Vulnerability to disability following traumatic brain injury

Pamela Jo MacMillan

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VULNERABILITY TO DISABILITY FOLLOWING TRAUMATIC BRAIN INJURY

A Dissertation

Presented to

The Faculty of the School of Education
The College of William and Mary in Virginia

In Partial Fulfillment

Of the Requirements for the Degree

Doctor of Philosophy

by

Pamela J. MacMillan

April 1999
Dedication

This dissertation is dedicated to David H. Winfrey, my husband and partner. Without his support, patience, and understanding, this project would not have been completed. He has rearranged his schedule and postponed many plans in order to support my educational efforts. He has been encouraging, helpful and a stable anchor. His computer expertise was invaluable in this project. I also dedicate this dissertation to our wonderful son, Christopher Michael, who arrived in the middle of this project. He is a joy and has enriched our lives immeasurably.

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VULNERABILITY TO DISABILITY FOLLOWING TRAUMATIC BRAIN INJURY (TBI)

ABSTRACT

There are an estimated 2 million TBIs each year in the United States of America. Psychosocial and neurobehavioral disorders, versus physical impairments, are the most disabling consequences of brain injury. There is a great deal of individual diversity in outcome that is poorly understood. To this date, most studies of outcome following TBI have focused on the effect of post-injury variables. These studies have generally employed gross measures of physical and cognitive status versus quality of life and adaptation to disability. Many studies have excluded persons with psychiatric and substance abuse histories. There is increasing appreciation that pre-injury characteristics such as coping history may influence outcome and that each person likely has a given level of vulnerability to disability following TBI. This vulnerability likely reflects a complex combination of both premorbid and post-injury variables. This formulation provided the framework for this study of the outcome of moderate and severe traumatic brain injury survivors. Forty-five adults at least two years post moderate or severe TBI were evaluated. Pre-injury psychiatric history and pre-injury substance abuse history in addition to social support following TBI were measured for each subject. This study hypothesized that persons with more severe premorbid psychiatric histories and substance abuse histories in addition to less social support following brain injury would demonstrate poorer adaptation. Subjects were rated on four outcome measures: employment status, independent living status, self-assessment of neurobehavioral functioning, and a significant other’s assessment of their neurobehavioral functioning. Pre-injury psychiatric and substance abuse histories predicted employment status. Pre-injury substance abuse history predicted independent living status. Social support following TBI predicted significant other’s assessment of subject’s neurobehavioral status. None of the independent variables were found to predict self assessment of neurobehavioral functioning.

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Vulnerability to Disability Following Traumatic Brain Injury
Description of the Problem

Each year in the United States of America, there are an estimated 2 million traumatic brain injuries. About 500,000 of these persons require hospitalization, and approximately 100,000 traumatic brain injuries result in persons with moderate to severe disabilities (Horn & Zasler, 1996). Traumatic brain injury claims 56,000 lives annually. The major cause of traumatic brain injury is motor vehicle accidents, accounting for approximately 50% of all injuries. Falls are another frequent cause, accounting for approximately 20% of injuries (Wood, 1987).

Traumatic brain injury (TBI) refers to mild to severe brain damage with associated dysfunction caused by an external physical force (physical injury to the head) or event that is significant enough to produce: (a) an alteration in consciousness and (b) associated neurological or neurobehavioral dysfunction (Begali, 1996).

Traumatic brain injury constitutes a major health problem in the United States. TBI is the most frequent cause of death and disability in persons under age 45. In general, TBI is the most common cause of neurologic mortality and morbidity in the United States of America (Jorge, Robinson, & Arndt, 1993; Kurtzke, 1987).

An estimated 70,000 to 90,000 persons sustaining a TBI are left with permanent, life changing physical, cognitive and behavioral deficits. Nationally, the peak incidence of TBI occurs among persons aged 15 to 24 years and occurs more frequently among
men than women. Traumatic brain injury occurs more often among single persons and is more common among persons from lower socioeconomic groups (Webb, Wrigley, Yoels, & Fine, 1995). Traumatic brain injury is not a curable malady; recovery is typically a lifelong process (Finlayson & Garner, 1994). Research indicates that the recovery process tends to be quite prolonged. It is estimated that it takes up to at least two years post injury before neurological recovery stabilizes (Dikmen, 1995; Johnston & Hall, 1994; Schalen, 1994).

Approximately 65% of patients who sustain a severe brain injury survive. In many cases, however, the survivor’s recovery is marked by prolonged, often permanent, sequelae. One third to one half of survivors of moderate/severe brain injury are at least moderately disabled. Other survivors are severely disabled or remain in a vegetative state (Alexandre, Colombo, Nertempi, & Benedetti, 1983; Bergman, 1987; Gelpke, 1983). The majority of persons surviving moderate to severe traumatic brain injury are males under 30 years old who may have 50 or more years of disability ahead of them (Thomsen, 1992).

At first glance, many traumatic brain injury survivors appear “normal,” because they are typically able to walk and talk. Among the survivors of traumatic brain injury, however, neurobehavioral disorders are among the most frequent long-term consequence. Neurobehavioral changes may include cognitive or memory impairment, apathy, aggressiveness, or mood disorders (Jorge et al., 1993). The residual cognitive and interpersonal deficits experienced by survivors of traumatic brain injury create long-term difficulties in the development and maintenance of relationships, employment, and reintegration into their families and communities (Prigatano, 1986).
Outcome Following Traumatic Brain Injury

Outcome from moderate to severe brain injury remains difficult to prognosticate precisely. There is a great deal of individual variability in patient recovery. Persons with traumatic brain injury represent a diverse group. To some extent, this observed diversity is a function of pre-injury differences in personality, social roles, and intellect (Mayer, Keating, & Rapp, 1986). Additionally, diversity in patient outcome arises from post-injury differences in pathophysiology and associated sequelae (Levin, Benton, & Grossmanm, 1982). Furthermore, outcome, at least in the survivor's view, can be subjective. What one patient and family may consider “positive” may be viewed as an insurmountable loss by another individual and his or her family.

Previous research has demonstrated that post-injury variables impact outcome. Variables such as length of coma, duration of post-traumatic amnesia, the presence of seizures, and type of brain injury are well documented and known to influence outcome from traumatic brain injury (Alexandre, 1983; Johnston & Hall, 1994; Ruff, Marshall, Crouch, Klauber, Levin, Barth, Kreutzer, Blunt, Foukles, Eisenberg, Jane, & Mamarou, 1993, Zasler, 1997). In addition, pre-injury status appears to influence outcome and may be particularly important when evaluating long-term outcome and adaptation following brain injury (Martelli, Zasler, & Braith, 1996).

In limited studies, it has been found that persons with a pre-injury history of substance abuse, psychiatric disorder, low intelligence, and poor occupational adjustment tend to have more complicated recoveries than similarly injured patients without such histories (Dawson & Chipman, 1995; Thomsen, 1992). Researchers, however, have paid
less attention to the premorbid factors that might influence outcome, possibly in part because of the difficulty of obtaining reliable information and the vast array of characteristics and events from which to choose (Dikmen, Machamer, Donovan, Wirm, & Terakin, 1995).

It is intuitively appealing to acknowledge that when a traumatically brain injured person is confronted with the long-term outcome of TBI, premorbid psychological coping characteristics appear quite important. The impact of the interaction between premorbid and post-injury personality variables on long-term outcome has not yet been determined but given the variability in patient recovery, investigation is warranted (Prigatano, 1986).

It is widely accepted, however, that premorbid intellectual, personality, and sociocultural characteristics interact with acquired brain injury to produce a complex symptom picture (Prigatano, 1986). Statements attributing post-injury behavioral disturbances solely to cerebral insult are "probably simplistic explanations" (Ewing-Cobb, Fletcher, & Levin, 1985, p.74).Clinicians involved in the rehabilitation of traumatically brain injured persons are frequently impressed that personality variables, both pre- and post-injury, contribute greatly to long-term outcome (Gans, 1983). In summary, it appears that there are important non-neurological predeterminants that contribute to outcome from TBI (Prigatano, 1986). Clearly, more research conducted in these areas appears indicated.

While the majority of research in brain injury has indeed looked at individual post-injury and premorbid variables (e.g. age) affecting outcome, there are no known studies to date which have evaluated the collective influence of these variables. Previous
research has provided a more than adequate foundation for understanding functional outcome following traumatic brain injury. Additional research is indicated to evaluate the combined effects of multiple variables on an individual’s residual level of disability. In addition, more in depth and comprehensive evaluations of outcome status would likely add to enriched and more meaningful understanding.

Evaluating the influence of premorbid and post-injury variables should result in better predictions and understanding of the risk factors associated with traumatic brain injury and the design of more appropriate intervention programs. This appears especially relevant given that the advances in pre-hospital, hospital, and surgical care have resulted in continued increases in survival rate from TBI (Dikmen, 1995). In the last ten years, there are increasing numbers of survivors of brain injury due to more aggressive neurosurgical care of persons with severe traumatic brain injury. While more people live following a severe brain injury, any effort to assist these persons in maximizing their lives and restoring a sense of self following such a catastrophic event would likely be well received. Furthermore, the majority of persons who sustain a traumatic brain injury tend to be young often with many years of life ahead of them. Both traumatically brain injured individuals and society would benefit from better treatments to enable these persons to increase their independence and enhance their quality of life.

Finally, services for the TBI survivor are particularly threatened by managed care organizations that attempt to substantially constrict treatment goals and lengths of stay. Pressures to reduce cost have already significantly reduced length of treatment services following TBI (Johnston & Hall, 1994). Development of more sophisticated assessment of client need and complexity should assist in effective lobbying for comprehensive and
specific treatment resources for survivors of traumatic brain injury.

Research Question

The purpose of this study is to answer the following research question: What is the influence of pre-injury psychiatric history and substance abuse history coupled with post-injury social support upon long-term outcome after traumatic brain injury?

This study hypothesizes that persons with more severe pre-injury psychiatric and substance abuse histories coupled with less social support after brain injury will demonstrate poorer adaptation on four outcome measures. This study proposes that persons with the aforementioned difficulties will demonstrate poorer adjustment as measured by: employment status, independent living status, self-assessment on a neurobehavioral functioning instrument, and a family member’s or significant other’s rating of subject functioning on a neurobehavioral functioning inventory.

Subjects will be recruited from two rehabilitation facilities, one private and one non-profit, and requested to participate in this research study. Should the subject agree, he or she will then be asked to select a family member or significant other to rate his or her functioning on a neurobehavioral functioning instrument.

Medical records will be thoroughly reviewed by the researcher in order to corroborate subject and informant information. Both subjects and informants will be interviewed regarding the subject’s current living and employment status, in addition to pre-injury psychiatric and substance abuse histories. Subjects will be requested to complete the Neurobehavioral Functioning Inventory-Patient Form to evaluate current functioning as well as the Lubben Social Network Scale in order to measure the subject’s level of social support. A family member or significant other chosen by the subject will
be asked to complete the Neurobehavioral Functioning Inventory-Family Form in order to evaluate his or her perception of the subject’s current functioning.

Limitations

This is a correlational study with the goal of prediction (versus experimental or quasi-experimental); therefore, one cannot infer causality. Caution is appropriate in interpretation. In addition, methodological limitations, including a lack of well-accepted and established rating scales for rating psychiatric and substance abuse history represent potential compromises of internal validity. To counterbalance this issue, the researcher will utilize multiple data sources including family and patient report with thorough medical record review. Any inconsistencies triggered will result in seeking of clarification or additional information. If a high confidence cannot be achieved with regard to accuracy of information, then that data point will be excluded. Fortunately, there were no such inaccuracies or conflicts in information obtained.

The extent to which the results of this study can be generalized from the convenience sample to the population of traumatically brain injured adults is limited by the fact that these subjects were not randomly chosen. Furthermore, one of the sites, is a non-profit hospital that accepts all patients regardless of ability to pay; the private practice facility only accepts insured patients. Therefore, this study may include more persons who possess fewer social and financial resources than other similarly brain injured adults. Efforts to balance the number of subjects from each site will be made in order to minimize the possibility of overrepresentation of poorly insured persons who have fewer resources in general and hence limit variability. Despite the possible limitations, the results of this study will hopefully offer illuminating information.
regarding the many variables that influence recovery and adaptation following traumatic brain injury.

**Ethical Considerations**

The following precautions will be taken to maintain ethical standards:

1) Subjects will be informed verbally and in writing that the purpose of the study is to determine the influence of pre-injury and post-injury characteristics on long-term recovery and adaptation following traumatic brain injury.

2) Permission of the subject's significant other or family member will be requested and required for full participation.

3) Subjects and significant others will be informed that participation (i.e. completion of brief interview and questionnaires) is strictly voluntary. Participation or declining to participate will in no way affect the subject's rehabilitation or treatment.

4) Strict measures will be taken to insure confidentiality of data. Subjects will be given a code number only meaningful to the researcher, thereby maintaining anonymity for each subject.

5) Subjects and significant others will be informed that he or she can withdraw participation in the study at any time without consequences.

6) Efforts will be made to insure that study participants are not over-stimulated when being interviewed or completing questionnaires. Interviews will be conducted in
a quiet and closed office space.

