of verbal intelligence. They recommended instead that problem-solving skills in everyday situations be assessed through self-report, analysis of individuals' verbal responses to specific test problems or observations of overt behavior.

Earlier research had demonstrated that impersonal cognitive tasks which have been widely used for diagnostic assessment with brain damaged individuals tap very different skills than the interpersonal P-S tasks (Gotlib & Asarnov, 1979; King, 1980). Such findings were interpreted to support the conclusion that the ability to solve impersonal cognitive P-S tasks is unrelated to competency in solving real life interpersonal conflicts and level of mental health (Spivack & Shure, 1974). Partial support for the dissociation between the two types of tasks was derived from the fact that the interpersonal measure was not significantly correlated with two of the three impersonal P-S instruments. However the interpersonal P-S measure was found to be significantly correlated with

the one impersonal verbal measure, Syllogistic Reasoning. Syllogistic Reasoning is a well-recognized P-S measure that requires a person to determine the relationship between two of three terms contained in two statements. The common skill dimension that it shared with the interpersonal measure proved to be general intellectual ability.

In contradiction to expectations, the present evidence indicated that the two impersonal problem-solving measures, WCST and Syllogistic Reasoning, may eventually enhance the clinician's ability to predict long term adjustment level if the tests are developed further. The WCST was found to be independent of IQ and related to adjustment for subjects with average ability. The results suggested that if the instrument could provide a greater range of scores, a linear relationship between its scores and adjustment for head injured persons with average intellectual ability may yet be derived. This finding is particularly relevant as WCST, a test which involves the ability to form concepts based on response feedback, to maintain response sets, and to shift sets (Lezak, 1976), has been extensively used in both research and clinical practice as a measure of P-S ability, especially with brain injured individuals (Heaton, 1981; King & Snow, 1981). Syllogistic Reasoning also has some P-S components that are associated with adjustment independent of IQ. However, these components need to be isolated as Syllogistic Reasoning seems to be primarily a measure of intellectual ability. Overall, adaptive functioning was found to be more systematically associated with cognitive, laboratory type tasks that do not contain any personal referent. It must be stressed, though, that in their present state, neither the WSCT or Syllogistic Reasoning, contributes significantly to our ability to predict adjustment beyond what is already known from

conventional intellectual testing.

E. Metacognitive Processing

Review of studies dealing with the long term cognitive deficits pointed to an accruing theme that CHI adults are unable to develop an efficient overall strategy when solving problems. It has been proposed that the general disruption of their higher level or strategic cognitive functioning rather than lower level cognitive and memory deficits may be reducing their competency level. Brown (1978) maintains that conscious executive control of one's basic cognitive processes is the highest form of intelligent and adaptive behavior, and subsumes general P-S skills. Substantial support for this position was derived from the qualitative data that illustrated that the CHI subjects either failed to adopt an overall effective strategy or could not verbalize their choice. This deficiency occurred on all problem-solving tasks, regardless of the component skills involved in each task. This finding is in keeping with Lezak's (1983) position that executive impairments are supramodal since they influence all behaviors. Generally, the subjects manifested serious limitations in their ability to monitor and evaluate their own and other's behavior. They were unable to explain their choice of P-S methods, the nature of the tasks, and the role of the tester. The data clearly demonstrated a significant breakdown in their metacognitive processing which seemed to effectively eliminate their higher level skill of introspection concerning their own performance. Furthermore, there were strong indications that CHI adults with impaired performance on P-S tasks did not profit from feedback and failed to revise their approach when demanded by changes in task characteristics. Overall, they

appeared rather inflexible in their reasoning. For instance, on one task, not one subject progressed systematically from the more arduous but obvious strategy to the more sophisticated but less effortful ones. Comparison of those individuals who developed even a simplistic strategy with those who did not indicated that their limited ability to develop and/or verbalize their strategy significantly hinders their effectiveness as problem-solvers.

On all tasks, the more proficient problem-solvers required less time to complete the tasks than those rated less skillful. The presence of even a simplistic strategy and the ability to profit from past experience tended to reduce the time to solve complex problems. However, when confronted with complex and often frustrating tasks, most CHI adults did not act impulsively but rather slowed down and put forth more effort. Unfortunately, the increased effort did not necessarily result in improved performance. Overall, the subjects did not develop more sophisticated and efficient strategies but rather unproductively spent more time working on the complex items.

Metacognitive processing purportedly plays a key role in daily living since self-evaluation against common sense reality is considered necessary regardless of the every day problem with which one is struggling (Brown, 1978). Disruption of the executive functions interferes with a person's ability for self-care, vocational productivity, and social relationships, even if one's basic cognitive skills are intact. Conversely, a person with a serious loss of lower level cognitive skills but adequate executive control can be an independent and productive member of society (Lezak, 1983). The description of a person with impaired executive functions is highly

consistent with the characteristics noted in the present group of CHI adults. In general, these individuals proved extremely inept at developing an overall strategy for performing complex tasks and at meeting their life demands.

For many of this sample, the deficits in metacognitive functioning were subtle and camouflaged by intact verbal and perceptual cognitive skills. Since the deficits are not easily observable, clinicians can overlook them by confining their assessment to highly structured settings and by using traditional quantifiable tasks (Lezak, 1983). According to Lezak (1982) the problem is compounded by a lack of standardized instruments for clarifying the existence of metacognitive deficits and for reliably assessing the degree of the deficiencies so that intra and interindividual comparisons can be made. Futhermore, this lack of standardized measures has limited research into the relationship of metacognitive deficits on laboratory-type tasks to daily living. According to Lezak (1982) understanding of the role of executive functions remains anecdotal and haphazard. For individuals incurring closed head injury, the clinical oversight and theoretical shortcomings often result in misdiagnosis such as malingering, laziness or emotional disturbance (Lezak, 1983) which can prevent appropriate intervention. The qualitative findings of the present study support Lezak's (1982) position that the daily living problems associated with limited executive functions need to become one of the major focuses of rehabilitation psychology. Unfortunately "many simply do not seem to appreciate the importance of the executive functions or psychological incapacitation that can result from their impairments" (Lezak, 1982, p. 283).

F. Summary of Clinical Significance

The results of this study illustrated a need for a change in orientation toward the assessment of CHI adults. The direction recommended is to move away from elaborate and lengthy cognitive test batteries while moving toward a more indepth examination of the person's functioning in his/her every day environment. Although traditional neuropsychological tests seem to be reliable measures of cognitive skills, their utility for understanding and assisting with adjustment problems of CHI adults is limited. Until further applied research is able to demonstrate which tests possess prognostic value, clinicians should de-emphasize test results when assisting with reintegration into the community. However, this recommendation does not imply the complete elimination of assessment instruments but rather suggests tasks be chosen depending on the purpose of the assessment. If the prime interest is reintegration, the WAIS-R offers clinicians the most valid indications of potential for adjustment but even it fails to provide sufficient detail for deriving specific expectations and programs for dealing with adjustment problems. Other instruments such as memory tasks and the WCST can help identify probable problem areas. Furthermore, Lezak (1983) advises that examiners incorporate some less structured tasks into their formal assessments and systematically question CHI individuals about their strategies in order to assess executive functions.

Most importantly though, prior to formulating prognostic statements and recommendations, clinicians should place more credance on their clinical judgement of the person's actual functioning in his/her natural environment. Hypotheses regarding cognitive deficits that may be

influencing his/her functioning level should be validated against the injured person's behavior. As CHI adults have difficulty accurately assessing their own adjustment and mental health, clinicians should interview a number of significant persons in their client's life, including family members, employers, and friends. Real-life observations may demonstrate some behavior deficits or strengths that as yet cannot be measured by standardized devices. Systematic observations by clinician/researchers may have the added advantage of eventually leading to the development of instruments with ecological validity.

VI. Tables

TABLE 1

CANONICAL CORRELATION

WEIGHTING SYSTEM	CANONICAL CORRELATION	WILK'S LAMBDA	D.F.	SIGN
1.	.62	.55	8	.12
2.	.34	.88	3	.45

TABLE 2

INDIVIDUAL CORRELATIONS

SIX MAIN VARIABLES

	CLINICAL	BELLS	MEPS	WCST	SYLL	TOWER
CLINICAL	1.00	.29	.40*	-.13	-.51**	-.27
BELLS		1.00	-.22	.12	-.06	-.11
MEPS			1.00	-.25	-.44**	-.28
WCST				1.00	.42*	.32*
SYLL					1.00	.33*
TOWER						1.00

* $p \leq .05$

** $p \leq .01$

N = 26

TABLE 3

MULTIPLE CORRELATION

CRITERION VARIABLE - BELL'S ADJUSTMENT INVENTORY

ENTERING PREDICTOR VARIABLE	MULTIPLE R	SIMPLE R	F	P	INCREASES IN MULTIPLE R	SIGN
MEPS	.22	-.22	1.19	.29	.22	S
TOWER	.28	-.11	.97	.39	.06	NS
SYLLOGISM	.31	-.06	.78	.52	.03	NS
WCST	.35	.12	.75	.52	.04	NS

TABLE 4

MULTIPLE CORRELATION

CRITERION VARIABLE - CLINICAL JUDGEMENT INDEX

ENTERING PREDICTOR VARIABLE	MULTIPLE R	SIMPLE R	F	P	INCREASES IN MULTIPLE R	SIGN
SYLLOGISM	.51	-.51	8.5	.01	.51	S
MEPS	.55	.40	4.95	3.37	.04	NS
WCST	.56	-.13	3.37	.04	.01	NS
TOWER	.57	-.27	2.5	.07	.01	NS

TABLE 5

INDIVIDUAL CORRELATIONS

SIX MAIN VARIABLES AND THREE IQ SCORES FROM WAIS-R

	CLINICAL	BELL'S	MEPS	WCST	SYLL	TOWER	VIQ	PIQ
VIQ	.65**	-.23	.57**	-.43*	-.57**	-.36*	1.00	.70**
PIQ	.64**	-.11	.52**	-.47**	-.78**	-.57**	.70**	1.00
FSIQ	.70**	-.17	.59**	-.46**	-.74**	-.50**	.91**	.93**

* p≤.05

** p≤.01

TABLE 6

PARTIAL CORRELATIONS

SIX VARIABLES WITH FSIQ CONTROLLED FOR

	CLINICAL	BELL'S	MEPS	WCST	SYLL	TOWER
CLINICAL	1.00	-.24	-.02	.31	.01	.14
BELL'S		1.00	-.15	.04	-.28	-.23
MEPS			1.00	.03	-.00	.03
WCST				1.00	.13	.12
SYLL					1.00	-.07
TOWER						1.00

* p≤.05

** p≤.01

N = 26

TABLE 7

MULTIPLE CORRELATION

FSIQ - FIFTH PREDICTOR VARIABLE

ENTERING PREDICTOR VARIABLE	MULTIPLE R	SIMPLE R	F	P	INCREASES IN MULTIPLE R	SIGN
FSIQ	.70	.70	23.1	.0001	.70	S
WCST	.73	-.13	13.38	.0001	.03	NS
TOWER	.74	-.27	8.71	.0005	.01	NS
MEPS	.74	.40	6.25	.0018	.00	NS
SYLL	.74	.51	4.77	.005	.00	NS

TABLE 8

MULTIPLE CORRELATION

DELETION OF LOWEST FSIQ SUBJECTS

FOUR PREDICTOR VARIABLES

ENTERING PREDICTOR VARIABLE	MULTIPLE R	SIMPLE R	F	P	INCREASES IN MULTIPLE R	SIGN
SYLL	.78	-.78	29.02	.00	.78	S
MEPS	.80	.39	15.84	.0001	.02	NS
WCST	.81	.02	10.52	.0004	.01	NS
TOWER	.81	-.14	7.47	.0014	.00	NS

TABLE 9

INDIVIDUAL CORRELATIONS

DELETION OF LOWEST FSIQ SUBJECTS

	CLINICAL	MEPS	WCST	SYLL	TOWER	VIQ	PIQ	FSIQ
CLINICAL	1.000	.39*	.02	-.78**	-.14	.64**	.69**	.74**
MEPS		1.00	-.11	-.27	-.13	.52**	.39*	.51**
WCST			1.00	.09	.09	-.27	-.25	-.26
SYLL				1.00	.12	-.45*	.63**	-.60**
TOWER					1.00	-.25	-.43*	-.36*
VIQ						1.00	.66**	.92**
PIQ							1.00	.90**
FSIQ								1.00

* $p \leq .05$

** $p \leq .01$

N = 21

TABLE 10

MULTIPLE CORRELATION

FSIQ AS FIFTH PREDICTOR VARIABLE
DELETION OF LOWEST FSIQ SUBJECTS

VARIABLE	MULTIPLE R	SIMPLE R	F	P	INCREASES IN MULTIPLE R	SIGN
SYLLOGISM	.78	-.78	29.02		.78	S
FSIQ	.85	.74	23.35		.07	NS
WCST	.86	.02	17.60		.01	NS
TOWER	.87	-.14	12.92		.01	NS
MEPS	.87	.39	9.71		.00	NS

TABLE 11

PARTIAL CORRELATIONS

FIVE VARIABLES - CONTROLLING FOR FSIQ
DELETION OF LOWEST FSIQ SUBJECTS

	CLINICAL	MEPS	WCST	SYLL	TOWER
CLINICAL	1.00	.02	.33	-.62**	.20
MEPS		1.00	.02	.05	.07
WCST			1.00	-.08	.00
SYLL				1.00	.13
TOWER					1.00

* $p \leq .05$

** $p \leq .01$

N = 21

TABLE 12

CONTINGENCY TABLES (LOWEST IQ SUBJECTS IN BRACKETS)
(SUBJECTS' ID NUMBERS IN QUADRANTS)

1) LEVELS OF FSIQ BY LEVELS OF ADJUSTMENT

	HIGH ADJ N = 11	LOW ADJ N = 10	
HIGH FSIQ N = 11 ≥ 90	02 16 04 20 07 24 15 26	01 12 22	11
LOW FSIQ N = 10 81 - 89	08 10 11 (17)	03 18 06 23 13 25 14(05,08 19,21)	10
	11	10	21

2) LEVELS OF FSIQ BY LEVELS OF SYLLOGISMS

	HIGH SYLL N = 12	LOW SYLL N = 9	
HIGH FSIQ N = 11 ≥ 90	02 15 26 04 16 07 20 12* 24	01 22	11
LOW FSIQ N = 10 81 - 89	09 03 11 18*	03 14 06 23 10* 25(05) 13 (08, 19,21)	10
	12	9	

*Ss who changed quadrants from (1)

TABLE 12 - continued

3) LEVELS OF SYLLOGISMS BY LEVELS OF ADJUSTMENT

	HIGH ADJ N = 11	LOW ADJ N = 10	
HIGH SYLL N = 12	02 11* 24 14 15 26 07 16 09* 20	12 18*	12
LOW SYLL N = 9	10 17	01* 14 03 22* 06 23 (05,08) 13 25 (19,21)	9

*Ss who changed quadrants from (1)

TABLE 13

CHI SQUARED ANALYSES

1) GROUPS ON WCST BY GROUPS ON CLINICAL ADJUSTMENT

	HIGH CLINICAL ADJUSTMENT	LOW CLINICAL ADJUSTMENT	
HIGH WCST	10	3	13
LOW WCST	3	10	13
	13	13	26

CORRECTED $\chi^2 = 5.54$, DF = 1, p = .02

RAW $\chi^2 = 7.54$, DF = 1, p = .006

PEARSON'S R = 0.54, p = .002

2) GROUPS ON WCST BY GROUPS ON SYLLOGISMS

	HIGH SYLL	LOW SYLL	
HIGH WCST	9	4	13
LOW WCST	5	8	13
	13	13	26

CORRECTED $\chi^2 = 1.39$, DF = 1, p = .24

RAW $\chi^2 = 2.48$, DF = 1, p = .12

PEARSON'S R = .31, p = .06

3) GROUPS ON WCST BY GROUPS ON TOWER

	HIGH TOWER	LOW TOWER	
HIGH WCST	8	5	13
LOW WCST	5	8	13
	13	13	26

CORRECTED $\chi^2 = .62$, DF = 1, p = .43

RAW $\chi^2 = 1.38$, DF = 1, p = .24

PEARSON'S R = .23, p = .13

TABLE 13 - continued

CHI SQUARED ANALYSES

4) GROUPS ON CLINICAL ADJUSTMENT BY GROUPS ON SYLLOGISM

	HIGH SYLL	LOW SYLL	
HIGH ADJ	11	2	13
LOW ADJ	3	10	13
	14	12	26

CORRECTED χ^2 = 7.58, DF = 1, p = .006

RAW χ^2 = 9.9, DF = 1, p = .002

PEARSON'S R = .62, p = .004

5) GROUPS ON CLINICAL ADJUSTMENT BY GROUPS ON TOWER

	HIGH TOWER	LOW TOWER	
HIGH ADJ	8	5	13
LOW ADJ	5	8	13
	13	13	26

CORRECTED χ^2 = .62, DF = 1, p = .43

RAW χ^2 = 1.38, DF = 1, p = .24

PEARSON'S R = .23, p = .13

TABLE 14

T-TESTS

DIFFERENCES IN LEVEL OF ADJUSTMENT BETWEEN HIGH AND LOW IMPERSONAL PROBLEM-SOLVERS

VARIABLE CLINICAL ADJ.	N	MEAN	STANDARD DEVIATION	STANDARD ERROR	T VALUE	DF	2-TAIL PROB.
GROUP I - HIGH WCST	13	8.89	2.5	.69	1.48	24	.15
GROUP II - LOW WCST	13	7.23	3.1	.87			

