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By

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ABSTRACT

VARIABLES AFFECTING VOCATIONAL OUTCOME FOLLOWING TRAUMATIC BRAIN INJURY

By

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This study investigated variables associated with successful employment following severe traumatic brain injury. Each year an estimated 500,000 to 750,000 individuals are afflicted by traumatic brain injury (National Head Injury Foundation, 1984). Those who survive traumatic brain injury are most often under the age of 25 (Karpman, Wolfe & Vargo, 1985). In fact, Rimel & Jane (1983) estimated that 72 percent of all traumatic brain injuries occur to individuals under the age of 30.

This study compared head injury survivors at various levels of employment on a number of variables including severity of injury, neuropsychological functioning, and premorbid employment characteristics. Subjects were sampled from three rehabilitation facilities located in three Midwestern states. All subjects had suffered severe closed head injuries with a length of coma of at least 24 hours.

Comparative analyses revealed significant differences between employment groups on measures of neuropsychological functioning and severity of injury. Those employed full time or successfully enrolled in college consistently exhibited less impaired neuropsychological abilities and shorter periods of coma as a group than those subjects employed part time, involved in sheltered or fully supported employment, or unemployed. A discriminant function analysis correctly classified those subjects who were employed full time or enrolled in college with 78% accuracy and

classified those subjects employed part time, involved in sheltered or supported employment, or unemployed with 79% accuracy.

The duration of time from the date of the injury until the first job was obtained was investigated. Those subjects with periods of coma of fifteen days or less had considerably shorter periods of unemployment post-injury than those subjects with periods of coma greater than fifteen days.

Premorbid occupational status had no direct effect upon employment status post-injury. However those subjects in higher skilled occupations premorbidly earned a greater hourly wage and worked more hours per week post-injury than those subjects who had been in unskilled positions prior to their injuries. Those in unskilled positions were younger at the time of their injury and at the time of the survey than those subjects from other occupational categories.

The results of the study indicate that there are significant differences between those subjects in different levels of employment on measures of neuropsychological functioning and severity of injury. Those subjects in the most demanding outcome categories (full-time employment, successful enrollment in college) exhibited less impairment in neuropsychological abilities and shorter periods of coma than those subjects in other employment categories. This indicates that neuropsychological measures can make significant contributions to vocational rehabilitation planning particularly in decisions regarding the appropriate level of employment for a particular client.

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A final gesture of appreciation, respect, and admiration goes out to the individuals and family members affected by traumatic brain injury. It is to their courage and humanity thai I dedicate this study.

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CHAPTER I

INTRODUCTION

Epidemiology

Traumatic brain injury is a term that encompasses a variety of conditions involving external insults to the head culminating in brain damage. Head injury, head trauma and brain injury all refer to conditions of traumatic brain injury and may be used interchangeably hereafter. Traumatic brain injuries may be categorized as either open or closed head injuries. Open head injuries are characterized by penetration of the skull by an external object. Closed head injuries are a result of rapid acceleration of a stationary or slower moving head by a moving object (acceleration injuries) or by rapid deceleration of the head as it comes in contact with a stationary or slower moving object (deceleration injuries) (Levin, Benton & Grossman, 1982).

The National Head Injury Foundation (1984) estimated the number of persons who survive a traumatic brain injury to range from 500,000 to 750,000 annually in the United States. Corthell & Tooman (1985) estimated the number of annual survivors in the United States to be approximately 335,000. However, these estimates may be conservative when estimating the incidence of mild head injuries which often go undiagnosed. For example, Conboy, Barth & Boll (1986), when estimating the inclusion of mild head injuries into the annual incidence stated that there are ". . . nearly 8 million recorded head injuries annually in the United States" (p. 203). One example of undiagnosed head injuries occurs within the context of spinal cord injury. The potential for undiagnosed concomitant head injury with spinal cord injured patients is well documented (Wilmot, Cope, Hall & Acker, 1985; Davidoff, Morris, Roth & Bleiberg, 1985; Bleiberg, 1984).

Traumatic brain injury is the leading cause of death among the young and the most frequent cause of brain damage for those under 40. As Rimel & Jane (1983) stated, "More persons die on American highways each year in automobile accidents than were lost in the entire Vietnam conflict, and central nervous system (CNS) trauma is the single most common cause of death in these accidents" (p. 9). This type of injury occurs most frequently in those under the age of 25 (Karpman, et al., 1985). Motor vehicle accidents account for nearly half of all traumatic brain injuries. Males comprise two-thirds of all victims (Rimel & Jane, 1983). Of those injured, nearly 60 percent are single white students and a disproportionate number are unemployed (Rimel & Jane, 1983). An estimated 50,000 people are permanently disabled annually as a result of traumatic brain injury (National Head Injury Foundation, 1984). Kalsbeek, McLaurin, Harris & Miller (1980) estimated the direct and indirect costs of head injury to be approximately 4 billion dollars annually.

A person who has suffered a head injury is three times more likely to suffer a second head injury and among those who have had more than one head injury, the incidence of a subsequent head injury is eight times that of the general population (Rimel & Jane, 1983). An estimated 25 percent of patients who suffer head injury required some form of professional treatment for alcohol abuse premorbidly (Rimel & Jane, 1983).

Traumatic brain injury is more than five times as frequent as spinal cord injury or multiple sclerosis, twice as common as cerebral palsy and more than eight times as frequent as muscular dystrophy (Kraus, et al., 1984). Despite the onset of traumatic brain injury, the life expectancy is 40 years from the time of injury for survivors which is close to a normal life expectancy (Rimel & Jane, 1983). The majority of head injured victims are met with disability during the years most often associated with employment. The National Head Injury Foundation has referred to head injury as the "silent epidemic," appropriately depicting the astronomical incidence yet the potential for oversight and undiagnosis.

Threats to Employment

Despite the value of work, the potential to engage in gainful employment is frequently threatened following traumatic brain injury. This is due to any number of medical, physical, cognitive, psychosocial and behavioral deficits which serve as obstacles toward return to employment.

The value of work in our society cannot be underestimated. Certainly financial issues place emphasis on the value of work in order to afford commodities such as housing, food, clothing and other necessary items. Society benefits from the work of its members both in terms of production and labor. Additionally, society benefits financially through tax revenues generated by employment.

Numerous psychological factors are influenced by the ability to engage in gainful employment. A sense of self-worth and esteem are influenced by one's ability to feel productive and useful. Additionally, work provides for the productive structuring of time which was felt by Berne (1961) to be crucial for adaptive functioning. In fact, Freud once identified the most significant indication of a psychologically normal person was the ability to love and to work effectively (Erikson, 1950).

The impact of unemployment often serves to exacerbate problems in psychosocial functioning and family adjustment. Oddy, Coughlan, Tyerman & Jenkins (1985) stated that unemployment exacerbated difficulties in social functioning often resulting in the head injured patients experiencing social isolation, decreased self-worth and despair. Bond (1976) found that work and leisure activities were the most disrupted aspects of daily life following severe head injury.

Among the numerous benefits experienced through gainful employment, the opportunity for social contact is invaluable. Thomsen (1974) found that the main problem most frequently mentioned by severely head-injured patients is a lack of social contact often attributed to diminished opportunities to make friends since much of their time is spent at home. Lishman (1978) stated that those who suffer head trauma encounter difficulties in vocational, personal and social adjustment. Oddy, et al. (1985) in a study of head injured patients found that, ". . . those who were working had been able to rebuild their social lives and sometimes marry" (p. 567).

Statement of the Problem

Several issues become apparent after gaining familiarity with the "silent epidemic" referred to as traumatic brain injury. The fact that this condition is occurring at epidemic rates with estimates as high as 8 million injuries annually emphasizes the alarming extent of the problem. A closer look reveals that this epidemic is greatest among the youth of our nation with 72 percent of all injuries occurring to individuals under the age of 30 (Rimel & Jane, 1983).

One significant issue which emerges is the fact that an epidemic disabling condition among the youth has a deleterious effect upon subsequent employment. The constellation of deficits that is associated with traumatic brain injury presents numerous obstacles related to employment. The need for innovative rehabilitative services to overcome the obstacles to employment posed by traumatic brain injury is clear.

Research that investigates the complex relationships between traumatic brain injury and subsequent employment offers the potential to increase our understanding of specific sequelae of traumatic brain injury and their impact upon employment. Increased knowledge of these relationships can assist in the development of innovative methods for vocational rehabilitation.

The subject of study is the effect that severe traumatic brain injury has upon employment. Severe traumatic brain injury is defined in this study as a length of coma of at least 24 hours. Characteristics associated with severe traumatic brain injury were analyzed with regard to their influence upon subsequent employment. These characteristics include indices related to the severity of the injury, and measures of neuropsychological abilities. The study also investigated the relationship between premorbid employment characteristics including level of employment and occupation and vocational outcome following the injury.

Two additional areas of investigation were pursued. The duration of time from the injury until the first job was obtained post-injury was examined. This was investigated to ascertain whether there are optimal time periods to return to work and whether the time periods are related to the severity of the injury. For example, are there differences in vocational outcome between those subjects who return to work within two years compared to those who do not return to work until three years? Do those subjects who suffer shorter periods of coma return to work sooner? Another area of study involved the relationship between initial employment success and the degree of vocational success at the time of the survey. Estimates of initial employment success included the number of months employed on the first job and client self-ratings of initial success.

Definitions

Within this area of investigation, certain definitions were important in order to maintain clarity in describing certain phenomena. The first definition pertains to severity of injury. A more thorough review of definitions related to severity is provided in the second chapter.

Few studies have investigated the incremental impact of loss of consciousness beyond 24 hours on subsequent vocational outcome. Some authors have stated that a lengthier period in loss of consciousness (L.O.C.) is negatively associated with successful vocational outcome (Carlsson, Von Essen & Lofgren, 1968; Cartlidge, 1981; Plum & Levy, 1978). Thomsen (1974) incorporated the term "very severe head injury" to describe a group of patients with a duration of post-traumatic amnesia of at least one month. Very few of these patients (less than 5%) were employed on a full-time basis at a 10-year follow-up study (Thomsen, 1984). This suggests that increased severity of traumatic brain injury as inferred by length of coma or post traumatic amnesia presents significant obstacles toward employment. It was, therefore, important to investigate the impact of the duration of loss of consciousness beyond the minimal level of 24 hours to investigate its relationship with subsequent vocational outcome.

The following categories were offered based in part on conventional increments of time which we use in everyday terminology (i.e., day, week, month):

1. Severity Level I (L.O.C. of 24-72 hours).
2. Severity Level II (L.O.C. of 4-7 days).
3. Severity Level III (L.O.C. of 8-15 days).
4. Severity Level IV (L.O.C. of 16-30 days).
5. Severity Level V (L.O.C. greater than one 30 days).

Another definition related to the term work or employment. To obtain clear and accurate assessment of work or employment estimates following traumatic brain injury, the following categories were offered:

1. Full-Time Employment
    a. Professional, managerial, technical
    b. Clerical
    c. Service
    d. Structural
        1) Skilled
        2) Unskilled
2. Part-Time Employment
3. Supportive Employment/Sheltered Employment
4. College
5. Unemployed

The occupational categories under the heading of full-time employment are listed within the Dictionary of Occupational Titles and utilized by Fraser, Dikmen, McLean, Miller & Temkin (1988) in a study related to vocational outcome one year following traumatic brain injury.

A number of measures of cognitive functioning were utilized in this study. The Wechsler Adult Intelligence Scale - Revised is frequently included in assessment of cognitive functioning following traumatic brain injury. The following indices were utilized to investigate estimates of cognitive functioning:

1. Full Scale I.Q.
2. Verbal I.Q.
3. Performance I.Q.
4. Specific Subtest Scores

The Full Scale I.Q. provides a global estimate of overall intellectual functioning. The Verbal I.Q. provides an estimate of various verbal, language mediated abilities over six subtests. The Performance I.Q. while not devoid of language mediation, provides a broad estimate of various perceptual-motor integrative tasks. Finally, the Digit Symbol test provides a measure of grapho-motor speed and integration. This subtest of the WAIS-R was indicated by Fraser, et al. (1988) to have high predictive validity in discriminating between those successfully employed and unemployed following brain injury.

Hypotheses

Within this investigation, the following hypotheses were tested:

Hypothesis 1:

> The extent of severity of injury (L.O.C.) is negatively correlated with successful vocational outcome.

Hypothesis 2:

> Neuropsychological abilities are positively related to successful vocational outcome.

Hypothesis 3:

> Differences in premorbid employment status are associated with differences in vocational outcome following traumatic brain injury.

Hypothesis 4:

Differences in the time in which employment re-entry occurs following traumatic brain injury is correlated with differences in successful vocational outcome.

Hypothesis 5:

The extent of successful initial employment following traumatic brain injury is positively correlated with subsequent employment success.

CHAPTER II

REVIEW OF LITERATURE

Pathophysiology

Traumatic brain injuries may be categorized as either open or closed head injuries. Open head injuries are characterized by penetration of the skull by an external object. This results in laceration of the scalp and perforation or fracture of the skull with subsequent destruction of brain tissue within the path of the missile. Bone fragments may penetrate the brain contributing to brain tissue damage (Levin, Benton & Grossman, 1982). Focal lesions result and functional impairment frequently is more localized to the specific site of injury and dependent upon the extent of brain tissue damage.

Closed head injuries are attributed to rapid acceleration of a stationary or slower moving head by a moving object or by rapid deceleration of the head as it comes in contact with a stationary or slower moving object (Levin, Benton & Grossman, 1982). Brain damage from closed head injury is caused by the physical properties of the brain and skull. The skull is hard and rigid with an irregular internal contour. This is in marked contrast to the brain which is a soft mass of jelly-like consistency (Corthell & Tooman, 1985). The volume of the brain is incompressible although its mass can shift and move when violently disturbed.

In the case of rapid acceleration or deceleration injuries, the brain is thought to rotate rapidly, contacting the skull in the process. The soft matter of the frontal and temporal lobes collide against the sharp protrusions of the sphenoid (Teasdale & Mendelow, 1984). Frontal and temporal regions are the most common sites for contusions regardless of where the skull is struck (Ommaya, Grubb & Naumann, 1971).

The result of a rapid acceleration or deceleration injury is diffuse axonal injury thought to occur by a shearing mechanism of the rapid yet differential movement of nerve fibers (Teasdale & Mendelow, 1984). Contusions may be produced at the site of impact (referred to as coup injuries) or in the area opposite the blow (referred to as contrecoup injuries). Whereas contusions are associated with focal deficits, diffuse axonal injury is thought to produce widespread impairment over a constellation of functions including physical, cognitive and behavioral (Corthell & Tooman, 1985).

Loss of consciousness is believed to reflect varying degrees of severity of diffuse axonal injury. This may include damage to the reticular activating system in the brain stem which regulates arousal. As Teasdale & Mendelow (1984) stated, "Whether there is a degree of injury sufficient to disturb hemisphere function and produce unconsciousness without involving the brainstem has not been established" (p. 9). Although most patients ultimately regain arousal following coma, axonal injury almost always results in varying degrees of permanent impairment in cognitive functions such as attention, speed of information processing, memory, concept formation and other abilities.

Secondary brain damage is a frequently documented occurrence following traumatic brain injury and may be due to either intracranial or extracranial events. Intracranial complications include intracranial hematomas, brain swelling, infection, hemorrhage and hydrocephalus.

Intracranial hematomas are caused by bleeding inside the skull which subsequently forms clots. An extradural hematoma is a clot which forms between the skull and meninges. This is usually associated with a skull fracture. Extradural hematomas are frequently associated with little or no primary brain damage and results of evacuation are usually good (Teasdale & Mendelow, 1984). Intradural hematomas are more common and more frequently associated with primary brain damage. The impact of an intradural hematoma is to inflict additional compression on the brain within the skull resulting in distortion of brain mass and coinciding cell death. Results of evacuation of intradural hematomas are not universally successful and if left unattended may result in increased brain pathology over time.

Brain swelling is caused by either an increase in cerebral volume or intracellular fluid. The cerebral volume is increased by blood circulated from the arterial, capillary and venous systems usually due to hypoxia or hypercapnia. Cerebral edema may obstruct circulation and result in an increase in blood volume. A condition referred to as vasogenic edema involves a disruption of the blood-brain barrier which allows movement of large molecules into the interstitial space. This results in an accumulation of fluid into the extracellular space resulting in brain swelling (Teasdale & Mendelow, 1984).

A condition known as cytotoxic edema entails the accumulation of fluid within the cell due to ischemia. Hydrostatic edema is a result of increased intravascular pressure due to a disruption of cerebrovascular regulation or an increase of venous pressure. A condition known as interstitial edema is found around the ventricles and associated with hydrocephalus and obstruction of cerebrospinal fluid.

Brain swelling may result in brain shift and intracranial pressure. Hypoxia or ischemia may then occur, resulting in additional brain damage.

Infections such as brain abscess or meningitis may occur several days following the injury. This is more likely to occur following a depressed skull fracture. If the fracture includes the skull base and nasal sinuses, leakage of cerebrospinal fluid may result (Teasdale & Mendelow, 1984). An increase in intracranial pressure may follow. Brain abscess may produce an increase in intracranial pressure or brain shift, both presenting additional risks of brain damage. Meningitis may contribute to an increase in intracranial pressure and is frequently thought to result in communicating hydrocephalus.

Additional intracranial factors which may occur include subarachnoid hemorrhage and hydrocephalus. Subarachnoid hemorrhage may lead to vasospasm with a resulting reduction of cerebral blood flow and ischemic brain damage (Macpherson & Graham, 1978). Hydrocephalus frequently occurs as a result of failure of cerebrospinal fluid to be absorbed in the arachnoid villi usually due to an obstruction.

Secondary brain damage may be due to extracranial factors in which injuries to other parts of the body may result in hypoxia or hypotension (Teasdale & Mendelow, 1984). Injuries to the chest frequently result in rib injuries which may obstruct movement of oxygen into and out of the lungs and result in an inadequate supply of oxygen to the brain. Aspiration of vomit may obstruct air flow. Blood loss from associated injuries may result in a dramatic reduction of blood pressure and may culminate in shock.

Secondary brain damage is ultimately due to a reduction in energy supplied to the brain usually due to hypoxia. The source of energy to the brain is derived in part by oxygen. A temporary reduction of oxygen to the brain produces a temporary cessation of brain functions. However, with prolonged reduction of oxygen, permanent brain damage occurs. Intracranial abnormalities such as ischemia and extracranial dysfunctions such as systemic hypoxia are the most common sources of brain tissue hypoxia resulting in damage.

Immediate Recovery

The term recovery is somewhat of a misnomer in describing the events that transpire following traumatic brain injury. Whereas recovery is typically associated with regaining function, within this context it will refer to subsequent changes in all spheres of functioning directly related to changes in neuronal functions.

The term spontaneous recovery is used to describe the healing that occurs within the brain itself following injury. This has been thought to entail the rectification of secondary factors such as evacuation of hematomas, reduction of brain swelling and intracranial pressure as well as the reestablishment of neuronal functioning.

Although spontaneous recovery has been conceptualized as a passive process associated with time, this is refuted by Stein (1987), who stated, "In fact, in some quarters, it is argued that rehabilitation therapy should not be initiated until all the spontaneous recovery that might occur has been completed. We now know that recovery is not 'spontaneous', nor is it time itself that mediates necessary events" (p. 6).

One of the active processes which Stein (1987) describes is the production of endogenous, growth promoting substances by the brain referred to as trophic factors. Trophic factors are thought to enhance the survival of neurons that may otherwise expire following brain injury. It has been observed that trophic substances are highly concentrated near the site of the injury with a peak occurrence of seven to ten days post-injury.

Unfortunately, brain injury may also be associated with the production of neurotoxic substances which are capable of destroying neurons or obstructing regenerative mechanisms. The extent of recovery is due in part to the competition between trophic and toxic substances and the subsequent outcome on neuronal regeneration (Stein, 1987).

Another active process which plays a significant role in spontaneous recovery is neuronal sprouting which signifies the establishment of new and alternate pathways and connections between neurons. This process is thought to help compensate for brain damage and cell death by providing alternate pathways and connections for surviving neurons thus contributing to recovery of function. In some instances, neuronal sprouting may be maladaptive and impede adaptive functions. Schneider & Jhaveri (1974) cite an example of maladaptive neuronal sprouting in hamsters. Damage to the superior colliculus resulted in optic fibers growing back across midline and reinnervating the ipsilateral superior colliculus. The resulting function entailed the hamster moving away from objects it desired because the object was perceived in the wrong visual field.

The issue of regaining consciousness following traumatic brain injury has assumed considerable significance in the classification of head injuries as well as establishing prognosis (Teasdale & Jennett, 1976). The definition of coma frequently involves confusion and disagreement. The Glasgow Coma Scale utilizes separate assessments of eye, verbal and motor responses to derive an index relating to the level of coma (Teasdale & Jennett, 1984). This scale provides an objective means of assessing coma and increasing the reliability among practitioners. The duration of coma may then be utilized to classify the severity of the head trauma as well as to make conjectures regarding prognosis.

An alternative method utilized to classify head injuries and to offer prognoses is the duration of post-traumatic amnesia. Symonds & Russell (1943) suggested that the duration of time from the injury until the recovery of on-going memory correlated with the extent of brain damage. This has become a widely used index in classifying the severity of brain damage. This becomes even more challenging to reliably assess due to confusion regarding the recovery of on-going memory. Levin, O'Donnell & Grossman (1979) offered an objective instrument referred to as the Galveston Orientation and Amnesia Test (hereafter referred to by the acronym GOAT) to assess the duration of post-traumatic amnesia. This instrument measures orientation to person, place and time, and memory for events preceding and following the injury.

Whether utilizing the length of coma or the duration of post-traumatic amnesia, considerable variability exists in the classification of head injuries in terms of level of severity. For example, Karpman, Wolfe & Vargo (1985) defined severe head injury as one resulting in a coma lasting over six hours and a post-traumatic amnesia over 24 hours. Thomsen (1974) defined severe head injury as one which includes a coma of at least 24 hours. Weddell, Oddy & Jenkins (1980) referred to a severe closed head injury as entailing a post-traumatic amnesia of at least seven days. Thomsen (1984) referred to "very severe head injury" as including a post-traumatic amnesia with a duration of at least one month. Jennett (1984) defined severe head injury as including a period of coma of at least six hours and a duration of post-traumatic amnesia greater than two days. Rimel, et al. (1982) classified severity of head injury based upon scores from the Glasgow Coma Scale with a severe head injury constituting a score of eight or less. Given the documented variability in determining the criteria for severity of injury, inconsistency among authors and clinicians in defining severity of head injury certainly exists.