7) Subjects will be offered frequent rest breaks and asked if additional assistance or explanation is needed in order to complete the questionnaires.
Chapter Two
A Selected Review of the Literature

In the preceding chapter, it was established that traumatic brain injury most often affects young persons with many years of life ahead of them. Early studies of brain injury have tended to focus on "survival", however, in recent years there is growing interest in how individuals adapt to and cope with the long-term residual effects of brain injury. Research has been helpful in determining who may survive a brain injury, however, it has been noted that pre-injury variables versus post-injury variables may in fact, be more helpful in determining which survivors might show the best long-term adaptation to their injuries (Bond, 1976; Corrigan, 1996; Kay, 1993; Prigatano, 1986).

Few outcome studies, however, have addressed the premorbid life events and behaviors that may significantly impact the physical, behavioral, cognitive and/or psychosocial and vocational status of individuals after traumatic brain injury.

The following review of the literature is offered to acquaint the reader with measures of severity of brain injury, brain injury rehabilitation, and commonly used instruments to measure outcome.

Severity of Brain Injury and Outcome

Depth and duration of coma have long been viewed as the most useful indicants of brain damage (Levin, Benton, & Grossman, 1982). Severity of brain injury is routinely determined in the medical profession by the Glasgow Coma Scale (Jennett & Teasdale, 1976). The scale evaluates three components of wakefulness independently of each other: (a) stimulus required to induce eye opening; (b) the best motor response; and, (c) the best verbal response. Each type of behavior is described in terms of a well-
defined gradient of responses. A Glasgow Coma Scale (GCS) score of 3 to 8 is defined as "severe" injury, 9 to 12 as "moderate" and 13 to 15 as "mild" brain injury. A coma is defined as the absence of eye opening, inability to obey commands, and failure to utter recognizable words. This definition corresponds to a total GCS of 8 or less (Levin et al., 1982).

Severity of brain injury is classified as mild, moderate, and severe. The most common type of brain injury is mild, which is defined as a Glasgow Coma Score of 13 to 15. Recovery and prognosis following mild traumatic brain injury remains a hotly debated topic. Some researchers have purported that all symptoms produced by mild brain injury resolve in the vast majority of patients within three months of injury (Barth, Macciocchi, Giordani, Rimel, Jane, & Boll, 1983; Levin et al., 1982; Miller, 1966; Rutherford, 1979). It has been speculated by those who believe recovery from mild traumatic brain injury should be complete, that persistent symptoms over one year in this population are the result of non-organic/psychological factors or outright malingering. Other researchers, however, have strongly disagreed (Leininger, Kreutzer, & Hill, 1990; Rimel, 1983). These researchers have found that a significant portion of persons sustaining mild brain injury have residual cognitive deficits including problems with attention, memory, and information processing as well as reactive depression and anxiety. Binder's (1986) review of the research literature concluded that there was considerable uncertainty regarding the persistence of cognitive dysfunction beyond the acute stages (i.e. greater than three months) of mild brain injury. Binder maintained that elderly persons as well as those with lower socioeconomic status or previous head injuries may have a poorer prognosis following mild traumatic brain injury.
Brain injured individuals rated on the Glasgow Coma Scale from 9 to 12 are defined as moderately brain injured. Most traumatic brain injury outcome studies, however, have focused on persons with severe injury. Few studies have exclusively evaluated the outcome of persons with moderate brain injury. Rather, persons with moderate brain injury are generally included in studies of persons with severe brain injury. In one study evaluating only moderately brain injured person, Rimel, Giordani, Barth, and Jane (1982), evaluated 197 clients three months after brain injury. Problems with memory (90%) and activities of daily living (87%) were reported. The overall unemployment rate for this moderately brain injured group was 69%.

Brain injured individuals rated on the Glasgow Coma Scale from 8 and less are defined as severely brain injured. Hawkins, Lewis, and Medeiros (1996) studied 55 adults (predominately young men) who were admitted to a trauma center with a severe brain injury. At one year follow-up, 90% of the patients were living at home. Sixteen percent required full-time supervision, while 82% were independent of supervision for most of the day. Twenty-five percent of the patients had returned to work in either full- or part-time capacity. Hawkins and colleagues (1996) concluded that although cognitive skills were diminished for the majority of patients, many had achieved a substantial reduction in disability within 18 months after traumatic brain injury.

According to current estimates, approximately 25% of patients with severe brain injury are able to maintain competitive employment at one year post-injury (Hawkins et al., 1996). It has been noted, however, that when brain injured persons are provided with intensive cognitively oriented rehabilitation coupled with support and structure at the work place, return to work rates can increase as high as 50% (Ben-Yishay, Rattok, Lakin,
Piasetsky, Ross, Silver, Zide, & Ezrachi, 1985). Approximately 40% of persons with severe brain injury are independent in dressing and self-care two years post-injury (Prigatano, 1986).

In assessing psychosocial outcome after severe head injury, Bond (1975) noted that post-injury memory and personality disorders negatively impacted social functioning. Bond also found that persons with memory and personality difficulties tended to be unemployed and were likely to lose pretrauma friendships.

Studies of severe brain injury indicate that post-injury difficulties can persist up to ten years after injury. Brooks, Campsie, & Symington (1987) reported on a group of 134 persons with severe traumatic brain injury. Using structured interviews and questionnaires, follow-up data regarding neurobehavioral sequelae were obtained from both clients and relatives between two and seven years post-injury. Approximately 75% of relatives reported that clients had difficulty related to slowed information processing, personality changes, memory impairments, and increased irritability. Between 54% and 65% of relatives indicated that clients had problems with reactive depression, anxiety, coordination difficulties, restlessness and mood changes. Notably, persons with pre-existing psychiatric or neurological difficulties were excluded from this study.

Schalen (1994) reviewed outcomes, five to eight years after injury, for 106 patients surviving severe traumatic brain injury who experienced good recovery/moderate disability as measured by the Glasgow Outcome Scale. Even in this highly selected group, 40% of these individuals had persistent problems with interpersonal relationships.

**Brain Injury Rehabilitation**

Rehabilitation of persons with a traumatic brain injury is a growing industry.
The scope of brain injury rehabilitation has grown significantly in size, in formal accreditation status, and in its research basis in the last two decades (Johnston & Hall, 1994). There are now 700 facilities in the United States which provide formal brain injury rehabilitation services (Hawkins et al., 1996). Acute rehabilitation, day rehabilitation, outpatient rehabilitation, transitional living programs, and vocational and community reintegration services compromise the rehabilitation continuum. Brain injury survivors may use one, a combination, or all aspects of the rehabilitation spectrum. Therapies utilized in the rehabilitation of the traumatically brain injured include physical therapy, speech and language therapy, occupational therapy, vocational retraining, community reintegration therapy, as well as neuropsychological rehabilitation and counseling.

As explained previously, research has consistently found that cognitive and emotional deficits associated with traumatic brain injury are the most permanently disabling difficulties with a highly negative impact on returning to normal life and social functioning (Hawkins et al., 1996). Cognitive, emotional, behavioral and psychosocial limitations are typically cited in the research literature as more debilitating than residual physical disabilities (Kreutzer & Marwitz, 1996; Prigatano, 1986; Spettell, Ellis, & Ross, Sandel, O’Malley, Stein, Spivack, & Hurley, 1991; Thomsen, 1992; Webb et al., 1995). The societal cost of assisting, supervising, and attempting to reintegrate these impaired individuals is staggering (Johnston & Hall, 1994).

It is generally agreed in the field that an individual’s quality of life after traumatic brain injury depends on a host of physical and psychosocial factors. When an individual sustains a brain injury, a dramatic imbalance in psychological, biological, and
environmental functioning occurs. Traumatic brain injury results in an abrupt transition from a predictable lifestyle to a state where competencies have changed, and expectations for the future are uncertain. Even with the passage of time, the person is typically not “cured”, but rather, is left with residual impairments (Trieschmann, 1990).

**Outcome Measures**

Outcome following traumatic brain injury has been measured in a variety of manners. Typically, return to school or employment, resumption of independence in activities of daily living, and the ability to live independently are viewed as highly favorable outcomes. Many studies employ family or caregiver’s ratings of the patient’s functioning in order to measure outcome. Family members are often the best respondents when assessing the outcomes for survivors of TBI who may have residual memory, attentional, and awareness deficits. Furthermore, family members are often most familiar with the survivor’s lifestyle and typically represent the social mores for the survivor’s culture of origin (Jacobs, 1987).

Neuropsychological test performance is also used to measure outcome. Improvements in orientation, attention/concentration, memory, problem-solving as well as planning and visual spatial skills are viewed as approaching favorable outcome.

The Glasgow Outcome Scale (GOS) has been utilized in most outcome studies in the last fifteen years (Spettell et al., 1991). The five categories of the GOS are: (1) good recovery, (2) moderate disability, (3) severe disability, (4) persistent vegetative state, and (5) death. Each category of outcome is a composite rating of cognitive, physical, and social functioning.

The Functional Independence Measures (FIM) scale is often utilized to evaluate
the status of brain injured persons. This scale assesses self-care, bowel and bladder control, transfers, ambulation, communication, cognition, and social interaction using 18 items of function, each rated on a seventeen point scale. The lowest possible total FIM score is 18; the highest 126. A score of one or “1” on any item corresponds with complete dependency; a score of seven or “7” represents complete independence without the need for assistive technology or environmental adaptation. This scale provides a gross measure of functional status.

The Disability Rating Scale (DRS) measures functional status and significant changes in functioning over time. A limitation of this instrument is that it measures general versus specific changes (Johnston & Hall, 1994).

The majority of these outcome instruments measure physical and cognitive performance versus the patients’ assessments of their situation and quality of life, leading to a somewhat constricted view of brain injury survivors.

Limitations to Adaptation

To restate, cognitive, behavioral, and psychological versus physical impairments are consistently cited in the research literature as the most limiting residual deficits of TBI (Prigatano, 1986; Webb et al., 1995). Specifically, problems in memory, attention, and problem-solving are experienced by a significant portion of moderate to severe traumatic brain injury survivors (Johnston & Hall, 1994). Poor emotional control, impaired frustration tolerance, reduced initiation, self-centeredness, sexual and social disinhibition, impulsivity, impaired anger management, depression, anxiety, and perseveration are common residual impairments (Prigatano, 1986). Survivors of traumatic brain injury are frequently described by significant others as “childish” or
"quick tempered" (Prigatano, 1986). One of the most common difficulties exhibited by these persons is a lack of awareness of their deficits and the impact of their behavior (Webb et al., 1995).

Injury to the brain alters the biological state of the individual and can, consequently, produce temporary and permanent changes in emotional and motivational responses (Prigatano, 1992). Emotional and adjustment difficulties are consistently cited in the research literature as long-term problems experienced by persons surviving a traumatic brain injury (Begali, 1996; Olver, 1995; Prigatano, 1992).

A "shattered sense of self" frequently exists at the center of cognitive, emotional, and behavioral difficulties (Miller, 1993, p. 34). Feelings of alienation from everything that was at one time meaningful can seriously undermine the recovery process and predispose those affected to despair (Lewis, 1986; Prigatano, 1992).

Taylor (1989) proposed a theoretical model that delineated three processes for coping with life-threatening experiences, including brain injury. First, the individual searches for meaning in the experience and then attempts to gain mastery over the event, specifically and, for life in general. Finally, the individual attempts to restore self-esteem and identity. Clearly these are formidable tasks for brain injured persons.

Personality and behavioral difficulties following brain injury can be viewed as the result of three possible causes. Personality changes or problems can be the result of neuropathological lesions and therefore be considered neuropsychologically based. There are also reactionary personality/behavioral problems secondary to the individual’s manner of coping. Finally, difficulties can reflect pre-existing personality disorders (Prigatano, 1986.) Psychological and behavioral deficits are typically the most difficult
for significant others to understand, manage, and accept. These difficulties (more often than physical impairment) frequently prohibit return to work and result in loss of pretrauma relationships (Prigatano, 1986). Furthermore, reactive emotional difficulties (e.g., depression, irritability) often increase in traumatically brain injured patients, even as cognitive, language, and motor difficulties improve or stabilize. Some studies have reported that patients show more emotional distress 12 months after brain injury than in the first six months (Fordyce, 1983). It is not surprising that social isolation has been consistently cited as the most frequent difficulty that long-term survivors of moderate and severe brain injury experience (Johnston & Hall, 1994).

Few studies have been conducted assessing quality of life in long-term brain injury survivors. Of those, most indicate that psychosocial complaints are the most predominant one year after injury (Webb et al., 1995). Dodwell (1988) noted that outcome following brain injury is heterogeneous. In his study of 56 individuals between zero to four years following brain injury, he cautioned clinicians to avoid using return to work as a measure of positive outcome following brain injury. Dodwell clarified that many persons with TBI are unable to return to their previous level of occupational functioning. Furthermore, many studies fail to note that persons are down graded in position or from full- to part-time status following TBI (Dodwell, 1988). Notably, while these persons may be able to work competitively, many lack higher level social skills and as a result, while employed, remain socially isolated.