VARIABLE CLINICAL ADJ.	N	MEAN	STANDARD DEVIATION	STANDARD ERROR	T VALUE	DF	2-TAIL PROB.
GROUP I - HIGH SYLL	14	9.5	2.9	.78	3.19	24	.004
GROUP II - LOW SYLL	12	6.4	1.8	.53			

TABLE 15

CHI SQUARED

GROUPS ON MEPS BY GROUPS ON CLINICAL ADJUSTMENT

	HIGH CLINICAL ADJUSTMENT	LOW CLINICAL ADJUSTMENT
HIGH WCST	8	5
LOW WCST	5	8

CORRECTED χ^2 = .62, DF=1, p=.43

RAW χ^2 = 1.38, DF=1, p=.24

PEARSON'S R = .23, p=.12

TABLE 16

T-TEST

DIFFERENCES IN LEVEL OF ADJUSTMENT BETWEEN HIGH AND LOW INTERPERSONAL PROBLEM-SOLVERS

VARIABLE CLINICAL ADJ	N	MEAN	STANDARD DEVIATION	STANDARD ERROR	T VALUE	DF	2-TAIL PROB.
GROUP I (HIGH MEPS)	13	8.67	3.36	.93	1.08	24	.29
GROUP II (LOW MEPS)	13	7.44	2.35	.65			

TABLE 17

MANOVA

MULTIVARIATE ANALYSIS OF MEANS FOR THE THREE IMPERSONAL P-S TASKS FOR FAST AND SLOW PROBLEM SOLVERS

CELL MEANS AND STANDARD DEVIATIONS

VARIABLE - WCST

FACTOR	MEAN	STANDARD DEVIATION	N
FAST GROUP	34.9	22.37	12
SLOW GROUP	45.0	19.67	11
ENTIRE SAMPLE	39.7	21.28	23

VARIABLE - SYLLOGISM

FACTOR	MEAN	STANDARD DEVIATION	N
FAST GROUP	5.9	5.3	12
SLOW GROUP	11.3	9.9	11
ENTIRE SAMPLE	8.5	8.1	23

VARIABLE - TOWER

FACTOR	MEAN	STANDARD DEVIATION	N
FAST GROUP	102.8	32.5	12
SLOW GROUP	133.5	30.4	11
ENTIRE SAMPLE	117.5	34.5	23

MULTIVARIATE TEST OF SIGNIFICANCE

TEST	VALUE	F	HYPOTH DF	ERROR DF	SIGN OF F
WILKS	.69	2.81	3	19	.070

UNIVARIATE F-TESTS (1,21) DF

VARIABLE	HYPOTH SS	ERROR SS	HYPOTH MS	ERROR MS	F	SIGN
WCST	583.5	9376.9	583.5	44.6	1.3	.27
SYLL	164.6	129.1	164.6	61.5	2.68	.12
TOWER	5413.3	20838.4	5413.3	992.3	5.46	.03

TABLE 18

HOTELLING'S T-SQUARED

MULTIVARIATE ANALYSIS OF MEANS FOR THE FOUR MEASURES
FOR GROUP I (≤ 3.6 years post-injury)
AND GROUP II (> 3.6 years post-injury)

T^2	DF1	DF2	F-RATIO	PROBABILITY
6.9	4	21	1.51	.24

TABLE 19

HOTELLING'S T-SQUARED

MULTIVARIATE ANALYSIS OF MEANS FOR THE FOUR MEASURES
FOR THE YOUNGER (19 to 26 years) AND
OLDER (27 to 37 years) GROUPS

T^2	DF1	DF2	F-RATIO	PROBABILITY
1.23	4	2	.27	.89

TABLE 20

HOTELLING'S T-SQUARED

MULTIVARIATE ANALYSIS OF THE MEANS FOR THE FOUR MEASURES
FOR TWO GROUPS DIFFERING IN LENGTH OF COMA

T^2	DF1	DF2	F-RATIO	PROBABILITY
3.71	4	21	.81	.53

TABLE 21

MANOVA

MULTIVARIATE ANALYSIS OF MEANS FOR THE FOUR MEASURES FOR THE TWO GROUPS DIFFERING IN LENGTH OF PTA

CELL MEANS AND STANDARD DEVIATIONS

VARIABLE - CLINICAL ADJUSTMENT

FACTOR	MEAN	STANDARD DEVIATION	N
SHORTER PTA	8.4	3.69	13
LONGER PTA	7.7	1.9	13
ENTIRE SAMPLE	8.05	2.9	26

VARIABLE - MEPS

FACTOR	MEAN	STANDARD DEVIATION	N
SHORTER PTA	9.46	7.02	13
LONGER PTA	7.69	6.09	13
ENTIRE SAMPLE	8.58	6.5	26

VARIABLE - WCST

FACTOR	MEAN	STANDARD DEVIATION	N
SHORTER PTA	45.46	22.09	13
LONGER PTA	40.23	23.97	13
ENTIRE SAMPLE	42.85	22.74	26

VARIABLE - SYLLOGISTIC REASONING

FACTOR	MEAN	STANDARD DEVIATION	N
SHORTER PTA	7.0	7.8	13
LONGER PTA	12.54	9.36	13
ENTIRE SAMPLE	9.7	8.9	26

MULTIVARIATE TEST OF SIGNIFICANCE

TEST	VALUE	APPROX F	HYPOTH DF	ERROR DF	SIGN OF F
WILKS	.82	1.18	4.00	21.00	.35

TABLE 22

MANOVA

MULTIVARIATE ANALYSIS OF MEANS FOR THE FOUR MEASURES
FOR THE THREE IMPACT SITE GROUPS

CELL MEANS AND STANDARD DEVIATIONS

VARIABLE - CLINICAL ADJUSTMENT

FACTOR	MEAN	STANDARD DEVIATION	N
RIGHT	7.81	2.39	12
LEFT	7.43	2.34	7
NO	9.11	4.17	7
ENTIRE SAMPLE	8.06	2.91	26

VARIABLE - MEPS

FACTOR	MEAN	STANDARD DEVIATION	N
RIGHT	8.08	6.78	12
LEFT	11.14	5.67	7
NO	6.86	6.94	7
ENTIRE SAMPLE	8.58	6.50	26

VARIABLE - WCST

FACTOR	MEAN	STANDARD DEVIATION	N
RIGHT	36.92	17.30	12
LEFT	50.86	29.69	7
NO	45.00	23.96	7
ENTIRE SAMPLE	42.85	22.74	26

VARIABLE - SYLLOGISTIC REASONING

FACTOR	MEAN	STANDARD DEVIATION	N
RIGHT	10.75	8.48	12
LEFT	10.14	9.46	7
NO	7.71	10.09	7
ENTIRE SAMPLE	9.77	8.90	26

MULTIVARIATE TEST OF SIGNIFICANCE

TEST	VALUE	APPROX F	HYPOTH DF	ERROR DF	SIGN OF F
WILKS	.70	.96	8.00	40.00	.48

TABLE 23

HOTELLING'S T-SQUARED

MULTIVARIATE ANALYSIS OF MEANS FOR THE FOUR MEASURES FOR THE TWO GROUPS, COMPLICATED AND UNCOMPLICATED

T^2	DF1	DF2	F-RATIO	PROBABILITY
1.88	4	21	.41	.80

TABLE 24

MANOVA

MULTIVARIATE ANALYSIS OF MEANS FOR THE FOUR MEASURES FOR THREE EDUCATION GROUPS

CELL MEANS AND STANDARD DEVIATIONS

VARIABLE - CLINICAL ADJUSTMENT

FACTOR	MEAN	STANDARD DEVIATION	N
EDUCATION 1	10.29	3.24	6
EDUCATION 2	8.23	1.66	10
EDUCATION 3	6.55	3.01	10
ENTIRE SAMPLE	8.06	2.91	26

VARIABLE - MEPS

FACTOR	MEAN	STANDARD DEVIATION	N
EDUCATION 1	12.67	7.37	6
EDUCATION 2	6.3	7.50	10
EDUCATION 3	8.4	3.75	10
ENTIRE SAMPLE	8.58	6.50	26

VARIABLE - WCST

FACTOR	MEAN	STANDARD DEVIATION	N
EDUCATION 1	35.33	31.61	6
EDUCATION 2	44.4	20.96	10
EDUCATION 3	45.8	19.80	10
ENTIRE SAMPLE	42.85	22.47	26

VARIABLE - SYLLOGISM

FACTOR	MEAN	STANDARD DEVIATION	N
EDUCATION 1	6.5	5.32	6
EDUCATION 2	11.0	10.82	10
EDUCATION 3	10.5	8.82	10
ENTIRE SAMPLE	9.78	8.90	26

MULTIVARIATE TEST OF SIGNIFICANCE

TEST	VALUE	APPROX F	HYPOTH DF	ERROR DF	SIGN OF F
WILKS	.63	1.31	8.00	40.00	.27

TABLE 25

MANOVA

MULTIVARIATE ANALYSIS OF MEANS FOR THE FOUR MEASURES FOR THE TWO FSIQ GROUPS - FULL SAMPLE

CELL MEANS AND STANDARD DEVIATIONS

VARIABLE - CLINICAL ADJUSTMENT

FACTOR	MEAN	STANDARD DEVIATION	N
LOW FSIQ	6.70	2.12	15
HIGH FSIQ	9.95	2.82	11
ENTIRE SAMPLE	8.06	2.90	26

VARIABLE - MEPS

FACTOR	MEAN	STANDARD DEVIATION	N
LOW FSIQ	6.67	5.6	15
HIGH FSIQ	11.18	6.98	11
ENTIRE SAMPLE	8.58	6.5	26

VARIABLE - WCST

FACTOR	MEAN	STANDARD DEVIATION	N
LOW FSIQ	51.07	19.1	15
HIGH FSIQ	31.64	23.29	11
ENTIRE SAMPLE	42.85	22.74	26

VARIABLE - SYLLOGISM

FACTOR	MEAN	STANDARD DEVIATION	N
LOW FSIQ	14.07	9.23	15
HIGH FSIQ	3.91	3.65	11
ENTIRE SAMPLE	9.77	8.9	26

TABLE 25 - continued

MULTIVARIATE TEST OF SIGNIFICANCE

TEST	VALUE	APPROX F	HYPOTH DF	ERROR DF	P
WILKS	.51	5.11	4.00	21.00	.005

UNIVARIATE F-TESTS with (1,24) D.F.

VARIABLE	HYPOTH SS	ERROR SS	HYPOTH MS	ERROR MS	F	P
CLINICAL ADJ	68.6	142.94	68.6	5.96	11.52	.002
MEPS	129.38	926.97	129.38	36.62	3.35	.08
WCST	2395.91	10533.48	2395.91	438.89	5.46	.028
SYLLOG.	654.77	1325.84	654.77	55.24	11.85	.002

TABLE 26

MANOVA

MULTIVARIATE ANALYSIS OF MEANS FOR THE FOUR MEASURES FOR THE TWO FSIQ GROUPS - FIVE LOWEST FSIQ S_s DELETED

CELL MEANS AND STANDARD DEVIATIONS

VARIABLE - CLINICAL ADJUSTMENT

FACTOR	MEAN	STANDARD DEVIATION	N
LOW FSIQ	6.58	2.39	10
HIGH FSIQ	9.95	2.82	11
ENTIRE SAMPLE	8.35	3.09	21

VARIABLE - MEPS

FACTOR	MEAN	STANDARD DEVIATION	N
LOW FSIQ	8.2	6.0	10
HIGH FSIQ	11.18	6.98	11
ENTIRE SAMPLE	9.76	6.55	21

VARIABLE - WCST

FACTOR	MEAN	STANDARD DEVIATION	N
LOW FSIQ	46.2	17.52	10
HIGH FSIQ	31.64	23.29	11
ENTIRE SAMPLE	38.57	21.56	21

VARIABLE - SYLLOGISM

FACTOR	MEAN	STANDARD DEVIATION	N
LOW FSIQ	9.2	4.47	10
HIGH FSIQ	3.91	3.65	11
ENTIRE SAMPLE	6.43	4.79	21

TABLE 26 - continued

MULTIVARIATE TEST OF SIGNIFICANCE

TEST	VALUE	APPROX F	HYPOTH DF	ERROR DF	P
WILKS	.54	3.46	4.00	16.00	.032

UNIVARIATE E-TESTS with (1,19) D.F.

VARIABLE	HYPOTH SS	ERROR SS	HYPOTH MS	ERROR MS	F	P
CLINICAL ADJ	59.83	130.98	59.83	6.89	8.68	.008
MEPS	46.57	811.24	46.57	42.70	1.09	.309
WCST	1110.99	8188.15	1110.99	430.96	2.58	.125
SYLLOG.	146.63	312.51	146.63	16.45	8.92	.008

TABLE 27

CHI SQUARED ANALYSES
LEVEL OF INTELLECTUAL ABILITY AND MAJOR DEMOGRAPHIC FACTORS
FULL SAMPLE

1) GROUPS ON FSIQ BY GROUPS ON TIME OF INJURY

	SHORTER TIME	LONGER TIME	
LOW FSIQ	9	6	15
HIGH FSIQ	4	7	11
	13	13	26

CORRECTED χ^2 = .63, DF = 1, p = .43

RAW χ^2 = 1.42, DF = 1, p = .23

PEARSON'S R = .23, p = .13

2) GROUPS ON FSIQ BY GROUPS ON AGE

	YOUNGER	OLDER	
LOW FSIQ	8	7	15
HIGH FSIQ	5	6	11
	13	13	26

CORRECTED χ^2 = 0.0, DF = 1, p = 1.0

RAW χ^2 = .16, DF = 1, p = .64

PEARSON'S R = .078, p = .35

3) GROUPS ON FSIQ BY GROUPS ON COMA

	SHORTER COMA	LONGER COMA	
LOW FSIQ	6	9	15
HIGH FSIQ	8	3	11
	14	12	26

CORRECTED χ^2 = 1.58, DF = 1, p = .21

RAW χ^2 = 2.74, DF = 1, p = .1

PEARSON'S R = .32, p = .05

TABLE 27 - continued

7) GROUPS ON FSIQ BY GROUPS ON PTA

	SHORTER PTA	LONGER PTA	
LOW FSIQ	8	7	15
HIGH FSIQ	5	6	11
	13	13	26

CORRECTED χ^2 = .01, DF = 1, p = 1.0

RAW χ^2 = .16, DF = 1, p = .69

PEARSON'S R = .35

TABLE 28

CHI SQUARED ANALYSES
LEVEL OF INTELLECTUAL ABILITY AND MAJOR DEMOGRAPHIC FACTORS
FIVE LOWEST FSIQ SUBJECTS DELETED

1) GROUPS ON FSIQ BY GROUPS ON TIME OF INJURY

	SHORTER TIME	LONGER TIME	
LOW FSIQ	5	5	10
HIGH FSIQ	4	7	11
	9	12	21

CORRECTED χ^2 = .036, DF = 1, p = .85

RAW χ^2 = .4 , DF = 1, p = .53

PEARSON'S R = .14, p = .28

2) GROUPS ON FSIQ BY GROUPS ON AGE

	YOUNGER	OLDER	
LOW FSIQ	6	4	10
HIGH FSIQ	5	6	11
	11	10	21

CORRECTED χ^2 = .05, DF = 1, p = .82

RAW χ^2 = .44, DF = 1, p = .51

PEARSON'S R = .15, p = .26

3) GROUPS ON FSIQ BY GROUPS ON COMA

	SHORTER COMA	LONGER COMA	
LOW FSIQ	5	5	10
HIGH FSIQ	8	3	11
	13	8	21

CORRECTED χ^2 = .39, DF = 1, p = .53

RAW χ^2 = 1.15, DF = 1, p = .28

PEARSON'S R = -.23, p = .15

TABLE 28 - continued

4) GROUPS ON FSIQ BY GROUPS ON IMPACT SITE

	RIGHT	LEFT	NO	
LOW FSIQ	4	3	3	10
HIGH FSIQ	5	3	3	11
	9	6	6	21

RAW χ^2 = .06 , DF = 2, p = .97

PEARSON'S R = -.05, p = .42

5) GROUPS ON FSIQ BY GROUPS ON COMPLICATIONS

	COM	UNCOM	
LOW FSIQ	6	4	10
HIGH FSIQ	6	5	11
	12	9	21

CORRECTED χ^2 = 0, DF = 1, p = 1.0

RAW χ^2 = .06, DF = 1, p = .8

PEARSON'S R = .05, p = .41

6) GROUPS ON FSIQ BY GROUPS ON EDUCATION

	ED1	ED2	ED3	
LOW FSIQ	1	4	5	10
HIGH FSIQ	4	4	3	11
	5	8	8	21

RAW χ^2 = 2.56, DF = 2, p = .32

PEARSON'S R = -.31, p = .08

TABLE 29

T-TESTS AND ANOVAS

MEAN DIFFERENCES IN FSIQ FOR GROUPS BASED ON DEMOGRAPHIC FACTORS - FULL SAMPLE

VARIABLE FSIQ	N	MEAN	STANDARD DEVIATION	STANDARD ERROR	T VALUE	DF	2-TAIL PROB.
GROUP I SHORTER TIME FROM INJURY	13	86.54	10.22	2.84	-1.86	24	.08
GROUP II LONGER TIME	13	94.85	12.48	3.46			
GROUP I YOUNGER AGE	13	89.92	12.35	3.42	-.32	24	.75
GROUP II OLDER	13	91.46	11.99	3.33			
GROUP I SHORTER COMA	14	94.86	11.81	3.16	2.04	24	.05
GROUP II LONGER	12	85.83	10.59	3.06			
GROUP I COMPLICATED	16	89.44	12.23	3.06	-.67	24	.51
GROUP II UNCOMPLICATED	10	92.7	11.85	3.75			
GROUP I SHORTER PTA	13	92.23	12.58	3.49	.65	24	.52
GROUP II LONGER PTA	13	89.15	11.59	3.21			