As a patient exhibits arousal from coma, numerous changes may occur. These changes are not uniform and may not be exhibited by all patients. They represent changes in the brain's ability to process information, maintain attention, register information to memory, execute motor acts, inhibit impulses and perform numerous other skills. A helpful model to conceptualize the progression of arousal from coma is the Levels of Cognitive Functioning developed by the staff at the Rancho Los Amigos Hospital. This model is as follows:

1. No Response: The patient is in deep coma and completely unresponsive.
2. Generalized Response: The patient reacts inconsistently and non-purposefully to stimuli in a nonspecific manner.
3. Localized Response: The patient reacts specifically but inconsistently to stimuli, orienting, withdrawing, or even following simple commands.
4. Confused-Agitated: The patient is in a heightened state of activity with severely decreased ability to process information.
5. Confused, Inappropriate, Non-agitated: The patient appears alert and is able to respond to simple commands fairly consistently, however, with increased complexity of commands or lack of any external structure, responses are

nonpurposeful, random, or at best fragmented toward any desired goal.

6. Confused-Appropriate: The patient shows goal-directed behavior, but is dependent on external input for direction.

7. Automatic-Appropriate: The patient appears appropriate and oriented within hospital and home settings, goes through daily routine automatically, but frequently robot-like, with minimal to absent confusion, and has shallow recall of what he/she has been doing.

8. Purposeful and Appropriate: The patient is alert and oriented, is able to recall and integrate past and recent events, and is aware of and responsive to his/her environment.*

These stages provide a descriptive sequence which is helpful to characterize the level of arousal and cognitive functioning of the patient. Patients may exhibit characteristics from more than one stage and a caveat may be raised that these stages should be used as a descriptive schema to help our understanding of the particular status of a given patient, not as a rigid diagnostic scale in which patients are pigeonholed. Patients differ in the speed in which they pass through stages. Longer periods of coma and post-traumatic amnesia are often associated with slower progression through these stages (Corthell & Tooman, 1985).

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*Original scale co-authored by Chris Hagen, Ph.D., Danese Malkmus, M.A. and Patricia Durham, M.S., Communication Disorders Service, Rancho Los Amigos Hospital, 1972.

These stages provide useful information regarding the level of competence in a number of cognitive and behavioral domains. As such, they offer insight into treatment planning and specific interventions that may be most appropriate at a particular stage. The first two stages describe coma and as such much of the treatment planning centers around medical management and stimulatory therapies aimed at increasing arousal and preventing sensory deprivation (National Head Injury Foundation, 1983). It is important to minimize the use of medications which have sedative side effects which may impede arousal with those patients in coma (Whyte & Glenn, 1986). Sensory stimulation may increase input into the reticular activating system which may in turn enhance arousal thus increasing a patient's responsiveness. As Whyte & Glenn (1986) stated:

> When patients spontaneously recover to a point where minimal awareness or responsiveness is possible with maximal stimulation, although response may be inconsistent and of no functional significance, to leave the patient without any stimulation while waiting for further improvement would amount to environmental deprivation. This has been shown to retard recovery and development of central nervous function in animals and humans. (p. 42)

The third stage describes increased arousal which begins to differentiate patients who are entering out of coma. The emphasis of intervention at this stage includes the continuation of medical management. Sensory stimulation may include more localized input with basic commands aimed at increasing responsiveness.

Medical management in the acute period following head injury and for patients with prolonged periods of coma is imperative in order to prevent the development of medical complications. The prevention of seizures is most frequently implemented through the use of prophylactic anticonvulsants (Jennett & Teasdale, 1981). Hypertension is commonly observed in patients following head injury. Beta-blocking medications are frequently utilized to control hypertension. These medications also have sedating properties and should be used prudently (Whyte & Glenn, 1986). Urinary tract infections occur frequently following head injury. Postvoid residuals should be monitored for completeness of emptying and urodynamic studies may be indicated in cases of incomplete voiding.

Disorders of muscle tone may require prescribed treatment to avoid the development of contractures. Decubitus ulcers are a common problem with the unaroused patient and may be prevented by regular increments of turning and repositioning the patient. Heterotopic ossification is an abnormal growth of bone usually around the joints of spastic extremities. Prophylaxis may be accomplished through the administration of diodium etidronate (Spielman, Gennarelli & Rogers, 1983).

The fourth stage of the Rancho's Scale signifies a marked increase in arousal. Despite this increase in arousal, attention and information processing are greatly impaired. The patient's cognitive abilities are greatly hindered and overall thought processes are characterized by confusion. There may be contamination of memory by confusion and learning is extremely limited. Confabulation is commonly observed and thought to be related to confusion. This impairment may be further exacerbated by fatigue which is a prominent symptom in this stage.

Additional symptoms which are common at this stage include increased psychomotor activity and disorientation. The patient may exhibit periods of increased psychomotor activity in a nonpurposeful manner which is often referred to as agitation. Post-traumatic amnesia continues through this period typified by the absence of memory of day to day events. The patient's behavior may be unpredictable, bizarre and impulsive (Rosenthal, 1983). Furthermore, the patient's behavior is often inconsistent, fluctuating between stuporous decreased arousal to a state of increased arousal and agitation (Rosenthal, 1983).

As the patient is able to deal with only minimal stimulation, measures should be taken to provide an appropriate level of stimulation. The amount of stimulation provided should be based upon the individual patient's ability and tolerance (Howard, 1985). As the amount of stimulation exceeds the patient's tolerance, agitation, irritability and outbursts frequently occur. Stimulation should be monitored from all sensory modalities and include everything from the amount of noise, lighting, the amount of visual stimulation as well as the complexity of the demands placed upon the patient. Directions should be clear and concrete. Duration of activities must coincide with the patient's tolerance so as to avoid excessive fatigue. Orienting objects such as family pictures and familiar materials may assist in the orientation process. Volume and tone of voice must be evaluated in relation to the patient's tolerance. Redirecting patients may be less invasive than attempting to obstruct the patient and may prevent agitation.

As the patient moves out of the agitated state and becomes more oriented to daily events, improvement in cognitive functioning is observed. Decrease of agitation and improvement in attention and information processing typify an improvement from the Confused/Agitated state of level 4 of the Rancho's Scale to level 5, referred to as Confused/Inappropriate. The patient's ability to respond to commands and directions improves. Ability to learn increases but remains minimal. Memory continues to be impaired with confusion continuing to contaminate accuracy of retrieval. The patient may be more amenable to redirection and more responsive to clear and concrete directions. The threshold for fatigue and overstimulation may be slightly improved.

Progression to level six of the Rancho's Scale, referred to as Confused/Appropriate is characterized by improvement in attention and information processing and a reduction of extreme confusion. The patient is more amenable to limited learning and orientation. Memory of daily events may improve and some awareness of one's condition may emerge. The patient is more able to participate in self-care and activities of daily living with decreased supervision. Endurance improves and the patient may be able to tolerate therapy sessions of increased duration and complexity. Sustained attention is increased and memory is less contaminated by confusion.

Improvement to level 7 of the Rancho's Scale, referred to as Automatic/Appropriate, is characterized by significant improvement in attention and information processing. Confusion has subsided with memory of daily events contingent upon the level of memory impairment. Post-traumatic amnesia will have terminated and there is a greater and more coherent sense of awareness of self, surroundings and activities. Learning ability is greatly improved and tolerance for complexity has increased. Communication is typically more coherent although it still reflects concreteness of thought. Ability to perform self-care and activities of daily living may require minimal supervision depending upon the level of physical and cognitive impairment. Therapy may focus upon mastery of activities of daily living and may begin to address independent living skills. Specific cognitive rehabilitation sessions may be implemented based upon the profile of cognitive impairment.

Improvement to level 8 of the Rancho's Scale, referred to as Purposeful/Appropriate, marks the final progression within this schema. Sustained attention and information processing have improved and the patient requires less structured supervision. Thought processes are more coherent with memory for daily events exhibiting more continuity and less contamination. Learning ability has improved and many patients are independent in activities of daily living and mobility depending upon the extent of physical and cognitive deficits. Communication is more coherent. The patient's behavior is typically more goal directed and purposeful. Awareness of injury has increased. The ability to deal with increased complexity is frequently observed compared to previous stages.

While the Rancho's Scale provides a descriptive paradigm with which to understand a patient's status, the scale becomes less descriptive at level eight beyond the features mentioned. Any number of patients who may all meet the criteria for level eight, may have differentiated functional profiles based upon differences in physical, cognitive, psychosocial and behavioral impairment. For example, a patient who remains nonambulatory due to hemiplegia, who remains moderately dysarthric with a prominent right homonomous hemianopsia with additional impairment in visual scanning and visual spatial organization, whose demeanor may be cooperative is fairly differentiated from another patient who is ambulatory, articulate in speech with severe memory impairment and difficulties in initiation and inhibition which result in considerable behavioral dysfunction. Both patients may meet the criteria for level eight with highly differentiated profiles requiring different treatment approaches.

Neuropharmacology

During recovery, the impact of psychoactive drugs may have a significant effect upon the recovering brain. Traumatic brain injury includes disturbance of neurotransmitter functioning and there is great variability as to specific disruption and extent of neurotransmitter functioning across the constellation of traumatic brain injury (Cope, 1988). Deficiencies of catecholominergic and serotonergic metabolites in the cerebrospinal fluid of traumatic brain injured patients are routinely reported which vary due to the specific neuroanatomical characteristics of the original brain injury (Cope, 1988). As Cope (1988) stated, "Even purely focal CNS injuries are known to have neurotransmitter effects far beyond the site of the injury. The condition of TBI has a varying profile of affected neurotransmitter systems from case to case" (p. 20).

Given these factors involving the potential functioning of neurotransmitters, the decision to use psychopharmacological agents for head injured clients requires careful consideration. The psychoactive properties of these drugs is primarily attributed to their impact and modification of neurotransmitter physiology. Additionally, the brain appears to have responses to drug interactions which are homeostatic in nature which result in further alteration of its own neurophysiology. These responses may be maladaptive as in the case of tardive dyskinesia related to the use of antipsychotic medication. In fact, the American Psychiatric Association (1985) stated that the use of neuroleptic medication for organic brain syndromes should be reserved for only short-term management not to exceed six months.

As Cope (1988) stated, "There is evidence that certain neuroactive drugs may either enhance or retard recovery from neurological lesions" (p.

22). Feeney, Gonzalez & Law (1982) found that the administration of amphetamine resulted in significant acceleration of recovery from hemiplegia in ablation and contusion studies with rats. Cope (1988) stated that a pharmacological approach to comatose or poorly aroused brain-injured patients may entail the use of catecholaminergic agonists such as amphetamine or L-Dopa which have been observed to enhance arousal.

Conversely, Feeney, et al. (1982) found that a single dose of haloperidol, a catecholaminergic blocking agent, resulted in significant delay of motor recovery in ablation and contusion studies with rats. Cope (1988) stated that ". . . even beyond the acute post-injury phase the use of catecholominergic blocking agents may increase expressed neurologic dysfunction" (p. 22). Porch, et al. (1985) observed that the use of haloperidol in the clinical management of aphasic patients resulted in a poorer recovery from their aphasic disorder than would be expected.

Endogenous depression may be an observed residual following traumatic brain injury. There is evidence from stroke patients that a form of depression may occur as a direct result of the brain injury. These patients respond to tricyclics as well as non-neurologically impaired depressed patients (Robinson, Starr, Lipsey, Rao & Price, 1985; Lipsey, Robinson, Pearlson, Rao & Price, 1984). However, an associated effect of tricyclic medications is a strong anticholinergic effect which may impede cognitive functioning. Careful consideration is warranted prior to the administration of tricyclic medication in the treatment of depression with brain injured patients.

Psychopharmacological agents have been utilized to accelerate remediation of cognitive deficits. Most frequently, cholinergic agonists such as amphetamine, and certain neuropeptides have been used to facilitate arousal and improvement in mentation (Evans, Gualtieri & Patterson, 1987).

The most frequent use of psychoactive drugs is in the management of the agitated organic brain injured patient. As discussed in describing levels four and five of the Rancho's Scale, with increased arousal from coma, cognitive functioning often lags behind motor recovery. The patient is frequently confused and irritable yet impervious to normal reassurance or counseling. These patients can be extremely difficult to manage and occasionally impossible to control unless sedated (Cope, 1988). As Cope (1988) stated, ". . . an economic incentive exists to control behavior by non-labor intensive means" (p. 28). This frequently entails the administration of neuroleptics despite little controlled evidence regarding their efficacy.

Antipsychotic medication is epileptogenic, thus increasing the risk for post-traumatic seizures. Additionally, there is a strong anticholinergic effect which is thought to impede cognitive functioning.

Minor tranquilizers such as benzodiazepines may exacerbate agitation and should be utilized only in acute behavioral emergency. They are also cortical suppressants thus impeding arousal and cognition. They are frequently utilized in the treatment of spasticity. In this instance, the trade-off between spasticity reduction and reduced arousal and cognition must be considered.

Anticonvulsants are utilized as a prophylaxis for seizures. However, phenobarbital and phenytoin are implicated in the reduction of arousal and cognition. Cope (1988) stated, "It has not been demonstrated that the use of anticonvulsants for prophylaxis of epilepsy is useful, and therefore should no longer be considered valid" (p. 33). Carbamezapine does not appear to impede cognitive functioning at therapeutic levels. In fact, some studies suggest that it may enhance mood, attention and information processing. In the case of seizure prophylaxis, it should be considered the medication of choice (Evans & Gualtieri, 1985).

Recovery following traumatic brain injury is influenced by numerous factors and improvement as such is probabilistic. As Stein (1988) stated, "Posttramatic recovery and/or impairment is rather a complex series of 'environmental' events whose outcome depends on the specific context in which the injury occurs" (p. 7).

Physical Deficits

Physical deficits following traumatic brain injury may vary in level of severity, type of impairment and extent of disability. They are typically associated with damage to the brain as opposed to the peripheral parts of the body. As such, prognosis is difficult to determine and is based in part on the improvement of the brain functioning as well as corrective treatment. Disorders of movement may include a number of different conditions. Spasticity is commonly observed following traumatic brain injury and is characterized by a hyperflexive state of the deep tendons with increased muscle tone. Spasticity is unidirectional with greater resistance in antigravity muscles. Resistance of the spastic muscle increases as the velocity of this passive resistance increases (Carew, 1985). Spasticity impedes motor functioning and may interfere with mobility and activities of daily living. If left untreated, it may result in contractures.

Loss of motor functioning may vary in severity from weakness to paralysis and may affect any or all extremities. Monoplegia involves paralysis of one extremity while hemiplegia involves paralysis of both upper and lower extremity on one side of the body. Paraplegia includes paralysis of lower extremities with quadriplegia involving paralysis of both upper and lower extremities. Decorticate hemiplegia involves paralysis including flexion of the upper extremity and extension of the lower extremity while decerebrate hemiplegia includes extension of both extremities on one half of the body (Nelson, 1983).

Decreased function and weakness referred to as paresis is common following traumatic brain injury. This may entail extremities on one half of the body (hemiparesis), lower extremities (paraparesis) or all extremities (quadriplegia).

Disorders of movement are commonly observed following traumatic brain injury and frequently impede mobility and activities of daily living. Ataxia refers to a discoordination of movement involving weakness and dyssynergy of movement. This frequently impedes balance and mobility and may interfere with functional activities particularly when there is upper extremity involvement. Ataxia is associated with lesions of the cerebellum.

Apraxia is described as the inability to perform certain learned or purposeful movements despite the absence of paralysis or sensory loss (Springer & Deutsch, 1985). Apraxia may serve to interfere with mobility and other functional activities. Kinetic or motor apraxia is associated with lesions of the premotor area of the frontal lobe on the opposite side of the body from the affected side. This condition results in impairment in fine movements such as holding a pen. Ideomotor apraxia is associated with damage to the parietal lobe of the dominant hemisphere. This condition results in impairment in complex motor acts upon command although automatic motor acts are less affected.

Ideational apraxia is an inability to formulate sequenced acts or use objects involving sequenced motor acts (Springer & Deutsch, 1985). Constructional apraxia involves an impairment in constructing figures or reproducing drawings. This is associated with damage to the occipital and parietal lobes, or perhaps the adjoining pathways. The apraxias are thought by some to be due to a disruption of the memories involved in sequenced, motor acts (Springer & Deutsch, 1985). Although not physical in the sense of muscle involvement, apraxia affects movement and purposeful physical activity.

There are numerous physical deficits not mentioned which may be associated with traumatic brain injury. Prognosis in terms of recovery of physical abilities is uncertain. However, rehabilitation intervention is indicated to prevent chronic abnormalities and to increase function.

<u>Cognitive Deficits</u>

Cognitive disturbances are manifested as difficulties in information processing due to brain damage. The damage to the brain alters the manner in which the person experiences and responds to stimuli which affects daily functioning (Ben-Yishay & Diller, 1983). Disturbances in cognitive abilities are perhaps the most prominent features following traumatic brain injury. As Levin (1985) stated, "Outcome research during the past decade has shown that chronic disability after severe head injury is primarily attributable to neurobehavioral sequelae, whereas motor and sensory deficits are less consequential for overall recovery" (p. 281).

The extent to which impairment in cognitive abilities impacts the adaptive functioning of the brain-injured patient has been well documented. Ben-Yishay & Diller (1983) stated, "By now it has been established with virtual certainty that the long-term mental sequelae outstrip the physical as a cause of difficulties with the vocational and personal rehabilitation of the patient and with the problems encountered in the areas of living arrangements, social readaptation, and strains on family life" (p. 171).

Disturbances in memory are the most frequent complaints voiced by patients following traumatic brain injury (Benton, 1979). Memory is a broad concept and may be further subdivided between verbal and nonverbal memory. Within both categories, distinctions are made between immediate memory (often referred to as short-term memory) and delayed memory (often referred to as long-term memory). Memory processes may be differentiated between encoding (which describes the storage) and retrieval of information. Remote memory is the memory for events which occurred premorbidly.

Although evidence for impairment of immediate memory following traumatic brain injury has been documented (Mandelberg & Brooks, 1975; Smith, 1974), this area often tends to be least affected following traumatic brain injury (Lezak, 1979). However, with increased duration between presentation of information and response, or increased task complexity, evidence of memory impairment increases with brain injured patients. Whereas the ability to recall successive digits does not demonstrate obvious impairment, recalling the digits backwards is frequently very difficult following head injury (Brooks, 1984; Lezak, 1979). Lezak (1979) found that patients who had suffered injury to the right hemisphere of the brain tended to show increased impairment in recalling digits in reversed order, perhaps indicative of impairment in visual scanning of the imagery of the digits.

Thomasen (1977) found an increase in performance difficulty of verbal memory as complex sentences were provided. Brooks (1984) found poorer performance on delayed recall of verbal information with head-injured clients. Additionally, there was evidence of less primacy or memory of the initial information, suggesting impairment in storage or encoding.

Levin (1985) stated that memory impairment is a common symptom following traumatic brain injury due to the vulnerability of the temporal lobes to contusion and hematoma caused by the structural irregularity and bony protrusion of the sphenoid wing. Brooks (1975) stated that the duration of post-traumatic amnesia is negatively correlated with memory performance, particularly when the duration exceeds seven days. Lezak (1979) found that the duration of coma correlated with persisting memory impairment three years following the injury.

Levin, Benton & Grossman (1982) assessed the long-term memory with the selective reminding test of Buschke. They found that damage to the temporal lobe of the left hemisphere resulted in the greatest impairment in performance of verbal memory. They found that improvement in memory performance is observed over 12 months if the injury was mild or moderate.

Levin, Grossman & Kelly (1976) observed visual memory deficits in patients who had suffered traumatic brain injury. Levin, Grossman & Kelly (1977) assessed remote memory by having patients recall popular television shows. They found evidence of impairment with no pattern of primacy (television shows five to years ago) or recency (television shows three years or less).

Another frequent area of impairment observed following traumatic brain injury is in attention and speed of information processing. Whereas simple reaction time frequently reveals minimal impairment, the degree of slowing increases as task complexity increases (Levin, 1985). Norman & Svahn (1961) found that as simple reaction time was increased in complexity to a three choice problem, speed decreased with brain-injured patients.

Impairment in attention and information processing often results in problems with task performance and may contribute to memory impairment. Head injured patients are often highly distractable, having considerable difficulty in sustaining attention (Levin, 1985). Additionally, speed of information processing may be impeded and interfere with daily activities. As Levin (1985) stated:

> Although severe CHI patients may eventually regain the capacity to solve complex problems, they frequently require a much longer period of time to reach the solution as compared to control subjects. In practical terms, inattention and reduced speed of information processing detract from the patient's adaptation from the work environment. (p. 285)

Cognitive impairment is often assessed within the broad realm of intelligence using an omnibus test such as the Wechsler Adult Intelligence Test. Despite the criticism that this test is not sensitive to the detection of specific impairment, numerous studies have documented the relatively poor performance on this exam by head-injured clients compared to control subjects (Levin, et al., 1979; Mandleberg & Brooks, 1975). It has been documented that head-injured clients frequently have greater difficulty with the performance subtests (Brooks, 1984; Benton, 1979; Levin, 1985). This may be due to the relatively simple responses of verbal items as contrasted with the necessary integration of numerous complex functions for performance items (Mandleberg & Brooks, 1975). Levin (1985) stated that prolonged coma and post-traumatic amnesia correlate with decreased performance on intelligence tests particularly on performance subtests.

Although aphasia is an infrequent sequel following traumatic brain injury, linguistic disturbances are common as ascertained by standardized tests measuring expressive and receptive language (Benton, 1979; Heilman, Safran & Geschwind, 1971). Levin (1976) in a highly selective study of 50 brain-injured patients found that a significant number exhibited impairment in picture naming (40%), word association (30%), and verbal retention (25%). This was assessed shortly after recovery from the acute confusional state. Najenson, Sazbon, Fiselyon, Becker & Schechter (1978) observed a consistent sequence of language functions in recovering brain-injured patients. This entailed comprehension of gestures and oral language followed over a period of time by oral expression, reading and writing. Thomsen (1975) found that aphasia associated with very severe head injury improved within two to three years but residual deficits in complex verbal skills persisted over time.

Brooks, Bond, Jones & Rizvi (1980) administered the Token Test and Word Fluency Test to brain-injured patients at six and 12 months post-injury. Little impairment was observed on the Token Test while considerable difficulty was observed with the Word Fluency Test at six months. However, at 12 months, performance was approaching normal. Levin

(1985) stated, "The studies of long-term recovery of language indicates that two-thirds of the patients who become aphasic after severe CHI fully recover language or improve to a level where they exhibit only specific deficits. . ." (p. 289).

Impairment in perceptual abilities is commonly observed following traumatic brain injury yet appears to receive less attention in the literature. As Levin (1985) stated, "The effect of traumatic brain injury on perceptual and motor skills have generally been accorded a minor role as compared to memory and information processing" (p. 289).