Harrick, Krefting and Johnston (1994) studied 21 persons with severe brain injury and found that at one year follow-up, patients cited their main concerns as physical and functional. At three year follow-up, however, their main complaints were depression
and loneliness. Irritability is also a common long term symptom following brain injury. In fact, irritability is the single most common personality complaint cited by both brain injured patients and their spouses (Prigatano, 1992). Clearly, in the long term, psychosocial and emotional competence are more important than physical concerns and more meaningful than improved test scores. It appears that making meaning of the event and adjusting to losses and lifestyle changes are the greatest challenges for the brain injury survivor.

In a study of 85 traumatically brain injured males, Moore, Stanbrook and Peters (1989) found that persons who used positive reappraisal coupled with efforts at increasing social support were more likely to have improved outcome and long-term adjustment to brain injury. Persons who had less optimal coping skills were found to have less favorable outcomes.

Depression itself can influence the recovery process. Depression persisting longer than six months post injury can adversely impact outcome from both a psychosocial and physical perspective (Jorge, Robinson, Starkstein, & Arndt, 1994). Furthermore, functional outcome following traumatic brain injury is believed to be related to the presence of effective social supports and avoidance of depressive episodes (Olver, 1995). Brain injury also impacts the patient’s family. Good use of problem-solving and behavioral coping strategies by the family in response to the brain injury is significantly related to lower levels of depression in the affected individual (Ponsford, Olver, Curran, & Ng, 1995).

Additional evidence supports social support as a positive prognostic variable (Webb et al., 1995). Patients with intact social support systems and continued family
support during the long recovery period following traumatic brain injury have been found to demonstrate improved recovery when compared to similar socially isolated patients (Webb et al., 1995). Katz and Alexander (1994) found that persons who live alone without good social support have a poorer outcome than those with good social support. Social support plays an important part in the individual’s ability to obtain the resources, both material and nonmaterial, to cope with the crisis of a brain injury and the long recovery process that is inherent in such a catastrophic event (Kozloff, 1987). Social support is essential for an individual to develop a sense of belonging and is known to buffer the individual from adverse life events (Lazarus & Folkman, 1984). There is evidence, however, that for most brain injury survivors, social support diminishes after time and that most of the individual’s support is derived from his or her family. During the first six months after the injury, both family and friends rally to offer support to the patient and to each other. Unfortunately, once the individual’s life is no longer in danger and recovery slows, many members of the patient’s support system cease visiting (Kozloff, 1987).

Jorge, Robinson, Starkstein, and Arndt (1994) evaluated 52 traumatically brain injured patients at three, six, and twelve months post injury. This study revealed that the development of major depression following injury was the most significant predictor of outcome following traumatic brain injury. Major depression negatively influenced both psychosocial and achieved level of physical independence in this brain injured group of patients. Jorge and others (1994) also noted that the variables of age, sex, education, socioeconomic status, premorbid levels of social functioning, social support, history of psychiatric disorder, or history of alcohol and drug abuse did not appear to be a
significant predictor of psychosocial outcome. This study, however, appears to have limitations in that it only evaluated patients up to one year post-injury. It may be that the role of premorbid psychosocial factors do not demonstrate peak influence until after neurological recovery has stabilized. Evaluation of these patients over a longer period of time than one year would likely better discriminate variables which impact long-term outcome following traumatic brain injury.

Variables Influencing Long-term Outcome Following Brain Injury

Research is emerging which describes the variables that impact long-term outcome following traumatic brain injury. Considerable support in the literature is offered that demonstrates a significant relationship between course of recovery and outcome for type of cerebral injury (i.e. diffuse versus focal) and acute neurological indices such as length of coma and post traumatic amnesia and the presence of seizures (Katz & Alexander, 1994). TBI survivors who are in coma for less than 20 days often regain independence in functional activities, whereas those individuals who remain in coma longer than 20 days are usually profoundly disabled (Johnston & Hall, 1994; Jones, 1981). Ruff, Marshall and Crouch (1993) found that patients in coma less than 20 days were two to seven times more likely to return to work in the first six months after traumatic brain injury than those who experienced longer duration of coma.

Focal versus diffuse injuries typically recover more favorably (Katz & Alexander, 1994). Diffuse injuries involve more generalized brain damage with wide spread lesions. Focal injuries are highly specific and typically affect one area of the brain. Diffuse injuries are typically caused by motor vehicle accidents while focal injuries are often caused by gun shot wounds. Katz and Alexander (1994), in a one year follow-up study of
243 traumatically injured patients admitted to a rehabilitation hospital found that persons with focal versus diffuse brain damage had better outcomes as measured by the Glasgow Outcome Scale (GOS). The presence of multiple collateral injuries is also associated with poorer recovery and outcome (Hawkins et al., 1996). Multiple injuries, especially severe thoracic and abdominal injuries, have an adverse effect on mortality and morbidity (Bowers & Marshall, 1980; Klauber, 1989). Spettell and others (1991), found that length of the brain injured person’s acute care hospitalization was associated with poorer outcomes.

Cowen, Meythaler, De Viro, Ivie, Lebow and Novack (1995) in a retrospective study of 91 traumatic brain injury patients admitted to an acute care facility, found that patients with an intracranial hemorrhage and skull fracture had poorer outcomes as measured by the Functional Independence Measure (FIM) scale. Patients experiencing hypoxia or hypotension after brain injury were also found to have poorer outcomes. In contrast with most research, Cowen et al. (1995) found that there was no effect from contralateral injuries, and that those with fractures had better outcomes. Cowen and others (1995) postulated that perhaps other organs or extremities besides the brain absorbed force from the accident, thereby protecting the brain. Cowen et al. (1995) excluded patients with a psychiatric or neurologic history from his study in an apparent effort to insure that results were clearly brain injury related.

In the neurosurgical literature neurological factors such as depth of coma, length of coma, pupillary reaction, eye movements, and motor response patterns have been employed to predict outcome (Jennett & Teasdale, 1976.) Persons with limited pupillary reaction, absent eye movements, and poor motor responses have been consistently found
to demonstrate poorer functional outcome following severe brain injury (Johnston & Hall, 1994).

The emphasis of predictive statements after TBI have historically been on survival and gross outcome measures of physical independence or dependence versus emotional adjustment or adaptation (Rao, Rosenthal, Cronin-Stubbbs, Lambert, Barnes, & Swanson, 1990). Few studies have assessed the emotional and psychosocial adjustment of persons over two years post moderate and severe traumatic brain injury (Webb, et al., 1995).

For many years, severity of brain injury as judged by length of post-traumatic amnesia has been considered the best measure of outcome after brain trauma. Post-traumatic amnesia is defined as the interval between the injury and the beginning of continuous day to day memory (Brooks, Campsie, Symington, Beattie, & McKinlay, 1987). However, it has now been determined that the extent to which outcome is related to overall brain injury severity diminishes with time (Brooks et al., 1986).

The Influence of Preinjury Variables on Long-term Outcome

Post-injury factors have not been especially helpful in predicting which survivors would demonstrate the best adaptation to their injuries. Factors other than severity and course of brain injury therefore become increasingly important in late outcome; however such factors are difficult to identify. Premorbid personality, stability of family background, occupational, and educational status as well as age are frequently cited as important in determining outcome from traumatic brain injury (Thomsen, 1992). Clinicians in the field of brain injury rehabilitation are becoming increasingly aware of how premorbid factors influence long-term coping and adjustment.
There is considerable support in the literature that poorer outcomes from traumatic brain injury are associated with increasing age. Recovery from brain injury is markedly better for survivors younger than 20 years (Spettell et al., 1991) and age beyond 40 years is associated with poorer outcome (Katz & Alexander, 1994).

Katz and Alexander (1994) studied 243 consecutive TBI patients admitted to a rehabilitation unit and found that at one year follow-up, no patient older than 20 years who was admitted with a GCS of 8 or less (i.e., severe injury) had recovered well, whereas almost 50% of patients younger than 20 years achieved a good recovery. Eighty percent of those older than 60 years were left severely disabled. The Glasgow Outcome Scale (GOS) was utilized to measure outcome (Katz & Alexander, 1994). According to Miller (1966), a well known expert in the field of brain injury: “All other things being equal, the younger the victim at the time of the injury, the better the outcome,” (p. 74).

Gordon, Von Holst, and Rudehill (1995) evaluated 2298 TBI patients treated at a neurosurgical clinic in Sweden over a 21 year period. They cited four factors as being highly associated with positive outcome as measured by the Glasgow Outcome Scale (GOS): age, type of injury (i.e. fall versus motor vehicle accident), severity of injury as measured by level of consciousness, and time elapsed between trauma and start of resuscitation. Reasons for the improved recovery of younger persons over older persons with TBI are not completely understood. Gordon et al. (1995) suggested that older persons’ less favorable adaptation to brain injury may be due to the physiology and pathophysiology of aging, as well as to the response of the aging brain to injuries.

The support for young age as a positive prognostic variable, however, is not universally supported in the literature. Dikmen (1993) noted that persons sustaining a
brain injury before age 16 years were more likely to have emotional and behavioral difficulties long term after their injury. Dikmen (1993) suggested that these individuals are immature at the time of their injury and as a result do not possess the requisite coping skills to manage the long-term impact that typically accompanies traumatic brain injury including loneliness and social isolation. However, Dikmen (1993) used long term psychological adjustment to measure outcome rather than survival and independence in basic activities which are generally used in the post-acute neurosurgical literature. There are also brain injury outcome studies which have found no significant correlation with age (Cowen, et al., 1995; Reeder, Rosenthal, Lichtenberg, & Wood, 1996).

A variety of premorbid variables such as intelligence, psychiatric disorder, and alcohol/substance abuse have also been found to predict recovery and outcome (Rutherford, 1989). Persons with higher intelligence, no history of alcohol or substance abuse, and no psychiatric history have been found to demonstrate improved recovery when matched on severity of injury (Rutherford, 1989). Typically, however, persons with psychiatric histories have been excluded from TBI outcome studies. The few studies which have not excluded such subjects have not evaluated long-term outcome or used complex outcome measures (Johnson & Hall 1994). Rather, they have tended to focus more on survival and physical functioning.

Ruff, Marshall, Klauber, Blunt, Grant, Foulkes, Eisenberg, Jane, & Marmarou (1990) found that TBI survivors with a history of alcohol abuse were more likely to have increased abnormalities on CT scans of their brains immediately following injury. Brooks, Symington, Beatie, Campsie, Bryden, & McKinlay (1989) found that a history of alcohol abuse prior to brain injury predicted memory performance on
neuropsychological assessment measures of memory three months after moderate and severe traumatic brain injury.

Dikmen, Donovan, Loberg, Machamer, & Temkin (1993) found that neuropsychological outcome is significantly related to brain injury severity and to alcohol use at one year post injury. They clarified, however, that though it is difficult to untangle the specific combination of a host of factors to the neuropsychological impairments they observed, their results point to a subtype of TBI patient outcome that is characterized by limited education, neuropsychological impairments, and a lifestyle concurrent with heavy alcohol consumption, including an increased risk for brain injuries (Dikmen, et al., 1993).

Persons with a history of alcoholism and substance abuse have been found to recover less well from cerebral trauma and may, in fact, be more predisposed to trauma than non-abusers of drugs and alcohol (Corrigan, 1996). Notably, the most commonly cited risk factor for TBI is a history of alcohol abuse (Brooks, et al., 1986). In fact, it is estimated that 50% to 66% of persons hospitalized for traumatic brain injury have a history of alcohol or drug use (Kreutzer & Harris, 1990). Corrigan (1995) noted that studies have reported 36% to 51% of patients with TBI have elevated blood alcohol levels at the time of injury. Most studies demonstrate that persons with a history of substance abuse have poorer outcomes from TBI than nonabusers (Dunlap, Udvarhelyi, Stedem, O’Connor, Isaacs, Puig, & Mather, 1991; Kreutzer et al., 1990; Rimel, Giordani, Barth, & Jane, 1982; Ruff, Marshall, Klauber, Blunt, Grant, & Foulkes, 1990; Solomon & Malloy, 1992).

Corrigan (1995) found that nearly two thirds of brain injury rehabilitation patients
may have a history of substance abuse (i.e. primarily alcoholism) that preceded their injuries. Intoxication at the time of brain injury was related to acute complications, longer hospital stays, and poorer discharge status; however these relationships may have been caused by collinearity with history. Nevertheless, history of substance abuse was associated with higher mortality rates, poorer neuropsychological outcome, and greater likelihood of repeat injuries as well as late deterioration (Corrigan, 1995). Corrigan evaluated persons up to 16 months following moderate and severe traumatic brain injury.

It has been speculated that those persons with a history of substance abuse and brain injury recover less well due to a combination of reduced cerebral reserve secondary to the effects of substance abuse coupled with presumptive poor premorbid coping skills (Corrigan, 1995; Levin & Grossman, 1982).

Many studies of outcome following traumatic brain injury, however, have excluded persons with substance abuse in order to avoid confounding study results. Furthermore, those studies which have evaluated substance abusers have tended to focus on very gross physical and cognitive outcome measures and have not evaluated long-term (i.e. greater than two years) functioning and adaptation. Evaluation of adaptation greater than two years after brain injury seems crucial, given that the brain injured persons structured rehabilitation services tend to decrease and fade after two years post injury (Webb, et al., 1995).