TABLE 29 - continued

ANOVAS

VARIABLE - FSIQ

BY VARIABLE - EDUCATION - 3 GROUPS

SOURCE	DF	SUM OF SQUARES	MEAN SQUARES	F	P
BETWEEN GROUPS	2	489.19	244.6	1.83	.18
WITHIN GROUPS	23	3082.33	134.01		
TOTAL	25	3571.53			

VARIABLE - FSIQ

BY VARIABLE - IMPACT SITE - 3 GROUPS

SOURCE	DF	SUM OF SQUARES	MEAN SQUARES	F	P
BETWEEN GROUPS	2	29.01	14.5	.094	.91
WITHIN GROUPS	23	3542.52	154.02		
TOTAL	25	3571.53			

TABLE 30

T-TESTS AND ANOVAS

MEAN DIFFERENCES IN FSIQ FOR GROUPS BASED ON DEMOGRAPHIC FACTORS - FIVE LOWEST FSIQ SUBJECTS DELETED

VARIABLE FSIQ	N	MEAN	STANDARD DEVIATION	STANDARD ERROR	T VALUE	DF	2-TAIL PROB.
GROUP I SHORTER TIME FROM INJURY	9	91.33	7.86	2.62	-1.07	19	.3
GROUP II LONGER TIME	12	96.25	11.91	3.44			
GROUP I YOUNGER AGE	11	93.0	10.5	3.17	-.52	19	.61
GROUP II OLDER	10	95.4	10.78	3.41			
GROUP I SHORTER COMA	13	96.08	11.33	3.14	1.09	19	.29
GROUP II LONGER	8	91.0	8.54	3.02			
GROUP I COMPLICATED	12	94.08	10.1	2.92	-.03	19	.98
GROUP II UNCOMPLICATED	9	94.22	11.49	3.83			
GROUP I SHORTER PTA	12	93.33	12.46	3.59	-.4	19	.69
GROUP II LONGER PTA	9	95.22	7.51	2.5			

TABLE 30 - continued

ANOVAS

VARIABLE - FSIQ

BY VARIABLE - EDUCATION - 3 GROUPS

SOURCE	DF	SUM OF SQUARES	MEAN SQUARES	F	P
BETWEEN GROUPS	2	423.21	211.60	2.17	.14
WITHIN GROUPS	18	1755.37	97.52		
TOTAL 20	2178.58				

VARIABLE - FSIQ

BY VARIABLE - IMPACT SITE - 3 GROUPS

SOURCE	DF	SUM OF SQUARES	MEAN SQUARES	F	P
BETWEEN GROUPS	2	21.50	10.75	.09	.91
WITHIN GROUPS	18	2157.05	119.84		
TOTAL	20	2175.58			

TABLE 31

COMPARISON OF CHI ADULTS' CATEGORIES ON THE MEPS TO NORMALS AND PSYCHIATRIC PATIENTS FROM PLATT AND SPIVACK'S (1974) STUDY

1. For story 1, which was concerned with a neighborhood leader, the normal group was more likely than the CHI adults to give the means of "offering plans or ideas" (56.7% of normals vs. 28% of CHI adults, corrected $\chi^2 = 5.18$, $p<.05$), while no significant difference was found between patients and CHI adults (37.8% for patients vs. 28% for CHI adults, $\chi^2 = .46$). As with the patient group (8.5% for patients vs. 20% for CHI adults, corrected $\chi^2 = .2$, $p>.05$), CHI adults tended to be more concerned with the mechanics of nominations and elections than the control group (20% of CHI adults vs. 0% of the controls, corrected $\chi^2 = 10.7$, $p<.05$).

2. Story 2 dealt with regaining an estranged girl friend and here there was no major difference in the frequency of usage by the controls and CHI adults of the mean, "resolving the problem by doing something," (20.2% for control vs. 32% of CHI adults, corrected $\chi^2 = 1.2$, $p>.1$). The CHI adults proved more likely to utilize this category than the patient group (8.2% for patients vs. 32% for CHI, corrected $\chi^2 = 8.84$, $p<.05$). On the other hand, just as with the control (7.3% of the control vs. 0% of CHI adults, corrected $\chi^2 = .77$, $p>.1$), the psychiatric patients were more likely than CHI adults to "wait for a phone call from the other person" (17.3% for patients vs. 0% for CHI, corrected $\chi^2 = 3.7$, $p<.1$).

3. For story 3 which had the theme of wanting to have friends in a new neighborhood, there was no significant difference between the controls and CHI adults in usage of the category "receiving a visit from neighbors (18.5% for controls vs. 4% for CHI adults, corrected $\chi^2 = 2.19$, $p>.1$) and no difference between the patients and CHI adults in the number of times this category was given (4.3% for patients vs. 4% for CHI adults, $\chi^2 = .0005$, $p>.1$). Furthermore, there was no difference between patients and CHI adults in giving the mean "visit the neighbors" (33.6% for patients vs. 24% for CHI adults, corrected $\chi^2 = .48$, $p>.1$). The difference between the normals and CHI adults was also nonsignificant (20.3% for controls vs. 24% for CHI adults, $\chi^2 = .005$, $p>.1$).

4. Story 4 focussed on meeting someone of the opposite sex. Here CHI adults were more likely to conceptualize meeting the person of the opposite sex by "starting a conversation" or "inviting to join" than the patients (40% for patients vs. 64% for CHI adults, corrected $\chi^2 = 3.86$, $p<.05$) than controls (15.7% for controls vs. 64% for CHI adults, corrected $\chi^2 = 18.03$, $p<.05$). The percentage of controls and CHI adults who incorporated the step of "proposing and/or becoming engaged" was very similar (15% for controls vs. 16% for CHI adults, $\chi^2 = .03$, $p>.1$) while CHI adults differed substantially from patients in frequency of usage (1.1% for patients vs. 16% for CHI adults, corrected $\chi^2 = 10.2$, $p>.05$).

TABLE 31 - continued

5. Story 5 dealt with regaining friends. Here controls and CHI adults (9.5% for controls vs. 20% for CHI adults, corrected $\chi^2 = .79$, $p>.1$) were more likely to use the category "introspection" than patients (2.7% for patients vs. 20% for CHI adults, corrected $\chi^2 = 10.8$, $p<.05$).

TABLE 32

QUALITATIVE SUMMARY OF RESPONSE PATTERN ON THE MEPS

Percentage of Subjects able to give Means for each Story.

Story	Per Cent
1	40%
2	72%
3	48%
4	72%
5	60%
6	32%
7	56%

$\bar{X}$ = 54%

Percentage of Subjects rated as No Means & Irrelevant Means even though they gave responses

Story	Per Cent
1	52%
2	24%
3	52%
4	24%
5	40%
6	44%
7	40%

$\bar{X}$ = 40%

Percentage of Subjects who made no response on each story

Story	Per Cent
1	8%
2	4%
3	0%
4	4%
5	0%
6	24%
7	4%

$\bar{X}$ = 6%

TABLE 32 - continued

Percentage of Subjects that elaborated on their Means

Story	Per Cent
1	0%
2	8%
3	24%
4	20%
5	24%
6	4%
7	12%

$\bar{X}$ = 13%

Percentage of Subjects that specified potential obstacles

Story	Per Cent
1	0%
2	0%
3	0%
4	0%
5	4%
6	4%
7	4%

(3 different Ss gave 1 obstacle for each of last 3 stories)

Percentage of Subjects indicating an awareness of time passage

Story	Per Cent
1	0%
2	8%
3	8%
4	32%
5	8%
6	4%
7	4%

$\bar{X}$ = 9%

TABLE 32 - continued

Percentage of Subjects whose answers indicated thinking prior to taking action

Story	Per Cent	
1	0%	
2	24%	
3	8%	
4	0%	$\bar{X}$ = 9%
5	20%	
6	8%	
7	0%	

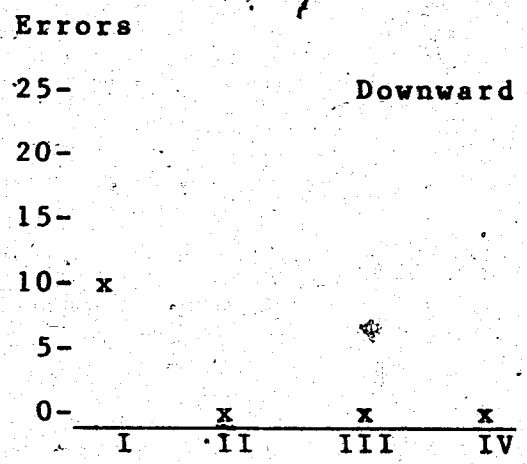
Percentage of Subjects who gave passive answers

Story	Per Cent	
1	0%	
2	0%	
3	4%	
4	4%	$\bar{X}$ = 2%
5	0%	
6	0%	
7	8%	

Number of Subjects who provided logical rationale for first five stories

Number of Rationales	Number of Subjects	Per Cent
0	14	56%
1	8	32%
3	2	8%
2	0	0%
4	1	4%
5	0	0%

TABLE 33
LEARNING CURVES - WCST



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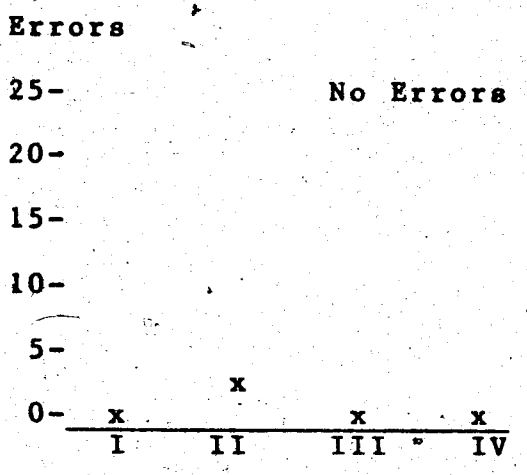

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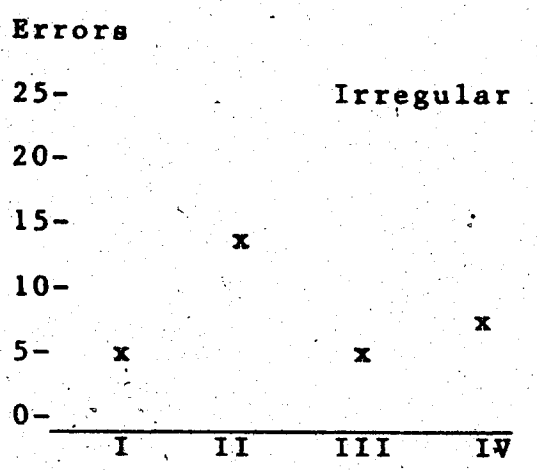

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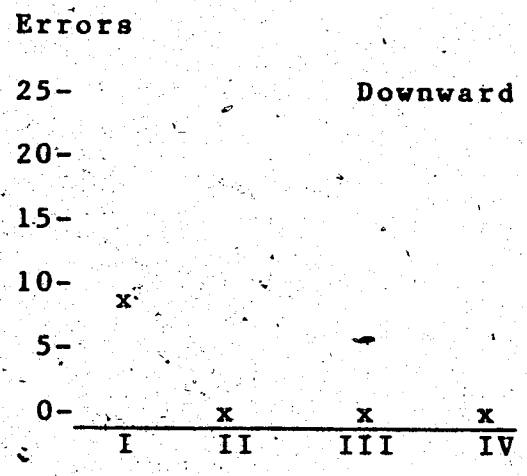
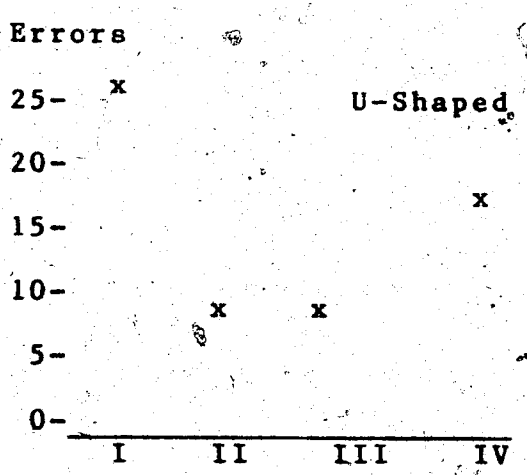
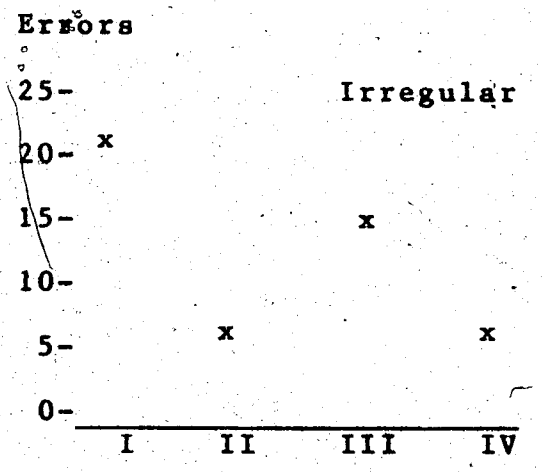


04

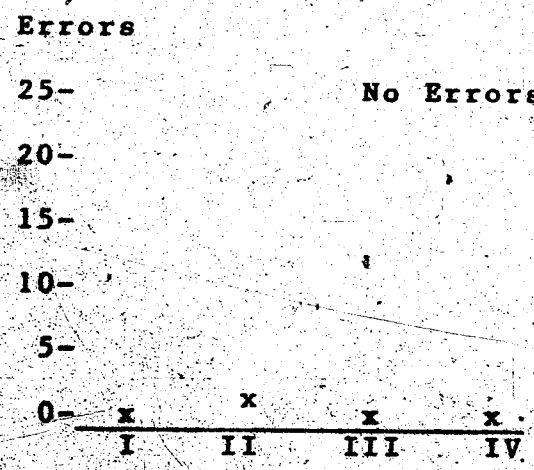


05

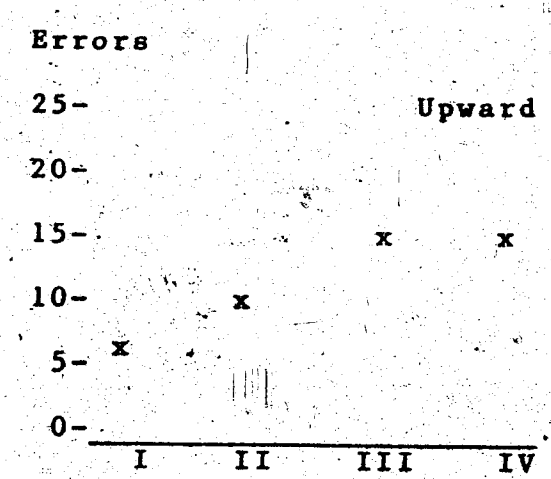


06

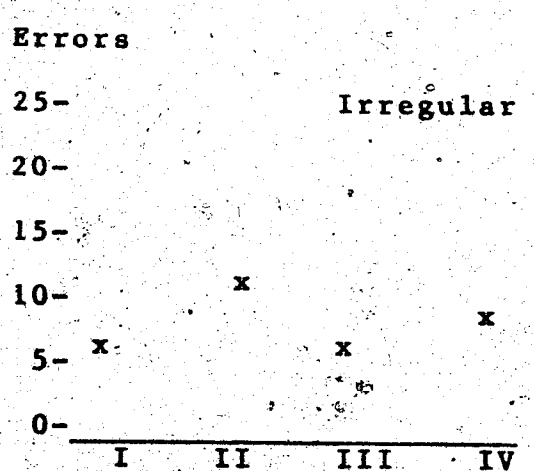
TABLE 33 - continued



07



08



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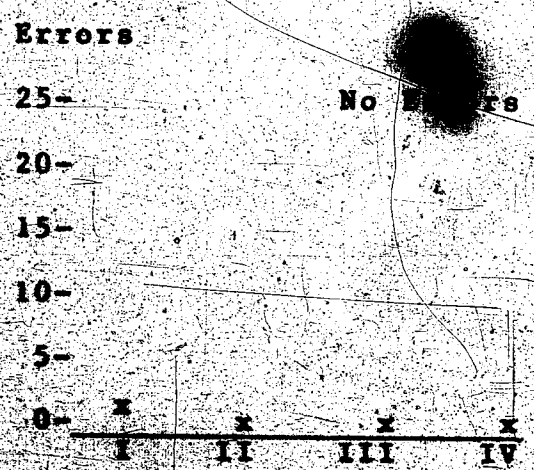