Levin, et al. (1977) found that one-fourth of the 46 subjects observed exhibited impaired perception of facial photographs. Prosopagnosia, the recognition of familiar faces was documented in a single case study of a brain-injured patient by Levin & Peters (1976). Hannay (1982) found impairment in lateralized presention of letters presented on a tachistoscope to 51 patients of severe traumatic brain injury. The investigators found impaired letter recognition when stimuli were presented separately to either visual field. However, normal recognition occurred when presentation was given in the central vision.

Bergman, Hirsch & Najenson (1977) found impairment in auditory perception in a group of 19 traumatic brain injured patients. Impairment was associated with a unilateral temporal lobe lesion producing impairment in the ear contralateral to the lesion site. Dikmen, Bertan & Temkin (1983) found impairment in performance of somatosensory perception in patients with mild and moderate brain injuries. Recovery was noted over an 18 month period.

Prigatano & Pribram (1982) found impairment in the perception and memory of facial expressions associated with emotion. Ross & Mesulam

(1979) observed that damage in the temporal lobe of the right hemisphere was associated with impairment in the comprehension of emotional tone in communication, referred to as prosody. Damage in the frontal region anterior to the Sylvian Fissure resulted in impairment in the ability to express prosody in speech. This suggests a role of the right hemisphere in language.

These results indicate a broad array of cognitive deficits following traumatic brain injury. As Corthell & Tooman (1985) indicated, deficits in abstraction, conceptualization and problem solving often results in considerable difficulty in functioning for brain-injured patients. These deficits may not be observed in discrete impairment of cognitive abilities yet serve to create great difficulty in daily living. As Corthell & Tooman (1985) pointed out:

> Often TBI clients cannot abstract out, or conceptualize, the essence or principle from the concrete details of the situation in which it is presented. Therefore, they may fail to apply it appropriately when a new situation arises. Or, they simply miss the point of what is being said, or fail to infer the meaning assumed. They may fail to grasp instinctively the implication of an event or conversation. For these reasons, problem solving becomes difficult when finding a solution to new problems involves assessing the solutions to similar problems encountered in the past, or adapting old principles to fit new situations" (p. 15).

Impairment in higher level, integrative cognitive abilities, referred to as executive functions results in perhaps the greatest obstacles in the adjustment of the brain-injured patient. As Corthell &

Tooman (1985) stated, "It is in their failures to carry out planned, organized, well-monitored, goal-directed activity successfully that traumatic head injured patients are likely to show the most debilitating residual deficits" (p. 16).

One area which results in difficulty for the brain-injured patient and frustration for family members and others is initiation. This is characterized by unmotivated behavior with little follow through on tasks. This may be masked in structured clinical settings and is most prevalent when the head-injured patient is left to self-initiation with little structure. This results in impeded task completion and decreased productivity with little semblance of goal-directed behavior.

Impairment in self-monitoring often results in little awareness of one's behavior. Thus, inappropriate behaviors such as emotional expression may go unnoticed and thus are difficult to correct. Discrimination is frequently compromised and subtle nuances in social interactions and settings are frequently not perceived or perceived inaccurately. Although these behaviors are often erroneously perceived as volitional, they represent organically based alterations in the brain-injured patient's ability to initiate, discriminate and monitor (Corthell & Tooman, 1985).

Impairment in a broad array of discrete and integrative cognitive abilities following traumatic brain injury are commonly observed sequelae and frequently result in obstacles towards adaptive functioning. As Benton (1979) stated, "Even relatively moderate cognitive impairment or emotional instability can render him unfit for a useful occupation and make him a heavy burden to himself and others" (p. 211). Therefore, much of rehabilitative efforts are aimed at remediation or compensation of cognitive deficits. This was described by Ben-Yishay & Diller (1983) as follows:

> The assessment of cognitive disturbances after traumatic brain injuries is a critical feature in the understanding of the nature of the underlying processes, the planning of remedial interventions, prognostication about the future potential for recovery of functions, and the post-rehabilitation management of the patient. (p. 167).

These deficits in cognition are influencing factors in subsequent behavioral manifestations and psychological disturbances.

Psychosocial Sequelae

Perhaps the most prominent and pervasive characteristics of traumatic brain injury are the striking changes which occur in psychosocial functioning. The effect of deficits in a vast array of cognitive domains combined with the psychological trauma associated with the disabling condition and dramatic changes in lifestyle result in significant psychosocial difficulties. This is succinctly described by Prigatano (1987a) in the following passage:

> Patients who suffer brain injury with neuropsychological sequelae have a personal reaction to their deficits. Moreover, their premorbid intellectual, personality, and sociocultural characteristics interact with acquired brain injury to produce a complex symptom picture which often involves the disorders of personality as well as cognitive functioning. (p. 1)

Goldstein (1952) reported that many changes in personality are observed following brain damage. Goldstein uses the term "catastrophic reaction" to describe psychological characteristics of brain damaged patients who are exposed to tasks which they are unable to complete successfully. These patients often appear to experience anxiety and may be unable to perform tasks within their capability. Goldstein felt that this assault on the patients' self-realizations often resulted in withdrawal and isolation or denial.

Lezak (1978) stated that emotional disturbances such as depression, anxiety and irritability are commonly seen in adults with brain damage. These may often result from less observable problems such as perplexity, distractibility, and fatigue. These problems are seen with every type of brain injury and appear to be associated with disruption of accustomed pathways. Perplexity may be characterized by a distrust of one's ability and may result in response hesitancy and self-doubt. This may result from a patient's experience of decreased cognitive functioning and may lead to a variety of emotional reactions related to decreased self-confidence. Irritability is often associated with fatigue or distractibility as the patient is rendered ineffective in sorting out incoming stimuli and often feels bombarded.

Lishman (1973) stated that posttraumatic psychosis may mimic symptoms of psychosis produced by schizophrenia and affective disorders. This may include confabulation, agitation, delusions and hallucinations. These symptoms are more frequent in injuries involving brain swelling and intracranial hematomas. Lishman (1973) stated that the presence of these symptoms bear no relationship to premorbid personality and that those which occur in the acute stages are more likely to be continued over time.

An extremely difficult residual of traumatic brain injury is denial. Denial is frequently observed in other disability groups and is thought to operate primarily as a psychological defense to cope with overwhelming anxiety related to the tragedy of the disability (Shontz, 1965; Wright, 1960). However, traumatic brain injury presents additional factors to consider including the pathophysiology of brain matter and the preponderance of cognitive deficits. Denial is associated with a distorted perception of reality on the part of the patient. Deaton (1986) stated that this may be harmful to the patient as it interferes with appropriate motivation and participation in rehabilitation efforts.

One form of denial in traumatic brain injured patients may be conceptualized as an unawareness of deficits. This may be of organic etiology as in the cause of anosagnosia. Anosognosia is associated with right hemisphere injury and frequently observed in company with left-sided neglect (Hier, 1983). It is associated with damage extending through frontal, parietal and temporal regions. The extent to which patients are capable of making realistic appraisals of their abilities is associated with subsequent performance in rehabilitation and may impact outcome (Lam, McMahon, Priddy & Gehred-Schulz, 1988). Denial may also be a manifestation of cognitive deficits which preclude the patient from fully comprehending, integrating and appreciating deficit areas (Baer, 1983). Finally, this may also occur as a psychological reaction to the tragedy following traumatic brain injury. Karpman, et al. (1985) stated that head injured persons are often unaware of changes in personality or behavior despite others awareness of the changes. Prigatano (1987) stated that unawareness of deficit "is perhaps one of the major predictors of outcome" (p. 10).

It is important in conceptualizing psychosocial symptomology and manifested affective states that one realize the role of neuropathology. Levin, et al. (1979) observed that psychiatric symptoms were most prevalent in head injured patients who had suffered severe injuries with coma greater than 24 hours. Frequently, neuropathology includes damage to subcortical structures with subsequent changes in affective states. Damage to subcortical structures may be more prevalent in traumatic brain injury than the attention it receives. For example, subcortical damage to structures such as the hippocampus and amygdala was observed by Graham, Adams & Doyle (1978) in 138 patients who died from craniocerebral injury. Prigatano (1987) stated that damage to the amygdala may account for increased emotionality often observed in traumatic brain injured patients and may be implicated in decreased frustration tolerance and irritability. Pribram & McGuinness (1975) stated that lesions interrupting the cortical-limbic reticular loop may exhibit indifference and hypokinesis.

Other factors which impact psychosocial adjustment include external factors involving changes in social network, support systems, changes in lifestyle and other areas. These changes may further contribute to feelings of loss and decreased self-worth. Oddy, Humphrey & Uttley (1978) found in a study of 50 young adults who had suffered traumatic brain injury, disturbances in social functioning including a decline in the number of close friends, a decrease in the frequency of social outings and an increase in feelings of loneliness. Thomsen (1974) reported that loneliness was the chief complaint in a study of 50 traumatic brain injured patients. Miller (1979) stated that while substantial recovery often occurs in intellectual functioning, significant readjustment problems may result in an overall poor prognosis. Prigatano (1987) stated that the major problem traumatic brain injured patients have to face is social isolation. The area of psychosocial adjustment is then perhaps the most salient and pervasive long-term sequel of traumatic brain injury.

Personality Disturbances

In differentiating personality disturbances from psychosocial sequelae, the former may be viewed as prominent features which are observable in interpersonal interactions and are fairly stable over time. These features are fairly descriptive of the manner in which one relates with others and proceeds to satisfy his/her needs. These are differentiated although influenced by psychosocial sequelae which may be less stable to time, more malleable to change and typically associated with an affective state. It is important to realize that in the realm of traumatic brain injury, both classes of symptomology are associated with neuropathology and impairment in cognitive functioning.

One personality change frequently reported entails a reduction in initiation. Patients may be able to verbalize what tasks they intend to perform and may be quite competent in conceptualizing the appropriate order or sequence of steps in a given task. However, tasks frequently go unmet and the patient appears to lack motivation or drive. Pribram & McGuinness (1975) stated that lesions which interrupt the cortical-limbic reticular loop often result in hypokinesis and indifference. This may result in a personality disturbance which presents as similar to a condition in which one is unmotivated (Bond, 1984). Lezak (1978) described the frequency of stimulus bound behavior in which there is decreased or an absence of initiative as well as difficulties in planning and organization. This disturbance may result in social dependency with limited demonstration of autonomous, independent behavior.

Another personality change frequently reported entails a reduction in impulse control. Patients may engage in behavior which is impulsive or inappropriate, seemingly unable to control urges. Valenstein & Heilman (1979) stated that orbital-basal frontal cortex injuries may produce problems of disinhibition. This may include inappropriateness, irritability, inappropriate sexual behavior or emotional outbursts (Bond, 1984). Lezak (1978) referred to this disturbance as an impaired capacity for control and self-regulation which may include impulsivity, restlessness and impatience.

Changes in emotional control and expression are frequently observed in patients following traumatic brain injury. Prigatano (1987a) stated that lesions of the anterior temporal lobe may produce a variety of affective disturbances. This may include characteristics such as paranoia, egocentricity, or aggression. Lesions in this area may produce impairment in utilizing affective states as arousal cues in learning and memory.

Difficulties in psychosocial functioning may be exacerbated by an impairment in the patient's ability to accurately express or comprehend the emotional qualities of speech. Ross (1981) stated that lesions in the perisylvian regions of the right hemisphere may result in aprosody or the inability to utilize affective intonation. Lesions anterior to the Sylvian Fissure of the right hemisphere may result in the inability to produce prosody of speech while lesions posterior to the Sylvian Fissure may result in impairment in the reception and comprehension of prosody in speech.

Lezak (1978) spoke of an impaired capacity for social perceptiveness which results in self-centered and egocentric behaviors. This is typified by a decreased capacity for empathy or self-evaluation. Prigatano (1987) stated that lesions anterior to the Rolandic strip result in a reduced ability to properly utilize information. This may result in inappropriate or childish behavior (Bond, 1984). Lezak (1978) described emotional alterations including lability and silliness. Most significant is "a relative and sometimes quite complete inability to profit from experience which compromises the patient's capacity for social learning even when the ability to absorb new information may be intact" (p. 592).

The significance of personality disturbances and their influence on long-term adjustment cannot be underestimated. Prigatano (1987a) stated that personality characteristics are important determinants of long-term behavioral outcome of brain injury. Fordyce & Rouche (1986) viewed psychosocial functioning as affecting vocational outcome. Yet the areas of personality disturbances and psychosocial sequelae are often minimally addressed in traditional approaches. The need for treatment interventions and coinciding research in this area is warranted.

Temporolimbic Epilepsy

Changes in psychological functioning may be associated with temporolimbic epilepsy. This is a neurological disorder characterized by abnormal electrical activity within the brain referred to as seizures. Temporolimbic epilepsy is elusive in diagnosis due to the difficulty in standard scalp electrodes to detect electrical activity in the medial and inferior temporal surface as well as deeper structures. As Spiers, Schomer, Blume & Mesulam (1985) stated, ". . . as much as two-thirds of the total population of patients with epilepsy may not be under treatment at any given time, one-third because they have discontinued treatment and one-third because they have never been treated" (p. 291).

Temporolimbic epilepsy serves as an example of neuropsychiatric phenomenon, psychiatric symptomology which is associated with cerebral dysfunction. As Spiers, et al. (1985) stated, "Temporal lobe epilepsy is a common condition in which complex neurological and psychiatric phenomenon are frequently seen in the same patient" (p. 289). Moreover, "It is also reasonable to assume that cases of temporolimbic epilepsy that have predominantly behavioral manifestations are particularly prone to be misdiagnosed as primary psychiatric conditions" (Spiers, et al., 1985, p. 291).

Ictal manifestations secondary to temporolimbic epilepsy may include all spheres of functioning including sensory, motor, autonomic, perceptual, ideational and emotional. Sensory alterations may include headache, tingling, numbness, nausea, and other abnormalities. Motor symptoms include automatisms, staring, twitching, scanning and other manifestations. As Spiers, et al. (1985) explained, the temporal lobe, while encompassing the regions of primary and secondary auditory association areas, also maintains connections with visual cortex, limbic structures and orbital frontal cortex. Thus, a broad constellation of symptoms may occur.

Changes in sensation and perception may result in auditory, visual, gustatory or olfactory distortions or hallucinations. This may range from ringing sounds to voices (auditory), patterns to people or demons (visual), metallic or foul taste (gustatory), or unpleasant odors sometimes nauseously unpleasant (olfactory).

The temporal lobes are associated with memory functions (Levin, High, Goethe, Sisson, Overall, Rhoades, Eisenberg, Kilisky & Gary, 1987). As such, memory distortions including flashbacks, feeling as though one were performing an act performed earlier in life (deja vu), or experiencing that one is capable of predicting future events (Jamais vu) have been observed in patients suffering from temporolimbic epilepsy (Spiers, et al., 1985).

Emotional changes associated with temporolimbic epilepsy are thought to be associated with the autonomic functions of the limbic system (Spiers, et al, 1985). Emotions are most often "forced", occurring rapidly and unpredictably. Moreover, they are most often negative. Emotional manifestations may include embarrassment, sadness and depression. Explosive laughter without the experience of happiness has been reported (Spiers, et al., 1985). Intense fear is a common occurrence (Strauss, Risser & Jones, 1982). In fact, the term "episodic dyscontrol" has been utilized to describe patients with episodic symptom manifestations characterized by abrupt explosive expression of primitive affect, including rage or anger (Gingis & Kiloh, 1980). This may include overt homicidal or suicidal identions. Autonomic motor responses may be observed simultaneously and may include purposeless running (Spiers, et al., 1985).

The role of limbic structures in mediating emotional behavior appears to be supported by observations of patients with temporolimbic epilepsy (Heilman & Valenstein, 1985). One of the limbic structures, the amygdala is associated with mediation of sexual behavior. Damage to the amygdala has resulted in observed abnormalities in sexual behavior referred to as the Kluver-Bucy syndrome (Carlson, 1986). Currier, Little, Suess & Andy (1971) described patients who had ictal behavior associated with temporolimbic epilepsy as exhibiting behavior similar to sexual intercourse. Exhibitionism and undressing have been reported with temporolimbic epilepsy patients (Hooshmand & Brawley, 1969; Rodin, 1973). Hyposexuality is a frequent complaint of those suffering from temporolimbic epilepsy (Heilman & Valenstein, 1985). This is associated with the mesobasal area of the temporal lobe and is to be contrasted with hypersexual abnormalities of the medial temporal lobe and deeper structures.

Perhaps the most fascinating features following temporolimbic epilepsy are the "typical" personality features (Geschwind, 1977). Deepened emotionality with an inability to experience humor is common (Heilman & Valenstein, 1985). As mentioned, anger and rage frequently of an explosive nature are observed. Hyperreligiosity and philosophical preoccupation occur as well as an augmented sense of personal destiny (Spiers, et al., 1985). Self-righteous moralism is frequently observed. Obsessionalism often with a concern for minor details is exhibited. Circumstantiality is common as are paranoid ideations. Hypergraphia occurs often taking the form of writing down minute details of one's life.

While temporolimbic epilepsy often presents a schizophreniform-life picture, there are distinct differences. While both are often associated with hallucinations, delusions or ideas of reference, temporolimbic epilepsy is devoid of family history or premorbid personality disturbances frequently seen with schizophrenia. Heilman and Valenstein (1985) stated that patients with temporolimbic epilepsy do not present with flat affect and tend to exhibit greater success interpersonally. Spiers, et al. (1985) state that psychotic episodes are more periodic and less disruptive with temporolimbic epilepsy and that hospitalizations are less frequent and of shorter durations.

Neuropharmacological Intervention: The Use of Carbamazepine

In considering pharmacological agents in the treatment of temporal lobe epilepsy, one must also weigh the side effects including decreased arousal, drowsiness and interference in cognitive functioning. Carbamazepine (tegretol) has been recommended as the agent of choice in relation to temporolimbic epilepsy (R. Sbordone, Personal Communication, November 15, 1988; M. Rosenthal, Personal Communication, December 6, 1988). Perhaps its efficacy may be attributed in part to its specific effects on limbic structures and its prophylactic effects in the kindling preparation (Evans & Gualtieri, 1985). Evans and Gualtieri (1985) stated that carbamazepine appears to have the least harmful neuropsychological side effects of all antiepileptic drugs. The side effects which have been documented include nausea, drowsiness, vertigo, ataxia, blurred vision and diplopia, all of which may be extinguished by decreasing the dosage.

The efficacy of carbamazepine may be due to its depressing effect upon the thalmus particularly the nucleus ventralis anterior which has been implicated in the spread of epileptiform discharges (Evans & Gualtieri, 1985). Furthermore, carbamazepine is thought to inhibit discharge in the reticulothalamic projections, thalamocortical projections, suppression of activity in efferent connections from the thalamus and afferent connections from the amygdala and hippocampus to the thalamus (Evans & Gualtieri, 1985).

Patients who have been treated with carbamazepine have been observed to outperform patients treated with other antiepileptics on a number of neuropsychological tasks. Most important is its demonstrated efficacy in reducing psychiatric manifestations. Evans and Gualtieri (1985) reported its stabilizing effects in relation to confusional states, paranoid ideations, aggressiveness, emotional swings and other symptoms. They stated that, "The psychotropic effect has been described as an increase in 'psychic tempo' in patients with the so called epileptic personality, with reported improvement in attention, concentration, and perseverance" (Evans & Gualtieri, 1985, p. 232).

More specific improvement is noted with bipolar affective symptoms, schizoaffective manifestations, episodic dyscontrol and uncontrolled rage. Reduction in emotional lability, agitation, hypoactivity and depression has been observed. Despite the lack of well-controlled studies, carbamazepine shows considerable promise in the treatment of a broad array of symptom manifestations, particularly those associated with temporolimbic epilepsy.

Temporolimbic epilepsy is an exemplary albeit unfortunate neuropsychiatric disorder which profoundly demonstrates the intricate relationship between brain and behavior. Neuropsychiatric disorders allow careful investigation and treatment which may enhance our sophistication in developing objective diagnostic criteria, refining pharmacological interventions and increasing our knowledge of the complexity of brain-behavior relationships.

Stages of Adjustment for the Individual and Family

Bray (1977) stated that the family of the disabled individual may experience the same emotions and conflicts as the disabled person. Family members adjust through a progression of developmental stages which parallel the traditional adjustment process observed in disabled persons. The stages are not mutually exclusive, discrete phenomenon nor is the developmental stage theory of family adjustment. The initial stage is referred to as the Anxiety Stage and is typified by fear, confusion and frustration. Initially confronted by the possibility of death of the disabled person, the family is faced with attempting to cope with a life-threatening situation in a strange environment which they have little knowledge of. Feelings of uncertainty and a lack of control and competence can result in an inordinate amount of anxiety experienced by the various family members.

The second stage is referred to as the Acceptance Stage and is characterized by a greater understanding of the disabling condition and the formation of realistic expectations. The final period, referred to as the Assimilation Stage, was observed to occur during the second year when the disabled person had achieved maximum recovery. The disabled person re-enters the family and the family often adjusts by close association of the adjustment of the disabled person.

Brodland (1977), in a study of family members of burn patients described a sequence of reactions which included: relief that the patient did not die, preoccupation with the recovery of the patient, fear and anxiety in coping with the psychosocial responses and associated behaviors of the disabled person, disappointment that "ideal" recovery did not occur, psychological preparation for the future, and trying to deal with the disabled person's disclosure of feelings. Brodland stated that frequently unrealistic expectations are maintained by the family.

Royers & Kreutzer (1984) stated that "family crises occur immediately following brain injury and then at intervals throughout the recovery process" (p. 343). They stated that an initial feeling of relief that the brain-injured person has survived often gives way to uncertainty, frustration and depression.

Lezak (1986) stated that ". . . many families undergo a series of reactions as their appreciation of the patient's condition evolves" (p. 243). Lezak proposed six stages which often characterize the adjustment process of family members. The first stage which encompasses the first few months is characterized by relief that the patient has survived and expectations that a full recovery will be forthcoming. The second stage is characterized by bewilderment and anxiety as the expected recovery is not taking place as hoped. This is followed by feelings of discouragement and guilt as the characterological changes due to the brain injury become more apparent. The fourth stage is typified by depression and despair as the patient is seen as a "different person" due to the continued presence of characterological changes. Expectations at this time become pessimistic, succumbing to the family's feelings of disappointment and despair. This is followed by feelings of grief and mourning as the period of time has increased (15 months or longer) and the residual characterological deficits of the brain-injured person persist. The final stage is referred to as reorganization in which the family attempts to adapt structurally to the stable deficits and associated changes in roles. Emotional detachment may allow for freedom and the debilitating effects of guilt and anger.

Vocational Outcome Studies

It becomes apparent following the preceding review that traumatic brain injury is frequently associated with any number of deficits in areas of physical, cognitive, psychosocial and behavioral functioning. Moreover, these deficits become more likely and frequently more debilitating as the severity of the injury increases. It comes as little surprise that difficulty in obtaining or maintaining employment is frequently observed with a patient who has incurred a severe traumatic brain injury.