Dawson and Chipman (1995) noted that a higher level of education leads to better outcome as does a physical environment which is not harsh or is easily adapted to accommodate people with disability. A variety of studies have found that premorbid intelligence is positively correlated with positive cognitive outcome after TBI (Barth et
Hawkins et al., (1996) studied outcome of 55 adults surviving severe TBI and found that persons with less than a high school education who were unemployed at the time of TBI demonstrated a poorer outcome at three months and one year follow-up than those patients who were employed and better educated at the time of their injury. Notably, most participants in this study were young males. Fifty-eight percent of these patients had elevated blood alcohol levels at the time of injury. While this statistic is not inconsistent with the literature, Hawkins and others (1996) did not assess continued alcohol use following injury to determine if this could account for poor outcomes.

Emerging evidence in the research literature relates personality and coping variables with outcome, including individual perceptions of having been victimized in an accident (Kay, 1992). Kay (1992) observed that brain injured persons who tended to “accept responsibility” for their accident coped much better with their residual disabilities than those who tended to experience themselves as having been victimized either by fate or another individual. While Kay based his formulations on those persons who recovered poorly from mild brain injury, his theory offers promise in explaining the individual variability in outcome following more severe brain injury.

An individual’s adaptation following a brain injury appears to reflect a person times situation interaction. One’s premorbid personality style influences the manner in which that person copes with and manages any disability or loss. Expert clinicians in the field of brain injury rehabilitation have suggested that persons with premorbid narcissistic or obsessive compulsive personality traits are prone to respond catastrophically and maladaptively to the losses associated with brain injury and subsequently cope less
optimally than other brain injured persons without these premorbid personality traits (Kay, 1992; Prigatano, 1986).

An individual's psychological and coping history also makes a significant contribution to adaptation following TBI. In a follow-up study of patients with moderate TBI, Rimel et al., (1982), suggested that a history of maladaptive behavior likely resulted in less than optimal outcome from TBI compared to outcomes for similarly injured peers. Shaffer, Chadwick and Rutter (1975) found that the post-injury psychiatric difficulties experienced by traumatically brain injured children correlated better with the degree of psychosocial adversity in the home than with the actual duration of the child's coma or severity of brain injury.

**Vulnerability to Disability**

A stress and coping formulation postulates that a brain injury results in multiple cognitive, emotional, social and physical demands which constitute, singularly and in combination, severe stressors which not only challenge the coping capabilities of the individual, but directly diminish available resources through the loss of premorbid skills coupled with reductions in social and financial supports (Kay, 1992). Social support, intelligence, resources, and skills tend to mitigate personal vulnerability and help people through crisis. This formulation incorporates the complex factors surrounding brain injury, the history the individual brings to the injury, and the environment that individual is left to deal with following the injury.

The concept of individual vulnerability suggests that a large number of variables will influence how the brain injury will affect the person, and that each person has a given level of vulnerability.
The concept of neurologic vulnerability already has support in the literature. Individual differences in brain structure, hormonal and neurotransmitter balances, and other biologic systems may make one brain more susceptible (Kay, 1992). Other factors such as age, drug or alcohol abuse, or prior central nervous system (CNS) damage may also increase neurologic vulnerability, magnifying the functional effect of nerve cell loss and damage (Kay, 1992; Satz, 1993). Prior substance abuse or brain insult may reduce the reserves of the brain to compensate or otherwise overcome deficits from the brain injury.

Satz (1993) in a theoretical model developed to explain individual diversity in outcome from acquired brain injury, proposed a brain reserve capacity hypothesis. According to Satz, a threshold factor accounts for instances of protection from or vulnerability to clinical symptoms when the central nervous system is diseased. He believes his concept of brain reserve capacity is a major factor in explaining threshold differences in the onset of clinical symptoms or the expression of disabilities after acquired brain injury. Brain reserve is treated as a hypothetical concept that is related to adaptive behavior. Satz further assumes that two psychosocial factors, namely, general intelligence and educational level, represent indirect, albeit imprecise, measures of this construct (Satz, 1993). Satz also cites advancing age as diminishing brain reserve capacity. In short, because of pre-injury vulnerabilities, individuals will vary in their adaptation to brain injury. Satz’s model has not yet been tested empirically, but seems promising to further explain diversity in outcome from traumatic brain injury.

While the research has been helpful in clarifying that there are many factors that influence outcome in traumatic brain injury, a number of issues need clarification. Many
studies have a lack of consensus defining the severity of brain injury. Additional concerns include a lack of consistency in using standardized outcome measures, use of gross outcome measures, lack of adequate control group, and control for the heterogeneity of patient population. Studies vary in terms of sample size, screening processes, and length of time post-injury. Many significant studies exclude patients with psychiatric, substance abuse, or neurological history (Cowen et al., 1995). Since these excluded individuals may, in fact, be more vulnerable to sustaining a brain injury (Corrigan, 1995), it seems most reasonable to include them in studies to understand better and provide meaningful treatment to brain injury survivors. Studies that have excluded persons with complicated histories in an effort to insure internal validity may result in compromised external validity since many persons who present for treatment after a brain injury also have histories of psychiatric difficulties as well as substance abuse.

Finally, outcome is hardly a unitary concept. While an individual may appear to have obtained a good outcome as measured by the Glasgow Outcome Scale, he or she may be depressed, isolated, and alienated. One may be hard pressed to convince this individual that he or she has experienced an optimal recovery. Traumatic brain injury interacts with a person’s psyche, physical and social history, and environment to produce a complex presentation. As a result of this interaction, individual diversity in outcome despite severity of injury is expected. Research that looks at complex factors while employing a variety of outcome measures, is necessary but lacking in the current brain injury literature.

In conceptualizing patient recovery from a “demands versus resources” model,
research is needed to clarify the assumption that pre-injury characteristics such as positive coping history, young age, social support, intelligence, and educational level collectively act as "deposits" in an individual's reserve or resource "bank" to enhance future adaptation (Satz, 1993).

New Research Efforts

Martelli, Zasler and Braith (1996) reported on an initial effort in increasing our understanding of the complex variables which mediate long-term adaptation to brain injury. Their preliminary study developed a "TBI Vulnerability to Disability Rating Scale" based on a synthesis of the outcome research literature. Factors consistently cited in the research literature as influencing outcome and recovery following traumatic brain injury were combined and rated. In one of the few empirical investigations of a theoretical model derived from the cerebral reserve - individual vulnerability- and stress and coping literature, Martelli et al. (1996) investigated the hypothesis that greater degrees of reserve would be associated with improved adaptation and recovery from neurological trauma, and that, to the extent that the adaptational reserve is limited, individuals can be expected to demonstrate increased vulnerability and poorer response to the adaptational demands of brain injury. Defining vulnerability in terms of the sum and degree of negative prognostic indicators, Martelli et al. devised a composite rating in order to evaluate the collective effect on disability status and vocational functioning following cerebral trauma.

The TBI Vulnerability to Disability Scale consisted of the following prognostic factors: length of post-traumatic amnesia (PTA), age, premorbid neurological status, premorbid psychiatric status, estimated premorbid IQ, post-traumatic seizures, marital
status, collateral injuries, and victimization perception. Using a convenience sample of 28 brain injured subjects (mean time since injury was 2.9 years), they found this combination of variables highly accurate in discriminating both vocational disability status following traumatic brain injury. Further analysis revealed that a simple linear combination of these variables and a composite index with a clinically derived cutoff score assigning subjects to "high" and "low" vulnerability groups reliably predicted vocational functioning after injury. This linear composite index also reliably predicted disability status.

The study by Martelli et al. (1996) demonstrated support for the proposal that persons who possess a greater number of purported negative prognostic factors would possess greater vulnerability to disability and show poorer post-injury adaptation following TBI. This was demonstrated in terms of both lower return to work rates and greater disability status. This preliminary study offered support for both the utility of a composite prognostic indicator approach to predicting outcome from TBI and the concept of vulnerability to disability as a mediator in adaptational outcome.

The TBI Vulnerability to Disability Rating Scale is based on the assumption that an individual possesses adaptational reserve for meeting neurologic and other demands and that greater degrees of reserve will be associated with higher levels of resilience and improved adaptation and recovery from trauma. Conversely, to the extent that individual reserve is limited or previously depleted, the person can be expected to demonstrate increased vulnerability to trauma and poorer response to adaptational demands like cerebral trauma. This conceptualization is consistent with the stress and coping literature which postulates that individuals cope with stress/threats (perceived demands) by
mobilizing their perceived resources (Lazarus & Folkman, 1984). Coping is defined as an individual’s cognitive and behavioral efforts to master demands and conflicts (Lazarus, 1976). In the influential model presented by Lazarus there are two categories of coping: (1) direct actions in which a person attempts to alter directly the source of stress; and (2) palliative actions, in which the person attempts to regulate the distressing emotions which may arise from a stressful event. An individual’s traditional mastery of coping will strongly influence his or her response to brain injury.

Hall, Wallborn, & Englander (1998), also employed a more complex conceptualization of adaptation after brain injury. Hall et al., evaluated persons with moderate and severe traumatic brain injury in the following areas: substance abuse history, psychiatric history, legal difficulties, arrests, and academic difficulties. They classified persons in terms of high or low risk categories, based on their pre-injury histories. Notably, Hall and others found no significant differences in the two groups. It should be noted, however, that this study used only the Functional Measure of Independence (FIM) and the Disability Rating Scale (DRS) as outcome measurement instruments.

Limitations to the Hall et al. (1998) study are as follows. First, this study evaluated persons only one year after moderate and severe traumatic brain injury. It could very well be that the FIM and DRS were too crude and not sensitive to psychological issues. Furthermore, the role of psychological factors may not demonstrate peak influence until after neurological recovery has stabilized which is thought to be at least two years post brain injury (Olver, 1995). Also, they defined premorbid psychological difficulties in a rather crude manner. Individuals were characterized as to
whether or not they had been involved in at least one psychiatric hospitalization prior to brain injury. This dichotomy may likely not be sensitive to the detection of coping liabilities, as it seems reasonable to speculate that many persons who have not experienced a psychiatric hospitalization do, in fact, have problems in adaptive coping.

**Summary**

The preceding review of the literature has attempted to illustrate both the complexities of brain injury severity and outcome in addition to the individual variables associated with outcome. The overarching conceptualization of individuals possessing a given level of vulnerability to disability based on a combination of both pre-injury and post-injury variables was presented as a way of increasing our understanding of individual differences in adaptation to brain injury.
Chapter Three

Research Design and Methodology

The design and methodology of the study will be described within the following sections:

1. Population and Sample
2. Data Gathering
3. Instrumentation
4. Research Design
5. Hypotheses
6. Data Analysis

Population and Sample

The target population for this study is adults with moderate to severe traumatic brain injury. The sample was taken from an accessible or convenience sample of traumatically brain injured adults (i.e. persons 18 years old or older) receiving follow-up outpatient services at a rehabilitation hospital and a private rehabilitation facility in southeast Virginia. The sample is comprised of 45 adults receiving both follow-up rehabilitation medicine or neuropsychological services. Twenty-three subjects were recruited from a non-profit, free-standing rehabilitation hospital and 22 subjects were recruited from a private rehabilitation and medical center in southeast Virginia.

Ages ranged from 24 to 63 years old, with a mean age of 43 years. Twenty-nine participants were male (64%) and 16 were female (36%). The gender ratio in this study is consistent with the incidence of brain injuries in the general population (Johnston &
Hall, 1994). Subjects in this sample, however are somewhat older than subjects in most studies of traumatic brain injury.

All subjects in the sample were alert and oriented for personal, situational, environmental, and temporal information. All demonstrated basic functioning in verbal expression, comprehension, and complex command following.

For the entire sample, there were forty Caucasian subjects (89%), four African American subjects (9%), and one Hispanic subject (2%). Ages for the sample ranged from 24 to 63 years with a mean age of 43 years. Forty-one subjects were right-handed (91%) and four were left-handed (9%).

Causes of the traumatic brain injury ranged from 30 subjects having been injured in motor vehicle accidents (67%), one due to gun shot wound (2%), three due to self-inflicted gun shot wounds (7%), three due to assaults (7%), four due to falls (9%), three due to bicycle accidents (7%), and one due to a being struck by a car while a pedestrian (2%). Age at the time of the brain injury ranged from 18 to 61 years old with a mean age of 33 years. Thirty of the respondents sustained severe brain injuries (67%) and 15 sustained moderate brain injuries (33%). Thirty-one (69%) of the subjects sustained diffuse brain injuries, five focal injuries (20%) and nine (11%) had a mixed combination of both focal and diffuse brain injuries.

At the time of their brain injury, 17 subjects (38%) had a college education, 11 (24%) had some college or vocational training, nine (20%) were high school graduates, and eight (18%) had not completed high school. This sample is somewhat more educated than the typical brain injured population (Webb, et al., 1995).

All subjects in this sample were at least two years status post moderate or severe
traumatic brain injury. Time since TBI ranged from two to twenty-five years. Mean number of years since brain injury was 10 years. Median time since injury was two years; mode was 10 years. Tables 1 through 5 visually describe the sample.