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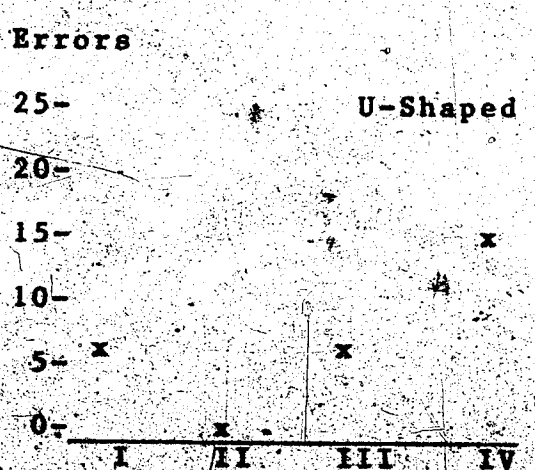

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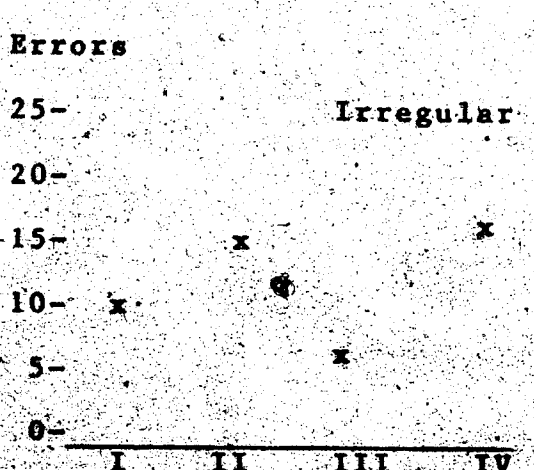
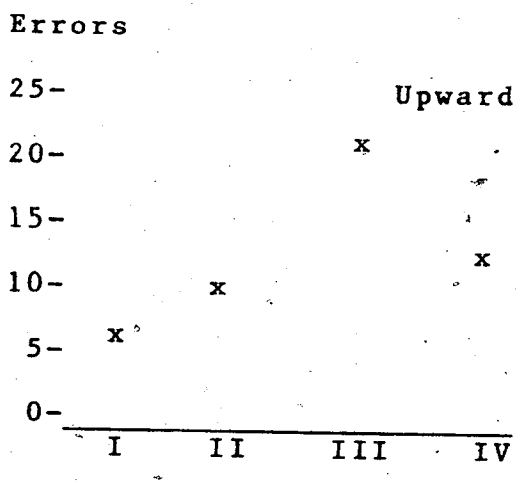
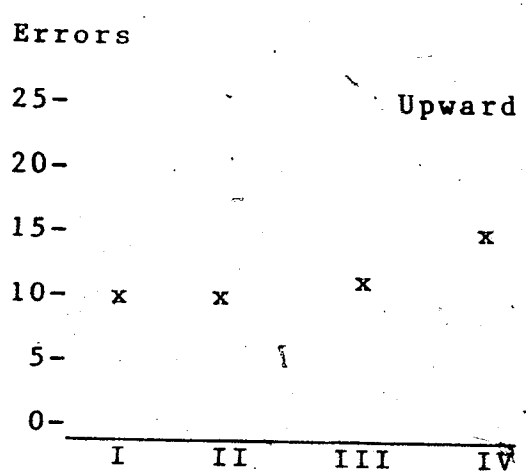


12

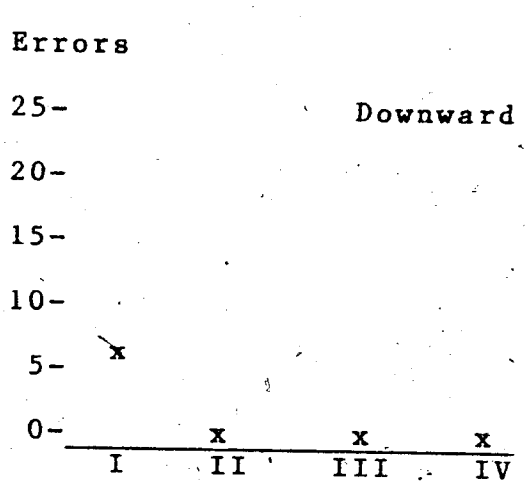
TABLE 33 - continued



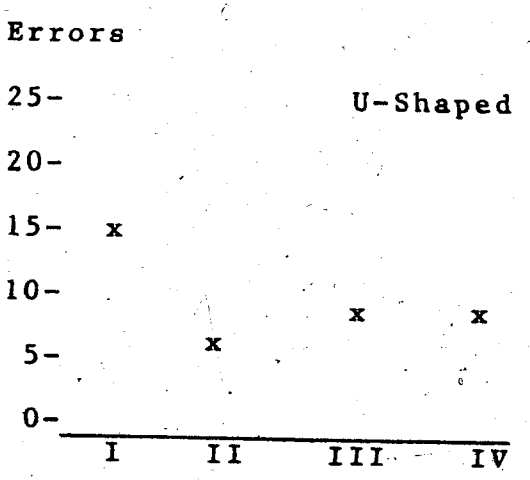
13 Quadrants



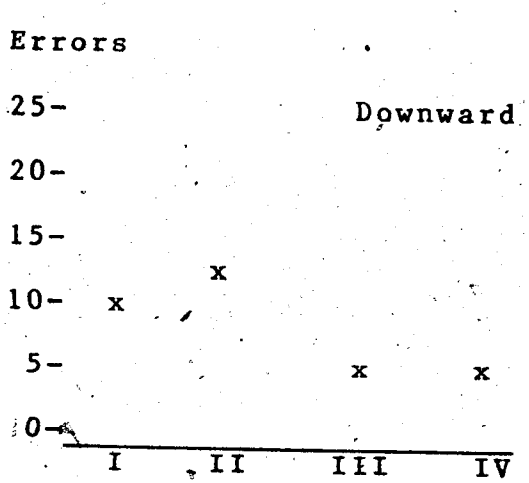
14 Quadrants



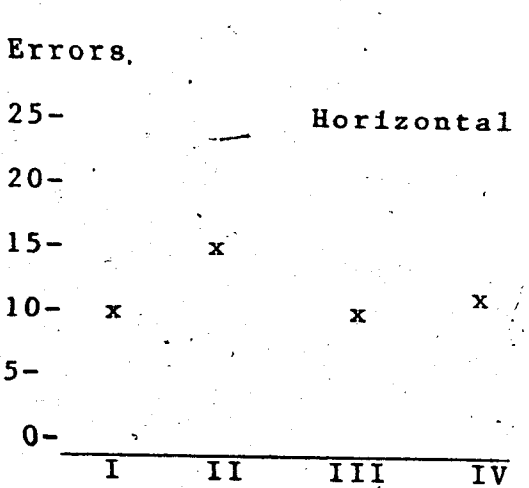
15 Quadrants



16 Quadrants

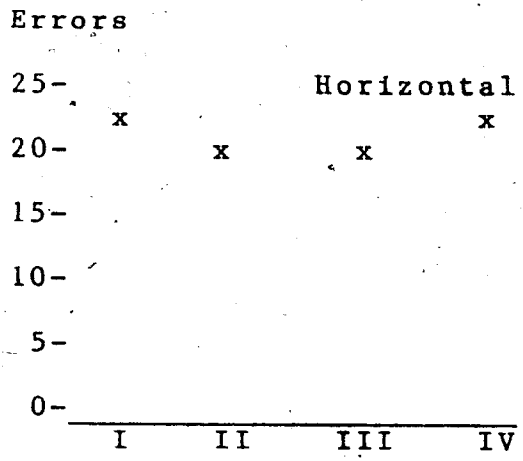


17 Quadrants

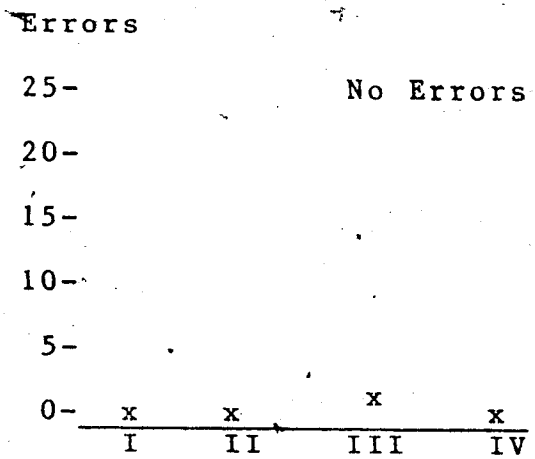


18 Quadrants

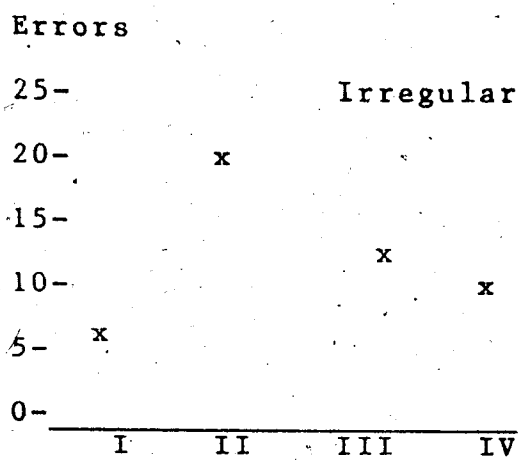
TABLE 33 - continued



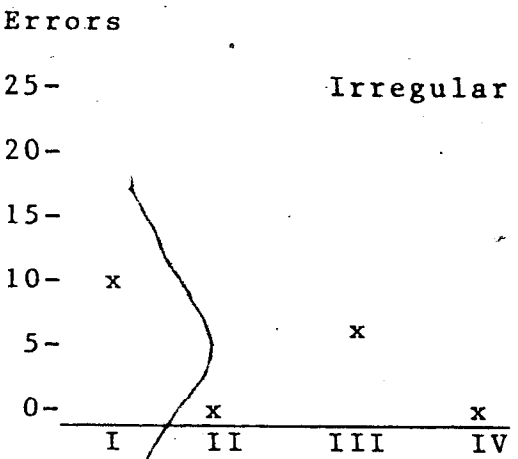
19 Quadrants



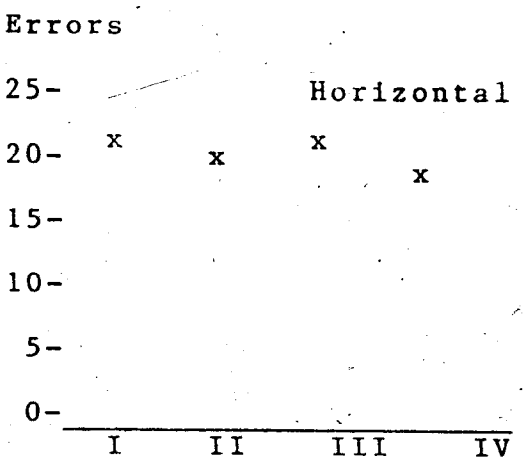
20 Quadrants



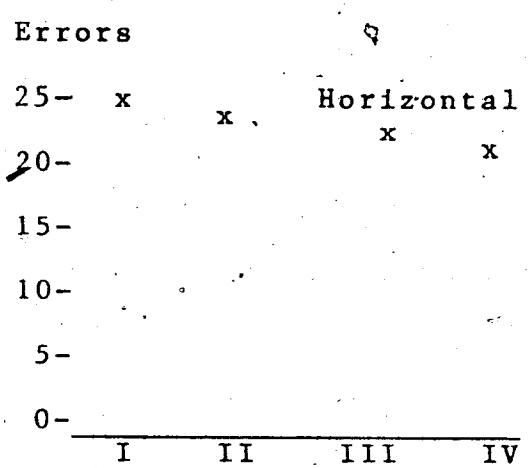
21 Quadrants



22 Quadrants

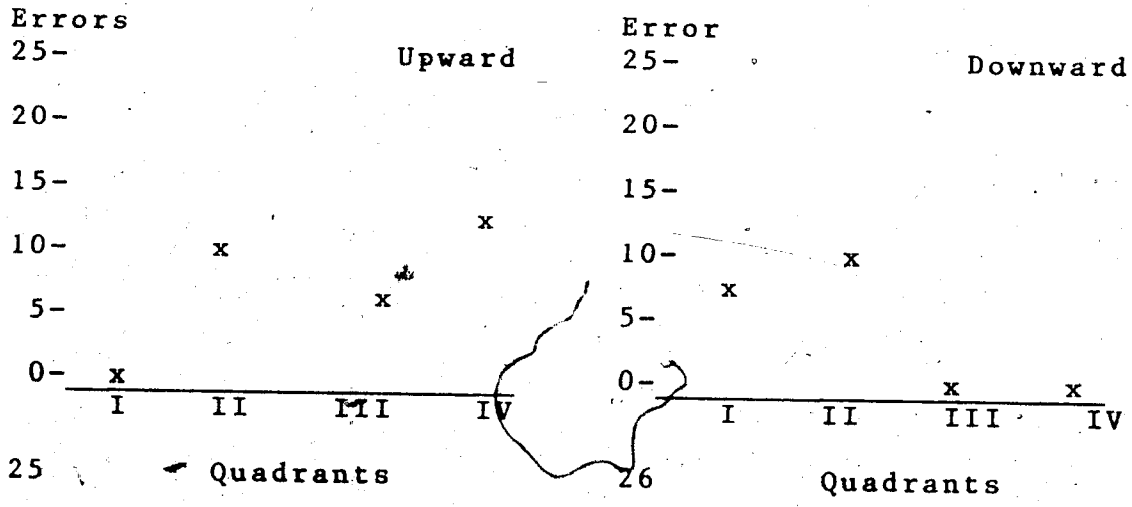


23 Quadrants



24 Quadrants

TABLE 33 - continued

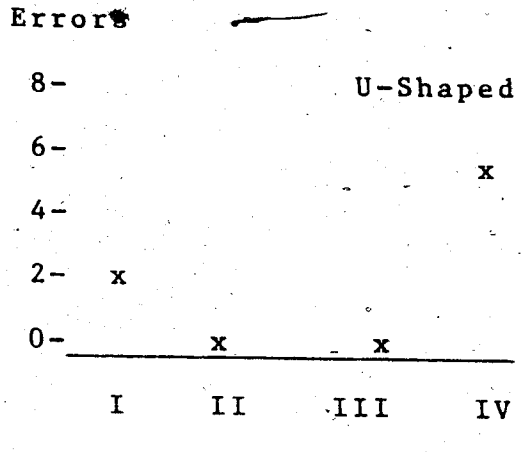


25

26

TABLE 34

INDIVIDUAL ERROR PROFILES - SYLLOGISTIC REASONING



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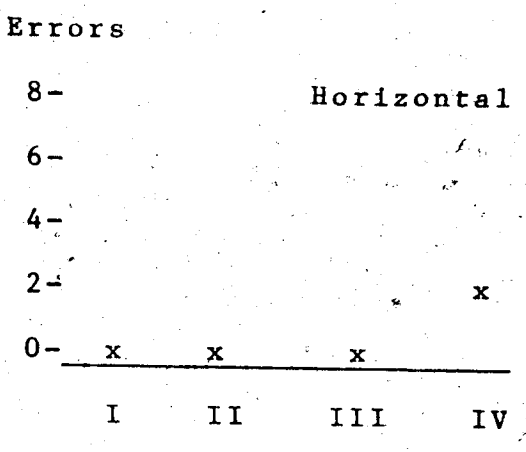
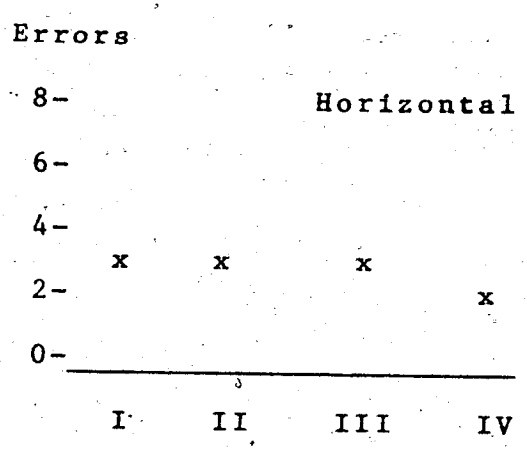
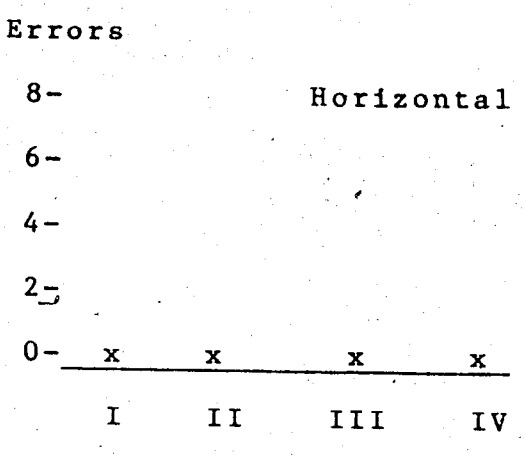