Prior to a review of documented vocational outcome studies with traumatic brain injured clients, a few caveats are warranted. First, there are differences in the level of severity of the traumatic brain injury incurred by patients included in various studies. Studies differ in whether patients with mild, moderate or severe injuries are included. Additionally, as mentioned previously, there are vast differences in how authors define severe head injury. These differences cannot be taken lightly as differences in severity potentially impact a client's residual deficits and employability, thus impacting the results in an outcome study.

A second concern which exists in reviewing vocational outcome studies resides in the definition of work. Work or employment may differ in the quantity or number of hours per week in which a person is involved.

Employment may also differ in the complexity or sophistication of work performed. This becomes more significant when making comparisons between post-injury employment and what type of work a patient performed premorbidly as well as making conjectures in terms of what type of work an adolescent or young adult may have been capable of performing had normal maturation not been impeded by traumatic brain injury. These issues warrant further scrutiny so that we may gain precision in our understanding of the relationship between severity of traumatic brain injury and type of employment typically obtained and maintained.

A final caveat is offered in the review of vocational outcome studies. The studies summarize group trends and by the very nature of the reporting of group results, individual differences are obscured. This caveat is raised by Kay, Cavallo, Ezrachi & Newman (1988) who stated, ". . . that prediction of vocational outcome for any one head injured person is a matter of probability" (p. 4). In this manner, results from vocational outcome studies should be used with great caution and individual predictions must be avoided. With these concerns raised, results from vocational outcome studies will be reviewed.

Early Studies

Many of the early studies in vocational outcome following traumatic brain injury utilized follow-up techniques such as questionnaires and interviews to ascertain the quality of adjustment following the injury. While these studies are devoid of many important factors such as specific measures of severity, neuropsychological status, premorbid vocational characteristics and other factors, they served an important groundbreaking role and as such provided a foundation for subsequent vocational outcome research.

Denny-Brown (1942, 1945) followed 200 head-injured patients (125 males, 75 females), primarily of mild and moderate severity. The findings of this research revealed that 136 patients were re-employed within two months and that only five patients remained unemployed after nine months. Negative prognosticators which prolonged the period of unemployment included a post-traumatic amnesia greater than seven days, initial restlessness, abnormal EEG, abnormal reflexes, initial apathy, age greater than 40, skull fracture and pending litigation. This study provides no descriptive statistics in terms of demographic characteristics, severity of injury or occupational categories. However, many of the variables which continue to assume considerable predictive validity in relation to vocational outcome were identified. To summarize the complexity of numerous factors affecting recovery following head injury, Denny-Brown (1945) stated, "Even more obscure is the relationship of such physical aftereffects to more general and less tangible symptoms such as headache, dizziness, intellectual deficit, psychoneurotic states, and changes in character and personality which are frequently associated with disability" (p. 429). Moreover, one of the great obstacles in making generalizations regarding head injured patients is, ". . . the lack of homogeneity in the pathological changes underlying the condition" (Denny-Brown, 1945, p. 429).

Additional studies of patients who have suffered mild head injuries suggest that persistent mental sequelae referred to generically as the post-concussional syndrome are negatively associated with employment. This syndrome includes symptoms such as headaches, dizziness, irritability, difficulty with concentration and other problems. Cook (1972) compared two groups of mildly head injured patients (mean PTA < 30 minutes). Those who exhibited a greater number of symptoms were more likely to remain unemployed. Cook (1972) found that the group with greater symptomology were more likely to be involved with financial compensation. This was also observed by Cartlidge (1978) and Cartlidge & Shaw (1981) who found that patients with pending compensation claims exhibited greater symptoms and were more likely to be unemployed.

The purported link between pending financial compensation and increased symptomology with unemployment with those who have suffered mild head injuries was argued by Miller (1966) who stated, "The post-concussion syndrome is graven on the heart of every claimant for compensation" (p. 257). However, this association was not found to exist by Mershey & Woodforde (1972), Kelly (1975), or McKinlay, Brooks & Bond (1983). Rimel, Giordani, Barth, Boll & Jane (1981) found a high rate of absenteeism in a group of mild head injured patients despite the absence of clinical signs or litigation. It may be surmised that pending compensation claims is a factor which requires further investigation, particularly in relation to the presence of symptoms following mild head injury. However, other factors may contribute to mental sequelae following mild head injury. As O'Shaughnessy, Fowler & Reid (1984) stated:

> This group is typically not seen by health care professionals as disabled and after discharge is left to its own resources. This group, however, is the one most likely to have psychological, social and behavioral problems and an estimated 20% of this group will ultimately be considered disabled. (p. 391).

O'Shaughnessy, et al. (1984) in a study of 39 patients (74% male, 26% female) who had suffered mild head injury found that 91% were employed by six months. However, 56% of the patients exhibited continued deficits at six months.

Russell (1934) in analysis of 200 patients who had incurred head injury indicated that prolonged unconsciousness and age over 50 were negative prognosticators related to employment. This was also stated by Denny-Brown (1942) and Symonds & Russell (1943).

Rowbotham, McIver, Dickson & Bousfield (1954) in a study of 236 head-injured patients who responded to a questionnaire, found that 207 were employed with 19 patients reporting a change to lighter work.

In reviewing the early studies which investigate vocational outcome following traumatic brain injury, a few caveats are warranted. The first issue which requires consideration is the fact that few of the studies mentioned in this section provide statistics on measures of severity of injury including a duration of loss of consciousness or post-traumatic amnesia. When these statistics are provided, it becomes readily apparent that the majority of the patients who comprise the particular group studied have suffered mild injuries (Cook, 1972; Rimel, et al., 1981; Denny-Brown, 1942, 1945).

A second flaw in these studies is that few provide descriptions on the type of work to which subjects have returned. It is difficult to ascertain whether subjects have returned to jobs at reduced capacities, the extent to which subjects obtain new employment, and whether subjects are employed on a full or part-time basis. Frequently, a single category which includes work, homemaking, school or training is used to describe employment. These flaws appear to inflate the true extent of successful employment following traumatic brain injury.

Changes in Vocational Studies

Following the foundation in vocational outcome research provided by Denny-Brown (1942, 1945), Russell (1934), and others, greater emphasis was placed on changes in employment following traumatic brain injury. A fine study by Rusk, Block & Lowman (1969) followed 93 patients from an original group of 127 who had suffered traumatic brain injury over a ten-year period. The average length of coma was three weeks. In a follow-up study of five to fifteen years post-injury, 46% of the patients were involved in some form of gainful employment. Rusk, et al. (1969) found that many of those employed (approximately 65%) returned to work in a reduced capacity or were retrained for new jobs. Approximately 35% of the patients were employed at follow-up with 10 patients functioning independently as homemakers. Among different premorbid occupations, a significant number of patients employed in unskilled positions premorbidly remained unemployed at follow-up (83%).

Gjone, Kristiansen & Sponheim (1972) followed 94 patients with severe intracranial injuries. The average length of hospitalization was three months with longer periods observed in patients who had brain stem lesions, subdural hematomas or combined intracranial lesions. At discharge, 41% were deemed able to return to employment. Of these 45 patients, less than half were observed to successfully return to work.

Najenson, Mendelson, Schechter, David, Mintz & Groswasser (1974) observed 169 patients who suffered severe head injury (128 male, 41 female). At discharge, the following categories and coinciding number of patients were observed: vegetative state (18), independent in activities of daily living (32), sheltered employment (36), simple work (51) and professional work (23). Of those employed, 36% were working at a reduced capacity. Negative prognostic indicators included prolonged unconsciousness, age greater than 45, severe motor deficits, epilepsy, aphasia and hemianopsia. In response to the significant number of patients unemployed, Najenson, et al. (1974) stated, "We think that this state of affairs is partly an expression of the brain-injured patient's inability to accept the change in his status, and, in part, due to the failure of his family and the wider community to understand and accept the alteration in his behavior" (p. 12).

VanZomeran & VanDenBurg (1985) reported on a follow-up study of 61 patients (54 male, 7 female) who had suffered severe head injury (PTA > 1 day). The average duration of post-traumatic amnesia was 30.5 days. Findings indicated that 58% of the patients had returned to their former job, 13% returned to their former job with modifications, 5% were occupied at a reduced capacity, 7% were in sheltered employment and 16% were not employed. The authors found that the duration of post-traumatic amnesia correlated with the ability to be employed. They identified a cutoff of 13 days of post-traumatic amnesia after which an increasing emergence of mental sequelae are observed.

Brucker & Randle (1972) followed 64 patients who had suffered a severe head injury (PTA > 24 hours, or compound fracture of the skull or intracranial hemorrhage) over a three-year period. They observed that 40% of the patients had returned to the same job level and pay, 24% returned to a reduced job level and pay and 35% remained unemployed. They found that psychological symptoms were the most adverse prognostic indicators.

Additional factors such as increased age, epilepsy, hemiplegia and dysphasia were viewed as obstacles toward successful employment.

The duration of coma is well documented as a negative prognostic indicator (Carlsson, Von Essen & Lofgren, 1968; Plum & Levy, 1978). Carlsson, et al. (1968) stated that the longer the period of coma, the less satisfactory the prognosis. Others have offered the duration of post-traumatic amnesia as a negative prognostic indicator (Mandleberg, 1975; Russell & Smith, 1961; VanZomeren & VanDenBerg, 1985). However, there is often discrepancy in defining coma or post-traumatic amnesia. As Reyes, Bhattacharyya & Heller (1981) stated, "PTA is an unreliable indicator because in most cases it is assessed after the patient has become oriented or verbal, by which point the patient has been extensively rehearsed in facts occurring prior to his awakening" (p. 20). They developed a rating scale referred to as the Post Traumatic Activity Level to utilize as a prognostic instrument. This is a five-point scale which includes: (a) coma, (b) sluggish, (c) appropriately active, (d) restless, and (e) agitated. From this scale, 87 patients (62 male, 25 female) received ratings upon admission to a rehabilitation hospital. At a minimum follow-up of one year, 49% of the patients were employed. However, the majority of patients who were successfully employed had received ratings of appropriate or restless. Those who received ratings of coma, sluggish or agitated were overrepresented in the unemployed category.

Lewin, et al. (1979) observed 291 patients selected from a head-injured population of 7,000 over a 24 year period. They found that 28% of the surviving patients remained disabled and that many of the patients were employed in a reduced capacity. Lewin, et al. (1979) took into account numerous factors such as post-traumatic amnesia, central neural disability such as ataxia or sensory deficit, mental disability such as neuropsychological or neuropsychiatric sequelae and age in determining prognosis. They found that increased post-traumatic amnesia was associated with unemployment and found that mental disability was a greater obstacle to employment than central neural disability except with manual laborers. However, they describe the hardships encountered by those who suffer from head injury in the following passage:

> Even for those whose recovery was excellent, the experience had been frightening and often disastrous. Most suffered weeks or months of misery, apprehensive of the significance of their forgetfulness, defective concentration, imbalance, and vertigo. Any personality change caused relatives intense distress. (p. 1537).

Longitudinal Studies

Several researchers have conducted longitudinal studies, following those who have suffered traumatic brain injury over a number of years. These studies provide considerable insight into the long-term effects of traumatic brain injury on vocational and social adjustment.

Thomsen (1974) followed 50 patients (37 male, 13 female) who had suffered severe head injury (L.O.C. greater than 24 hours). The patients were subdivided into aphasic/focal (anomia), aphasic diffuse (verbal paraphasias), and nonaphasic. Of the three groups, five of the aphasic/focal patients returned to employment four of the nonaphasics were employed, while none of the diffuse/aphasic patients were employed.

Overall, 28% of the patients were involved in either employment, school or sheltered employment.

Thomsen (1984) followed 40 patients (28 male, 12 female) who had incurred severe blunt head trauma (PTA > one month). A follow-up study of 10-15 years revealed that two patients were employed full-time and four patients part-time. An additional seven patients were in sheltered employment and three female patients were functioning as homemakers. Thomsen (1984) found that brainstem injury was a negative prognostic indicator, being associated with prolonged dysarthria and motor impairment.

Oddy, et al. (1978) observed 49 adults who had suffered severe head injury (PTA > 24 hours). Of the 49 patients, 45 had been employed prior to their injury. At six months 22 patients were employed full-time, seven had worked sporadically and 16 remained unemployed. Oddy, et al. (1978) found that physical disability was an important factor and that age was inversely related to recovery from head injury. Additionally, the duration of post-traumatic amnesia correlated significantly with prolonged unemployment.

Oddy & Humphrey (1980) studied 54 patients who had suffered severe closed head injury (PTA > 24 hours). Of the 54 patients, 45 had been employed full-time prior to the injury. At six months, 30 had returned to work with an additional seven returning by twelve months. Following two years, only five remained unemployed. Oddy & Humphrey (1980) found that of eight patients who had not returned to work within one year, seven had post-traumatic amnesia which exceeded seven days. Additionally, physical disability appeared to be a greater obstacle to employment than cognitive impairment or personality disturbance.

Weddell, Oddy & Jenkins (1980) studied 46 patients (31 male, 13 female) who had suffered a severe closed head injury (PTA > seven days) with a median coma of four weeks. A two year follow-up revealed that five patients returned to their former job, 11 were employed full-time in a reduced capacity, three functioned as homemakers, five had worked but were not currently employed and 20 remained unemployed. There was no difference in social economic status between the employed and the unemployed. However, the unemployed had a greater incidence of neurophysical impairment, greater rating of personality change indicated by a relative, increased memory impairment and lower scores on the Standard Progressive Matrices.

Oddy, Coughlan, Tyerman & Jenkins (1985) reported findings from a seven year follow-up study of 34 patients (27 male, 7 female) who had suffered severe head injury (PTA > 7 days). The findings indicated that 21% of the patients were employed in a former job, 14% were employed at a lower level, 12% were functioning as homemakers, 7% had worked but were unemployed at the time of the study and 47% remained unemployed. Of significance was the finding that all those who had been employed at two years post-injury remained employed at seven years. Conversely, all the patients who were unemployed at two years, remained unemployed at seven years post-injury. Oddy, et al. (1985) observed an association between employment and social adjustment as stated:

> . . . those who were working had been able to rebuild their social lives and sometimes marry. On the other hand, the combination of unemployment and the associated greater disability proved too give a disadvantage to overcome and

> there appeared few opportunities for these unfortunate people to develop a social life. (p. 567).

Program Efficacy Studies

Several studies have provided statistics on vocational outcome as a means of demonstrating program efficacy. Ben-Yishay, Rattok, Lakin, Piasetsky, Ross, Silver, Zide & Ezrachi (1985) offered statistics on nearly 100 patients who had suffered severe head injury (loss of consciousness > 1 day). The majority of the patients were at least two years post-injury and most were unemployed upon admission to a comprehensive outpatient program. Ben-Yishay, et al. (1985) reported that most of the patients exhibited difficulties in attention, insufficient awareness of deficits, impulsivity, difficulties in learning, inadequate interpersonal skills and other problems. The admission criteria required independence in activities of daily living and ambulation, a Full Scale WAIS-R I.Q. of at least 80, verbally communicative and at least a minimum degree of motivation.

The program approach is multimodel, attempting to remediate diverse functions in cognition, psychosocial functioning and compensatory strategies. As Ben Yishay, et al. (1985) described:

> It is futile to attempt to separate the cognitive deficits, the psychiatric sequelae that are directly (i.e. causatively) related to the brain injury, and the so called functional disturbances that are presumed to be exacerbated versions of preexisting "dynamic" or personality problems from those affective responses of the patient that are reactive in nature (that is, in response to the patient's awareness of "losses"

resulting from the head injury and the anticipated, real or imagined, future consequences of the brain injury). (p. 254).

Ben-Yishay, et al. (1985) reported that 65% of the patients who have completed their program are competitively employed, an additional 15% are in sheltered employment and 20% remain unemployed.

Scherzer (1986) reported results of a three year comprehensive outpatient program involving 32 patients (25 male, 8 female) who suffered severe head injury. The average length of coma was 46 days. Improvement was noted in areas of attention, visual information processing and manual dexterity. Of the 32 patients treated, six were able to return to the same level of job as they had performed premorbidly, four were temporarily employed, an additional four were deemed ready for employment and 18 remained unemployed.

Prigatano, Fordyce, Zeiner, Rouche, Pepping & Wood (1984) reported outcome data on 18 patients (15 male, 3 female) who completed a comprehensive outpatient program. Comparisons were made with 17 untreated brain-injured patients who served as controls. The patients had all suffered severe head injury (length of coma > 24 hours). Subjects were matched on age, educational achievement and sex. Analysis of variance was utilized to compare pretest and posttest measures. The patients enrolled in the rehabilitation program showed greater improvement in neuropsychological indices (WAIS Performance I.Q., Block Design, Wechsler Memory Quotient, Digit Symbol). Additionally, the program patients showed greater improvement in personality adjustment based on relative reports on the KATZ Adjustment Scale. Of the 18 patients treated, nine were employed or in school at follow-up compared to five of 17 controls.

Prediction Studies

More recently, many researchers have attempted to assess the relative predictive value of factors associated with traumatic brain injury. This demonstrates the continued progression in this line of research from descriptive studies which have described the phenomena associated with vocational outcome following traumatic brain injury to studies which now attempt to investigate the relative weight of relationships between factors associated with traumatic brain injury (independent variables) and vocational outcome (dependent variables). This progression demonstrates the heuristic value of research and displays the increase in knowledge of this area of investigation.

Heaton, Chelume & Lehman (1978) investigated the predictive validity of neuropsychological indices on subsequent vocational outcome. This is an area of considerable discussion and as Heaton, et al. (1978) stated:

> The sensitivity of tests to brain damage is no assurance that they tap abilities that are important in patients' day-to-day activities. Furthermore, even if an important ability is tapped by a particular test, the cut-off score which suggests impaired brain function may be quite different from that predicting, for example, inability to perform adequately at work. (p. 408)

Patients were selected over a three-year period and numbered 381 (78% male, 22% female). Of the patients, 45% were employed full-time, 10% were employed part-time and 45% remained unemployed. The unemployed were found to be older than those employed part-time and less educated than those employed full-time. Neuropsychological results including the Halstead-Reitan Battery, WAIS-R, Peabody Individual Achievement Test and the Figure Memory Subtest of the Wechsler Memory Scale were obtained. Those employed full-time performed higher on most tests, receiving normal ratings on the Halstead-Reitan Battery. The part-time employed performed in the intermediate area compared to the other groups, receiving a mildly impaired rating on the Halstead-Reitan Battery. The unemployed performed worse than the other groups. Additionally, scores from the MMPI (Minnesota Multiphasic Personality Inventory) found that the unemployed patients had greater elevations on the F-scale and all clinical scales. Heaton, et al. (1978) performed a stepwise discriminant analysis and found the Average Impairment Rating to have the greatest predictive value followed by the WAIS-R Verbal and Performance scores, the Peabody Individual Achievement Test and the clinical scales of the MMPI.

Dennerell, Rodin, Gonzales, Schwartz & Lin (1966) found that employed epileptic patients performed better than unemployed patients on a number of indices including the WAIS-R Performance and Verbal scores, the Halstead-Reitan Battery and several indices of social competence on the California Personality Inventory.

Fraser, Dikmen, McLean, Miller & Temkin (1988) followed 102 patients (69 male, 33 female) who had suffered a head injury with a minimum loss of consciousness or duration of post-traumatic amnesia of one hour. Of the 102 patients, 48 were determined to have been working prior to their injury. Among the subgroup of 48 patients, 35 were employed at one year post-injury, nine were unemployed and four were in school. Differences on neuropsychological measures were found between those who were employed and those who remained unemployed. The unemployed patients exhibited considerably more difficulty on numerous tasks involving motor speed, cognitive flexibility, visual-spatial memory and other abilities at one month post-injury. Retrospectively, the unemployed group also exhibited a greater duration of time before they were able to follow simple commands ($M > 24$ hours) during their recovery compared to the employed patients ($M > 1$ hour). Among the employed patients, 40% reported one or more post-concussional symptoms such as fatigue or irritability. Despite obtianing work, the employed patients exhibited a significant incidence of interruption in their employment with 29% having worked intermittently. A significant number of the patients reported job-related difficulties.

Kaplan (1988) followed 25 patients (18 male, 7 female) who had suffered severe head injury with an average length of coma of nearly 10 days. Length of coma and duration of post-traumatic amnesia were negatively correlated with successful re-employment. Additionally, family adjustment measures on pretrauma functioning were associated with more adaptive coping strategies following the injury. These measures were associated with successful re-employment. Kaplan (1988) found psychosocial adjustment and interpersonal skills to be more predictive of successful vocational outcome than specific vocational competencies. Kaplan (1988) offered caution in terms of the value of cognitive remediation and placed greater emphasis on interpersonal skills training and psychosocial adjustment.

Summary of Vocational Studies

It becomes apparent that employment following traumatic brain injury is a complex phenomenon with considerable disparity in reported outcome statistics across studies. To attest to the fact that employment following traumatic brain injury is no easy matter is the persistent investigation through research on this topic approaching six decades.

Pertinent trends may be briefly summarized. Many studies reviewed in the first section (Early Studies) reported outcome statistics with no mention or differentiation between severity of injury, the type of employment obtained and any changes in employment status. The ratio of success appears to be extremely high with many studies reporting over 90% of the subjects returning to work. These findings may be inflated by loose definitions of employment, and the subjects who comprise the studies appear to have suffered predominantly mild injuries. Nonetheless, these studies provide a foundation for subsequent research and as such possess considerable heuristic value.

Additional studies are reported which begin to report statistics related to severity of injury and describe more specifically employment settings and changes in employment status. Many of these studies focus on subjects who have suffered severe traumatic injuries (Rusk, et al., 1969; Gjone, et al., 1972; Najenson, et al., 1974; VanZomeran & Van Den Berg, 1985; Brucker & Randle, 1972; Reyes, et al., 1981). Accordingly, the incidence of successful reemployment decreased from previous studies with estimates ranging from 25% to 76% of subjects successfully employed. The majority of these studies provide estimates below 50% in terms of subjects employed following severe traumatic brain injury.

The longitudinal studies which are cited provide a picture of long-term adjustment following severe traumatic brain injury. While Thomsen (1974) reported that 28% of the patients followed were either involved in productive activity (competitive employment, school or sheltered employment) at a ten-year follow-up, only 18% of the patients were competitively employed with less than 7% employed full-time (Thomsen, 1984). Oddy et al. (1978) observed that nearly 50% of patients followed were employed. At a seven-year follow-up study, this had decreased to 35% (Oddy, et al., 1985). These longitudinal studies followed those who had suffered severe traumatic brain injury with a post-traumatic amnesia duration of at least one week.