**Sample (N=45)**

Table 1.
Sample by Gender

<table>
<thead>
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<th>Gender</th>
<th>Number</th>
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<tr>
<td>Male</td>
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<tr>
<td>Female</td>
<td>16</td>
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<td>Total</td>
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Table 2.
Sample by Race

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<td>White</td>
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<tr>
<td>Black</td>
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<tr>
<td>Hispanic</td>
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<td>2%</td>
</tr>
<tr>
<td>Total</td>
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<td>100%</td>
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Table 3.
Sample by Injury Severity

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<th>TBI Severity</th>
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</thead>
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<tr>
<td>Moderate</td>
<td>15</td>
<td>33%</td>
</tr>
<tr>
<td>Severe</td>
<td>30</td>
<td>67%</td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
<td>100%</td>
</tr>
</tbody>
</table>
Table 4.
Causes of Traumatic Brain Injury (TBI)

<table>
<thead>
<tr>
<th>Cause of TBI</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVA</td>
<td>30</td>
<td>67%</td>
</tr>
<tr>
<td>Gunshot Wound</td>
<td>1</td>
<td>2%</td>
</tr>
<tr>
<td>Self Inflicted Gunshot</td>
<td>3</td>
<td>7%</td>
</tr>
<tr>
<td>Fall</td>
<td>4</td>
<td>9%</td>
</tr>
<tr>
<td>Bike Accident</td>
<td>3</td>
<td>7%</td>
</tr>
<tr>
<td>Assault</td>
<td>3</td>
<td>7%</td>
</tr>
<tr>
<td>Pedestrian Accident</td>
<td>1</td>
<td>2%</td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 5.
Type of Traumatic Brain Injury (TBI)

<table>
<thead>
<tr>
<th>TBI Type</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diffuse</td>
<td>31</td>
<td>69%</td>
</tr>
<tr>
<td>Focal</td>
<td>5</td>
<td>20%</td>
</tr>
<tr>
<td>Mixed</td>
<td>9</td>
<td>11%</td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
<td>100%</td>
</tr>
</tbody>
</table>

Brain injury rehabilitation was initiated immediately for 41 (91%) of the subjects. Two subjects (4%) received rehabilitation two years following brain injury, one (2%) received rehabilitation three months after injury, one (2%) six months after injury, and one (2%) four years following brain injury. No brain injury survivors declined to participate in the study when approached by the researcher.

A family member or significant other identified by the brain injured subject was also requested to participate in the study in order to provide his or her assessment of the subject’s functioning and to corroborate interview material. Fourteen (31%) of these were the subjects’ mothers, eight were wives (18%), and seven were friends (16%).
Other significant others include three fathers (7%), one husband (2%), two girlfriends (4%), three boyfriends (7%), two fiancées (4%), two sisters (4%), and finally, two daughters (4%). As in the case of brain injury survivors in this study, no family members or significant others declined to participation. Review table 6 for graphic description of the informants.

Table 6.

Description of Informants for Neurobehavioral Functioning Inventory-Family Form (NFI-F)

<table>
<thead>
<tr>
<th>Relationship to Person with TBI</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother</td>
<td>14</td>
<td>31%</td>
</tr>
<tr>
<td>Wife</td>
<td>8</td>
<td>18%</td>
</tr>
<tr>
<td>Girlfriend</td>
<td>2</td>
<td>4%</td>
</tr>
<tr>
<td>Daughter</td>
<td>2</td>
<td>4%</td>
</tr>
<tr>
<td>Sister</td>
<td>2</td>
<td>4%</td>
</tr>
<tr>
<td>Father</td>
<td>3</td>
<td>7%</td>
</tr>
<tr>
<td>Husband</td>
<td>1</td>
<td>2%</td>
</tr>
<tr>
<td>Friend</td>
<td>7</td>
<td>16%</td>
</tr>
<tr>
<td>Fiancé</td>
<td>2</td>
<td>4%</td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
<td>100%</td>
</tr>
</tbody>
</table>

Data Gathering

Brain injury survivors and a significant other such as a family member, friend, or caregiver were requested to meet with the researcher for a brief interview regarding the brain injured person’s demographic information. Based on the survivor’s and significant other’s report in conjunction with medical records, the researcher rated the subject, or brain injury survivor, in terms of the following pre-injury variables: marital status at time of injury, neurologic history, educational status at time of injury in addition to premorbid psychiatric and substance abuse history. The researcher rated psychiatric and substance history as none, mild, moderate and severe on a scale created for this study to avoid using...
dichotomous categories such as "present" or "absent." The researcher also collected information regarding the following post-injury variables: severity or grade of brain injury, diffuse versus focal injury, length of coma, and presence of seizures after brain injury. The subject was asked to complete the Lubben Social Network Scale (Lubben, 1988) in order to measure the subject’s current level of social support. The brain injury survivor and his or her significant other were requested to complete the patient and family forms of the Neurobehavioral Functioning Inventory in order to evaluate the subjects’ as well as the significant others’ perceptions of the brain injury survivors’ current level of functioning across a variety of domains. Medical records were thoroughly reviewed by the researcher at both locations in order to corroborate information. Employment and independent living status were ascertained by consensus of medical record review, subject and significant other report.

Instrumentation

The Neurobehavioral Functioning Inventory was utilized to measure current cognitive, physical, and emotional functioning. The Lubben Social Network Scale was employed to measure the brain injured participant’s current social support system.

Employment status of the subject was rated as follows: disabled, unemployed, sheltered work shop, supported employment, full-time competitive employment, part-time competitive employment, homemaker, volunteer, or student. Living status was classified as: nursing home, assisted living facility/adult home, home with assistance in activities of daily living such as dressing and bathing, home with supervision in medications or finances, or independent living.
The Neurobehavioral Functioning Inventory

The Neurobehavioral Functioning Inventory is a multipurpose inventory that is compromised of six independent scales reflecting problems frequently experienced by traumatically brain injured clients: Depression, Somatic, Memory/Attention, Communication, Aggression, and Motor. Separate patient and family forms of the Neurobehavioral Functioning Inventory were designed to collect the perspectives offered by both the injured individual and a second party observer. Normative scales are provided by both client and family member ratings of client behavior based upon client age and amount of time the client was unconscious at the time of injury (Kreutzer, et. al.1996). The inventory consists of 83 items grouped into the six categories mentioned above. Frequency of problem is rated on a 4 point scale of (1) never (2) sometimes, (3) often, or (4) always. For all scales, Chronbach's alpha has ranged from .86 to .95 (Kreuter, et. al, 1996). Concurrent validity has been demonstrated by comparison with neuropsychological test data and Minnesota Multiphasic Personality Inventory (MMPI) personality profiles. Each brain injured subject and a chosen other provided separate percentile scores regarding the subject's functioning on the following scales: depression, somatic, memory/attention, communication, aggression and motor functioning. The six scores on each form are averaged for a total score for the Patient Form and a total score for the Family Form.

The Lubben Social Network Scale

The Lubben Social Network Scale is composed of 10 items, designed to measure the participant's social contact with family and friends, frequency of interactions, and living arrangements. Each item is rated from 0 to 5, with a total possible score of 50. A
score of 50 indicates frequent interaction with the social network and a score of 0 indicates no social interaction. The reliability of Lubben Social Network Scale has demonstrated an alpha of .70 (Lubben, 1988). According to Lubben (1988), individuals obtaining a score under 22 are at risk for low social support and isolation. For purposes of this study, scores were divided in tripartite split cutoffs. Low social support was defined as a score of 0-23 and medium social support a score of 24-27. Finally, a score of 28 to 50 points was identified as a high level of social support.

**Research Design**

This study is correlational. The goal of the study was to determine the collective influence of both pre-injury characteristics of psychiatric and substance abuse histories coupled with the post-injury variable of social support on long-term functioning following moderate and severe traumatic brain injury. These variables have been identified in the research literature as impacting outcome following traumatic brain injury. There have, however, been many studies that have excluded persons with significant psychiatric and substance abuse history. In addition, those limited studies which have included such persons have not been conducted measuring long-term outcome and have often used only gross and limited outcome measures to assess functioning. This study intends to evaluate the collective influence of the aforementioned three variables on long-term TBI outcome using a variety of measures to assess physical, emotional, and psychosocial functioning as well as quality of life. In this research study, adaptational resilience and vulnerability were conceptualized in terms of the number of individual variables associated with poor outcome following traumatic brain injury.

Forty-five adults at least two years post moderate or severe traumatic brain injury
were recruited from two rehabilitation facilities that provide follow up rehabilitation services. Adults at least two years post moderate or severe traumatic brain injury and a significant other chosen by the subject were requested to volunteer to participate.

Participants in this study and a family member or significant other were interviewed by the researcher who rated the patient accordingly in terms of the following: education, psychiatric and substance abuse history, type of brain injury, duration of coma, and presence of seizures following injury. Current employment and living status were also assessed. Both the brain injured person and a significant other were asked to complete the Neurobehavioral Functioning Inventory in order to evaluate the brain injured person’s current level of emotional, cognitive and physical functioning.

Hypotheses

The research hypotheses directing this study is based upon the research literature integrated with the conceptualization of vulnerability suggesting an explanation for the variability in patient recovery following traumatic brain injury.

In this study, the following hypotheses will be examined: Adults at least two years after moderate or severe traumatic brain injury with more severe pre-injury psychiatric and substance abuse histories as well as less social support following brain injury will demonstrate poorer post-injury adjustment as measured by:

1. . . . employment status.

2. . . . independent living status.

3. . . . self report on the Neurobehavioral Functioning Inventory-Patient Form.

4. . . . family or significant other assessment on the Neurobehavioral Functioning
Inventory-Family Form.

This study hypothesized that those persons with greater premorbid and post-injury vulnerabilities will more likely be unemployed, require assistance in living, and will show poorer overall post-injury adaptation as measured by The Neurobehavioral Functioning Inventory on both the Patient and Family Form.

Analyses

The statistical techniques employed in this study determined how the negative prognostic indicators of psychiatric history and substance abuse history in combination with less social support following injury correlated with patient outcome. Studies that use bivariate or multiple regression/correlation include those that attempt to understand or explain the nature of a construct for purposes of developing or testing theories (Grimm & Yarnold, 1997). Grimm and Yarnold (1997) maintained that “one can gain a better understanding of the nature of a phenomenon by identifying those factors with which it co-occurs” (p.33). Information about co-occurrence helps to further define the theoretical constructs involved in the study. Accordingly, analysis employing a stepwise linear regression equation was utilized to explore each of the four hypotheses. Following significant results using stepwise linear regression, subjects were grouped into high and low risk categories, as appropriate. Non-parametric, CHI Square tests were then utilized in order to further explain the relationship between vulnerability and outcome in more practical terms.
Chapter Four
Results

This chapter provides a summary of the results of this exploratory investigation. Four hypotheses were proposed regarding the effect of the three independent variables (i.e. premorbid psychiatric history, premorbid substance abuse history, and post-injury social support) on the dependent variables (i.e. employment status, independent living status, as well as self and significant other’s rating on the Neurobehavioral Functioning Inventory) on outcome after TBI. Regression analyses were used to evaluate each of the four hypotheses. When appropriate, the subjects were then classified into high and low risk groups, and a CHI square test was employed to further highlight differences.

Hypothesis #1:

Hypothesis #1 proposed that subjects with more severe premorbid psychiatric histories and substance abuse histories with less social support following injury will demonstrate poorer post injury adjustment as measured by employment status.

In order to evaluate this hypothesis, correlation analysis followed by a stepwise linear regression procedure was employed to examine the combined effects of premorbid psychiatric history and substance abuse history and post-injury social support on employment status. Initial correlation analysis demonstrating the relationship of each of these variables to employment status, as well as each other, is presented in Table 7.
Table 7.

Correlational Analysis by Employment Status.

<table>
<thead>
<tr>
<th></th>
<th>Work Status</th>
<th>Pre_PsyHx</th>
<th>Pre_Subst</th>
<th>LSSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work Status</td>
<td>1.000</td>
<td>.694</td>
<td>.542</td>
<td>-.151</td>
</tr>
<tr>
<td>Pre-PsyHx</td>
<td>.694</td>
<td>1.000</td>
<td>.464</td>
<td>-.006</td>
</tr>
<tr>
<td>Pre-Subst</td>
<td>.542</td>
<td>.464</td>
<td>1.000</td>
<td>.025</td>
</tr>
<tr>
<td>LSSS</td>
<td>-.151</td>
<td>-.006</td>
<td>.025</td>
<td>1.000</td>
</tr>
<tr>
<td>Sig. (1-tailed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work Status</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.161</td>
</tr>
<tr>
<td>Pre-PsyHx</td>
<td>.000</td>
<td>.001</td>
<td>.485</td>
<td></td>
</tr>
<tr>
<td>Pre-Subst</td>
<td>.000</td>
<td>.001</td>
<td>.435</td>
<td></td>
</tr>
<tr>
<td>LSSS</td>
<td>.161</td>
<td>.485</td>
<td>.435</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
</tbody>
</table>

With alpha set at .05, it can be seen in Table 7 that both premorbid psychiatric status and substance abuse history were significantly positively correlated with lower employment status (r = .69 and .54, respectively, p < .01) while post-injury social support was not (r= -.15., p > .16), showing only a weak trend toward a negative association with lower employment status. With regard to the interrelationship of the subject (i.e., vulnerability) variables, it can be seen that premorbid psychiatric and substance abuse history had a strong positive association (r=.46, p< .01) while neither was correlated with post-injury social support (r approximately 0 for both, with p > .5).