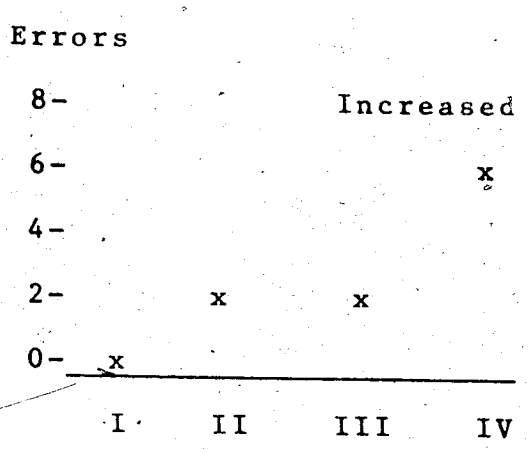
02



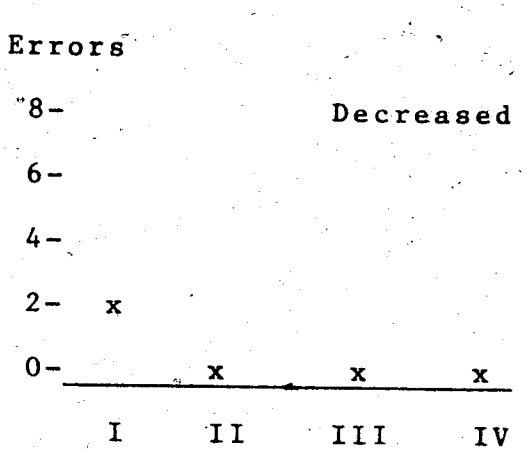
03



04

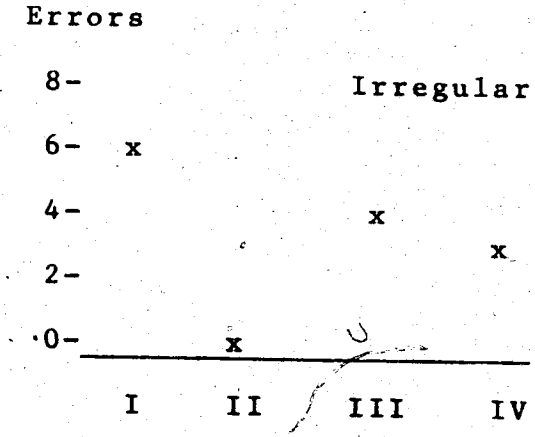


06



07

TABLE 34 - continued



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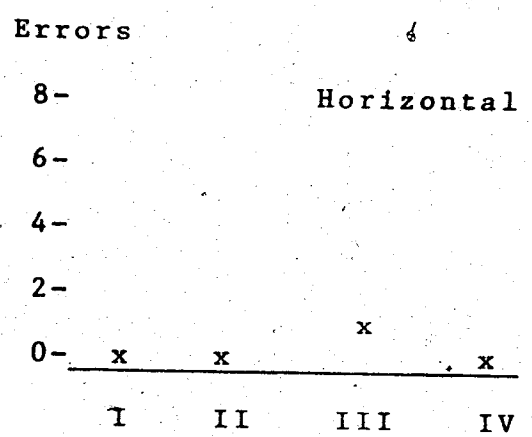

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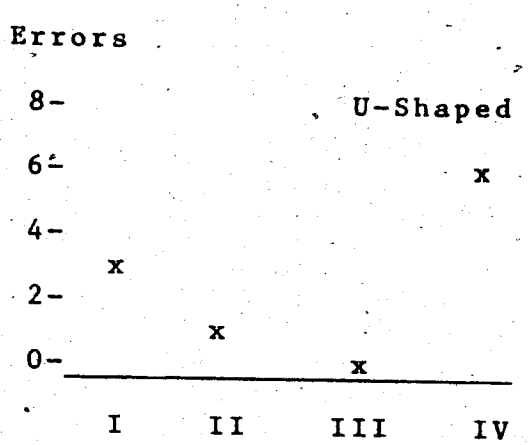

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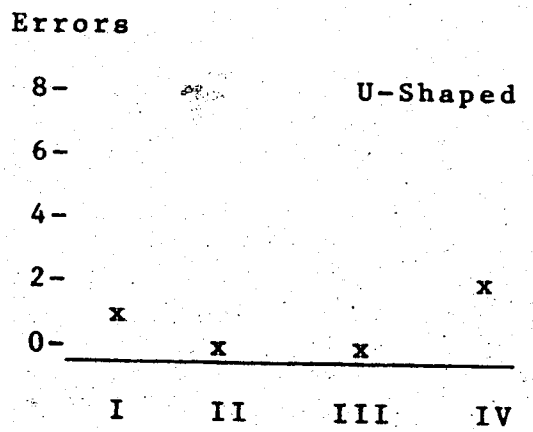

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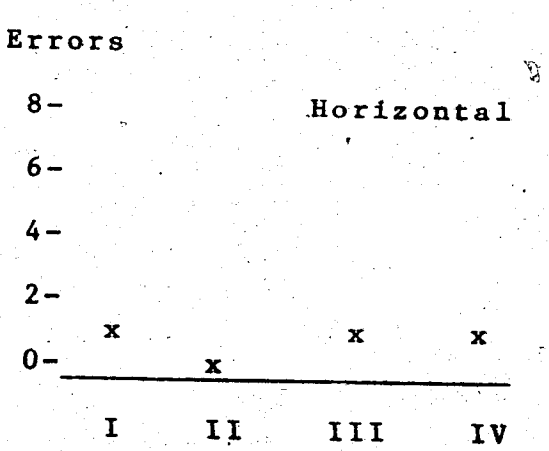

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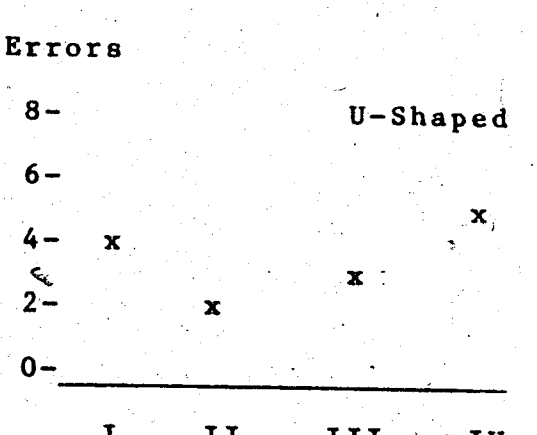
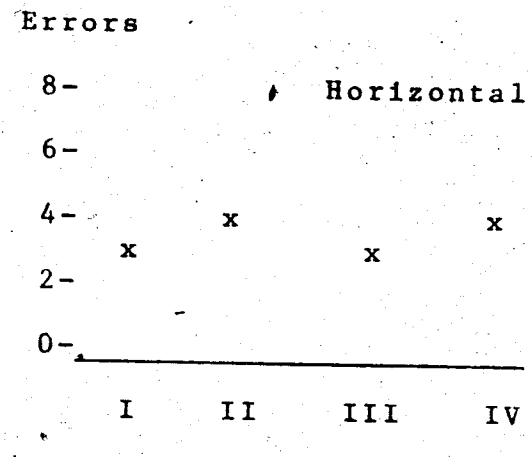
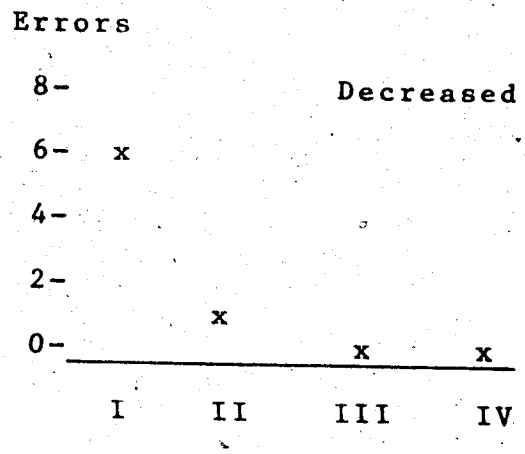


13

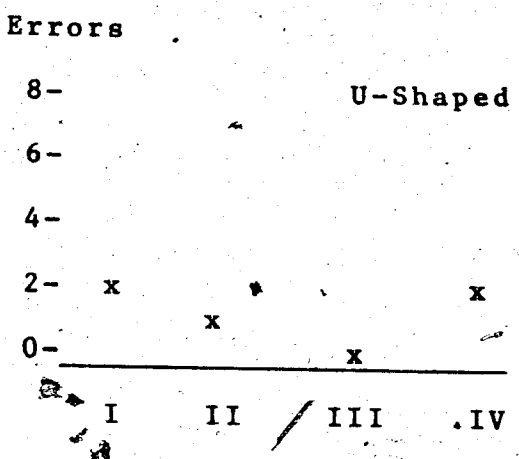
TABLE 34 - continued



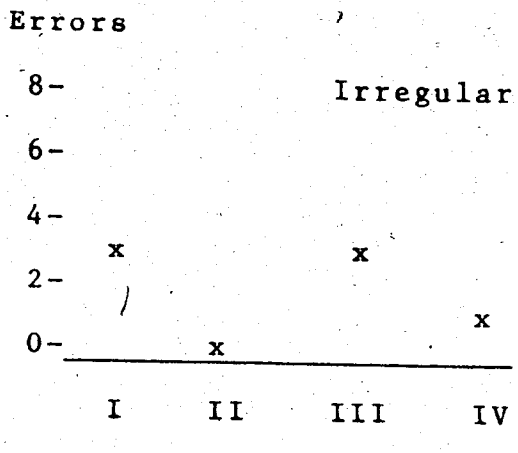
14



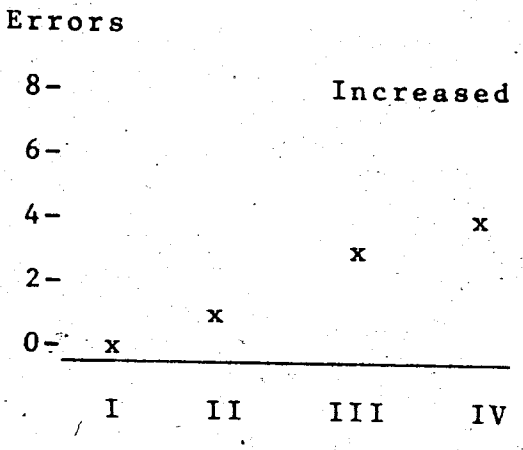
15



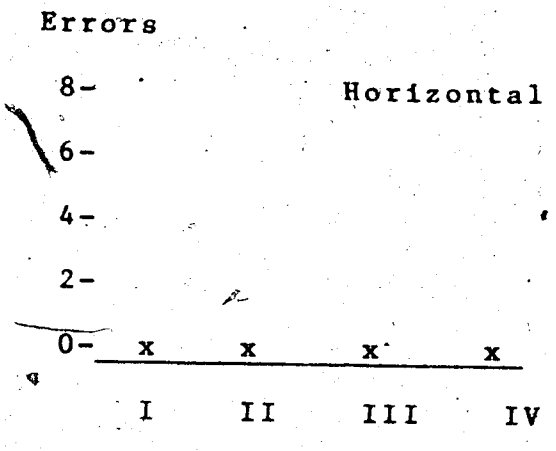
16



18

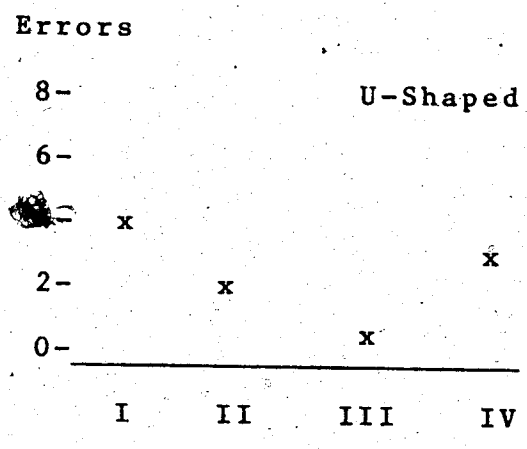


20



21

TABLE 34 - continued



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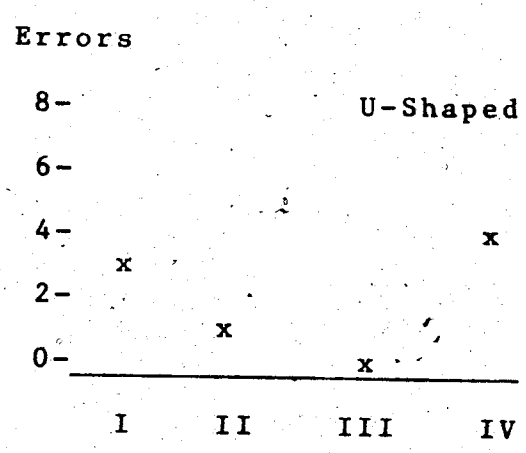

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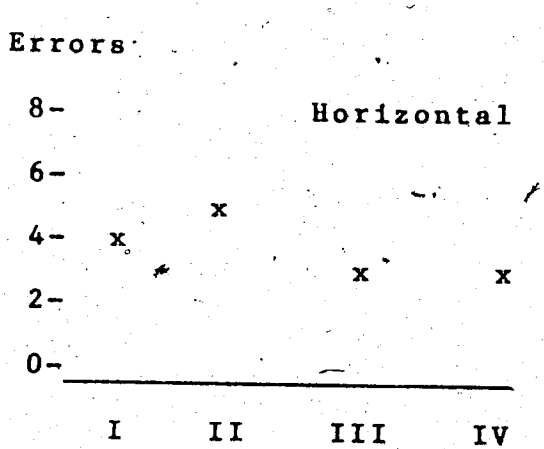
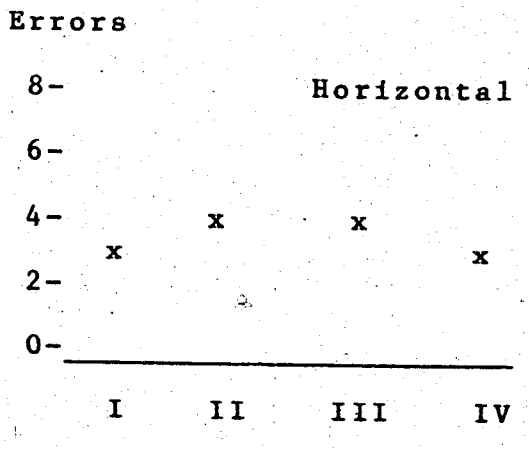


24



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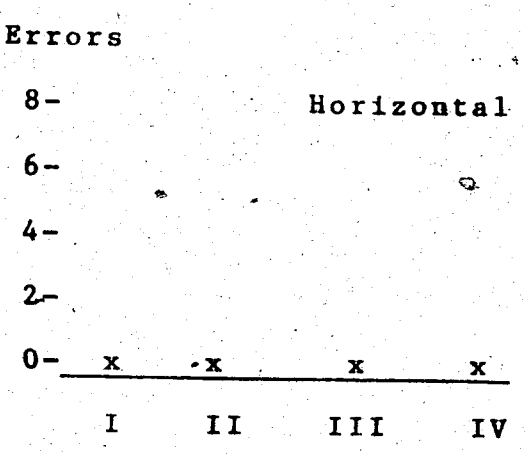
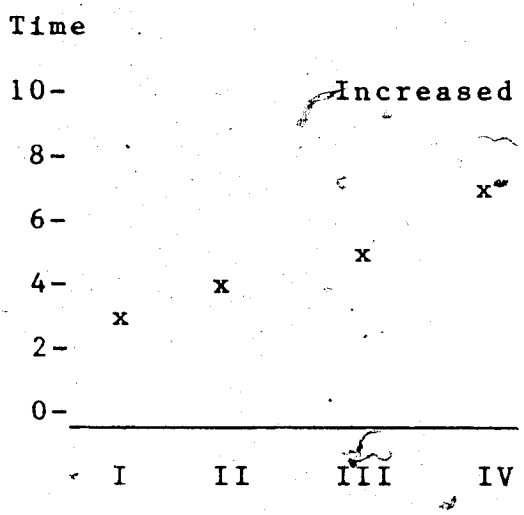
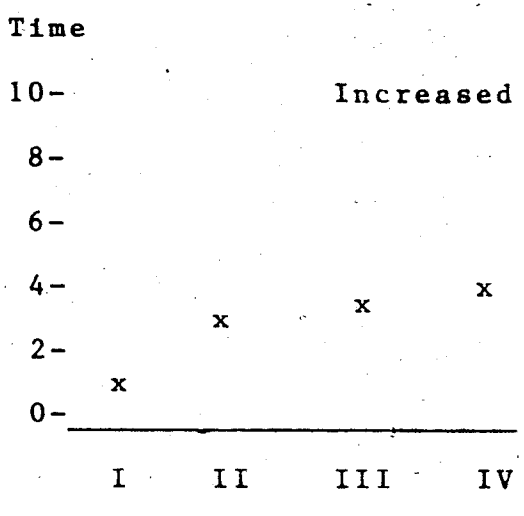