The fact that the program efficacy studies utilize employment as a measure of program success speaks to the challenge of employment following traumatic brain injury. Ben Yishay et al. (1985) reported that 65% of severely brain injured patients were employed following successful completion of their rehabilitation program. Scherzer (1986) reported that 18% of the patients who had successfully completed the rehabilitation program were employed with an additional 12% engaging in temporary employment. Prigatano, et al. (1984) reported that 50% of the severely brain injured patients who completed their program were either employed or enrolled in school.

The prediction studies once again attest to the interest in employment following traumatic brain injury. Heaton, et al. (1978) compared the predictive validity of neuropsychological measures. The authors reported that 55% of the subjects studied were employed. However, they provide no statistics describing the severity of injury which the subjects suffered. Fraser, et al. (1988) investigated the predictive validity of neuropsychological measures and premorbid employment characteristics on subsequent employment following traumatic brain injury. They reported that approximately 70% of the subjects were employed. However, there appears to have been considerable disparity in terms of severity with those unemployed having exhibited a greater duration of loss of consciousness.

It becomes apparent that once the focus of investigation is limited to those who have suffered severe traumatic brain injury, reasonable estimates of subsequent employment range from 25% to 50%. When one takes a careful examination of the nature of work which is being conducted, it is likely that a significant number of those employed following traumatic brain injury are in positions which may be either reduced in status, or be temporary or part-time in nature. Therefore, an estimate of those who are involved in full-time employment may be much more conservative than estimates provided. This is not surprising given the numerous deleterious effects of traumatic brain injury on physical, cognitive and psychosocial abilities. This area warrants further investigation so as to accurately assess factors which impact successful employment following severe traumatic brain injury.

CHAPTER III

RESEARCH DESIGN AND PROCEDURES

The purpose of this study was to identify the extent to which certain variables associated with traumatic brain injury correlated with subsequent vocational outcome. Comparative analyses between subjects at various levels of employment including those who were unemployed was investigated. The purpose of this chapter is to describe the variables of interest and to offer the design which was utilized for the investigation.

This study entailed a comprehensive analysis of vocational outcome following severe traumatic brain injury. A number of critical issues missing in past studies concerning employment following traumatic brain injury were addressed in this study. The study limited the investigation to only subjects who had suffered a severe traumatic brain injury with a minimum length of coma of 24 hours. Specific outcome categories were utilized in order to achieve greater precision in defining employment. Comparative analyses as well as prediction analyses were employed to ascertain those variables most strongly associated with vocational outcome. Premorbid employment characteristics including hours worked weekly, occupational status, and number of months employed the year preceding the injury were analyzed to determine the relationship between premorbid employment and post-injury employment. These issues were addressed in this study to provide new findings in this complex yet crucial area of employment following severe traumatic brain injury.

An important area of investigation involves the impact of the severity of injury as measured by duration of loss of consciousness or coma on subsequent neuropsychological status. As numerous studies have indicated an inverse relationship between duration of coma and performance on tests of intellectual performance (Klove & Cleeland, 1972; Levin, Grossman, Rose, and Teasedale, 1979), further investigation of this relationship confined to a population of severe craniocerebral trauma survivors was important in order to obtain greater precision in our understanding of this complex relationship.

Numerous studies have documented the relationship between severity of injury (Teasedale & Jennett, 1974) as well as neuropsychological status (Ben-Yishay, et al., 1985; Prigatano, et al., 1984) and successful outcome. However, few studies have limited their investigation to only those survivors of severe injuries. It was therefore important to determine within a population of severe craniocerebral trauma survivors the extent to which indices of severity and neuropsychological status were associated with differences in outcome measures.

The impact of premorbid employment characteristics is an important area of investigation in relation to vocational outcome. While premorbid personality characteristics are thought to impact outcome following severe head trauma, there have been few studies which have attempted to evaluate the predictive value of premorbid employment factors (Fraser, et al., 1988). This study investigated the impact of premorbid vocational characteristics upon vocational outcome post injury including premorbid factors such as level of employment, occupation and the number of months employed during the year preceding the injury.

The approach that was taken in this study involved obtaining a sample of subjects who had suffered severe traumatic brain injury. Subjects were deemed to be successfully employed by being currently employed for a minimum of three consecutive months by the same employer or to have successfully completed two consecutive terms at a college or university. Inclusion of students into the employed category was based in part on the fact that due to the demographic characteristics of closed head injury, a significant proportion of survivors were of college-age at the time of their injuries. Subjects were classified as being unemployed if they were not earning a competitive wage at the time of the investigation. Subjects were considered to be employed full time if they were working ar least 35 hours per week at the time of the study. Those subjects employed less than 35 hours per week were considered part-time employees. Subjects who were involved in sheltered employment or supported employment (wage subsidized by someone other than the employer) were classified in a separate category. This resulted in five employment categories as follows: full-time employment, part-time employment, successful college enrollment, sheltered or supported employment and unemployment.

These groups met criteria in relation to severity of injury at the time of selection. Subjects selected had a minimum loss of consciousness of 24 hours following their injury. This was documented in the medical records. Correlations were investigated between a number of independent variables associated with traumatic brain injury and vocational outcome. Causality cannot be specified in this context due to the number of variables involved, the complexity of the central nervous system, and numerous extraneous variables associated with individual differences. However, certain variables were found to correlate with vocational outcome. These findings may serve to increase our knowledge of the complex relationship between traumatic brain injury characteristics and vocational outcome. In this manner, advances in services, treatment planning, and research may be augmented.

Variables

The independent variables investigated have been cited in the literature as having predictive value related to vocational outcome following traumatic brain injury. In this manner the duration of coma (Teasedale & Jennett, 1974, 1986), neuropsychological status (Ben-Yishay, et al., 1985; Prigatano, et al. 1984) and premorbid employment status (Fraser, et al., 1988; Kaplan, 1988) were the primary independent variables of interest.

A particular area of interest within this study involved the significance of initial employment following traumatic brain injury. In this spirit, two additional measures were reviewed. The first variable was the time in which employment was re-entered following traumatic brain injury. If the timing of employment following traumatic brain injury possessed predictive value, this would contribute greatly to the knowledge and practice of vocational rehabilitation by providing optimal time periods post-injury which are associated with greater likelihood for successful employment. This would assist in treatment planning in terms of job placement.

The extent to which the initial vocational placement into competitive employment is successful was an additional variable of interest in this study. This is based upon the rationale that initial employment success has considerable impact upon subsequent psychological factors such as self-efficacy and confidence which may then affect future behavior pertaining to employment. For example, those subjects who experience initial success in employment following traumatic brain injury, would be more confident in their ability to maintain or obtain employment and would be thought to have a greater likelihood for employment success. This was ascertained by several measures. The number of consecutive months employed in the first job post-injury offers some indication of success in terms of initial employment. The nature of termination following the first job provides information regarding initial success. Additionally, the subjects' self-report on the extent to which they perceived their first employment experience post-injury as successful was utilized as an estimate of initial employment success. Additional variables included age, sex, and years of education. The independent variables were as follows:

<u>Independent Variables</u>

1. Duration of Loss Of Consciousness
2. Neuropsychological Indices
   a. Full Scale I.Q.
   b. Verbal I.Q.
   c. Performance I.Q.
   d. WAIS-R Subtest Scaled Scores
   e. Predicted I.Q.
   f. Memory Quotient
3. Premorbid Employment Status
   a. Full-time Employment
      1) Professional, managerial, technical
      2) Clerical
      3) Service
      4) Structural/Skilled
      5) Structural/Unskilled
   b. Part-time Employment
   c. College
   d. High school
   e. Unemployed
4. Years of Education
5. Age
6. Sex

7. Number of Months Employed Premorbidly

8. Successful Initial Employment

The dependent variables pertained to vocational outcome status. The variables were as follows:

1. Employment Status Post-Injury
    a. Full-time Employment
        1) Professional, managerial, technical
        2) Clerical
        3) Service
        4) Structural/Skilled
        5) Structural/Unskilled
    b. Part-time Employment
    c. Supported or Sheltered Employment
    d. College
    e. Unemployed

2. Hourly Wage

3. Number of Months Employed Past Year

4. Level of Satisfaction with Current Employment
    a. Extremely Satisfied
    b. Satisfied
    c. Indifferent
    d. Dissatisfied
    e. Extremely Dissatisfied

5. Number of Job Changes Since Injury.

Data Analysis Procedures

A number of areas of investigation were of interest. Evaluating differences between groups utilizing categorical independent variables and interval or continuous dependent variables was achieved through the use of the analysis of variance (hereafter referred to as ANOVA). As Glass and Hopkins (1984) stated, "The analysis of variance is a method of statistical inference that evaluates whether there is any systematic (i.e. nonrandom) difference among the set of J "means" (p. 325). ANOVA was utilized to investigate the following hypotheses:

1. Those who are successfully employed have shorter periods of

coma than those unemployed.

2. Neuropsychological performance is positively correlated with successful vocational outcome.

3. Premorbid occupation is associated with differences in wage post-injury.

4. Those who are successfully employed have shorter durations of unemployment prior to returning to work post-injury.

5. Successful employment is associated with initial employment success post-injury.

Analysis of covariance (ANCOVA) was utilized to examine hypotheses in which two independent variables were both correlated with an outcome measure. ANCOVA provides an opportunity to utilize one of the variables as a covariate. This results in the subjects being controlled on the particular variable while the independent variable of interest is examined. ANCOVA was utilized to examine differences between employment groups in relation to the duration of time from injury until the first job was obtained. Within this context, severity of injury as measured by period of coma served as the covariate. Subjects were controlled for severity of injury while the period of time from injury to initial job placement was examined. This increased statistical power as well as precision of the phenomenon measured (Kirk, 1982).

In addition to evaluating differences between groups, relationships between independent variables and dependent or outcome measures was of interest. A discriminant analysis was utilized to determine which combination of independent variables could best predict outcome. Within this study, group membership of interest involved employment or unemployment. As Kerlinger and Pedhazur (1973) state:

> The discriminant function is a regression equation with a dependent variable that represents group membership. With only two groups, discriminant function analysis amounts to

> multiple regression analysis with the dependent variable taking the values of 1 and 0. There are several measures for each individual in a sample. Using these measures as independent variables and a vector of 1's and 0's as the dependent variable, we solve the regression in the usual manner. The resulting equation, the discriminant function, maximally discriminates the members of the sample; it tells us to which group each member probably belongs (p. 337).

Finally, there were a number of analyses which entailed the extent to which groups based upon a categorical variable (i.e., employment level) differed in the frequency of certain events. For example, an area of interest was the extent to which premorbid occupational categories are associated with differences in the frequency of employment post injury. Analyses of this nature were completed through the use of chi-square statistics which determine whether the differences in frequencies of certain variables is statistically significant (Glass & Hopkins, 1984).

Data Collection Procedures

The study was retrospective in nature. The investigation entailed comparative analyses of variables which differentiated those who have successfully maintained employment and those who were unemployed following severe traumatic brain injury. Information pertaining to a number of independent variables including length of coma, measures of intellectual functioning, date of injury, etc. was obtained from medical records. This information was augmented by a telephone interview which was utilized to obtain current information on employment as well as premorbid employment characteristics. The goal was to derive a complete compilation of data on an individual pertinent to the investigation. A copy of the data summary profile may be reviewed in Appendix A.

Subjects were obtained from three rehabilitation programs which serve as exemplary within the field of head injury rehabilitation. These settings were chosen because vocational rehabilitation is a prominent component of their programming. Many of their clients were likely to meet the criteria for the study and were involved in some aspect of employment. Approval was obtained from the respective agencies in addition to approval from the Committee for the Study of Human Subjects at Michigan State University (UCRIHS) prior to the initiation of this study.

Facility Characteristics

The rehabilitation facilities were located in three Midwestern states. All three facilities were private facilities. While all three facilities also provided rehabilitation services to outpatient clients, two of the facilities provided residential services. All facilities employed traditional health care personnel including physical therapists, occupational therapists, speech pathologists, recreation therapists, registered nurses, psychologists and rehabilitation counselors. A brief description of each facility will summarize the general characteristics.

The first facility had over 100 paid employees at the time of the study. This included the allied health professionals mentioned as well as administrative staff, support and clerical staff and paraprofessional staff. Clients who received services at this facility had to be medically stable and devoid of severe behavioral problems. Two vocational rehabilitation counselors were employed on a full-time basis. Vocational services provided included vocational assessment, supervised work evaluations, and job placement. The program offered residential and outpatient rehabilitation services.

The second facility employed over 100 personnel and provided both residential and outpatient services. In addition to the customary allied health personnel, two vocational rehabilitation counselors were employed on a full-time basis. Services provided included vocational assessment, supervised work evaluations, and job placement. This facility also provided supported employment enclaves which offered work adjustment training. This facility accommodated a broader range of clients including those who exhibited more prominent behavioral problems.

The third facility provided rehabilitation services exclusively on an outpatient basis. This facility employed approximately 30 staff. In addition to the customary allied health professional, one full-time vocational specialist was employed. There were no supported employment enclaves available for work adjustment training. However, as with the first facility, community-based volunteer positions were often utilized for purposes of work evaluation. Job placement services were offered.

Informed Consent

Much of the demographic, medical, and treatement information was obtained from medical records of the rehabilitation programs involved in the study. Information gathered was protected in terms of confidentiality and anonymity through several means. The data summary profile in Appendix A used code numbers rather than names and the data was maintained solely by the primary author. Discussion of the data was limited to group results with no mention of specific subjects.

The dependent variables were obtained by client self-report through a brief telephone interview. Clients were fully informed about the nature of the study including the voluntary nature of the study. Verbal consent was obtained prior to the initiation of an interview. The question of accuracy of information due to the presence of traumatic brain injury arises in terms of client self-report. To assess the accuracy of the information, 25% of the subjects involved in the study were randomly selected. Information on this sample was cross-validated by either a facility staff member familiar with the individual or a family member pending the subject's consent. A copy of informed consents pertaining to subject and permission to interview a family member are available for review in Appendices C and D. Permission was obtained from the respective rehabilitation programs as well as the Committee for the Study of Human Subjects at Michigan State University (UCRIHS) prior to the initiation of this study.

Pilot Study

A pilot study was undertaken to test the procedures developed for this study. The pilot study was completed at one of the rehabilitation facilities that participated in the study.

Twelve individuals who suffered severe traumatic brain injury with at least 24 hours loss of consciousness were sampled. This included review of medical records and completion of a telephone interview. The results of the pilot study will be briefly summarized and are listed in the attached tables.

The pilot sample was comprised of nine males and three females. The average number of months since the time of their injury was 56. Average duration of coma was 12.9 days. Neuropsychological testing was carried out at an average of 18 months post-injury. In terms of intellectual functioning, average Verbal, Performance, and Full Scale I.Q.'s on the Wechsler Adult Intelligence Scale-Revised were 95, 93, and 94 respectively. The average memory quotient for 10 subjects was 94.

The average age of the subjects at the time of the interview was 28 with the average number of years of education at 13. For those who were employed, the average number of hours worked weekly was 26 with an average wage of $6.19. These figures are lower than premorbid measures of 33 hours worked weekly and an hourly wage of $7.36. The average number of months post-injury prior to sustained employment was 30.

The pilot study identified certain limitations in data collection. Measures of post-traumatic amnesia were most often missing. Although this construct has received considerable attention in the literature, it is infrequently assessed in regional hospitals pertinent to this study. While loss of consciousness is nearly always provided, there is considerable variability in terms of the source including emergency hospital reports, acute rehabilitation reports, neuropsychological reports, etc. The Glasgow Coma Scale was rarely cited as the diagnostic instrument used to assess coma.

Table 1: <u>Subject Demographic Data</u>

Variable	M	SD	Range
Sex 3 Females 9 Males			
Age	28.0	6.2	22.0
Education	13.3	1.9	6.0

Table 2: <u>Neuropsychological Data</u>

Variable	M	SD	Range
Loss of Consciousness	12.8	11.1	40.5
Verbal IQ	95.2	6.9	18.0
Performance IQ	92.6	11.3	36.0
Full Scale IQ	94.2	8.1	25.0
Digit Symbol	6.7	2.1	7.0
Memory Quotient	94.1	17.3	54.0
Months Post-Injury Tested	18.0	15.5	43.0

Table 3: Employment Data

Variable	M	SD	Range
Pre-Injury			
Weekly Hours	33.4	11.4	30.0
Hourly Wage	7.4	3.5	8.5
Post-Injury			
Weekly Hours	26.0	15.5	30.0
Hourly Wage	6.1	4.4	11.5
Months Post-Injury Employed	30.0	15.7	50.0

Data related to physical, speech, and behavioral impairments was highly variable and often incomplete. This was not surprising as there is no commonly accepted instrument to assess and rate behavioral adaptation following traumatic brain injury and while subtle impairments in language are common, obvious impairment in speech such as aphasia is infrequent. The lack of an empirical instrument or test to document behavior and personality disturbances following traumatic brain injury makes this data of questionable validity and reliability. However, these variables were documented when available with the potential for future analysis. The information obtained from client interviews was straight forward with no difficulties encountered. The completion of this pilot study indicated that the primary hypotheses were measurable with the proposed methodology.

CHAPTER IV

RESULTS

Subject Characteristics

Ninety-four subjects were contacted from 126 successive admissions over a two year period from three rehabilitation facilities. Based upon a review of medical records, the study included only those subjects who suffered a traumatic brain injury with a duration of coma of at least 24 hours. The study did not examine subjects with other neurological conditions such as cerebral vascular disorders, tumors, anoxia, or penetrating head injuries. Telephone interviews with the subjects took place no less than one year from the time they each incurred their injuries.

The demographic profile of the subject pool (see Table 4) shows that: 68 subjects were male (72.3%) and 26 were female (27.7%); the average age of the subjects at the time of the interview was 31 years old and average age at the time of the injury was 26 years old. The average number of years of education was nearly 13 (12.9). The average duration from the time the injury was sustained to the time of the interview was 58 months. The subjects sampled included 54 from facility 1 (57.4%), 23 from facility 2 (24.5%), and 16 from facility 3 (17.0%). These facilities were located in three Midwestern states.

Table 5 summarizes the sample's distribution of accident types and average duration of coma. Seventy-four (78.7%) of the subjects were involved in motor vehicle accidents, 6 (6.4%) were injured in falls, 6 (6.4%) suffered from motorcycle accidents, 4 (4.3%) had been struck by a vehicle while riding a bicycle, and 4 (4.3%) were injured as pedestrians struck by vehicles. The average duration of coma for the subject pool was 20 days.

Table 4: <u>Subject Demographic Data</u>

Variable		M	SD	RANGE
Sex	68 Males	(72.3%)		
	26 Females	(27.7%)		
Age		31.0	9.8	42
Education (Years)		12.9	2.2	12
Duration Post-Injury (Months)		58.4	42.6	228
Facility 1: 54		(57.4%)		
Facility 2: 23		(24.5%)		
Facility 3: 16		(17.0%)		

Table 5: <u>Type of Accident</u>
<u>Loss of Consciousness</u>

Variable	N	M	SD	RANGE
Type of Accident				
Motor Vehicle	74	(78.7%)		
Fall	6	(6.4%)		
Motorcycle	6	(6.4%)		
Pedestrian	4	(4.3%)		
Bicycle	4	(4.3%)		
Length of Coma (Days)		20.5	20.2	89

As Table 6 indicates, 46 subjects had documented evidence of some form of secondary cerebral complication during the acute phase of their recovery. Of this group, 19 (20.2%) subjects had subdural hematomas, 7 (7.4%) had cerebral edema or brain swelling, 2 (2.1%) subjects had experienced increased intracranial pressure, 4 (4.3%) had hydrocephalus, 6 (6.4%) subjects had intradural hematomas, and 18 (19.1%) had incurred cerebral hemorrhages. Ten of the subjects incurred two types of secondary cerebral complications and one subject suffered from three complications.

Seventy-one (75.6%) subjects were employed on a full-time basis prior to their injury (see Table 7) and 8 (8.5%) subjects held part-time jobs. Six (6.4%) subjects were high school students, and 7 (7.4%) were enrolled in college. Two (2.1%) subjects were neither students nor employed. Of the seventy-nine subjects employed, 12 (15.2%) subjects were employed in professional, managerial, or technical positions, 8 (10.1%) worked in clerical positions, and 3 (3.7%) subjects worked in service industry positions. Twenty-seven (34.2%) subjects worked in a structural setting involving some level of training (structural/skilled), and 29 (36.7%) subjects were in positions which required no specialized training. Prior to their injuries, subjects earned an average hourly wage of $9.64 and worked an average of 37 hours per week (see Table 9).

Table 6: Secondary Cerebral Complications
Location

Variable	n	%
Cerebral Complication:		
Subdural Hematoma	19	20.2%
Brain Swelling	7	7.4%
Increased Intracranial Pressure	2	2.1%
Hydrocephalus	4	4.3%
Intradural Hematoma	6	6.4%
Hemorrhage	18	19.1%
None Reported	48	51%
Location (n=46)		
Right Frontal	22	48%
Right Posterior	5	11%
Left Frontal	9	20%
Left Posterior	2	4%
Subcortical	8	17%

Table 7: Premorbid Employment
Premorbid Occupation

Variable	n	%
Premorbid Employment (n=94)		
Full-Time Employment	71	75.6%
Part-Time Employment	8	8.5%
High School	6	6.4%
College	7	7.4%
Unemployed	2	2.1%
Premorbid Occupation (n=79)		
Professional, Managerial, Technical	12	15.2%
Clerical	8	10.1%
Service Industry	3	3.7%
Structural/Skilled	27	34.2%
Structural/Unskilled	29	36.7%

Table 8: Specific Premorbid Job Titles

Variable	n
Professional, Managerial, Technical	12
Child Development Teacher	1
Dentist	1
Detective	1
Faculty, University	1
Industrial Engineer	1
Manager, Insurance Claims	1
Manager, Retail Store	1
Manager, Marketing	1
Public Relations Representative	1
Tax Analyst	1
Teacher, Elementary School	1
Teacher, Secondary School	1
Clerical	8
Administrative Secretary	1
Data Clerk	2
Office Secretary	3
Paralegal Secretary	1
Teller, Bank	1
Service	3
Grocery Checker	1
Grocery Clerk	1
Waitress	1

Table 8 (cont'd)

Structural/Skilled	27
Account Manager	1
Automobile Mechanic	2
Butcher	1
Carpenter	1
Custodial Supervisor	1
Diesel Mechanic	1
Expediter, Asphalt	1
Forklift Operator	2
Glass Blower	1
Landscaper	1
Machinist	3
Manager, Auto Parts	1
Manager, Service	1
Supervisor, Assembly	3
Supervisor, Auto Repair	1
Supervisor, Manufacturing	1
Truck Driver	1
Truck Mechanic	2
Welder	2
Structural/Unskilled	29
Air Conditioning Installer	1
Assembly	2
Avionic Maintenance	1
Bicycle Messenger	1
Boatswain's Mate	1
Car Wash Clerk	1
Clark	2
Delivery	1
Dishwasher	2
Hatchery Worker	1
Heating Installation	1
Hotel Clerk	3
Iron Worker	1
Laborer	2
Mechanic Assistant	2
Multiple Winder	1
Plant Care Assistant	1
Quality Control	2
Roofer	1
Shipping Clerk	1
Window Fitter	1

Table 9:
Premorbid Hours
Premorbid Wage

Variable	M	SD	RANGE
Premorbid Hours (Weekly)	37.0	8.2	25.0
Premorbid Wage (Hourly)	$9.64	5.7	26.7

Psychometrics:

The study used the Wechsler Adult Intelligence Scale-Revised (WAIS-R) as the primary measure of neuropsychological status post-injury. The WAIS-R is a compilation of 11 subtests which assess a wide array of intellectual abilities. The subtests are grouped into those which are mediated primarily by verbal abilities (Verbal Tests) which result in a Verbal IQ and those which present a variety of novel tasks involving visual perception, visual discrimination, spatial reasoning, visuo-construction, and graphomotor integration (Performance Tests). These latter subtests result in a Performance IQ.