Stepwise linear regression analysis examining the combined effects of premorbid
psychiatric history and substance abuse history and post-injury social support on employment status produced a two variable model with premorbid psychiatric and substance abuse history predicting, and accounting for 54% of the variance, in employment status (F(2,42)=24.9, p<.001; R²=.54). See table 8 for a visual representation.

Table 8.

Linear Regression for Employment Status

Model Summary

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of The Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.694</td>
<td>.481</td>
<td>.469</td>
<td>1.56</td>
</tr>
<tr>
<td>2</td>
<td>.737</td>
<td>.543</td>
<td>.521</td>
<td>1.48</td>
</tr>
</tbody>
</table>

ANOVA

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum Of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regression</td>
<td>97.168</td>
<td>1</td>
<td>97.168</td>
<td>39.856</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>104.832</td>
<td>43</td>
<td>2.438</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>202.000</td>
<td>44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Regression</td>
<td>109.594</td>
<td>2</td>
<td>54.797</td>
<td>24.906</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>92.406</td>
<td>42</td>
<td>2.200</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>202.000</td>
<td>44</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Predictors: (constant) Pre_psyHx...
b. Predictors: (constant) Pre_PsyHx, Pre_Subst...
c. Dependent Variable: Work Status
In order to further delineate the relationship between premorbid psychiatric history and substance abuse history with work status, a non-parametric chi square analysis was performed. To accommodate this analysis, subjects were split into low and high premorbid substance abuse groups. Groups were labeled as follows: None/Mild = 0, 1, N=32; Moderate/Severe = 2, 3, N = 13) and low and high premorbid psychiatric history (None/Mild = 0, 1, N=26; Moderate/Severe = 2, 3, N = 19). Results of analysis examining the relationship of these two variables with work status are included in Tables 9 and 10. As can be seen in Table 9, a highly significant relationship between premorbid psychiatric history and work status was obtained ($X^2 (2,45) = 18.1, p < .0001$). Inspection of this table reveals that only two persons with a significant psychiatric history were employed following their brain injury, and both of these persons were working in a part time capacity. Of persons working after brain injury, over 90% (19 of 21) had no significant premorbid psychiatric history, while 100% (11 of 11) of those working full time had no significant psychiatric history. In contrast, 71% (17 of 24) of persons who were not working had significant premorbid psychiatric histories, while only 29% (7 of 24) had a non-significant premorbid psychiatric history.
Table 9.

Employment Status by Premorbid Psychiatric History

<table>
<thead>
<tr>
<th>Work Status</th>
<th>Full Time</th>
<th>Count</th>
<th>% within Living Status</th>
<th>% within Premorbid Psych Hx</th>
<th>None (2=mild)</th>
<th>Moderate/Severe</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>11</td>
<td>100.0%</td>
<td>42.3%</td>
<td></td>
<td></td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>42.3%</td>
<td>100.0%</td>
<td>24.4%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part Time/Supported</td>
<td>Count</td>
<td>8</td>
<td>80.0%</td>
<td>30.8%</td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>% within Living Status</td>
<td>20.0%</td>
<td>10.5%</td>
<td>22.2%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Working</td>
<td>Count</td>
<td>7</td>
<td>29.2%</td>
<td>26.9%</td>
<td></td>
<td></td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>% within Living Status</td>
<td>70.8%</td>
<td>89.5%</td>
<td>53.3%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>26</td>
<td>57.8%</td>
<td>100.0%</td>
<td></td>
<td></td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>% within Living Status</td>
<td>42.2%</td>
<td>100.0%</td>
<td>100.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Table 9 continued.

**Chi-Square Tests**

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Df</th>
<th>Asymp Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>18.116</td>
<td>2</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Likelihood</td>
<td>22.307</td>
<td>2</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Linear-by-Linear Association</td>
<td>16.998</td>
<td>1</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>45</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is also demonstrated below in Table 10, that a highly significant relationship between premorbid substance abuse and work status was obtained ($X^2$ (2,45) = 11.4, $p < .005$). Inspection of this table reveals that only one person with significant premorbid substance abuse was employed following brain injury, and this was in a part time capacity. Of persons working after brain injury, well over 90% (20 of 21) had no premorbid substance abuse. In contrast, 50% (12 of 24) of the persons who were unemployed after their brain injury had significant premorbid substance abuse histories.
Table 10.

Employment Status by Premorbid Substance History

<table>
<thead>
<tr>
<th>Work Status</th>
<th>Full Time</th>
<th>Count</th>
<th>None (2=mild)</th>
<th>Moderate/Severe</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>34.4%</td>
<td>24.4%</td>
<td></td>
</tr>
<tr>
<td>Part Time/ Supported</td>
<td>Count</td>
<td>9</td>
<td>1</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>90.0%</td>
<td>10.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>28.1%</td>
<td>7.7%</td>
<td>22.2%</td>
</tr>
<tr>
<td>Not Working</td>
<td>Count</td>
<td>12</td>
<td>12</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50.0%</td>
<td>50.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>37.5%</td>
<td>92.3%</td>
<td>53.3%</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>32</td>
<td>13</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>71.1%</td>
<td>28.9%</td>
<td>100.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
Table 10 continued.

**Chi-Square Tests**

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>df</th>
<th>Asymp Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>11.412</td>
<td>2</td>
<td>.003</td>
</tr>
<tr>
<td>Likelihood</td>
<td>14.331</td>
<td>2</td>
<td>.001</td>
</tr>
<tr>
<td>Linear-by-Linear Association</td>
<td>10.354</td>
<td>1</td>
<td>.001</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>45</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Finally, the utility of employing a simple, linear combination of predictor variables (i.e., simple addition of rating scores for premorbid psychiatric and substance abuse histories) was employed using a chi square analysis. To accommodate this analysis, subjects were split into low and high vulnerability groups (Low = 01, N = 23; High = 2 and above; N=22). The strong significant relationship that was obtained is presented in Table 11 ($\chi^2 [2, N=45, p < .001] = 25.3$). As can be seen, only 2 of the 20 persons in the high vulnerability group were working, and this was in only a part-time capacity. In contrast, only 17% (4 of 23) of the low vulnerability subjects were not employed.
Table 11.

**Work Status Vulnerability**

<table>
<thead>
<tr>
<th>Work Status</th>
<th>Full Time</th>
<th>Count</th>
<th>% within</th>
<th>Vulnerability Score</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Work Status</td>
<td></td>
<td>11</td>
<td>100.0%</td>
<td></td>
<td>100.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>47.8%</td>
<td></td>
<td>24.4%</td>
</tr>
<tr>
<td>Part Time/</td>
<td></td>
<td>8</td>
<td>80.0%</td>
<td>20.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Supported</td>
<td></td>
<td></td>
<td>34.8%</td>
<td>9.1%</td>
<td>22.2%</td>
</tr>
<tr>
<td>Not Working</td>
<td></td>
<td>4</td>
<td>16.7%</td>
<td>83.3%</td>
<td>100.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>17.4%</td>
<td>90.9%</td>
<td>53.3%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>23</td>
<td>51.1%</td>
<td>48.9%</td>
<td>100.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
Table 11 continued.

Chi-Square Tests

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Df</th>
<th>Asymp Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>25.257</td>
<td>2</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Likelihood</td>
<td>30.726</td>
<td>2</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Linear-by-Linear Association</td>
<td>23.316</td>
<td>1</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>45</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hypothesis 1 was generally supported. Pre-injury psychiatric history and substance history were demonstrated to significantly affect employment status after brain injury. Social support did not offer any contribution in explaining the difference between those brain injured persons who were employed following injury.

Hypothesis #2:

Hypothesis #2 proposed that subjects with more severe premorbid psychiatric histories and substance abuse histories in addition to less social support following injury will demonstrate poorer post-injury adjustment as measured by independent living status.

To evaluate this hypothesis, correlation analysis followed by a stepwise linear regression procedure was employed to examine the combined effects of premorbid psychiatric and substance abuse history and post-injury social support on independent living status. An initial correlation analysis demonstrating the relationship of each of
these variables to employment status, as well as each other, is presented in Table 12.
With alpha set at .05, it can again be seen that both premorbid psychiatric status and substance abuse were significantly positively correlated with lower independent living status (r = .38 and .57, respectively and p < .05 and p< .01, respectively) while post-injury social support demonstrated no association (r= .06, p > .5). With regard to the interrelationship of the subject (i.e., vulnerability) variables, it was previously noted that premorbid psychiatric and substance abuse history had a strong positive association (r=.46, p< .01) while neither was correlated with post-injury social support (r approximately 0 for both, with p > .5, as indicated in Table 12).

Table 12.

Correlations by Living Status

<table>
<thead>
<tr>
<th>Living Status</th>
<th>Pre_PsyHx</th>
<th>Pre_Subst</th>
<th>LSSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>Work Status</td>
<td>1.000</td>
<td>.376</td>
</tr>
<tr>
<td></td>
<td>Pre-PsyHx</td>
<td>.376</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>Pre-Subst</td>
<td>.573</td>
<td>.464</td>
</tr>
<tr>
<td></td>
<td>LSSS</td>
<td>.062</td>
<td>-.006</td>
</tr>
<tr>
<td>Sig. (1-tailed)</td>
<td>Work Status</td>
<td>.</td>
<td>.006</td>
</tr>
<tr>
<td></td>
<td>Pre-PsyHx</td>
<td>.006</td>
<td>.</td>
</tr>
<tr>
<td></td>
<td>Pre-Subst</td>
<td>.000</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>LSSS</td>
<td>.342</td>
<td>.485</td>
</tr>
</tbody>
</table>

Stepwise linear regression analysis examining the combined effects of premorbid...
psychiatric and substance abuse history and post-injury social support on living status produced a one variable model with premorbid substance abuse history showing moderate prediction, and accounting for 33% of the variance, for living status (F(1,43)=20.97, p<.001; R^2 = .33). See table 13.

Table 13.
Linear Regression for Living Status

<table>
<thead>
<tr>
<th>Model Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ANOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>1 Regression</td>
</tr>
<tr>
<td>Residual</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

a. Predictor: (constant) Pre_Subst...
b. Dependent Variable: Living Status

In order to further delineate this relationship, a chi square analysis was conducted and is presented in Table 14. In order to facilitate this analysis, premorbid substance abuse history was spilt into low and high risk groups (None/Mild = 0, 1, N=32;
Moderate/Severe = 2, 3, N = 13). The significant relationship that was obtained is presented in Table 14 ($X^2 [2,N=45], p < .001] = 21.1$). As can be seen, the vast majority (i.e. 90% or 29 of 32) persons with no significant premorbid substance abuse were living independently, while only a small minority (i.e. 23% or 3 of 13) of those with premorbid substance abuse were living independently.

Table 14.

Living Status by Premorbid Substance Abuse

<table>
<thead>
<tr>
<th>Living Status</th>
<th>Independent</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% within Living Status</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>% within Premorbid Substance</td>
<td>90.6%</td>
</tr>
<tr>
<td></td>
<td>% of Total</td>
<td>64.4%</td>
</tr>
<tr>
<td></td>
<td>Count</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>% within Living Status</td>
<td>90.6%</td>
</tr>
<tr>
<td></td>
<td>% within Premorbid Substance</td>
<td>90.6%</td>
</tr>
<tr>
<td></td>
<td>% of Total</td>
<td>64.4%</td>
</tr>
<tr>
<td></td>
<td>Count</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>% within Living Status</td>
<td>27.3%</td>
</tr>
<tr>
<td></td>
<td>% within Premorbid Substance</td>
<td>9.4%</td>
</tr>
<tr>
<td></td>
<td>% of Total</td>
<td>6.7%</td>
</tr>
<tr>
<td></td>
<td>Count</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>% within Living Status</td>
<td>27.3%</td>
</tr>
<tr>
<td></td>
<td>% within Premorbid Substance</td>
<td>9.4%</td>
</tr>
<tr>
<td></td>
<td>% of Total</td>
<td>6.7%</td>
</tr>
<tr>
<td></td>
<td>Count</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>% within Living Status</td>
<td>100.0%</td>
</tr>
<tr>
<td></td>
<td>% within Premorbid Substance</td>
<td>15.4%</td>
</tr>
<tr>
<td></td>
<td>% of Total</td>
<td>4.4%</td>
</tr>
<tr>
<td></td>
<td>Count</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>% within Living Status</td>
<td>71.1%</td>
</tr>
<tr>
<td></td>
<td>% within Premorbid Substance</td>
<td>100.0%</td>
</tr>
<tr>
<td></td>
<td>% of Total</td>
<td>71.1%</td>
</tr>
</tbody>
</table>
Table 14 continued.

Chi-Square Tests

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>Df</th>
<th>Asymp Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>21.145</td>
<td>2</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Likelihood</td>
<td>21.301</td>
<td>2</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Linear-by-Linear Association</td>
<td>19.983</td>
<td>1</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>45</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hypothesis 2 was partially supported. Pre-injury substance abuse was found to moderately predict independent living status after brain injury, while pre-injury psychiatric history and post-injury social support did not add to the prediction.