26

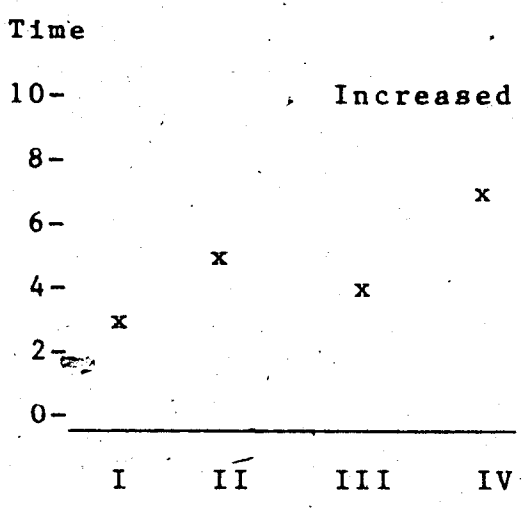
TABLE 35
INDIVIDUAL TIME PROFILES -- SYLLOGISTIC REASONING



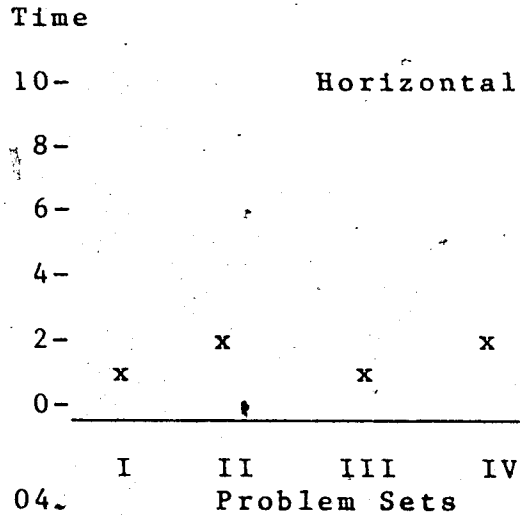
01



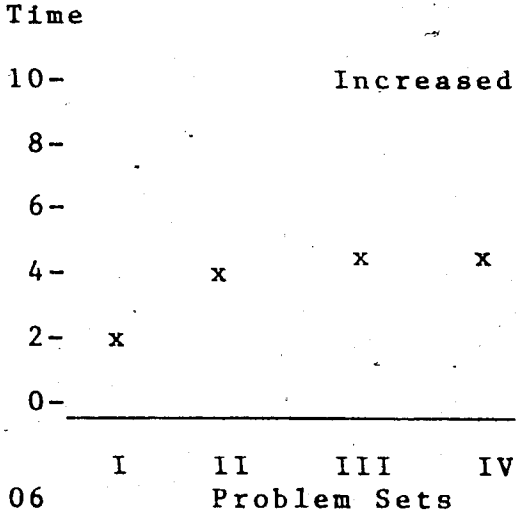
02



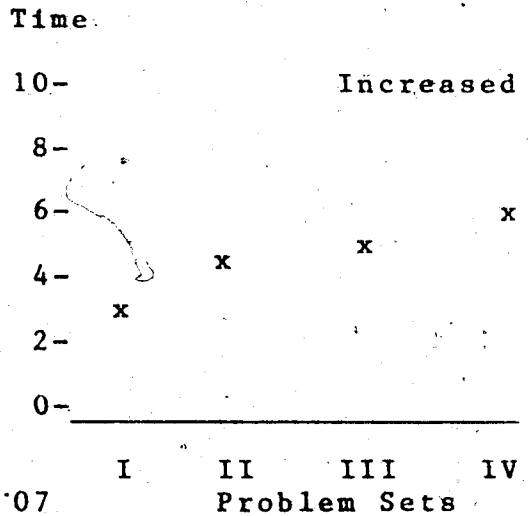
03



04

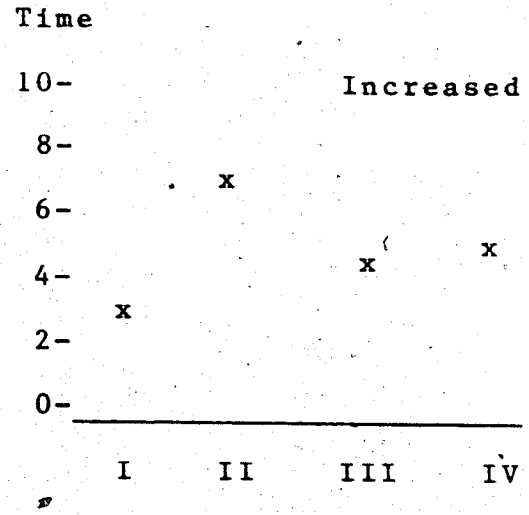


06

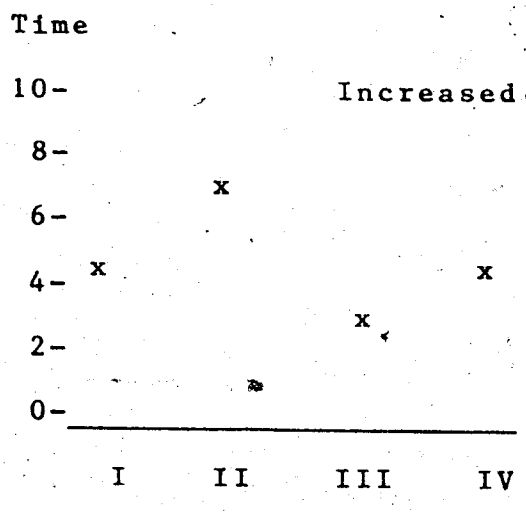


07

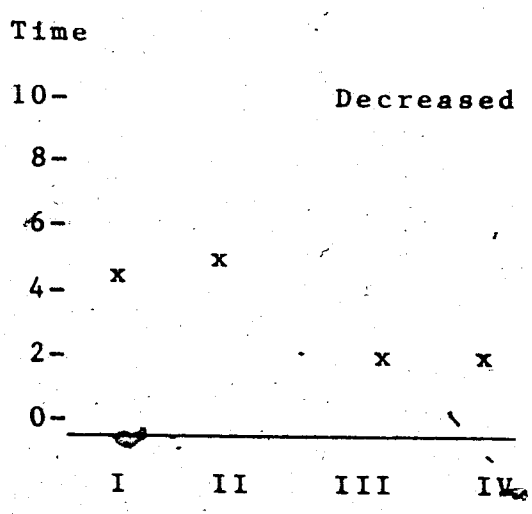
TABLE 35 - continued



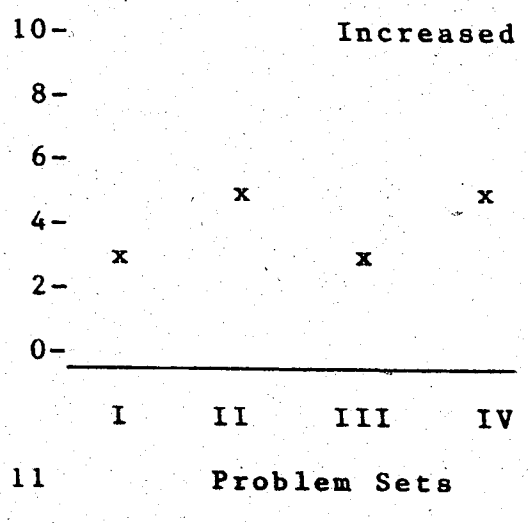
08



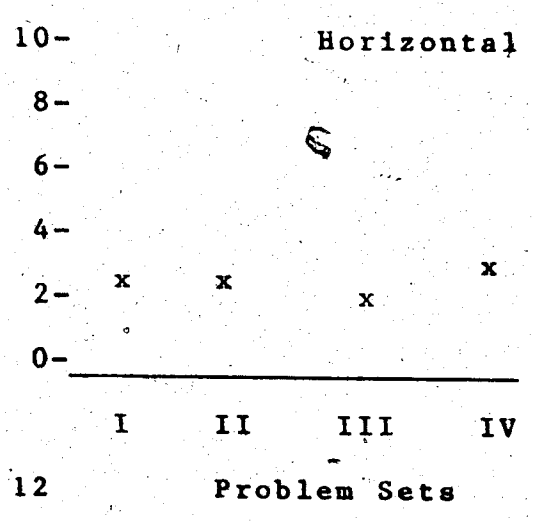
09



10



11



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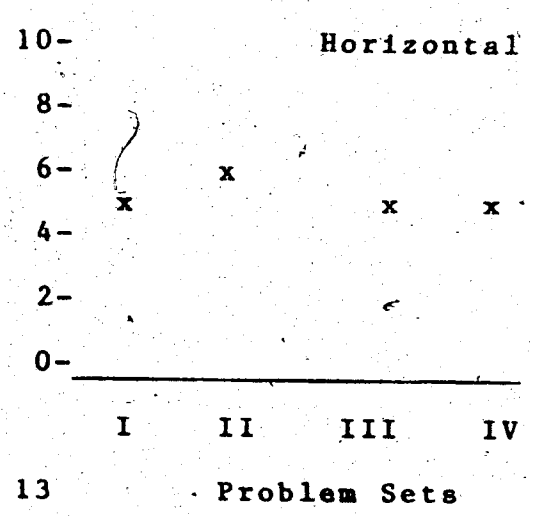
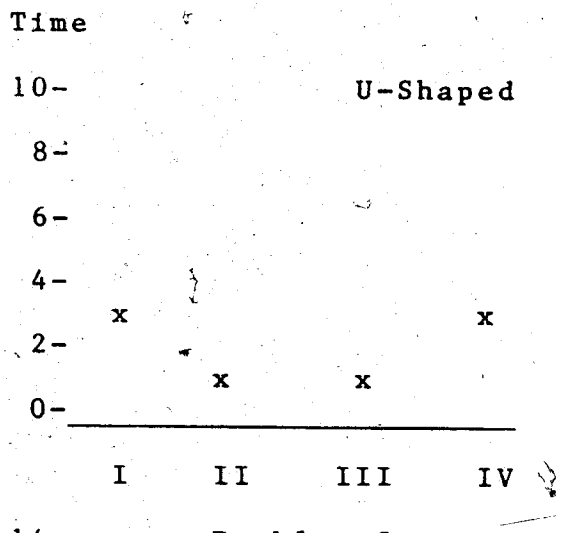
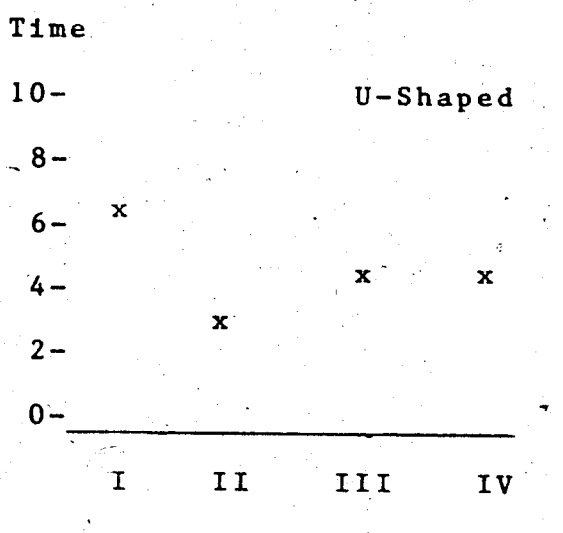


13

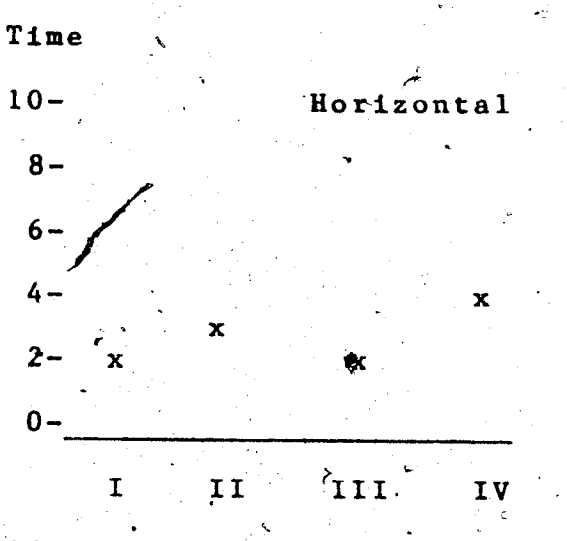
TABLE 35 - continued



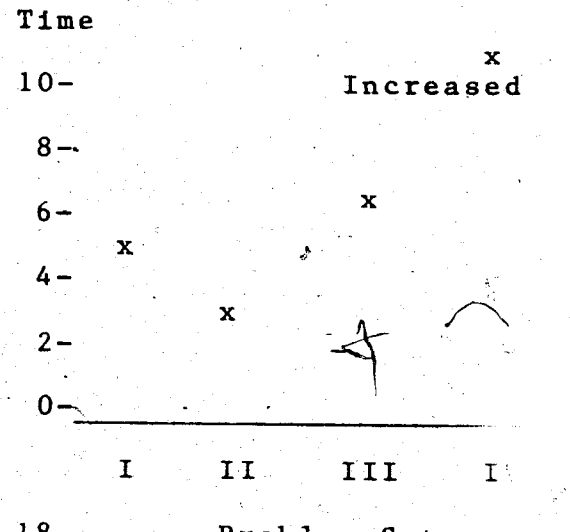
14



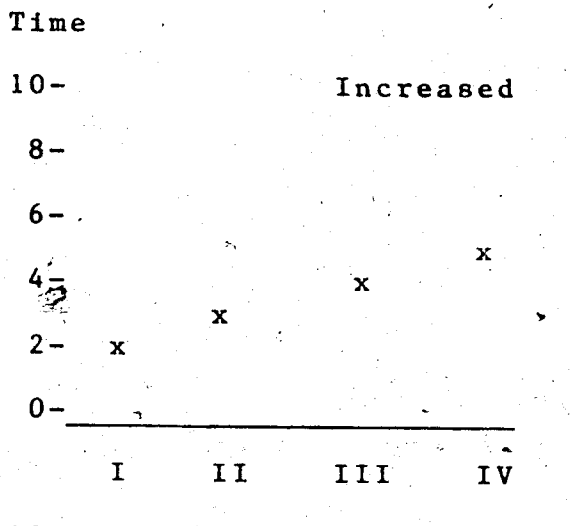
15



16



18



20

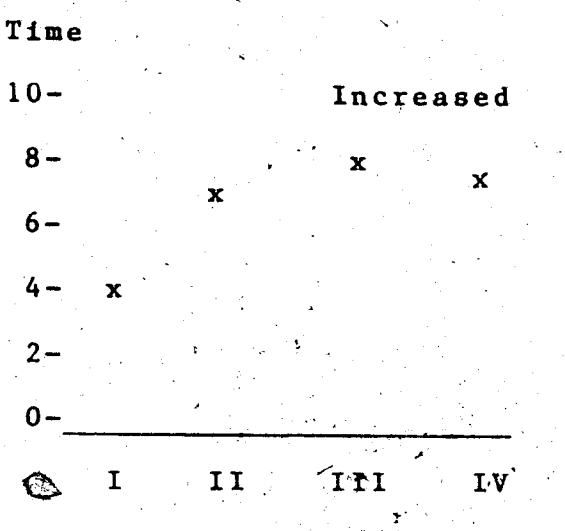


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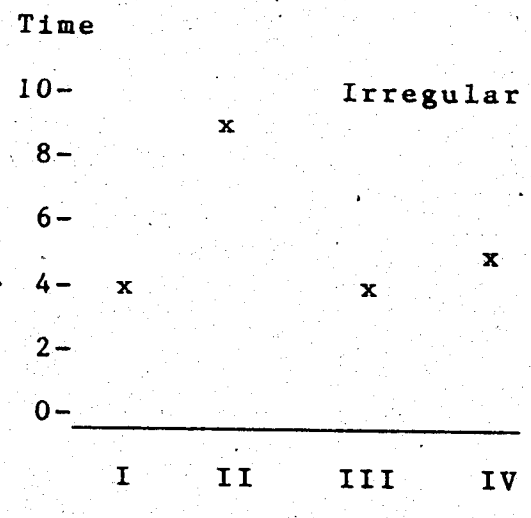
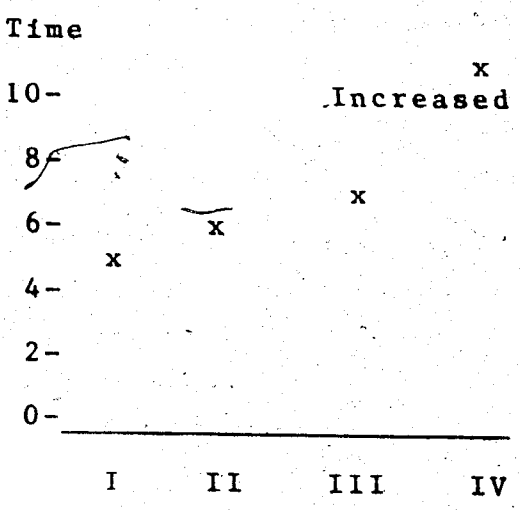
TABLE 35 - continued