The psychometric data were based upon test results which occurred at 31 months post-injury on average. In instances when more than one set of test results was available in the medical chart, the results which exceeded 6 months post-injury were selected for the study. This was done to avoid the lingering effects of confusional states frequently observed following severe craniocerebral trauma which often times unduly suppresses performance on neuropsychological tests.

The subtest scores (see Table 11) are based on a mean of 10 and a standard deviation of 3. The majority of subtest scores for the sample fall within the average range. The exceptions include low average performances in remote memory and fund of knowledge (Information), visuoconstruction (Object Assembly), and graphomotor speed and integration

(Digit Symbol).

A few pertinent findings from the results of the WAIS-R warrant discussion (see Table 10). The Full Scale IQ for the sample falls within the low average range (89.4) nearly one standard deviation below the mean for the general population. This is significantly below the level that would be expected for this sample based upon the equation developed by Barona, Reynolds and Chastin (1984). Their equation was developed through regression analysis. It utilizes demographic characteristics to provide an estimate of premorbid intelligence. The discrepancy between predicted and measured IQ scores illustrates the deleterious effects of traumatic brain injury upon global intellectual functioning.

While most WAIS-R subtest scores fall within the lower portion of the average range for the sample, the mean Digit Symbol subtest score of 6 is greater than a full standard deviation below the mean as listed in the WAIS-R Manual. This supports previous findings that the Digit Symbol subtest is an extremely sensitive measure to identify the effects of traumatic brain injury (Fraser, et al., 1988).

Table 10: Results from WAIS-R

Variable	M	SD	RANGE
Months Post-Injury Examination Completed	31.0	40.0	191
Full Scale IQ	89.4	12.2	53
Predicted IQ	103.1	7.0	35
Verbal IQ	92.0	13.1	58
Performance IQ	86.6	13.1	62

Table 11: WAIS-R Subtest Scaled Scores

Variable	M	SD	RANGE
Verbal Tests			
Information	7.8	2.6	16
Digit Span	8.9	2.6	16
Vocabulary	8.5	2.5	11
Arithmetic	8.6	2.7	11
Comprehension	9.0	3.0	15
Similarities	9.0	2.6	12
Performance Tests			
Picture Completion	8.0	2.5	13
Picture Arrangement	8.1	2.8	12
Block Design	8.8	2.4	10
Object Assembly	7.8	3.0	13
Digit Symbol	6.0	2.6	11

In addition to the WAIS-R neuropsychological data gathered for the present study included measures of verbal, visual, and general memory functioning. Because the study sampled subjects from three facilities, different measures estimating memory performance were available. In the event that the particular facility used the Wechsler Memory Scale-Revised (n=16), the study relied upon the Verbal, Visual, and General Memory Indexes. A number of subjects (n=13) had received the original Wechsler Memory Scale. For these subjects, the Memory Quotient was utilized as an index of general memory functioning. This study computed a verbal memory measure by deriving a standard score utilizing the raw score for memory passages and the original norms provided in the Wechsler Memory Scale Manual (Wechsler 1973). A visual memory score was computed in the same fashion using the raw score for figural memory. Eighteen subjects were given the Serial Digits Learning Test (SDLT) and Benton Visual Reproduction Test (BVRT). This study computed standard scores for these subjects from the percentile scores available using the SDLT as a measure of verbal memory, the BVRT as a measure of visual memory, and the average of the two tests as a measure of general memory functioning. Only the measure of general memory functioning was used in subsequent analyses. This was because a significant number of subjects did not have available scores of verbal and visual memory rendering these measures not useful.

Average verbal memory and general memory scores for the sample (see Table 12) are nearly a full standard deviation below the mean based upon normative data provided in the Wechsler Memory Scale-Revised Manual (Wechsler, 1987). Visual memory scores are near the bottom of the average range based upon normative data. This depression of memory functions corroborates findings from the WAIS-R which underscores the impact of severe craniocerebral trauma upon neuropsychological abilities.

Table 12: Measures of Memory

Variable	M	SD	RANGE
Verbal Memory	87.0	14.5	71
Visual Memory	90.4	16.6	78
General Memory	86.7	15.8	68

The general memory measure revealed a correlation of .58 with Full Scale IQ (*p*< .001). Visual and verbal memory measures supported the anticipated relationships with Performance and Verbal IQ scores, respectively. The computed measure for verbal memory correlates .61 with Verbal IQ (*p*< .001). The derived measure of visual memory correlates .60 with Performance IQ (*p*< .001). Correlations between verbal memory and Performance IQ (.31, *p*< .12), and visual memory with Verbal IQ (.38 *p*< .04) do not show the strength of relationships and further demonstrates the strength of the expected relationships between verbal memory/Verbal IQ and visual memory/Performance IQ based upon known lateralization effects. The correlations are displayed in Table 12 with p-values adjusted with the Bonferonni method. This method adjusts the probabilities relative to the number of correlations performed thereby controlling the experiment-wise error (Wilkinson, 1989). These relationships support the validity of the measures obtained.

Table 13: Correlations Between Measures of Memory and Intelligence

	General Memory	Verbal Memory	Visual Memory
Full Scale IQ	.63 (*p*< .001)	.54 (*p*< .001)	.56 (*p*< .001)
Verbal IQ	.58 (*p*< .001)	.60 (*p*< .001)	.38 (*p*< .04)
Performance IQ	.52 (*p*< .01)	.33 (*p*= .247)	.60 (*p*< .001)

Vocational Status Post-Injury:

Subjects who had become employed by the time of the survey did so after an average of 29.8 months following their injury. Subjects who were either employed or had successfully completed two consecutive terms in college with a minimum of at least two courses per term were classified as employed (n=43) for the purposes of this study (see Table 14). Subjects who were either unemployed, homemakers, employed in a sheltered workshop setting, or involved in supported employment which was completely subsidized by someone other than the employer were considered unemployed (n=51). Fifty-one subjects were considered unemployed following their injuries, in considerable contrast to premorbid figures in which only two individuals were neither employed or enrolled in school.

Table 14 shows that, based upon hours worked per week, 20 (21.3%) subjects were employed on a full-time basis, 15 (16.0%) subjects were employed part-time, and 8 (8.5%) had completed at least two consecutive terms in college. In addition, 11 (11.7%) subjects were involved in either sheltered or fully supported employment, three (3.2%) subjects were homemakers , three (3.2%) subjects were involved in vocational training, and 34 (36.2%) subjects were unemployed.

As Table 15 points out, of those subjects who were gainfully employed in jobs (n=35), six (14.3%) subjects were employed in professional, managerial, or technical occupations, four (9.5%) subjects were in clerical positions, three (7.1%) subjects were employed in service industry positions, six (14.3) subjects were in structural positions involving some level of training, and 16 (54.8%) subjects were employed in unskilled positions.

Table 14: Employment Status Post-Injury Based Upon Hours Worked Per Week

Variable	n	%
Employed Full-time (> 30 hours per week)	20	21.3
Employed Part-time	15	16.0
College	8	8.5
Sheltered Employment	11	11.7
Vocational Training	3	3.2
Homemaker	3	3.2
Unemployed	34	36.2

Table 15: Occupations of Those Employed (n=35)

Variable	n	%
Professional, Managerial, Technical	6	14.3
Clerical	4	9.5
Service	3	7.1
Structural/Skilled	6	14.3
Structural/Unskilled	16	54.8

Table 16: Specific Job Titles Post-Injury

Variable	n
Professional, Managerial, Technical	6
Child Development Teacher	1
Claims Adjustor	1
Market Researcher	1
Teacher, Elementary Education	1
Teacher, Secondary Education	1
Teacher, Vocational Education	1
Clerical	4
Clerk, Office	1
Data Clerk	1
Paralegal Secretary	1
Teller, Bank	1
Service	3
Grocery Checker	1
Grocery Clerk	1
Dishwasher	1
Structural/Skilled	6
Graphic Arts Technician	1
Machinist	1
Sales, Automobiles	1
Sales, Clothing	1
Supervisor, Assembly	1
Welder	1
Structural/Unskilled	16
Airport Clerk	1
Assembly	2
Buffer	1
Hotel Clerk	1
Inventory Clerk	1
Janitor	3
Laborer	1
Library Assistant	1
Pharmacy Clerk	1
Pipe Cleaner	1
Polisher	1
Poultry Worker	1
Usher	1

DATA ANALYSIS

Review of Neuropsychological Results Between Employment Groups

The study formulated employment categories based upon the number of hours worked per week as well as the level of supervision required. The categories included: full-time employed (n=20), part-time employed (n=15), college students (n=8), sheltered or supported employment (n=11), or unemployed which includes homemakers and those involved in vocational training (n=40). Homemakers (n=3) were included into the unemployed group because they were not earning a competitive wage at the time of the study. Those subjects involved in vocational training (n=3) were not considered to be competitively employed and did not meet the criteria of enrollment in a college or university. Analysis of variance was utilized to observe differences between the employment groups on a number of measures. Using Full Scale IQ as a measure of global intellectual ability (see Table 17), significant differences were observed between employment groups, $F(4,8)=6.2$, ($p<.001$). The study incorporated the Bonferroni Procedure (Kirk, 1982) to perform a priori multiple comparisons. With this procedure, alpha is determined by the number of comparisons made (Glass & Hopkins, 1984). This procedure provides an opportunity to test a number of comparisons while controlling the experiment wise error. As Kirk (1982) states, "The procedure basically consists of splitting up alpha among a set of planned contrasts." (p. 107).

Significant differences on the Full Scale IQ measure showed that those employed full time (M=99.2) exceeded those employed part time (M=87.2) ($p<.01$) and those involved in sheltered employment (M=79.3) ($p<.001$). College students (M=99.1) exceeded those involved in sheltered employment ($p<.001$), those who were employed part time ($p<.01$) and those unemployed (M=87) ($p < .001$). Those who were employed part time were indistinguishable from those who were in sheltered employment or those unemployed.

Table 18 contrasts employment groups on measures of general memory functioning, $F(4,63)=5.0$, ($p < .001$). Multiple comparisons indicated that college students performed better on memory functioning (M=104.9) than those employed part time (M=80.1) ($p < .001$), those in sheltered employment (M=81) ($p < .002$), and those unemployed (M=85.2) ($p < .001$). Those employed full time (M=91) did not achieve statistically significant superiority in terms of memory functioning.

Differences between employment groups on the Digit Symbol subtest of the WAIS-R was also examined, $F(4,68)=2.7$, ($p < .04$). Multiple comparisons indicated that those employed full-time (M=7.8) were superior compared to those in sheltered employment (M=4.2) ($p < .01$), and those unemployed (M=6.0) ($p < .01$). College students were not different from the other employment groups (M=6.0).

Table 17: Analysis of Variance
Independent Measure: Employment Groups Post-Injury
Dependent Measure: Full Scale IQ

Source	DF	Mean-Square	F-Ratio	p
Employment Group	4	745.98	6.2	< .001
Error	80	119.69		

Group	M	SD
Full-time Employed	99.2	12.5
College Students	99.1	6.5
Part-time Employed	87.2	11.6
Unemployed	87.0	10.5
Sheltered Employment	79.3	11.4

Table 18: Analysis of Variance
Independent Measure: Employment Groups Post-Injury
Dependent Measure: Memory Score

Source	DF	Mean-Square	F-Ratio	p
Employment Group	4	956.68	5.0	< .001
Error	63	190.08		

Group	M	SD
College Students	104.9	12.0
Full-time Employed	91.0	11.5
Unemployed	85.2	16.3
Sheltered Employment	81.0	11.2
Part-time Employed	80.1	13.0

The results of neuropsychological measures suggested that in terms of group means, those subjects employed full time or who have successfully completed two consecutive terms in college were superior to those employed part time, those involved in sheltered employment, or those unemployed. Measures of general intellectual functioning, memory, and graphomotor integration all showed this pattern. Those employed full time or successfully enrolled in college did not differ on neuropsychological measures and consistently outperformed those employed part time, those involved in sheltered employment or those unemployed. This suggests that distinctive differences exist and those in the most demanding employment categories (full-time employment, college) demonstrated superior abilities on a number of neuropsychological measures. Those employed part time did not differ on the neuropsychological measures described from those involved in sheltered employment or those unemployed.

In addition to the differences observed on neuropsychological measures, differences occurred between the employment groups in terms of the disparity between obtained Full Scale IQ post-injury and predicted IQ $F(4,79)=4.4$, ($p < .01$). Multiple comparisons indicated that collectively those employed full time or enrolled successfully in college exhibited less disparity between the observed and predicted measures compared to those employed part time, those involved in sheltered employment, or those unemployed ($p < .001$). This suggests that beyond actual performance differences between employment groups, there is evidence to suggest that those involved in the more demanding employment categories (full-time employment, college) exhibited less compromise in terms of global intellectual functioning compared to premorbid predictions.

Examination of differences between the employment groups in terms of length of coma indicated significant differences $F(4,84)=3.6$, ($p < .01$). However, multiple comparisons suggested that the only significant differences between employment groups in terms of length of coma indicated shorter durations for those employed full time or enrolled in college compared to those involved in sheltered or fully supported employment ($p < .01$). This suggests that while consistent differences exist on measures of neuropsychological status in favor of those employed full time or those successfully enrolled in college, that same degree of correspondence did not occur with respect to length of coma.

Premorbid Employment Occupations

The study examined premorbid employment occupations (classified in Table 7) to determine their influence on employment post-injury. Because of inadequate cell size for the five occupational classifications listed, the categories were collapsed into three occupational categories to allow for adequate cell membership. Group 3 included all those subjects who were employed in professional, managerial, or technical occupations along with those in clerical positions and those enrolled in college (n=32). Group 2 consisted of those working in occupations which required some level of skill or training (structural/skilled, n=30). Group 1 contained those who held unskilled positions or service industry positions (n=30).

Table 19 details how significant differences emerged between the three occupational groups in terms of premorbid wage $F(9,83)=9.7$, ($p < .001$). Those in group 3 (M=$11.53) and group 2 (M=$11.32) exceeded those in unskilled or service industry positions (M=$6.21) in terms of premorbid hourly wage ($p < .001$).

Premorbid occupational groups also displayed significant differences in terms of years of education $F(2,91)=14.8$, ($p < .001$). Multiple comparisons determined that those in group 3 (M=14.4) had a greater number of years of education than either those in group 2 (M=12.4) or those in group 1 (M=11.9) ($p < .001$). There was no significant difference between groups 2 and 1 with respect to years of education. In terms of Full Scale IQ post-injury, there were significant differences $F(2,82)=6.6$, ($p < .01$) between those employed in occupations encompassed within group 3 (M=95.2) achieving higher IQ's than those in group 1 (M=84.4) ($p < .001$). Those employed in group 3 nearly achieved statistical superiority compared to those employed in skilled position encompassed in group 2 (M=88.3) ($p < .03$).

While premorbid occupational status was significantly related to post-injury measures of global intellectual functioning, there were no significant differences in terms of graphomotor speed on the Digit Symbol subtest or general memory functioning. These findings demonstrate the relationship between premorbid factors such as education and occupation upon post-injury IQ. However, graphomotor integration and memory are less influenced by these premorbid factors than Full Scale IQ. This is due to the fact that Full Scale IQ is an omnibus measure that includes a number of tests which are associated with education, cultural background, and occupation (Lezak, 1983).

Table 19: <u>Analysis of Variance</u>
<u>Independent Variable:Premorbid Occupation</u>
<u>Dependent Variable: Premorbid Wage</u>

Source	DF	Mean-Square	F-Ratio	p
Occupation	2	258.3	9.7	< .001
Error	79	26.7		

Group	M	SD
Occupational Group 3	11.53	6.72
Occupational Group 2	11.32	5.01
Occupational Group 1	6.21	3.38

Table 20: <u>Analysis of Variance</u>
<u>Independent Variable: Premorbid Occupation</u>
<u>Dependent Variable: Years of Education</u>

Source	DF	Mean-Square	F-Ratio	p
Occupation	2	54.3	14.8	< .001
Error	91	3.7		

Group	M	SD
Occupational Group 3	14.4	2.6
Occupational Group 2	12.4	1.3
Occupational Group 1	11.9	1.5

Table 21: <u>Analysis of Variance</u>
<u>Independent Variable: Premorbid Occupation</u>
<u>Dependent Variable: Full Scale IQ Post-Injury</u>

Source	DF	Mean-Square	F-Ratio	p
Occupation	2	870.5	6.6	< .01
Error	82	131.9		

Group	M	SD
Group 3	95.2	11.5
Group 2	88.3	11.8
Group 1	84.4	11.1

The findings indicated that the occupational categories utilized in the study are valid measures and supported by the following relationships. Those employed premorbidly in Group 3 (professional, managerial, technical, clerical) were more educated than those subjects in Premorbid Occupational Group 2 (structural/skilled) or Group 1 (structural/unskilled). Those in Group 3 demonstrated higher Full Scale IQ's than those in Group 1. Finally, those subjects in Premorbid Occupational Groups 3 and 2 earned a greater hourly wage as would be expected compared to subjects in unskilled positions. This provides support for the validity of the occupational categories utilized as well as the self-reporting of the subjects involved in the study.

Premorbid occupation did not demonstrate a significant correlation with post-injury employment status (r = .13). Chi square statistics were performed to further investigate the relationship between premorbid occupational classification and post-injury full-time employment. Those who were in premorbid occupations encompassed within Group 3 (professional, managerial, technical and clerical) nearly achieved statistical superiority compared to those who were employed in unskilled jobs premorbidly (Group 1) in terms of full-time employment post-injury X^2 (1, $\underline{n}$=52) = 3.8 ($\underline{p}$ = .051). There were no significant differences between those in Group 3 and those subjects who were employed in structural/skilled positions premorbidly (Group 2) X^2 (1, $\underline{n}$=56) = .8, ($\underline{p}$=.8). Additional analyses were performed by combining full-time and part-time employment resulting in an overall measure of post-injury employment. There were no significant differences in overall employment post-injury when comparing the three premorbid occupational categories. These results suggest that while premorbid occupational status approaches a statistically significant relationship with post-injury full-time employment, there is no apparent association with employment when including those employed on a part-time basis.

Those who were employed in managerial, professional, technical or clerical positions prior to the onset of traumatic brain injury earned a greater hourly wage post-injury (M=8.96) than those who had been employed in unskilled positions premorbidly and were employed post-injury (M=4.70) (p <.03). Moreover, as a group, those subjects from Occupational Group 3 worked more hours per week post-injury (M=34.1) than those from Group 1 (M=23.0) (p <.03). This indicates that while premorbid occupational status does not directly relate to employment status post-injury, it does influence employment characteristics such as hourly wage and hours worked per week.

The premorbid occupational groups were compared in terms of age and significant differences were observed F 7.4, (2,82) (p < .01). Those who were employed in unskilled positions prior to their injuries (Group 1) were significantly younger at the time their injuries were suffered (M = 22.3) than those subjects in either structural/skilled positions (Group 2) (M = 28.8) or those in professional, managerial, technical or clerical positions (Group 3) (M = 29.9) (p < .01). This indicates that those subjects who were employed in unskilled positions premorbidly, suffered their injuries earlier in life than other subjects. These subjects may have had less opportunity toward career development due to the untimely onset of their injuries at an earlier age.

Table 22: Analysis of Variance
Independent Variable: Premorbid Occupation
Dependent Variable: Hourly Wage Post-Injury

Source	DF	Mean-Square	F-Ratio	p
Premorbid Occupation	2	55.3	2.9	< .08
Error	40	19.3		

Group	M	SD
Occupational Group 3	9.00	6.8
Occupational Group 2	6.80	4.5
Occupational Group 1	4.70	1.3

Table 23: Analysis of Variance
Independent Variable: Premorbid Occupation
Dependent Variable: Hours Employed Post-Injury

Source	DF	Mean-Square	F-Ratio	p
Premorbid Occupation	2	387.7	3.1	< .06
Error	40	126.0		

Group	M	SD
Occupational Group 3	34.1	10.0
Occupational Group 2	29.3	12.6
Occupational Group 1	22.9	10.2

Premorbid occupational status was examined to determine whether there was any influence on employment change post-injury. The three Occupational Categories were compared in relation to whether subjects returned to the same employer or a new employer following their injury. Chi square analyses indicated that there was no significant difference between the three occupational groups in terms of employment change X^2 (1, N = 68) = 1.3, (p < .26). This indicates that within this study, premorbid occupational status had little effect on subjects returning to work with the same employer.

The association between employer change and sustained employment was examined. Subjects who were hired by the same employer (n = 17) were compared with subjects who returned to a new employer (n = 52) in relation to employment status at the time of the survey. Those who returned to work with the same employer showed an advantage in remaining employed which approached statistical significance X^2 (1, N = 69) = 3.3 (p < .07). As a group, those subjects who returned to work with the same employer earned a greater hourly wage (M=10.80) than the group who returned to work with a new employer post-injury (M=5.20) F=18.4, (1,39) (p<.001).

Further examination revealed that as a group those subjects who returned to work with the same employer suffered less severe injuries as ascertained by length of coma (M = 8.1 days) compared to those subjects who returned to work with a new employer (M = 23.7 days) F=9.4, (1,64) (p < .01). Additionally, those subjects who returned to work with the same employer demonstrated superior neuropsychological performance as demonstrated by Full Scale IQ (M = 97.1) compared to those who returned to work with a new employer (M = 87.2) F=7.1, (1, 59) (p < .02). This suggests that while returning to work with the same employer is associated with greater likelihood for employment success, the subjects in the study most likely to return to the same employer suffered less severe injuries and exhibited less impairment in global neuropsychological status. This indicates that severity of injury and subsequent neuropsychological status are likely to be mitigating factors and associated with the ability to return to work with the same employer.