**Hypothesis # 3:**

Hypothesis #3 proposed that subjects with more severe premorbid psychiatric histories and substance abuse histories in addition to less social support following injury will demonstrate poorer post-injury adjustment as measured by self report of their overall functioning on the Patient Form of the Neurobehavioral Functioning Inventory.

In order to evaluate this hypothesis, correlation analysis followed by a stepwise linear regression procedure was employed to examine the combined effects of premorbid psychiatric and substance abuse history and post-injury social support on patient self rated neurobehavioral functioning. A total score, indicating quality of life was obtained by averaging the subject’s scores across the six scales. Initial correlation analysis demonstrating the relationship of each of these variables to subject rated neurobehavioral

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functioning, as well as each other, is presented in Table 15. With alpha set at .05, it can be seen that none of the predictor variables were significantly correlated with self-rated neurobehavioral status (absolute values of r’s < .15, p’s > .2).

The interrelationship of the subject (i.e., vulnerability) variables, as previously noted, showed that premorbid psychiatric and substance abuse history had a strong positive association (r=.46, p< .01) while neither was correlated with post injury social support (r approximately 0 for both, with p > .5).

**Table 15.**

**Correlations by Neurobehavioral Functioning Inventory-Patient Form (NFI-P)**

<table>
<thead>
<tr>
<th></th>
<th>AVGNFI-P</th>
<th>Pre_PsyHx</th>
<th>Pre_Subst</th>
<th>LSSS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pearson Correlation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVGNFI-P</td>
<td>1.000</td>
<td>.109</td>
<td>.129</td>
<td>-.118</td>
</tr>
<tr>
<td>Pre-PsyHx</td>
<td></td>
<td>1.000</td>
<td>.464</td>
<td>-.006</td>
</tr>
<tr>
<td>Pre-Subst</td>
<td></td>
<td></td>
<td>1.000</td>
<td>.025</td>
</tr>
<tr>
<td>LSSS</td>
<td></td>
<td>-.118</td>
<td>-.006</td>
<td>1.000</td>
</tr>
<tr>
<td><strong>Sig. (1-tailed)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVGNFI-P</td>
<td>.</td>
<td>.238</td>
<td>.200</td>
<td>.219</td>
</tr>
<tr>
<td>Pre-PsyHx</td>
<td>.238</td>
<td>.</td>
<td>.001</td>
<td>.485</td>
</tr>
<tr>
<td>Pre-Subst</td>
<td>.200</td>
<td>.001</td>
<td>.</td>
<td>.435</td>
</tr>
<tr>
<td>LSSS</td>
<td>.219</td>
<td>.485</td>
<td>.435</td>
<td>.</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVGNFI-P</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Pre-PsyHx</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Pre-Subst</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>LSSS</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
</tbody>
</table>

Stepwise linear regression analysis examining the combined effects of premorbid psychiatric and substance abuse history and post-injury social support on self-rated neurobehavioral status revealed that no combination of the variables significantly
predicted self-rated neurobehavioral status. Forcing the three variables into a simple linear regression analysis demonstrated this non-significant relationship (F(3,41)=.48, p>.6 R²=.03).

Table 16.
Linear Regression for Neurobehavioral Functioning Inventory-Patient Form (NFI-P)

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of The Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.185</td>
<td>.034</td>
<td>-.036</td>
<td>19.67</td>
</tr>
</tbody>
</table>

ANOVA

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regression</td>
<td>561.385</td>
<td>3</td>
<td>187.128</td>
<td>.484</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>15860.093</td>
<td>41</td>
<td>386.832</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>16421.478</td>
<td>44</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Predictor: (constant) LSSS, Pre_PsyHx, Pre_Subst...
b. Dependent Variable: AVG NFI-P

Hypothesis 3 was not supported, as none of the variables significantly predicted subject self-assessment of neurobehavioral functioning.
Hypothesis #4:

Hypothesis #4 proposed that subjects with more severe premorbid psychiatric histories and substance abuse histories in addition to less social support following injury will demonstrate poorer post-injury adjustment as measured by a family member’s or significant other’s rating of their post-injury adjustment on the Family Form of the Neurobehavioral Functioning Inventory.

In order to evaluate this hypothesis, correlation analysis followed by a stepwise linear regression procedure was employed to examine the combined effects of premorbid psychiatric and substance abuse history and post-injury social support on family rated patient neurobehavioral functioning (averaged across the six scales). Initial correlation analysis demonstrating the relationship of each of these variables to family rated patient neurobehavioral functioning, as well as each other, is presented in Table 17. With alpha set at .05, it can be seen that only social support on the Lubben measure was significantly correlated with family rated patient neurobehavioral status ($r = -.36$, $p < .01$). This negative association indicates that higher patient perceived social support is associated with less family rated neurobehavioral dysfunction (or higher levels of neurobehavioral functioning).
Table 17.

Correlations by Neurobehavioral Functioning Inventory-Family Form (NFI-F)

<table>
<thead>
<tr>
<th></th>
<th>AVGNFI-F</th>
<th>Pre_PsyHx</th>
<th>Pre_Subst</th>
<th>LSSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVGNFI-F</td>
<td>1.000</td>
<td>-0.080</td>
<td>-0.105</td>
<td>-0.356</td>
</tr>
<tr>
<td>Pre-PsyHx</td>
<td>-0.080</td>
<td>1.000</td>
<td>0.464</td>
<td>-0.006</td>
</tr>
<tr>
<td>Pre-Subst</td>
<td>-0.105</td>
<td>0.464</td>
<td>1.000</td>
<td>0.025</td>
</tr>
<tr>
<td>LSSS</td>
<td>-0.356</td>
<td>-0.006</td>
<td>0.025</td>
<td>1.000</td>
</tr>
<tr>
<td>Sig. (1-tailed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVGNFI-F</td>
<td></td>
<td>0.301</td>
<td>0.245</td>
<td>0.008</td>
</tr>
<tr>
<td>Pre-PsyHx</td>
<td>0.301</td>
<td></td>
<td>0.001</td>
<td>0.485</td>
</tr>
<tr>
<td>Pre-Subst</td>
<td>0.245</td>
<td>0.001</td>
<td></td>
<td>0.435</td>
</tr>
<tr>
<td>LSSS</td>
<td>0.008</td>
<td>0.485</td>
<td>0.435</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVGNFI-F</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Pre-PsyHx</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Pre-Subst</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>LSSS</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
</tbody>
</table>

The interrelationship of the subject (i.e., vulnerability) variables, as previously noted, showed that premorbid psychiatric and substance abuse history had a strong positive association ($r=.46, p<.01$) while neither was correlated with post injury social support ($r$ approximately 0 for both, with $p > .5$).

Stepwise linear regression analysis examining the combined effects of premorbid psychiatric and substance abuse history and post-injury social support on family rated patient neurobehavioral status revealed a single variable model that significantly
predicted, and accounted for 12.7% of the variance for family rated patient neurobehavioral status ($F(1,43)=6.2$, $p < .05$; $R^2 = .127$).

Table 18.

Linear Regression for Neurobehavioral Functioning Inventory-Family Form (NFI-F).

Model Summary

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of The Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.356</td>
<td>.127</td>
<td>.106</td>
<td>16.60</td>
</tr>
</tbody>
</table>

ANOVA

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regression</td>
<td>1</td>
<td>1717.209</td>
<td>1717.209</td>
<td>6.232</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>43</td>
<td>275.562</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>44</td>
<td>13566.360</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Predictors: (constant) LSSS...
b. Dependent Variable: AVG NFI-F

Hypothesis 4 was partially supported. Post-injury social support was found to significantly predict family or significant other’s rating of subject functioning on the Family Form of the Neurobehavioral Functioning Inventory. Pre-injury psychiatric history and substance abuse history did not add to the prediction.
Summary

Three of the four research hypotheses were partially supported. A combination of pre-injury psychiatric history and substance history was found to significantly predict employment status after traumatic brain injury. Substance abuse was found to significantly predict independent living status. No single variable or combination of variables was found to significantly predict subject's self-assessment of neurobehavioral functioning. Post-injury social support was found to significantly predict family or significant other's assessment of subject's neurobehavioral functioning after brain injury.
Chapter Five
Summary and Discussion

Scope of the Problem

Traumatic Brain Injury constitutes a major health and societal problem in the United States of America. Traumatic Brain injuries occur in a tri-modal distribution with highest incidences in children (i.e. younger than five years old), young adults (i.e. 16 to 34 years) and older adults (i.e. 65 years and older, Cifu, et al., 1996). TBI rates are highest for males age 15 to 24 years and for both sexes after age 70 (Reeder, et al., 1996). In general, adult men represent two-thirds of the brain injuries sustained between ages 15 to 70 (Reeder, et al., 1996). It has been established in the research literature that recovery from brain injury takes an average of at least two years and that there is significant patient diversity with regarding to long-term outcome. TBI outcomes range from subtle changes in the personality of the injured person to profound physical, cognitive, and psychosocial disability. Neurobehavioral, cognitive, and adjustment difficulties, versus physical impairments, are the most disabling long-term effects of traumatic brain injury (Schalen, 1994).

Improved emergency responses and acute trauma care have led to a dramatic rise in the number of persons who survive TBI. Before the origination of the shock trauma unit, one of every two persons with TBI died as a result of injuries. Today, the percentage of persons with TBI who survive after medical intervention is as high as 90% depending on the expediency of paramedic and shock trauma interventions (Papastrat, 1992). With these noted advances in health care and neurosurgical techniques, it can be
anticipated that increasing numbers of persons survive with severe injury to the brain, requiring substantial rehabilitation services and assistance.

Importance of Enhanced Understanding

The importance of understanding the differences in patient recovery from traumatic brain injury can not be underestimated. Given that many survivors of brain injury are young persons who would normally be working and contributing to society, it seems crucial that we develop increasingly sophisticated ways to understand patient need and to account for the variability in patient outcome. Persons with traumatic brain injury represent a diverse group. This diversity reflects differences in both pre-injury and post-injury characteristics. With regard to outcome, researchers have routinely report significant individual differences among clients (Dodwell, 1988), but have been puzzled by this great variability. Success, in the treatment arena, is often attributed to the “lucky” few. It is important that we increase our ability to understand and assist those clients who demonstrate poorer outcomes following traumatic brain injury in order to maximize those person’s post-injury abilities to assist them in becoming productive members of society and experiencing a positive quality of life. Increased understanding will improve our ability to enhance the brain injury survivor’s ability to exert control and have choices for living. The implications of improved understanding are even more dramatic in view of the fact that brain injury itself tends to be an affliction of younger men.

Many studies have simply focused survival and functional outcome following moderate and severe traumatic brain injuries. Historically, post-injury factors such as type of injury and duration of coma have been used to prognostic outcome. It has become increasingly evident that post-injury variables are not as helpful in explaining
long-term outcome and predicting which persons will demonstrate the best adaptation to their injury. It is not uncommon to see similarly injured persons who show dramatic differences in mood management, living and employment status (Webb, et al., 1995). It has become increasingly understood that pre-injury factors may, in fact, help us to understand which persons demonstrate less disability following TBI (Kay, 1992).

**Future Directions**

Increasingly sophisticated models of behavior are emerging in the fields of medicine and psychology that assist with conceptualizing and designing treatment interventions for challenging health care situations. Biopsychosocial models represent alternative theoretical approaches to dualistic and reductionistic biomedical models that explain disability in terms of measurable biological variables. Given such factors as a twentieth century shift from a prevalence of infectious, single agent diseases to multiply determined chronic illnesses, it seems inevitable that multi-axial and clinical models would emerge to incorporate psychological, social, and cultural factors with biological factors to explain disease and its variable expression in health outcomes.

A stress, coping, and vulnerability formulation of traumatic brain injury postulates that the brain injury results in multiple cognitive, emotional, social and neurophysical demands which constitute singularly and in combination, severe stressors. These stressors not only challenge the coping capabilities of the person, but directly diminish available resources through loss of premorbid skills and a combination of reductions in social and financial supports (Martelli, Braith, & MacMillan, 1992). This formulation includes a complex interaction of factors surrounding brain injury, the history the individual brings to the injury, and the environment the individual confronts.
afterwards.

Kay's (1992) proposed concept of individual vulnerability suggests that a large number of variables, ranging from biological to psychosocial, influence the impact and outcome of a brain injury for any given individual. Individual differences in brain structure, hormonal, and neurotransmitter balances, and other biological systems represent pre-injury differences that may render one brain injury more susceptible to, or magnify, neurologic impairment; subsequently, a wide variety of personality and psychosocial variables interact to produce a unique functional outcome. At this time, Kay's promising theoretical formulations have not been subjected to a great deal of empirical research.

Unfortunately, many studies of brain injured persons have excluded persons with psychiatric and substance abuse history in order to avoid confounding outcome determination. (Cifu, et al., 1996, Cowen, et al., 1995, Dikmen, et al., 1995). Many studies have only used gross, functional outcome measures and have not followed persons past one year post injury.