22 Problem Sets



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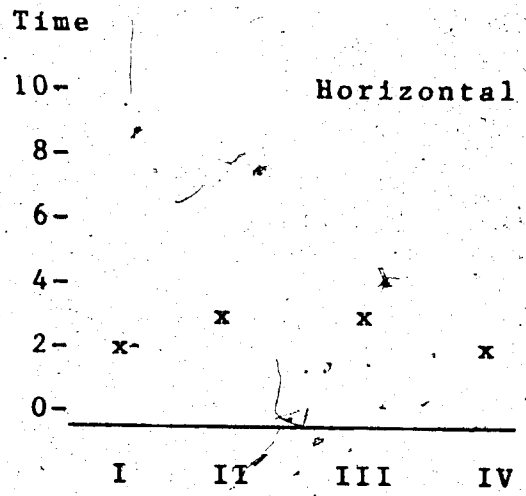

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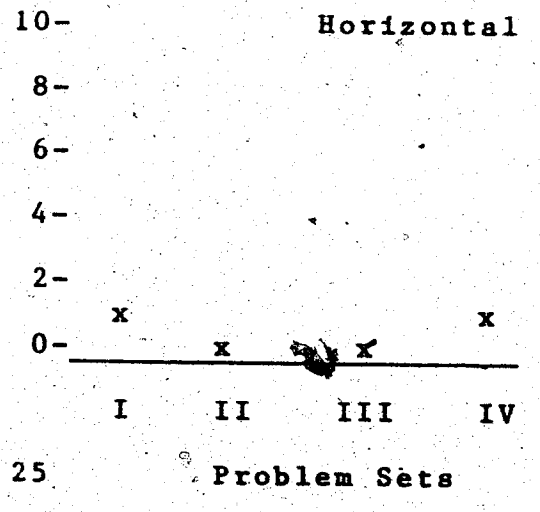

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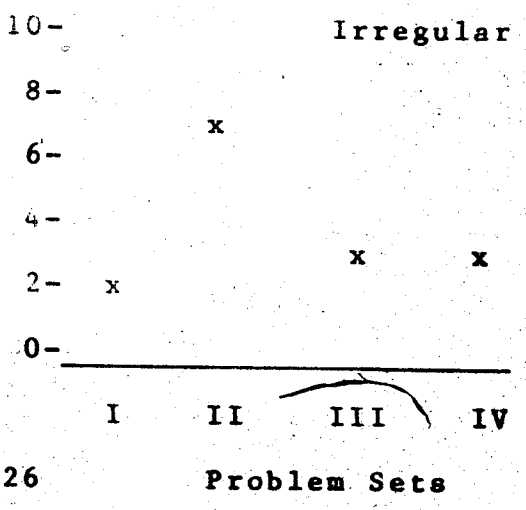

26 Problem Sets

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APPENDIX A

CLINICAL ADJUSTMENT INDEX

CLINICAL ADJUSTMENT INDEX

Please rate each client on the following seven (7) point scale with regard to your judgement of their current level of interpersonal problem solving ability at home, at work and in the community (social). The scoring criterion below provides you with general descriptions of how a person with varying levels of interpersonal problem solving skills functions in the three areas. If your client demonstrates a combination of skills for two levels, score accordingly using the midpoints between the levels.

Please review the judgement criterion before evaluating each client. It is important that you maintain consistent criteria for evaluating each person.

HOME: Family (Intimate) Relationships

1 2 3 4 5 6 7

1. The client has a prolonged history of maladaptive functioning in the home which demonstrates a chronic inability to resolve family conflicts or marital discord. This is reflected by one of any combination of the following:

   - a series of short-term relationships;
   - repetitive abuse/neglect of children;
   - remaining in a severely physically/mentally abusive relationship - repetitive separations without ever solving problems;
   - the person is a social isolate in that she/he has no in-depth relationships either family or partner;
   - if under 25 years of age and living at home, the person has recurring conflicts with parents that result in repetitive comings and goings as well NO indications of developing intimate relationships.

2. This person may show some of the characteristics of number 1 but to a lesser extreme. This individual is totally dependent on parents, spouse, or significant friend. The person's relationships are peaceful and cooperative but he/she functions much like a five-year old child.

   - if single and over 20 years of age, the person at this level would not demonstrate any initiative to develop intimate relations or independence.

3. This person would be described as passively inadequate as she/he needs spouse or parent to make most major judgements. The

significant others have reduced their expectations but still involve the person in the decision making process.

- if single and over 20 years of age, this individual has some opportunity to develop intimate relationships (dating) and lives independently but relies heavily on family.

4. At this level a person would have been in at most, two significant relationships involving marriage and/or common-law associations. Within this relationship, she/he would demonstrate adequate functioning with some problems that are generally short term as they are resolved through compromise that are not severely debilitating to either spouse or children. She/he is able to discuss most problems even if not completely able to resolve them and/or tends to arrive at socially acceptable solutions.

   - if over 25 and single, the person would have left home or be making concrete plans to do so. The individual would be able to resolve most differences with family members, make own decisions and be gradually developing own independence and intimate relationships.

   - if under 25 and living at home, there needs to be definite indications of developing independence (i.e., saving money or planning to go to school) and own primary relationships. The person must be exercising reasonable judgement in selection of friends and potential significant others.

5. The person would be currently involved in a stable ongoing intimate relationship for approximately one year and would have made a serious emotional commitment. Within the relationship, the person would be meeting many of his/her own and the partner's needs and if applicable their children's needs as well. She/he would demonstrate an awareness and sensitivity toward the other person and would attempt to constructively resolve problems but is not always successful. The person has some interests outside the home beyond work and does not rely on family to meet all emotional needs.

   - if there are children, the person would have a warm relationship with children as he/she would be involved and interested but lack some higher level communication skills. The individual would be attempting to develop consistent discipline and age appropriate expectations but as yet unable to fully achieve this goal.

   - if under 25, the person would be in the midst of establishing an ongoing intimate relationship (i.e., serious dating). In his/her relationship with significant others including parents and close friends, the young adult would be considerate of others' needs and sensitive to their findings.

6. At this level, the person is judged by themselves and others to have a satisfying intimate relationship that fosters growth for

each member both within and outside the family. Within problem solving or conflict situations, the person demonstrates awareness and sensitivity that generally leads to satisfying temporary solutions for major problems but the more serious problems arise again. The person though attempts to re-evaluate the solutions.

- if there are children, the individual shows considerable parental affection combined with age appropriate and flexible expectations. The person has achieved the balance between discipline and leniency.

- if under 25, the person may be in the process of establishing an intimate relationship but would still be expected to promote growth for their significant others and to attempt positive problem resolution.

7. She/he is judged to have a well adjusted family life with strong, healthy relationships. This person is supportive of spouse and children and all members are able to develop independent life outside the family. She/he is able to resolve problems with creative solutions that allow for maximum freedom and growth for self and other members. She/he is striving continuously to improve the relationship as the partners have long-term goals and ideals for the relationship.

WORK: Performance in School, Paid Employment or as a Homemaker

1 2 3 4 5 6 7

1. The client is unable to handle demands of paid employment which is demonstrated by the following:

   - chronic unemployment;
   - school history of repetitive failure and truancy;
   - starting and stopping upgrading and/or training programs.

   On a day-to-day basis, this type of person acts impulsively without any realistic plans for improvement. She/he feels like a victim of society or circumstances and lacks any confidence in results of efforts or abilities.

   - if a homemaker, she/he is unable to organize household responsibilities so that the home is chaotic, a mess and unpredictable and the children are generally out of control. The children are removed periodically for neglect and/or abuse. The children have to be cared for by someone else.

   - if under 25, this person has been unemployed or uninvolved in school program for at least a year and demonstrates no initiative to find employment and is therefore financially

dependent on family and government.

2. This person would be drifting from one short-term job to another with no career direction. For significant periods he/she is financially dependent on parents or government for daily living needs. The person is extremely dependent on others but is actively involved in non-academic or career programs (long-term physical therapy, life skills, and/or stimulation program).

   - if a homemaker, children are at home but the person requires some supervision and/or help running the home. The spouse would be worried about the children's safety if alone with the person.

3. This person, especially if under 25, may have some vague career plans but experiencing difficulty obtaining steady employment. In general, this person is passively dependent and inadequate. The person may have achieved relative success in the work force because other people are accommodating to his/her deficiencies (i.e., different expectations from the average person). This level of person may be working in sheltered workshop setting that offers structure and supervision as well as reduced demands.

   - if in school in an academic or job-related program, this person may be persevering but experiencing significant difficulties. The school personnel may be accommodating to the person's weaknesses.

   - if a homemaker, the person cares for the children independently with no abnormal concerns regarding the children's safety but the person still demonstrates significant problems with organization and parenting skills.

4. This person may have had several jobs but usually is employed full time with work providing an acceptable degree of satisfaction. If asked, the employer would be basically satisfied. The person's choice of work and actual level of work conforms to society's expectations rather than their own goals. Even though this type of person works steadily and at an acceptable level of productivity, she/he feels that real success is outside his/her control.

   - if under 25, this person has a general career aim and is steadily employed in related jobs. If a student, this person is handling the demands of school independently and achieving average grades or performance level.

   - if home full time, the children and household are reasonably cared for and the person's parenting skills seem adequate.

5. At this level, the person would be pleased and satisfied with their employment situations as the choice of work would have been based on consideration of his/her abilities, needs, and interests. The employer would describe him/her as a conscientious worker as the person has some personal goals and standards.

- if a student, the person would have put thought into their preparation and be directed by realistic goals. In general, the student would be a satisfied and a hard worker as demonstrated by adequate or above progress.

- if a homemaker, the person would be expected to possess the above characteristics - satisfaction, conscientious worker - and have given their choice reasonable thought and have some personal career goals. The person would have supplemented their housework and childcare with some productive outside interests.

6. This person would have a well thought out career choice and there would be evidence of periodically re-evaluating his/her career progress as the person would be striving to improve his/her choice. Long-term planning would be demonstrated by the knowledge of the steps required to meet his/her goals. Aspects of the work would feel stimulating and the employer would consider the person an asset and describe the employee as self-motivated.

- if a student, the person would choose their course work thoughtfully based on their goals, interest and abilities. The individual would be self-motivated and exert extra effort to meet personal standards that go beyond grades.

- if a homemaker, the person would be expected to have a long-term career goal, be willing to re-evaluate progress, and feel stimulated. His/her outside commitments would enhance the individual's career plan.

7. This person has a good work history in that job changes have been to enhance career and broaden experience. She/he has been able to find satisfying employment that is sufficiently stimulating and challenging which is reflected in the fact that the person talks positively and with pride. In turn, she/he is considered to be a valuable employee whose contribution is greater than the average. In general, this type of person feels one achieves and succeeds through one's own efforts and therefore continues to be motivated to accomplish new things. She/he has long-term goals and is pleased with accomplishments. His/her success is also recognized by others.

- if a homemaker, this person would be satisfied, challenged and stimulated as well would speak with pride about the choice. She/he would provide extra stimulation to the children and be involved outside the home.

SOCIAL: Involvement in Community Groups, Relationship with Friends and Co-Workers

Note: Activities should be the kind that involve ongoing contact with others and offer the potential of making friendships.

1 2 3 4 5 6 7

1. This person is unable to develop mutually satisfying friendships. This may be indicated by:

   - social isolation;
   - repetitive manipulation of others or by friends;
   - engaging only in social interaction when intoxicated with alcohol or drugs.

   She/he tends to be a passive follower of others who also act impulsively. Therefore, this type of person generally has a history of anti-social activities including criminal acts, drug or alcohol additions.

2. This person is a loner who makes no effort to make friendships but is not addicted to alcohol or drugs. As this person is generally passive, he/she does not manipulate others but may be manipulated by others. This person generally cannot meet friends' needs but may have a few altruistic friends.

3. This person is making an effort to develop mutual friendships but due to lack of social skills, the friendships generally do not materialize or has mutual friendships involving two overly dependent and needy people. For example, may join clubs and activities but contact never goes beyond superficialities at meetings. This person is highly dependent on family members for social contact and/or social outings mostly center on superficial contact involving drinking and/or drugs.

4. This person tends to have casual friends in that they make minimal demands on each other. She/he usually does not have a history of anti-social activities but lacks involvement in the community beyond some conventional expectations such as parent/teacher meetings, non-participating community league members. This person tends to follow others who are perceived as socially acceptable and may accept minor responsible roles when requested but would not volunteer for positions that require effort and leadership.

   - if under 25, this person would have a small group of friends that he/she sees socially for constructive activities such as parties and sports. These may be primarily informal gatherings rather than organized groups.

5. At this level, the person would have continuing friendships that entail some emotional support, generally for tangible problems. The person is willingly involved in social and community activities such as coaching and leading men's and women's clubs. The person would choose his/her associations responsibly based on personal evaluation of merit.

6. The individual would have active and healthy friendships outside the family and would put forth an effort for the friendships to be quality relationships. The person would be actively involved and demonstrate initiative combined with personal need satisfaction in clubs and social activities such as donating home for activities. The person is able to find a balance that is reasonably comfortable among the social activities, other responsibilities and personal needs. He/she demonstrates flexibility in roles depending on the needs of groups or associations.

7. This person has mutual satisfying and growth producing friendships that are close and trusting but outside the family. She/he would make an effort to enrich relationships. She/he has a history of involvement and responsibility for some community activities. At times has demonstrated leadership roles as realizes a person needs to take an active role in activities and friendships. The person consistently makes healthy choices regarding level of involvement based on an overall evaluation of responsibilities, commitments and own needs.

APPENDIX B

BELL'S ADJUSTMENT INVENTORY

Due to copyright restrictions pages 213 to 219 containing the Bell's Adjustment Inventory and manual were removed. These items can be obtained through Consulting Psychologists Press, Inc., Palo Alto, California.

APPENDIX C

MEANS-ENDS PROBLEM SOLVING PROCEDURE

MEPS

MEPS

"In this procedure, we are interested in your imagination. You are to make up some stories. For each story you will be given the beginning of the story and how the story ends. Your job is to make up a story that connects the beginning that is given to you with the ending given to you. In other words, you will make up the middle of the story."

(1) Read both the beginning and end of the story.

(2) "Please repeat the key words which end the story," (to ensure understanding - for the first two stories).

(3) "Remember, I need a real good story."

(4) "The only problem occurs when a respondent begins by listing discrete alternative solutions. Just redirect him/her to tell a story, like he/she were watching a movie - everything that happens from the time (repeat beginning) to the end (repeat end).

(5) Repeat the story back and ask, "Please explain the rationale or reasons underlying your answer."

MEPS (continued)

1. Mr. A. was listening to the people speak at a meeting about how to make things better in his neighborhood. He wanted to say something important and have a chance to be a leader too. The story ends with him being elected leader and presenting a speech. You begin the story at the meeting where he wanted to have a chance to be a leader.

2. H. loved his girlfriend very much, but they had many arguments. One day she left him. H. wanted things to be better. The story ends with everything fine between him and his girlfriend. You begin the story with his girlfriend leaving him after an argument.

3. Mr. C. had just moved in that day and didn't know anyone. Mr. C. wanted to have friends in the neighborhood. The story ends with Mr. C. having many good friends and feeling at home in the neighborhood. You begin the story with Mr. C. in his room immediately after arriving in the neighborhood.

4. One day Al saw a beautiful girl he had never seen before while eating in a restaurant. He was immediately attracted to her. The story ends when they get married. You begin when Al first notices the girl in the restaurant.

5. John noticed that his friends seemed to be avoiding him. John wanted to have friends and be liked. The story ends when John's friends like him again. You begin where he first notices his friends avoiding him.

6. One day George was standing around with some other people when one of them said something very nasty to George. George got very mad. George got so mad he decided to get even with the other person. The story ends with George happy because he got even. You begin the story when George decided to get even.

7. Joe is having trouble getting along with the foreman on his job. Joe is very unhappy about this. The story ends with Joe's foreman liking him. You begin the story where Joe isn't getting along with his foreman.