Table 24: Patterns of Occupational Change
Post-Injury Occupation

Premorbid Occupation	Professional, Managerial Technical (n = 6)	Clerical (n = 4)	Service (n = 3)	Structural Skilled (n = 16)	Unskilled (n = 16)	College (n = 8)	Unemployed (n = 51)
Professional, Managerial, Technical (n = 12)	5						7
Clerical (n = 8)		3	1	1		1	2
Service (n = 3)			1				2
Structural/ Skilled (n = 27)	1			5	4	1	16
Unskilled (n =29)			1		9	1	18
High School (n = 6)					1	1	4
College (n = 7)		1			1	4	1
Unemployed (n = 2)					1		1
TOTAL 94	6	4	3	6	16	8	51

Predicting Employment Categories Post-Injury

The results of neuropsychological measures indicated that as a group, those subjects who were employed full time or enrolled in college consistently exceeded those employed part time, those involved in sheltered employment, or those subjects unemployed. Based upon these findings, the employment groups were collapsed into three groups for the purpose of prediction analysis. Those employed full time or successfully enrolled in college comprised Group 3. Group 2 contained those subjects employed part time. Finally, those who were unemployed including homemakers, those enrolled in vocational training, and those subjects involved in sheltered employment made up Group 1. Pearson correlations were performed between independent variables and the employment groups listed as a prerequisite to performing prediction analyses. Independent variables included neuropsychological measures post-injury, severity of injury ascertained by length of coma, and premorbid characteristics including occupation, and years of education.

Correlations between neuropsychological measures and employment groups are within the moderate range and frequently achieve statistical significance (see Table 25). The relationship between length of coma and employment groups does not achieve statistical significance. Finally, the relationships between premorbid demographic characteristics including age, sex, years of education, and premorbid occupation are not statistically significant. Therefore, the variables which demonstrate significant relationships with the employment groups are the neuropsychological measures.

Table 25: Correlations between Independent Variables and Employment Groups

Variable	r	p
Full Scale IQ	.59	< .001 **
Picture Arrangement	.59	< .001 **
Performance IQ	.53	< .001 **
Similarities	.51	< .001 **
* Prediction Points	-.50	< .001 **
Verbal IQ	.48	< .001 **
Block Design	.46	< .01 *
Digit Symbol	.43	< .01 *
Predicted IQ	.23	< .05
Length of Coma	-.25	≤ .08
Memory Measure	.24	≤ .09
Age	-.19	≤ .07
Premorbid Occupation	.13	≤ .23
Education (Years)	.13	≤ .22
Sex (1=Males, 2=Females)	-.10	≤ .34

* Prediction Points is the calculated disparity between the predicted IQ based upon demographic variables (Barona, et al. 1984) and the actual Full Scale IQ obtained post-injury.

The disparity between predicted and obtained IQ correlated significantly with employment. Length of coma approached significance. Demographic variables, including age, sex, years of education, and premorbid occupation yielded weak correlations with employment level.

Table 26 shows the results of the univariate F-statistics. The study employed a discriminant function analysis, based upon the variables identified, to predict group membership with regards to employment. The employment groups included Group 1 (unemployed), Group 2 (part-time employment), and Group 3 (full-time employment, college students). The discriminant function equation indicated that the strongest predictors of employment following severe traumatic brain injury were the neuro-psychological measures. The overall equation yielded an aggregate statistic which is relatively modest (Wilk's Lambda=.13). The overall canonical correlations are .59 and .35. The equation predicted subjects who were employed full time or in college at 62% and those who were unemployed was made with 67% accuracy. The equation accurately predicted those employed part time with 58% accuracy.

Table 26: Univariate F-statistics for Discriminant Function Analysis (Full-time, Part-time, Unemployed) N=66

Variable	F-statistic	p
Picture Arrangement	8.3	< .01
Full Scale IQ	8.0	< .01
Performance IQ	5.4	< .01
Similarities	6.2	< .01
Block Design	5.9	< .01
Digit Symbol	5.8	< .01
Prediction Points	5.8	< .01
Verbal IQ	5.4	< .01
Length of Coma	3.7	< .05
Premorbid Occupation	1.6	NS
Predicted IQ	1.1	NS
Education	.4	NS

The results of the discriminant function analysis are modest. This is not surprising because of the presence of the part-time employment group. Previous results had indicated that this group was indistinguishable from the unemployed group on a number of neuropsychological measures. Therefore, a second discriminant function analysis was performed in which the part-time employed group and the unemployed group were combined. The prediction entailed the discrimination between those who were employed on a full-time basis or successfully enrolled in college from those who were either employed part time, involved in sheltered employment, or unemployed.

Table 27 shows the univariate F-statistics. The discriminant function equation included 66 of the subjects; the remainder were not included due to missing data. The aggregate statistic for this equation is represented by the Wilk's Lambda of .03. The Canonical correlation coefficient is .57. The discriminant function equation accurately predicted those subjects who were employed full time or successfully enrolled in college with 78% accuracy. Those employed part time, involved in sheltered employment, or unemployed were predicted into their respective group with 79% accuracy. This suggests that when the prediction is limited to either full-time employment or college enrollment, that the equation offers some predictive value well above chance.

Table 27: Univariate F-statistics
Discriminant Function Analysis
(Prediction of full-time Employment
or Successful College Enrollment)

Variable	F-statistic	p
Full Scale IQ	15.0	< .001
Picture Arrangement	12.7	< .01
Performance IQ	12.5	< .01
Block Design	12.0	< .01
Similarities	11.6	< .01
Predicted Points	10.5	< .01
Verbal IQ	10.2	< .01
Digit Symbol	7.6	< .01
Length of Coma	7.5	< .01
Premorbid Occupation	2.2	NS
Predicted IQ	2.1	NS
Education	.8	NS

Examination of Employment Characteristics

The original employment groups post-injury (Employed full-time, part-time, unemployed) were utilized to examine differences in terms of employment characteristics. In terms of hourly wage, those employed on a full-time basis exceeded those who were employed on a part-time basis $\underline{F}$= 23.1, (1,41) ($\underline{p}$< .001). This suggests that those who are employed on a full-time basis are distinguishable from other subjects on earnings as well as hours worked per week. In terms of employment stability, those who were employed full-time at the time of the interview had been employed a greater number of months the past year than the unemployed group $\underline{F}$=39.4, (1,80) ($\underline{p}$< .001). The full-time employed group approached statistically significant superiority over the part-time employed group in terms of months employed the past year $\underline{F}$=3.8, (1,80) ($\underline{p}$ < .06). The groups did not differ significantly in terms of number of consecutive months employed with the same employer.

In examining the impact of premorbid employment characteristics upon employment post-injury, several variables were reviewed. These included the number of months employed during the year prior to the injury, the number of months employed with the same employer during the year of the injury, and premorbid hourly wage. There were no significant differences between the employment groups post-injury on these measures.

The number of jobs post-injury was examined across the three groups. The part-time employed group (M=3.7) exceeded those unemployed (M=1.0) $\underline{F}$=7.8, (89,1) ($\underline{p}$< .01). They did not exceed those employed full time (M=1.5) $\underline{F}$ 4.4 (89,1) ($\underline{p}$< .05).

The employment groups were examined in terms of overall job satisfaction. Those subjects who were employed either on a full-time or part-time basis provided higher ratings of employment satisfaction than those in the unemployed group which included those involved in sheltered employment and homemakers $\underline{F}$=6.9, (78,2) ($\underline{p}$< .01). There was no difference between those subjects who were employed on a full-time basis or those employed on a part-time basis.

The Timing of Return To Work Post-Injury

The number of months from the time injuries were sustained to the time in which the first job was obtained post-injury was examined (see Table 28). Subjects were rated in terms of the severity of their injury based upon the length of coma as follows: Severity Level 1 (1-3 days), Severity Level 2 (4-7 days), Severity Level 3 (8-15 days), Severity Level 4 (16-29 days), Severity level 5 (> 29 days). Analysis of variance indicated significant differences between these groups in terms of the period before returning to employment F=5.3, (4,82) (p< .01). Multiple comparisons pointed to Severity Groups 1 (M=22.4), Group 2 (M=24.5), and Group 3 (M=25.7) having significantly shorter periods of time until employment is re-entered than Severity Level's 4 (M=49.0) and 5 (M=53.0). (p< .01).

The employment groups were compared based upon the period from injury to first employment. Analysis of Covariance was performed using the severity of injury as a covariate. The results indicated that the employment groups differed significantly in terms of the number of months from injury to first employment F=3.7, (2,83) (p< .03). Multiple comparisons indicated that those subjects who were employed full time (M=21.5) had returned to work sooner than those who remained unemployed (M=49.0) (p< .001). The results indicate than those subjects who incurred more severe injuries had greater periods of time before returning to work compared to subjects with less severe injuries (see Table 29). Additionally, those subjects who were unemployed at the time of the study, had greater periods from the time of injury until the first return to employment was made. This includes a sizeable number of subjects who remained unemployed since their injury.

Subjects who had not had a single job since their injury were deleted in an effort to ascertain the effect of time post-injury on success in returning to employment. Level of severity achieves statistical significance on this basis $F=5.3$, (4,54) ($p< .01$). Those subjects from Severity Level 1, Level 2, and Level 3 have significantly shorter periods before returning to work than those subjects in Severity Levels 4 and 5 ($p < .001$). This indicates that collectively, subjects who had periods of coma of less than fifteen days returned to work much sooner than those with durations of coma that exceeded fifteen days.

The employment groups did not show significant differences in the period of time returning to work once those subjects who had not made a single employment attempt were deleted ($p < .18$). The period of time from injury to initial employment was further examined using chi square analysis. Subjects who had been employed at least once post-injury were categorized based upon the interval of time from injury to employment. Category 1 involved those subjects who obtained employment within 24 months following their injury. Category 2 encompassed a return to employment from 25 to 36 months post-injury. Category 3 included those subjects who returned to employment no sooner than 37 months from the time of their injury. Chi square analyses indicated that those subjects who returned to employment within 24 months (Category 1) were more likely to be employed at the time of the study than those subjects who returned to employment following three years from their injury (Category 3) X^2 (1,N = 52) = 6.1, ($p < .02$).

The subjects who returned to work at different intervals of time were compared on Full Scale IQ to determine the extent to which neuropsychological integrity may influence the timing of return to employment post-injury. Those subjects who returned to work within two years following their injury (Category 1) had higher Full Scale IQ's (95.4) than those who returned to work after three years (Category 3) (84.4) $\underline{F}$=4.4, (2,66) (p<.01). Additionally, those subjects who returned to work within two years had significantly shorter periods of coma (M=11.3) compared to those subjects who returned to work after three years (M=27.2) $\underline{F}$=4.4, (2.66) ($\underline{p}$<.01). The results suggest that those subjects who were employed at the time of the study were more likely to have returned to work sooner than those who were unemployed. However, the successfully employed subjects also exhibited superior neuropsychological performance and less severe injuries which may account for their shorter period of unemployment post-injury.

Table 28: Analysis of Variance
Independent Measure: Level of Severity
Dependent Measure: Length of Time to Employment Post-Injury

Source	DF	Mean-Square	F-Ratio	p
Severity Level	4	4816.5	5.3	<.01
Error	82	904.4		

Group	M	SD
Severity Level 1	22.4	18.3
Severity Level 2	24.5	15.6
Severity Level 3	25.7	17.6
Severity Level 4	49.0	34.6
Severity level 5	53.0	28.9

Table 29: Analysis Of Covariance
Independent Measure: Employment Status Post-Injury
Covariate: Severity Level
Dependent Measure: Length of Time to Employment Post-Injury

Source	DF	Mean-Square	F-Ratio	p
Employment Status	2	3195.4	3.7	<.03
Severity Level	1	9861.6	11.4	<.01
Error	83	866.2		

Group	M	SD
Employed Full Time	21.5	16.1
Employed Part Time	34.9	24.1
Unemployed	49.0	35.8

The issue of successful initial employment post-injury was examined. The number of months employed on the first job post-injury was examined. The employment groups did not differ on this measure F=.986, (2,77) (p< .40). The employment groups were compared in terms of their rating of initial employment success using a Kruskal-Wallis analysis of variance for ranked data (Wilkinson, 1988). The results did not yield significant differences between the groups in terms of self rating of initial employment success.

Examination of Full Scale IQ

This study relied heavily on Full Scale IQ as a measure of global intellectual functioning. This measure has been utilized to examine differences between employment groups and as a predictor of employment status post-injury. While Full Scale IQ has been criticized as an omnibus measure often insensitive to the effects of traumatic brain injury (Brooks, 1984), it has proved to be particularly useful in this study as an estimate of premorbid achievement as well as an indication of global neuropsychological status post-injury.

It has previously been indicated that Full Scale IQ discriminated between premorbid occupational groups with those subjects employed in professional, managerial, or technical occupations exhibiting superior performance (pg. 101). A multiple regression analysis was performed in order to capture the variables which are associated with Full Scale IQ. The regression analysis was performed utilizing years of education and length of coma as predictors. Additionally, demographic variables including premorbid occupation, age and sex were entered into the equation. The adjusted squared multiple R derived from the equation with Full Scale IQ as the dependent variable is .44 ($p < .001$). Examination of the contributions made by the independent variables indicated that length of coma and years of education were the only predictors to achieve statistical significance (see Table 30). This corroborates the notion that Full Scale IQ is a sensitive measure in relation to premorbid achievement (years of education) as well as severity of injury (length of coma).

Subjects with varying levels of severity were examined in relation to Full Scale IQ. The categories based upon number of days in coma are as follows: Severity Level 1 (1-3 days), Severity Level 2 (4-7 days), Severity Level 3 (8-15 days), Severity Level 4 (16-29 days), Severity Level 5 (. 29 days). Analysis of covariance was utilized with years of education serving as the covariate. The results indicate significant differences between the subject groups on Full Scale IQ F=6.5, (5,73) ($p<$ .001). Multiple comparisons revealed that those in Severity Level 1 (M=96.8) exceed those in Severity Level 3 (M=88) ($p<$ .01), Level 4 (M=89.4) ($p<$ .001), and Level 5 (M=81) ($p < .001$). Those subjects in Severity Level 2 (M=95.3) exceeded those in Level 5 ($p<$ .001) (see Table 31). This further corroborates the finding that Full Scale IQ is a useful discriminator in relation to severity of injury. The combined value as both a measure of premorbid achievement and global neuropsychological status post-injury underscores the important role which this measure serves in predicting employment following severe traumatic brain injury.

Table 30: Regression Equation

Independent Variables:
Length of Coma
Years of Education

Dependent Variable:
Full Scale IQ

Variable	STD Error	STD Coefficient	p
Length of Coma	.06	-.43	< .001
Years of Education	.48	.50	< .001
Premorbid Occupation	1.8	.036	NS
Sex	2.7	.05	NS
Age	.13	.02	NS

Table 31: Analysis of Covariance
Independent Variable: Length of Coma Category
Covariate: Years of Education
Dependent Variable: Full Scale IQ

Source	DF	Mean-Square	F-Ratio	p
LOC Severity	4	566.7	6.5	< .001
Years of Education	1	3267.3	37.6	< .001
Error		87.0		

Group	N	M	SD
Level 1		96.8	12.6
Level 2		95.3	12.6
Level 3		88.0	8.6
Level 4		89.4	12.8
Level 5		81.0	9.0

CHAPTER V

DISCUSSION

Summary of Results

The main thrust of this study was to investigate variables associated with successful employment among survivors of severe traumatic brain injury. Employment categories post-injury were clearly specified and included: full-time employment, part-time employment, sheltered or supported employment, successful enrollment in college, or unemployment. Based upon these outcome measures, significant distinctions were observed.

Psychometric data consistently indicated higher performance in favor of those employed full time or those successfully enrolled in college compared to other employment categories. These measures indicated greater preservation of neuropsychological status which included a composite of various intellectual abilities (Full Scale IQ), speed and efficiency of processing information (Digit Symbol Subtest), overall memory performance (General Memory Measure) and the calculated disparity between predicted and achieved Full Scale IQ (predicted points). Comparative analyses supported the anticipated findings that the most demanding employment groups (full-time employment, successful enrollment in college) would excel in the neuropsychological measures.

These preliminary analyses assisted in the formulation of outcome groups which were utilized in prediction analysis. The correlation matrix indicated clearly that the neuropsychological measures exhibited the most significant relationships to employment. These correlations were moderate yet clearly exceeded demographic characteristics including age, sex, years of education, and premorbid occupation.

Based upon these findings, a series of discriminant function analyses were performed. The initial discriminant analysis predicted into three employment groups: (1) unemployment (including homemakers, supported or sheltered employment, and vocational training); (2) employed part time (<35 hours per week); (3) employed full time or successfully enrolled in college. The initial discriminant analysis accurately identified those subjects who were unemployed with 67% accuracy, those employed full time or enrolled in college with 62% accuracy and those employed part time with 58% accuracy. The Wilk's Lambda of .13 suggested relatively modest predictive validity when attempting to classify subjects into these three employment categories.

The employment groups were collapsed by combining those employed part time and those unemployed into a single employment category. The resulting equation increased significantly in accurately placing subjects into their appropriate categories as indicated by the Wilk's Lambda of .03. The accuracy approached 80% for the two groups.

These results point to a number of important findings. The first is that full time employment or successful enrollment in college following severe craniocerebral injury is an ambitious endeavor. These outcome groups are clearly distinguishable from the unemployed or part-time employed groups on the basis of neuropsychological data. Their success appears to be most closely associated with the residual integrity of the central nervous system as measured by neuropsychological data.

This finding is intuitively logical. Full-time employment is perhaps the most demanding human activity and requires optimal integration of neuropsychological abilities. While discrete neuropsychological tasks contributed to the formulation of an equation which capably predicted were either employed full time or successfully enrolled in college demonstrated greater performance on Full Scale IQ (*p* < .01) (pg. 97), general memory functioning (*p* < .01) (pg. 98) and on the Digit Symbol Test (*p* < .04) (pg. 98). Among the correlational and discriminant function analyses, the neuropsychological measures demonstrated the strongest relationship to employment (pg. 110) (pgs. 111, 112). The results support the hypothesis that neuropsychological abilities are associated with successful vocational outcome.

Hypothesis 3:

> Differences in premorbid employment status are associated with differences in vocational outcome following severe traumatic brain injury.

The type of premorbid occupation did not demonstrate a significant relationship to employment rate post-injury (r=.13) (pg. 110). This was corroborated further by the insignificant contribution of premorbid occupation to the discriminant function equation in predicting post-injury employment (pgs. 111, 112). However, those who were employed premorbidly in managerial, professional or technical occupations were more likely to be employed on a full-time basis post-injury as a group than those subjects who had been employed in unskilled positions (*p*=.051) (pg. 104). Those who were employed in unskilled positions premorbidly were significantly younger than those in other premorbid occupational groups (*p* < .01) (pg. 105). The results do not support the hypothesis that premorbid employment status is related to employment post-injury. However, the results provide interesting information previously discussed in terms of the relationship between unskilled employment premorbidly and younger age.

single return to employment were deleted from the unemployed group, there was no significant difference between the employment groups in terms of the period of time from injury to initial employment. Subjects were categorized by the period of time from injury to employment. Those subjects who returned to employment within two years were more likely to be employed at the time of the survey than those who took over three years to return to employment. This finding was interpreted cautiously due to the fact that upon inspection of the two groups, those who returned to work within two years had significantly shorter periods of coma and higher Full Scale IQ's than those subjects who took over three years to return to work. This suggests that the crucial variables may be severity of injury and neuropsychological integrity which are associated with an earlier return to work and greater likelihood for successful employment.

The impact of premorbid occupation was examined in terms of its relationship with employment post-injury. While the relationship of premorbid occupation and post-injury employment status is nonsignificant, a few relationships deserve mention. Those who were employed in professional, managerial, technical or clerical positions prior to their injury earned a greater hourly wage if employed post-injury than those in unskilled positions. They also worked more hours in a week post-injury than those in premorbid occupations which were unskilled. Those in unskilled positions premorbidly were significantly younger at the time of their injuries. This indicates a significant disruption in their maturational process compared to other subjects. It is possible that having suffered their injuries at a younger age that these subjects may have received less training, education or experience in relation to career development.

It becomes apparent that there is little movement upward in terms of occupational status following severe traumatic brain injury. Of the six subjects who were employed in professional, managerial or technical positions post-injury (see Table 24, p. 107), five had been employed in this occupational category premorbidly. This indicates that only one subject advanced into this category post-injury. This pattern is also observed in those subjects employed in skilled positions post-injury (n=6). In this occupational category, only one subject advanced from an unskilled position premorbidly to a skilled position post-injury. This underscores the impact of severe traumatic brain injury. Beyond a drastic increase in unemployment, there is little occupational advancement observed following severe traumatic brain injury.

Those subjects who returned to the same employer following their injuries approached statistical superiority in terms of employment compared to those subjects who returned to work with a new employer. They also earned a greater hourly wage (M=10.80) than those who returned to work with a new employer (M=5.20). However, those who returned to work with the same employer had shorter periods of coma and higher Full Scale IQ's than subjects who returned to a new employer. These results demonstrate that neuropsychological status is a powerful factor which is associated with a greater likelihood for employment, shorter periods of unemployment, a greater hourly wage and a greater chance of returning to work with the same employer. This indicates that employers may be more willing to accommodate employees following traumatic brain injury if these employees do not exhibit significant compromise in neuropsychological functioning. This is associated with successful vocational behavior as these subjects as a group were more likely to be employed. Finally, the increase in hourly wage for this group suggests that the subjects were performing work of greater complexity and sophistication which may be associated with less compromise in neuropsychological functioning.

It is important to observe that those who were employed on a full-time or part-time basis, had higher ratings of satisfaction than those who were unemployed or in sheltered employment. This underscores the value placed upon employment and emphasizes that while those subjects who were employed part time were often indistinguishable from those unemployed on a number of neuropsychological measures that, as a group, they provided higher ratings in terms of employment satisfaction.

The employment groups post-injury did not differ in terms of the number of months employed during the year preceding their injury, premorbid hourly wage, or the number of months with the same employer during the year prior to their injury. There was no basis to infer differences in terms of premorbid employment stability based upon these findings when comparing the employment groups post-injury. The employment groups did not differ in terms of the number of months on the first job post-injury or in terms of self ratings of initial employment success.

The findings indicate that significant differences are observable in terms of employment following severe craniocerebral injury. These differences are based upon neuropsychological performance and suggest that there is some potential to predict employment following severe head injury. While rehabilitation decisions must not be based solely upon neuropsychological data, the findings from this study support a role in utilizing neuropsychological data to assist in rehabilitation decisions. The findings provide a foundation for further research into this area.

employment, the area of greater difficulty which may only be inferred is in the integration of various abilities necessary to master multifaceted tasks such as employment.

While full-time competitive employment or successful enrollment in college is untenable for many subjects following severe craniocerebral trauma, the findings suggest that many subjects are capable of part-time employment. Those who were employed part time were indistinguishable from those unemployed. This is an important finding and indicates that while full-time employment or successful enrollment in college is untenable for many subjects following severe craniocerebral trauma, many subjects appear to be capable of employment on a part-time basis.

An important finding is that full-time and part-time employment appear to be discrete entities. Moreover, these distinctions are measurable and the resulting discriminant analysis provides an equation which may assist in rehabilitation planning. These findings suggest that decisions pertaining to employment following severe head injury can be influenced by neuropsychological data.

Another area of interest which was partially supported by the findings was the duration of time from the injury until employment is re-entered. The findings indicate than subjects with greater severity of injury took considerably more time before returning to work. Those who were in a coma more that fifteen days required nearly five years before they returned to work. This is in contrast to nearly two years for those who were in a coma less than fifteen days.

Those who were employed post-injury on a full time basis had returned to employment in a considerably shorter period of time than those who were unemployed. However, when those subjects who had not made a facilities. These programs were private facilities and, as such, raise questions about the representativeness of the sample in relation to national demographic characteristics. A number of the demographic characteristics of the sample are commensurate with epidemiological characteristics of those who suffer head injury. This includes the overrepresentation of males (72%) compared to females, the average age at the time of the injury (26 ± 9) and the distribution of accident types with a significant proportion of the injuries resulting from motor vehicle accidents (78%). However, only two nonwhite subjects were included in the study. This underscores the need for increasing both service provision and research to include nonwhite survivors of head injury.

The premorbid vocational characteristics of the current sample appear to be more advantaged than past studies have indicated (Fraser, et al., 1988; Adams & Putnam, 1989). Subjects were more likely to be employed or enrolled in school prior to their injury. Only two subjects were neither employed or enrolled in school at the time of their injuries.

Since the subjects were sampled from comprehensive rehabilitation programs, the amount and intensity of rehabilitative interventions received may exceed that of many survivors. Some authors have argued that rehabilitation interventions are associated with a favorable outcome (Arronow, 1987; Prigatano, et al., 1984). This presents a caveat in terms of generalizing the results to subjects who did not receive comparable rehabilitation programming. The geographical limitations imposed by sampling from facilities located in three Midwestern states reduces the generalizability of these findings to other geographic locations which may differ in terms of economic, cultural, and social characteristics.

There are certain limitations inherent in a retrospective study. A prominent threat to the internal validity in retrospective studies is the effect of history. This entails the extent to which subjects sampled differ with respect to the time period which itself could influence the findings. A number of safeguards were instigated to decrease this threat. All subjects were sampled based upon their participation in the rehabilitation programs during a two year period. This eliminates the effect of history upon rehabilitation planning. Subjects completed a structured telephone interview as a component of the study. This provided current information on outcome variables including employment, living arrangement, estimate of employment success, and employment satisfaction. This augmented the gathering of data from medical records and provided current information on the subjects during the same time period.

There are certain measures which support the internal validity of the study. The premorbid occupational groups were associated with differences which were anticipated. Those in professional, managerial or technical occupations were more educated than subjects in other occupations. Those in professional, managerial, technical or structural/skilled occupations earned a greater hourly wage than those in unskilled positions premorbidly. These measures suggest that subjects were accurate in the information they provided.

Subjects from the three facilities were compared on a number of measures to acertain whether facility characteristics may have influenced outcome. There were no significant differences between the groups on measures of length of coma, Full Scale IQ, or post-injury wage. Additionally, the correlation between facility and post-injury employment (.08) was nonsignificant.

Twenty-five subjects were randomly selected from the study. Their report of employment status (employed, sheltered/fully supported, unemployed, college) was compared with ratings provided by a family member or staff member. The correlation of .93 suggests considerable reliability in terms of subjects' self-report and increases the confidence in the internal validity of the study.

These limitations withstanding, the results do support the finding that observable differences exist between subjects in various employment categories following severe craniocerebral injury. These findings emphasize differences in neuropsychological abilities which subsequently effect employability. The findings show promise in predicting gross employment outcomes based upon neuropsychological data. This supports the notion that neuropsychological data has potential to assist in vocational rehabilitation planning.

<u>Implications for Future Research</u>

There are a number of specific questions which remain following the completion of this study. These issues provide opportunities for future investigations. An area which has been identified as playing a significant role in successful outcome following severe traumatic brain injury is the psychosocial adjustment of the head injured victim (see pages 43-51). This was corroborated by Prigatano (1987a) who stated, "... personality variables play a major role in long-term outcome, particularly psychosocial adjustment" (p. 3). Despite the consensus that personality variables and psychosocial factors influence outcome, there is little agreement in terms of a standardized instrument to assess these areas with those who have suffered severe traumatic brain injury. Traditional psychological tests have typically been standardized on psychiatric visuoperception, there has been less certainty in terms of their ability to provide useful information pertaining to functional activities such as independent living or employment (Heaton, et al., 1978). As Heinrichs (1990) stated. "...the validity of using neuropsychological test data to guide rehabilitation, disposition, and many aspects of everyday life is highly questionable" (p. 171). Within this context, the importance of validating psychometric data with functional outcomes becomes more apparent.

This study provided evidence that neuropsychological data does provide predictive validity in relation to employment following severe traumatic brain injury. Of the numerous variables entered into the discriminant function analyses, the psychometric data consistently demonstrated the strongest relationship to employment. This study served an important role in demonstrating that neuropsychological data does possess predictive validity in relation to employment following severe traumatic brain injury. The study has heuristic value in serving as an impetus for future studies which attempt to validate neuropsychological data on functional activities.

In addition to the vital role of demonstrating validity, the study also provides some evidence that neuropsychological data has utility by assisting in rehabilitation planning. The neuropsychological measures employed in this study provide useful information in terms of a given client's employability following severe traumatic brain injury. When this information is used in concert with injury characteristics, premorbid occupation, behavioral competence, motivational factors, and environmental factors pertaining to the availability of employment opportunities and employer attitudes, significant contributions can be made in terms of items of anger, social contact, work/school, and leisure. Physical disability had no relationship to emotional well being. Kaplan (1988) utilized the Portland Adaptability Inventory in a study of 25 traumatically brain injured survivors. He found that psychosocial adaptation was predictive of successful vocational outcome. Further studies are needed to determine the value of this promising instrument.

An area which is frequently cited as having a powerful influence on successful outcome is that of premorbid personality. This study reviewed indices of premorbid functioning including years of education, premorbid occupation, and premorbid employment characteristics. A study which thoroughly constructed premorbid profiles through structured family interviews, examination of school transcripts, and use of other informational sources would be extremely useful. Comparisons between premorbid personality characteristics, neuropsychological status post-injury, and outcome may shed light into these complex relationships.

The results of this study indicate the value of neuropsychological data in predicting employment following severe craniocerebral trauma. Limitations of this study include the absence of other neuropsychological indices (i.e., The Category Test, Tactual Performance Test, etc., Reitan & Wolfson, 1985) which may have contributed to the prediction analysis. Additionally, there were often times missing data on the few instruments utilized in this study. Future prospective studies which use multivariate analyses and include a more thorough compilation of neuropsychological test scores are needed to investigate more completely the feasibility of predicting outcome based upon neuropsychological status.

The specific outcomes explored in this study were limited to level of employment (i.e., employed full time, part time, sheltered employment, etc.). This limitation was due to the number of subjects employed post-injury which eliminated the possibility of exploring differences between occupational groups. Future studies which investigate the relationship between neuropsychological status and occupation post-injury would make great contributions to the field of rehabilitation. Distinctions which are identified in various occupational categories could assist in vocational counseling and placement by providing empirical guidelines for success in various occupational categories.

The inclusion of college students in this study was not by design. A number of subjects who were successfully enrolled in college were included to achieve a desired sample size. However, once included, significant findings were observed which indicated that successful college performance is associated with neuropsychological status following severe craniocerebral trauma. Those who were successfully enrolled in college as a group, outperformed other employment categories with the exception of those employed on a full-time basis. This underscores the need for future studies which investigate college performance following severe craniocerebral trauma. This is imperative considering that the majority of head injured victims are of college age. Future research may provide findings which assist in providing guidance in the decision making of those victims interested in attending college.

The issue of initial employment success following severe traumatic brain injury was not found to be of importance in this study. This area was limited to measures which included the number of months employed on the first job and self-report of initial employment success. These measures may have not adequately captured the initial employment experience. Future studies which examine more thoroughly the initial employment experience with particular attention devoted to psychological phenomena are needed. Within this realm, self-efficacy beliefs may offer promise in understanding the impact of the initial employment experience upon future feelings of competence in relation to obtaining or maintaining employment. Self-efficacy beliefs have been observed to be powerful mediators in predicting future performance in a variety of domains including academic achievement (Bandura, 1977; Lent, Brown & Larkin, 1984). This area warrants investigation within the context of employment following severe traumatic brain injury. Findings may contribute to developing strategies within the vocational rehabilitation process which would enhance self-efficacy beliefs.

It was observed that those clients who were employed in unskilled positions premorbidly were younger as a group than those in skilled or professional occupations. This suggests that there are a number of subjects who have limited training or experience in specific occupations. These limitations are no doubt compounded immensely following neuropsychological impairment associated with severe craniocerebral trauma. These subjects may require more extensive services in vocational rehabilitation to compensate for limited occupational skills. Studies which investigate the relationship between premorbid occupational status and vocational outcome post-injury would make sizeable contributions to the knowledge and practice of vocational rehabilitation following severe traumatic brain injury.

There were seven subjects involved in supported employment at the time of the study. This study did not examine issues pertaining to the efficacy of supported employment interventions. Wehman and Goodall (1990) stated that a comprehensive individual placement model of supported employment which provides a trained employment specialist on the job with the client indefinitely has resulted in success rates (70%) higher than other models. Wehman, Kreutzer, Stonnington, et al. (1988) indicated that approximately 70 percent of clients placed in jobs within an individualized supported employment approach had been retained. Future research which examines vocational rehabilitation strategies including supported employment models with victims is needed.

Behavioral dysfunction following severe traumatic brain injury presents numerous impediments to employment. This issue is underscored by Haffey and Lewis (1989) who stated, "The primary barriers to occupational placement for this population, however, are psychomotor and cognitive processing slowness, cognitive-communicative disorders, emotional and social behavioral control problems, and inept or inadequate interpersonal social skills" (p. 148). Future research which investigates the nature and type of behavioral problems which serve as detriments to employment is needed. Additionally, studies which investigate the efficacy of innovative interventions including work adjustment training and supported employment are important to ascertain the benefit of such approaches.

Final Thoughts

It is apparent that employment following severe traumatic brain injury is a complex area of investigation. Numerous factors which influence and interact to make this such a difficult area include premorbid personality characteristics, neuropsychological status, psychosocial and neurobehavioral sequelae, rehabilitative interventions and vocational rehabilitation services. It is the desire of this author that by identifying certain characteristics which differentiate those at various levels of employment post-injury, this study may provide some contribution to the knowledge and practice of rehabilitation with those who have suffered severe traumatic brain injury. It is deemed fitting to draw this study to a conclusion by sharing some of the thoughts offered by the subjects of this study when offered the opportunity.

* Rehabilitation should begin sooner following head injury.
* There should be a more gradual transition from rehabilitation to independence.
* Rehabilitation services should be directed more to specific areas including work.
* Employer discrimination makes it difficult to get a job.
* Clients should avoid jobs which may be dangerous.
* Physical therapy was extremely helpful.
* Rehabilitation should place more emphasis on family adjustment.
* Self reliance is important following head injury.
* Current job is not the end goal.
* Clients need to be careful when explaining their injury to employers.
* It is difficult to obtain a fair wage.
* Programs should provide work opportunities in areas of interest.
* Maintaining positive relationships with other employees is crucial.
* Confidence is important to be successful.
* Difficulties with transportation interfered with timeliness to work.
* Clients should not be pushed back to work too soon.

* The trial work period was too long.

* Clients need more help in finding jobs.

* Clients should review disability benefits before getting a job.

* People have many misconceptions about head injury.

* Workers and supervisors are overly concerned about performance.

* People should realize that head injuries can happen to anyone.

* Clients are often placed beneath what they are capable of.

* There are numerous alternative forms of employment available particularly to parents with children.

* There is too much red tape in pursuing support.

* False promises provided by rehabilitation professionals can result in disappointment for the client.

* Clients can become motivated by being told that they can't work.

* Clients are often "dumped" by their employers after head injury.

* Constant changes on a job can make it difficult for clients.

* Psychotherapy was very helpful.

* A longer period of vocational training would have increased overall preparation for work.

APPENDIX A

DATA SUMMARY PROFILE

APPENDIX A

Data Summary Profile

Code #________________ Date of Birth______________________

Sex _____________________ Date of Injury________________________

Duration of Loss of Consciousness________________________________

Type of Injury: __________ Motor Vehicle Accident
__________ Fall
__________ Other (Describe) ___________________
____

Duration of Post-Traumatic Amnesia_______________________________

Secondary Cerebral Complication:
__________ Subdural Hematoma
__________ Brain Swelling
__________ Increased Intracranial Pressure
__________ Hydrocephalus
__________ Epidural Hematoma

Full Scale IQ (WAIS-R) __________ Performance IQ __________

Verbal IQ ___________ Digit Symbol __________

Premorbid Employment Status:
__________ Employed Full-Time Dates of
__________ Part-Time Employment Employment__________
__________ High School
__________ College
__________ Training
__________ Homemaker
__________ Other
__________ Unemployed

Premorbid Occupation:

Job Title________________________________ D.O.T. Code____________
__________ Professional
__________ Clerical
__________ Service
__________ Structural/Skilled
__________ Structural/Unskilled

Number of Months from Time of Injury to Re-Entry into Employment__________

Number of Months Employed in First Occupation Following Injury
____________ Years of Education __________
Presence of Physical Deficits:

_________ Imbalance
_________ Ataxia
_________ Hemiplegia
_________ Spasticity
_________ Other (Describe) _______________________
____

Presence of Speech Deficits:
_________ Dysarthria
_________ Motor Aphasia (Expressive)
_________ Sensory Aphasia (Receptive)
_________ Anomia
_________ Other (Describe) _______________________
____

Behavior Difficulties:
_________ Irritability
_________ Impaired Self Monitoring
_________ Disinhibition
_________ Changes in Personality (Describe) _______
____
____
____

Employment Status, First Placement Post-Injury
_________ Employed Full-Time
_________ Part-Time Employment
_________ School
_________ Training
_________ Homemaker
_________ Supported
_________ Other (Describe) _______________________
____
_________ Unemployed
_________ Dates Employed

Occupation:
_________ Professional
_________ Clerical
_________ Service
_________ Structural/Skilled
_________ Structural/Semi-Skilled

Employment Change:
_________ Same Job/No Change
_________ Same Job/Modifications
_________ Same Employer/New Job
_________ New Employer/Same Job
_________ New Employer/New Job
_________ Unemployed

Duration of Employment, First Placement ____________________

Reason for Termination: _________ Employer Termination
_________ New Job
_________ Change of Location

Other (Specify): ____

Employment Status:

- _________ Employed, Full-time
- _________ Part-Time Employment
- _________ School
- _________ Training
- _________ Homemaker
- _________ Supported
- _________ Other (Describe) ____________________
- _________ Unemployed
- _________ Dates Employed

Occupation:

- _________ Professional
- _________ Clerical
- _________ Service
- _________ Structural/Skilled
- _________ Structural/Unskilled

Employment Change:

- _________ Same Employer/Same Job
- _________ Same Employer/New Job
- _________ New Employer/Same Job
- _________ New Employer/New Job
- _________ Unemployed

Financial:

- _________ Worker's Compensation
- _________ Wage Replacement
- _________ Social Security Disability
- _________ Long Term Disability

Family Status:

- _________ Married
- _________ Single
- _________ Divorced

Spouse Employed ____

Living Situation:

- _________ Living with Spouse
- _________ Living Independently
- _________ Living with Parents
- _________ Living with Other (Describe) ______________
- _________ Supervised Living

APPENDIX B

CLIENT QUESTIONNAIRE

APPENDIX B

Client Questionnaire

Code #________________

1. Are you currently employed? _______ Yes _______ No

   If you responded no, please go to number 9.

   If you are employed, please continue.

2. Please list your job title. ________________________

3. How long have you been at your current job?

   __________ Year(s) __________ Month(s)

4. Briefly describe your job duties and responsibilities:

   ____
   ____
   ____
   ____

5. Have there been any changes or modifications made on your job to accommodate any difficulties you might have?

   _______ Yes _______ No

   Please describe any changes made on your job.

   ____
   ____
   ____

6. How many hours do you work each week? ______________

7. What is your hourly wage? ____________________

8. Please check any benefits you receive from employment:

   ______________ Medical Insurance ______________ Vacation ______________ Disability Insurance

Other: ____
____

9. Please list previous jobs you have had since your injury.

   ________________ Job Title ________________________ Dates Employed

Reason for Leaving:

________________ Employer Requested Termination ______________ Accepted New ______________ Chose to Leave

Other (Please Explain):

____
____
____

Job Title | Dates Employed

Reason for Leaving:

Employer Requested Termination | Accepted New | Chose to Leave

Other (Please Explain):

____
____
____

Job Title | Dates Employed

Reason for Leaving:

Employer Requested Termination | Accepted New | Chose to Leave

Other (Please Explain):

____
____
____

10. How many jobs have you had since your injury? ________

11. What is your marital status?

Single | Married | Divorced

12. Please list any jobs you had prior to your injury:

Job Title | Dates Employed

Hourly Wage

Reason for Leaving:

Employer Requested Termination | Accepted New | Chose to Leave

Other (Please Explain):

____
____

____

Job Title — Dates Employed

Hourly Wage

Reason for Leaving:

Employer Requested Termination — Accepted New — Chose to Leave

Other (Please Explain):

Please check the box which best describes your experience for the following questions:

13. How much support do you feel you received from family members following your injury?

1 No Support — 2 Very Little — 3 Some Support

4 Much Support — 5 Very Much Support

14. How supportive is your current or most recent supervisor?

1 No Support — 2 Very Little — 3 Some Support

4 Much Support — 5 Very Much Support

15. How helpful was your family's support in your return to work?

1 Not Helpful — 2 Not Very Helpful — 3 Somewhat Helpful

4 Helpful — 5 Very Helpful

16. Please check any of the benefits you currently receive:

____ Worker's Compensation ____ Long Term Disability

____ Social Security Disability ____ Wage Replacement

Other (Please Describe):

17. How satisfied are you with your current employment status?

____ 1 Extremely Dissatisfied ____ 2 Dissatisfied ____ 3 Indifferent

____ 4 Somewhat Satisfied ____ 5 Extremely Satisfied

18. Please rate the following services in their importance of assisting your return to employment. Use the following rating:

____ 1 Not Helpful ____ 2 Not Very Helpful ____ 3 Somewhat Helpful

____ 4 Helpful ____ 5 Very Helpful

____ Psychological Counseling ____ Vocational Counseling

____ Group Psychotherapy ____ Supported Employment or Supervised Work Experience

____ On-The-Job Training

Other (Please Describe):

19. Are there other services which you did not receive but feel would have been helpful?

Please Explain:

___

___

___

20. Please list any other issues which you feel should be considered in discussing employment following traumatic brain injury:

___

___

___

___

___

___

Thank you for your assistance

Education Level ________

Currently driving? ______

Vocational rehabilitation services received:

______ Job trial/supported employment
______ On-the-job training
______ Job placement assistance
______ Private rehabilitation services

Level of satisfaction with current living situation:

1	2	3	4	5
Very dissatisfied	Dissatisfied	Mixed	Satisfied	Very Satisfied

Level of satisfaction with current employment:

1	2	3	4	5
Very dissatisfied	Dissatisfied	Mixed	Satisfied	Very satisfied

Estimate of difficulty of job:

1=Great Difficulty 2=Some Difficulty 3=No Difficulty

_____ Getting along with supervisor
_____ Getting along with co-workers
_____ Producing quantity of work
_____ Producing quality of work
_____ Following the rules

Estimate of success on first job post-injury:

1	2	3
Successful	Moderate Success	Unsuccessful

Duration between injury and first job: _____

APPENDIX C

INFORMED CONSENT FOR INTERVIEW (SUBJECT)

APPENDIX C

Informed Consent for Interview (Subject)

Investigator: "Hello. May I please speak with ______ ________.
If unavailable for call:
"Thank you. I will call back again."

If subject is available:

Investigator: "Hello. My name is Bob Fabiano. I am currently conducting an investigation into employment issues following traumatic brain injury. This issue continues to receive considerable attention from rehabilitation professionals. The purpose of the study is to gain a better understanding into factors which affect employment following traumatic brain injury. Your name has been provided by a rehabilitation facility which you previously received services from. I am calling to request your participation in the study by completing a brief telephone interview. This entails answering questions pertaining to your employment experience.

Let me emphasize that your choice whether or not to participate in this telephone interview which will take approximately 20 minutes is entirely voluntary. Your choice will in no manner affect your relationship with the rehabilitation facility. If you choose to participate, you may choose not to answer any particular questions. The results of your interview will be kept confidential and anonymous. Results of the study will be discussed only in terms of group findings with no reference made to individual participants. Are you willing to participate?"

If no:

Investigator: "Thank you for your time and consideration."

If yes:

Investigator: "I would also like to request your permission to contact your closest relative should additional information be required. Is this acceptable?"

If yes, the format for the interview is provided in the "Client Questionnaire" in Appendix B of the proposal.

Example of instance when an additional person will be requested for clarification.

Investigator: "I have a few questions pertaining to the specific dates and average hours per week which you worked on the most recent jobs you have had. With your permission, I would like to contact your closest relative who may be able to clarify this information. Is this acceptable?"

APPENDIX D

INFORMED CONSENT FOR INTERVIEW (SIGNIFICANT OTHER)

APPENDIX D

Informed Consent for Interview (Significant Other)

Investigator: "Hello. May I please speak with ______ __________."

If unavailable:
"Thank you. I will call back again."

If available:

Investigator: "Hello. My name is Bob Fabiano. I am currently conducting an investigation into employment issues following traumatic brain injury. This issue continues to receive considerable attention from rehabilitation professionals. The purpose of the study is to gain a better understanding into factors which affect employment following traumatic brain injury. I have recently spoken with ____ _______ and received his/her permission to contact you in the event that further information was required.

I am calling to request your permission to complete a brief telephone interview which entails answering questions pertaining to ____ ________ employment experience.

Let me emphasize that your choice whether or not to participate in this phone interview which will take approximately 15 minutes is entirely voluntary. Your choice of whether or not to participate will have no bearing on _____ ________ relationship with the rehabilitation facility. If you choose to participate, you may choose not to answer any particular questions. The results of the interview will be kept confidential and anonymous being maintained solely by myself. Results of the study will be discussed only in terms of group findings with no discussion of individual participants. Are you willing to participate?

If no:
"Thank you for your time and consideration."

If yes, information pertaining to specific questions of the "Client Questionnaire" will be requested.

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