APPENDIX D

WISCONSIN CARD SORTING TEST

WCST

WCST

"This test is a little unusual, because I am not allowed to tell you very much about how to do it. You will be asked to match each of the cards in these decks to one of the four key cards.[a] You must always take the top card from the deck,[b] and place it below the key card you think it matches.[c] I can't tell you how to match the cards, but I will tell you each time whether you are right or wrong. If you are wrong, leave the card where you've placed it, and try to get the next card correct. Use this deck first,[d] and then continue with the second deck. There is no time limit on this test."

a. Lay out the stimulus cards across the table from the patient, in the standard order, with the first card at the patient's left side.

b. Throughout the test, the stimulus cards and the cards in the decks should be kept in order. Never shuffle the cards or allow the patient to do so. As they face the patient, the figures on the cards should have the following configurations (triangles have the bases facing down, and stars have two points facing down): cards with one figure have it in the center, cards with two figures have one in the upper left and one in the lower right; when there are three figures they are in the configuration of an equilateral triangle, with two figures on either side of the top and the third figure at the bottom of the card; when there are four figures they are in the configuration of a square, with one figure at each corner of the card.

c. Point to the four stimulus cards.

d. Examiner hands the first deck to the patient, and places the second deck to the side.

WCST (continued)

(1) What do you think is the purpose of this task?

(2) What were you trying to do?

(3) Have you ever done this task before? If so, what were you told or shown at that time?

(4) Can you tell me exactly how you were matching the cards? Please state all the rules you tried to use to match the cards and the order you tried them in if possible.

(5) Please describe what I was doing while you were trying to match the cards.

(6) Why did you use more than one rule?

(7) If the subject classified for none, one or two of the categories, sort the cards for one of the categories. "Does this look right to you? According to what principle are these cards sorted?" If the subject verbally understands, have him/her sort for 10 cards. Then, if correct, give him/her 10 more and change the criterion.

(8) If the subject does not see or understand the reclassified principles or categories after demonstration, explain the principles to him/her. "Now please explain the principle as you understood it." Then after he/she has explained it, have him/her demonstrate with 10 cards. If he/she gets 10 right, then give another 10 but change the principle.

(9) Did you use any other method of classification besides color, form, or number? If yes, what were they?

APPENDIX E

TOWER OF HANOI

Tower of Hanoi

The subject is shown the task and told that:

> "The problem is to move all the disks from A to C in the smallest number of moves and they must end up in the same order on C as they are originally on A. However, you may only move one disk at a time and a disk may never be placed on top of another smaller than itself. If you decide that you made a wrong move, you are allowed to go back to an earlier point in the solution, or to the beginning."

No other cues are given but if the subject breaks the rules, he is reminded of the rule and the disks are placed back. The inappropriate move is counted.

AFTER THREE DISK TASK

(1) Have you ever done this task before? If so, what were you told or shown at that time?

(2) Please describe, in as much detail as possible, how you solved this problem. Give as many steps and in order as you can.

AFTER FOUR DISK TASK

(1) Please describe, in as much detail as possible, how you solved this problem. Again, give as many steps and in order as you can.

AFTER FIVE DISK TASK

(1) Please describe, in as much detail as possible, how you solved this problem. Again, give as many steps and in order as you can.

(2) What changes in your strategy or plan did you have to make as you went from problem one to two or three?

APPENDIX F

SYLLOGISTIC REASONING

Syllogistic Reasoning

INSTRUCTIONS

1. Read statements.
2. Solve problem.
3. Is the conclusion true or false?
4. Circle the correct answer.

   For Example: Tina is smaller than Sally.
   Sally is smaller than Ann.

   Conclusion: Tina is smaller than Ann. True or False

5. Work as quickly as you can, remembering that being correct is the most important factor.

QUESTIONS

After Each Sheet:

(1) Please describe, in as much detail as possible, the strategy or method you used to solve the problems (including what you were thinking and saying to yourself).

At the End:

(1) What strategy or method did you consider the most effective in solving the problem?

SHEET 1 Time: _____

1. Mary is taller than Sue.
   Sue is taller than Joan.

   Conclusion: Mary is taller than Joan. True or False

2. Ann is shorter than Jane.
   Jane is shorter than Alice.

   Conclusion: Alice is shorter than Ann. True or False

3. Alice is older than Sally.
   Sally is older than Ann.

   Conclusion: Alice is older than Ann. True or False

4. Joan is younger than Susan.
   Susan is younger than Donna.

   Conclusion: Joan is younger than Donna. True or False

5. Betty is taller than Karen.
   Karen is taller than Carla.

   Conclusion: Carla is taller than Betty. True or False

6. Sharon is younger than Cheryl.
   Cheryl is younger than Rita.

   Conclusion: Rita is younger than Sharon. True or False

7. Peggy is older than Ruth.
   Ruth is older than Leanne.

   Conclusion: Peggy is older than Leanne. True or False

8. Marie is shorter than Angela.
   Angela is shorter than Gina.

   Conclusion: Gina is shorter than Marie. True or False

SHEET 2 Time: _____

1. Susan is taller than Ann.
   Jane is taller than Susan.

   Conclusion: Ann is taller than Jane. True or False

2. Frances is shorter than Joan.
   Susan is shorter than Frances.

   Conclusion: Joan is shorter than Susan. True or False

3. Sharon is younger than Mary.
   Leanne is younger than Sharon.

   Conclusion: Leanne is younger than Mary. True or False

4. Norma is older than Alice.
   Karen is older than Norma.

   Conclusion: Karen is older than Alice. True or False

5. Rita is shorter than Janice.
   Sally is shorter than Rita.

   Conclusion: Janice is shorter than Sally. True or False

6. Lily is taller than Ruth.
   Cheryl is taller than Lily.

   Conclusion: Ruth is taller than Cheryl. True or False

7. Allison is younger than Pam.
   Diane is younger than Allison.

   Conclusion: Diane is younger than Pam. True or False

8. Jane is older than Sally.
   Sybil is older than Jane.

   Conclusion: Sybil is older than Sally. True or False

SHEET 3 Time: _____

1. Ann is taller than Alice.
   Susan is shorter than Alice.

   Conclusion: Susan is taller than Ann. True or False

2. Betty is shorter than Gina.
   Sharon is taller than Gina.

   Conclusion: Betty is shorter than Sharon. True or False

3. Marie is younger than Carla.
   Betty is older than Carla.

   Conclusion: Marie is younger than Betty. True or False

4. Cheryl is older than Betty.
   Susan is younger than Betty.

   Conclusion: Cheryl is older than Susan. True or False

5. Norma is taller than Sharon.
   Ruth is shorter than Sharon.

   Conclusion: Ruth is taller than Norma. True or False

6. Ellen is shorter than Susan.
   Alice is taller than Susan.

   Conclusion: Ellen is shorter than Alice. True or False

7. Lily is younger than Susan.
   Pam is older than Susan.

   Conclusion: Pam is younger than Lily. True or False

8. Ann is older than Sarah.
   Becky is younger than Sarah.

   Conclusion: Becky is older than Ann. True or False

SHEET 4 Time: _____

1. Peggy is taller than Susan.
   Peggy is shorter than Becky.

   Conclusion: Susan is taller than Becky. True or False

2. Gina is shorter than Ruth.
   Gina is taller than Leanne.

   Conclusion: Leanne is shorter than Ruth. True or False

3. Carla is older than Diane.
   Carla is younger than Rita.

   Conclusion: Rita is older than Diane. True or False

4. Karen is younger than Susan.
   Karen is older than Anna.

   Conclusion: Anna is younger than Susan. True or False

5. Ann is taller than Susan.
   Ann is shorter than Sally.

   Conclusion: Susan is taller than Sally. True or False

6. Sally is shorter than Pam.
   Sally is taller than Pat.

   Conclusion: Pam is shorter than Pat. True or False

7. Susan is older than Sarah.
   Susan is younger than Joan.

   Conclusion: Sarah is older than Joan. True or False

8. Margaret is younger than Pam.
   Margaret is older than Sally.

   Conclusion: Pam is younger than Sally. True or False

APPENDIX G

CONSENT FORM

PERSONAL FACT SHEET

OUTLINE OF PARTICIPANT INTERVIEW

Consent Form

I, _____, understand that my participation in the study of head injury is to increase understanding of the long-term effects of severe closed head injuries. It is anticipated that further knowledge gained from this study may eventually lead to more effective ways of assisting individuals who have suffered this type of injury.

Through discussions with the principal investigators, I am aware that my involvement will require approximately six hours of my time and one hour of one of my family member's time. Furthermore it has been explained that I will be asked to complete a general ability test, four cognitive tasks, a personality inventory as well as participate in an interview with a certified psychologist who will be asking personal questions. My spouse or other family member has also agreed to be interviewed by the same certified psychologist.

I am also aware that I am free to withdraw from the study at any time or to refuse to complete any tasks or answer any questions. I have been assured that my confidentiality will be strictly protected as all information will be immediately coded and the resulting publication will deal with group findings.

It is my understanding that this study is being conducted by:

R.H. Short, Ph.D.	Department of Educational Psychology University of Alberta
A.F. Wilson, M,D.	Faculty of Medicine, University of Alberta
S.J. Wolfe, M.Ed.	Psychologist, Graduate Student Department of Educational Psychology University of Alberta.

One of the investigators has discussed the study and my participation with me and is willing to answer any other questions that arise.

Signature of Subject _____

Signature of other Family Member _____

Date _____

Witness _____

Personal Fact Sheet

(To be Filled in by Participants)

DATE: _____

SEX: _____ AGE: _____

MARITAL STATUS: Single _____ Married _____ Separated _____

Divorced _____ Remarried _____ Common-Law _____

BIRTHPLACE: _____

BIRTH DATE: _____

ETHNIC ORIGIN: _____

HOW LONG HAVE YOU LIVED IN CANADA: _____

IN ALBERTA: _____

OCCUPATION: _____

NAME OF CURRENT FAMILY PHYSICIAN: _____

FAMILY (no names)

Parents	Age or Birthdate	Education	Occupation	Health (If Deceased, Cause)
Father				
Mother				
Other; e.g. Guardian/ Step-Parent				

Brothers/Sisters (Oldest to Youngest)	Age or Birthdate	Education	Occupation	Health	Marital Status

Husband/Wife (including ex or common-law	Age or Birthdate	Education	Occupation	Health	Marital Status

Children	Age or Birthdate	Education	Occupation	Health	Marital Status

WORK HISTORY

Specify type of work and please explain any career interruptions and job changes. Begin [redacted] recent.

PERIOD FROM/TO	EMPLOYER	LOCATION	JOB DESCRIPTION	REA[redacted]

Please list any medical or psychological testing you have had since leaving the hospital.

NAME OF TESTER (Doctor, etc.)	LOCATION	DATE	TYPE OF TESTING	RESULTS (if known)

EDUCATIONAL HISTORY

POST SECONDARY (Any Type of Training After High School)

PROGRAM (University, College, Apprenticeship)	NAME OF INSTITUTION	LOCATION	AREA OF STUDY	PERIOD OF STUDY From/To	COMPLETED PROGRAM (If No, Why)	DEGREE OBTAINED

HIGH SCHOOL

NAME(S) OF SCHOOL(S)	LOCATION	AREA OF STUDY (i.e., Vocational or Matriculation)	YEARS ATTENDED	GRADES COMPLETED	REASON FOR CHANGING SCHOOLS

ELEMENTARY (If cannot remember specific schools, estimate number of schools)

NAME(S) OF SCHOOL(S)	LOCATION	YEARS ATTENDED	GRADES	REASON FOR CHANGING SCHOOLS

INTERVIEW QUESTIONS - PARTICIPANT
(Outline for Interviewer)

NAME: _____ DATE: _____

PERCEPTION OF ACCIDENT

Date: Type:

Please describe your accident including events and circumstances preceeding and surrounding it.

Emergency Care:

Did anyone administer first aid at the scene of the accident?

Do you know of any medical procedures performed before consciousness was gained (e.g., surgery, tracheotomy)?

Length of time unconscious?

How do you know this?

Length of hospitalization - Acute care hospital?
- Rehabilitation hospital?

Did you require any corrective surgery after you regained consciousness?

Immediately following the accident (0-3 months), please describe:

a) Physical Disabilities:
b) Emotional Changes:
c) Changes in Thinking (memory, reasoning):
d) Changes in Speech:
e) Personality Changes:
f) Other:

Please describe any ways in which you are different at this time than you were before your accident.

a) Physically:
b) Emotionally:
c) Thinking:
d) Speech:
e) Personality:
f) Others:

Personal habits that you are uncomfortable with, or which cause problems for you (e.g., sleep disturbances; inappropriate laughing;nervous mannerisms such as nail biting; shyness; problems stealing; sexual difficulty; eating problems; communication),

a) Before the accident:
b) After the accident (3-9 months):

c) Now:

Please describe your personality traits (strengths and weaknesses) before the accident.

a) Strengths:
b) Weaknesses:

After (3-9 months).

a) Strengths:
b) Weaknesses:

Now.

a) Strengths:
b) Weaknesses:

FAMILY HISTORY AND RELATIONSHIPS

What serious illnesses are in your family including such things as allergies, diabetes, heart disease, cancer, mental illness, mental deficiencies, alcoholism, epilepsy) and the relationship of the person to you (i.e., maternal grandmother, sister)?

Your health - any serious infectious diseases, operations, accidents, hospitalizations, seizures, medication:

a) Before the accident:
b) Since the accident:

Circumstances of your Birth and Early Development

Did your mother have any health problems, take medication, use drugs, drink alcohol, smoke, or have emotional stress during her pregnancy with you?

Delivery - normal, abnormal, complications, forceps, Caesaerian, weight, position; e.g., breech):

Any difficulty with feeding? Were you breast or bottle fed? Allergies?

At what age did you:

a) Sit independently:
b) Walk (at least 10 steps):
c) Use two words together:
d) Speak in short sentences:
e) Toilet trained: Day -
Night -

What general impressions from your parents have you about your birth and early development (e.g., everything normal, problems learning to talk).

How would your parents describe you as an infant (0-2years) (cuddly, restless, colicky, calm, irritable)?

As a preschooler (2-5 years)?

How would you or your parents describe you between the ages of:

a) 6 - 8 years:
b) 9 - 12 years:
c) 13 - 16 years:
d) 17 - 19 years:

Family Relationships

Describe your parents and their marital relationship.

a) Mother:
b) Father:
c) Relationship:

Were your parents ever separated? How long and how often?

If divorced, what age were you when they separated and divorced?

Please describe your relationship with your parents after their divorce.

a) Mother:
b) Father:

Please describe your relationship with your step-parents, if any.

Describe your relationship with your parents (including amount of contact, whether you were living with them).

a) Before the accident:
b) After the accident:

Describe your family's reaction to your accident commenting on the behavior of your:

a) Mother:
b) Father:
c) Siblings:
d) Spouse:

Do you find your accident caused any changes in your family relationships? If so, please elaborate.

Tell me about your relationship with your siblings.

a) Before the accident:
b) After the accident:

If applicable, describe your marital relationship (strengths and weaknesses).

a) Before the accident:
b) After the accident:

How long have you been married?

Before the accident, had you and your spouse ever separated?

Before the accident, did you have any other marital relationships?

If yes, how long were you married to your previous spouse(s)?

Since the accident, have you and your spouse ever separated, considered separation or divorce, or did divorce?

How do you feel your marriage has changed since your accident?

At the present time, are you satisfied with your marriage?

If applicable, what were the ages of your children at the time of the accident?

Please describe your relationship with your children.

a) Before the accident:
b) After the accident (3-9 months):
c) Now:

Did your children experience any emotional changes that you feel are related to the accident?

If not married, were you involved in a significant and intimate relationship prior to the accident?

If yes, please describe the relationship.

a) Before the accident:
b) After the accident:

If you were single and relatively unattached at the time of the accident, please describe your dating and social behavior.

a) Before the accident:
b) After the accident:

WORK/SCHOOL HISTORY

Please describe the type of student you were in elementary or high school (e.g., average, above average, repeat any grades, receive any extra help, special placement, best and worst subjects).

Please describe your post secondary training or education.

Since your accident, have you attended any rehabilitation, retraining, or upgrading programs. If yes, when, how long and describe your progress.

Describe your career plan.

a) Before the accident:
b) After the accident:

What are your career plans now? How do you plan to reach your goals? Are you satisfied with your progress?

Describe your present job.

Are you generally satisfied with and stimulated by your present job?

Since your accident, have you had to make any changes or have you noticed any changes in

a) Your type of work:
b) Your level of responsibility:
c) Your relationship with your co-workers:
d) Your relationship with your supervisor:

Social Relationships

Describe your relationships with other children when you were growing up.

What types of activities were you involved in as a child (sports, hobbies, clubs).

What illegal activities (minor offenses or others) have you been involved in (charged? convicted? committed but not caught, including drugs).

a) As a child:
b) Teenager:
c) Adult, prior to accident:
d) Adult, after accident:

Amount, and kind of alcohol, drug and cigarette consumption (i.e., average amount of alcohol in week).

a) As a teenager:
b) Adult, prior to accident:
c) Adult, after accident:

Describe your relationships and activities when you were a teenager.

Describe your social relationships as an adult.

a) Before the accident:
b) After the accident:

What types of leisure activities and in what capacity are/were you involved in (i.e., sports, community, professional organizations, church groups).

a) Before the accident:
b) After the accident:

How do you feel your accident has affected your social life, social relationships, activities, relationships with friends or co-workers?

Is there anything further you would like to add to give me a better picture of how things are going for you?

Please comment on your feelings while answering these questions.