At this time, there appears to be a subset of brain injured persons whose residual adaptation is poorly understood. Such persons are often labeled as “treatment failures” and remain dependent and unproductive following their injury. Unfortunately, many of these persons are unable to resume any form of productive activity and represent a significant cost to our society.

Resources and Treatment

In terms of health care dollars, the TBI survivor represents a financial exposure that is difficult to forecast in terms of outcome or long-term severity (Papastrat, 1992).
To insure effective use of health care funds, it is important for clinicians to assist financial providers by making early, realistic predictions for each case. Given recent and anticipated changes in Medicare, Medicaid, and Social Security, a more sophisticated understanding of the complex needs of the person with TBI is crucial.

More information about how persons with traumatic brain injury cope with and manage residual disabilities would allow the design of more appropriate treatment interventions to facilitate maximal recovery and adaptation. Finally, it may be that some persons, because of premorbid vulnerabilities, simply need more time and rehabilitation resources to demonstrate a positive outcome. Increasing our understanding of these factors allows us to more realistically and appropriately manage health care dollars.

**Study Summary**

This study evaluated the outcome of 45 adults with moderate and severe traumatic brain injury who were at least two years post injury. Subject demographic, medical, psychological, social, and substance abuse histories were obtained from medical record review. Subjects and a significant other were interviewed regarding the subject’s pre-injury and post-injury history. Subjects also completed instruments measuring current level of social support and their assessment of their functioning on a neurobehavioral functioning inventory. A family member or significant other chosen by the subject also rated their impression of the subject’s functioning on a neurobehavioral functioning inventory. Subjects were also rated as to their current employment and independent living status.

This study hypothesized that brain injured persons with less social support after injury coupled with pre-injury histories of both psychiatric difficulties and substance
abuse problems would demonstrate poorer adaptation to their brain injuries than similarly injured subjects without such histories and higher levels of social support. It was hypothesized that subjects with the aforementioned difficulties would demonstrate lower employment status and lower independent living status. It was also hypothesized that subjects with premorbid psychiatric and substance abuse histories would rate themselves as functioning more poorly on a neurobehavioral functioning inventory than would subjects without such difficulties. Finally, it was hypothesized that subjects with psychiatric and substance abuse histories and limited post-injury social support would be rated by a significant other as having more neurobehavioral dysfunction.

Results of this exploratory research are promising. As hypothesized, more severe history of psychiatric difficulties and substance abuse problems were found to predict employment status following traumatic brain injury. Notably, social support following injury was found not to add to the prediction equation. Nineteen of 21 persons employed following traumatic brain injury had no or mild psychiatric history. In contrast, 17 of 24 persons not working had significant psychiatric histories. Only one of 21 subjects working full or part-time had a significant psychiatric or substance abuse history. These findings are consistent with the limited research on premorbid psychiatric history negatively impacting functional recovery one year after brain injury (Johnston & Hall, 1994). It is also consistent regarding the negative impact of substance abuse on cognitive functioning with increased risk for deterioration following injury (Corrigan, 1995). Additional research regarding the brain injured person’s pre-injury job status in contrast to their post-injury job category is needed to understand which persons are able to resume similar occupations and which individuals needed to be downgraded in terms of job.
Substance abuse was found to significantly predict independent living status, while pre-injury psychiatric history and social support following injury were not significant predictors. Persons with a significant substance abuse history were more likely not to be living independently following brain injury. Again, this is consistent with preliminary research findings by Corrigan (1995) that substance abuse history is associated with deterioration at one year post injury.

Pre-injury psychiatric and substance abuse history did not significantly predict subjects’ assessment of their functioning on a neurobehavioral functioning inventory. Social support following injury was also not a significant predictor on this outcome measure. This finding was unanticipated. This finding may be due to the fact that perhaps all brain injured persons experience similar symptomatology, but the difference is in how the individual copes with, or mobilizes his or her resources in response to difficulties. Therefore, persons who were likely to be independently living or employed following injury, may in fact, also have great difficulties, but these individuals are simply more adaptively compensating for post-injury reductions in functioning. Clearly, more research in this area is needed with more objective measures of functioning combined with measures of emotional adjustment.

Social support following injury significantly predicted family or significant other’s ratings of the subject’s neurobehavioral functioning following injury. Pre-injury psychiatric and substance abuse histories did not significantly predict family or significant other’s ratings of the subject’s post-injury functioning. This is consistent with Webb and others’ (1995) finding that patients with high levels of post-injury social
vulnerable to disability than others and, therefore, require either different or additional post-injury assistance. Optimistically, this could impact utilization review practices and promote increased cooperation from managed care and other financial providers in the community.

Furthermore, this study deepens our understanding that pre-injury characteristics impact post-injury adjustment and adaptation to impairments. Increasing appreciation of the impact of pre-injury coping liabilities can lend support to efforts to increase and expand psychosocial interventions after brain injury. This impact is invaluable given that emotional and behavioral disturbances are the most socially and vocationally disruptive sequelae of traumatic brain injury (Prigatano, 1992). These disturbances influence the brain injured person's social relationships, ability to sustain employment, and place a great burden on family members (Brooks, et al., 1986).

**Theoretical Implications**

This exploratory research represents a beginning point in conceptualizing variability in TBI outcome in terms of collective vulnerabilities. Neurologic disease occurs within a multi-axial matrix of a person's physiologic, psychological, social history, and post-injury environment to produce a complex presentation where diversity in outcome is expected. Understanding that psychological and coping liabilities are one such pocket of vulnerabilities should assist in providing better post-injury intervention. Treating the person versus the type of injury will likely lead to improved understanding and outcome for this challenging medical problem which currently confronts our society.

**Limitations**

The following limitations are acknowledged in this study. The sample is a
post-injury assistance. Optimistically, this could impact utilization review practices and promote increased cooperation from managed care and other financial providers in the community.

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Limitations

The following limitations are acknowledged in this study. The sample is a convenience sample and all persons who participated are involved in follow-up.
rehabilitation service. Furthermore, mean years post brain injury was 10 years which is significantly greater than many follow-up studies of traumatic brain injury. Finally, in the brain injury literature, there appears to be a lack of consensus regarding measurement of premorbid characteristics such as psychiatric and substance abuse history.

Furthermore, because these factors are assessed retrospectively, there is always the potential for bias, selective memory, distortion, or minimization of dysfunction by both clients and significant others. In citing these weaknesses, however, these caveats should also be acknowledged. While this was a convenience sample of persons still receiving rehabilitation services, this may be more reflective of the actual population of brain injury survivors who require prolonged treatment. The fact that these subjects had a mean time since injury of 10 years may further support this assertion. This study also attempted to more specifically and accurately assess psychiatric and substance abuse history by avoiding dichotomous definitions and by securing information from multiple sources including medical records, a significant other, as well as the subject.

Suggestions for Future Research

At this point, additional research evaluating the concept of individual vulnerability and how it influences long-term adaptation following traumatic brain injury is needed. Studies of brain injury survivors who are at least two years post injury should be conducted to further increase our understanding of the differences in adaptation after neurological recovery has stabilized and psychological factors have presumably begun to exert their influence.

Follow-up studies will optimally identify pockets of vulnerability within biological, medical, psychological, and social areas. Follow-up studies should most
certainly include persons with premorbid psychiatric and substance abuse histories since these persons actually represent a substantial number of individuals at risk for traumatic brain injury (Corrigan, 1995; Kreutzer & Harris, 1990). Furthermore, since post-injury variables such as injury severity and length of coma have been helpful in predicting mortality and morbidity, but not necessarily illuminating in determining which persons will demonstrate the best adaptation to their injuries, it seems clear that more evaluation of the effects of premorbid status in combination with post-injury variables is needed.

Including persons with complicated pre-injury histories should increase our understanding of the individual variability in recovery from and adaptation to moderate and severe traumatic brain injury. This should enable us to target high risk individuals and provide them with more intense interventions based on identified needs.

An ample and adequate sample size in future studies will be required in order to effectively evaluate the multiple variables that most likely represent the complex and multi-faceted concept of individual vulnerability. Attempts to secure a more randomized sample, perhaps from a source such as the Coma Data Bank would increase our understanding of persons who remain in rehabilitation and those who do not receive services past the very early stages of brain injury.

As previously noted, many TBI outcome studies have employed gross measures of functional independence to evaluate outcome. Global outcome measures are not sensitive enough to evaluate outcome involving long-term adjustment and adaptations to residual impairments (Johnston, 1989). More complex outcome measures are indicated to evaluate residual psychosocial and cognitive dysfunction, which will likely be manifested most clearly in social and occupational roles, and are for most moderate and
severe TBI survivors, the most disabling consequence of brain injury (Johnston, 1989). Research using measures of psychological adjustment and coping appear strongly indicated and will be helpful in enriching understanding the needs of the TBI survivor. Ratings should also be provided by a family member or significant other to further evaluate the brain injury survivor’s function.

Long-term outcome studies should also include assessment of post-injury employment status, given that lost work is the largest societal cost produced by TBI, albeit an indirect one (Cope & O’Lear, 1993).

Follow-up studies of individual vulnerability should assist in the identification of specific vulnerabilities in order to target those persons who will likely require additional services following TBI and in the design of appropriate interventions, in addition to support and advocacy for funding. A TBI is a crisis which could endanger an individual’s well being and exceed his or her resources. TBI disability places demands upon society to financially, physically, and emotionally support the individual. Understanding vulnerabilities would optimally assist rehabilitation providers, family members, and third party payers in moderating expectations for continued support and treatment following the acute stages of TBI. Maximizing the brain injured person’s coping skills and adjustment should facilitate improved functioning with increased productivity and feelings of self-worth.

Theoretically based research can provide structure when interpreting behavior because it can pinpoint the vulnerability, predict how it will interact with the environment, and prescribe specific interventions. Such increased understanding will optimally result in more intensive treatment with decreased disability and cost to society.
Finally, when vulnerabilities are clearly identified with empirical support and treatments are provided accordingly, follow-up investigation is warranted to evaluate if modifications and extensions in target interventions do actually enhance outcome.

**Speculations**

It may well be that a “maladjustment” factor exists that can explain why some individuals can and do recover more optimally following any trauma. It seems that those persons who historically cope poorly, continue to demonstrate coping liabilities in the face of increased biological, psychological, social, or environmental stress. More investigation of a maladjustment factor will likely increase our ability to target and effectively assist those persons who will require additional and or different intervention following TBI.
Appendix A

Informed Consent Form to Participate in Research Study about Traumatic Brain Injury

Your assistance in participating in a study regarding brain injury is requested. The purpose of this study is to increase our understanding of how pre-injury and post-injury characteristics influence recovery and adaptation after moderate and severe traumatic brain injury. It is our hope that the information we glean from this study will increase our ability to determine which persons might require additional rehabilitation services in order to achieve optimal living, employment and adjustment.

Should you agree to participate in this study, information regarding your brain injury will be obtained from your medical records at this facility. The steps that we are asking you to complete are as follows: You will be asked to complete two questionnaires. The first is a Neurobehavioral Functioning Inventory to rate your cognitive, emotional and psychological adjustment. The second instrument is the Lubben Social Network Scale to assess how much social support and contact you have in your current life. A family member or significant other that you chose will also be asked by you to complete the family form version the Neurobehavioral Functioning Inventory to assess how that person views your current functioning. It should take approximately 15 minutes to complete all instruments.
Appendix A

TBI Study Consent Form: page 2

Your participation in this study is strictly voluntary and must be approved by you. Declining to participate in this study will in no way affect your treatment (past, present or future) at this facility. Information obtained from this study will not become a part of your medical record and will be kept confidential from anyone else at this facility with the exception of the researcher. Should you decide to participate, you may drop out or withdraw participation at any time, again without penalty or affect upon your rehabilitation treatment.

I have read the above and decided to participate in this study understanding that I may withdraw my consent and participation without any penalty or impact on my rehabilitation treatment at this facility.

________________________________________
TBI Subject
Signature and Date

________________________________________
Significant Other of Person with TBI
Signature and Date
Appendix B

TBI DATA COLLECTION/CODING WORKSHEET

Site collected: ___________ Client ID Code: ___________

Current Age: ___________ Age Injured: ___________

TBI Grade & Date of Injury: ___________

Cause of Injury: ___________________________________________________________________

Length of time before rehab was initiated after TBI: ___________

Gender: _______ Race: _______ Handedness: _______

A. PRE-INJURY/PREMORBID VARIABLES

AGE
0. Less than 40 years old at time of injury
1. Over 40 years old at time of injury

MARITAL STATUS at Injury:
0. Married/Co-habitating
1. Steady Significant Other
2. Single or Widowed
3. Divorced

EDUCATION:
0. College Graduate
1. Vocational School or College Course work
2. High School Graduate
3. Did not graduate High School

PSYCHIATRIC HISTORY:
0. NONE:
No history of depression, mental health problems or participation in counseling or psychotherapy.
1. MILD:
Participation outpatient counseling/psychotherapy for depression or adjustment issues.
AND no inpatient psychiatric treatment
2. MODERATE:
Greater than 3 distinct episodes of outpatient psychotherapy or counseling
AND medication prescribed for anxiety, depression
OR 1 psychiatric hospitalization
3. SEVERE:
Greater than one psychiatric hospitalization OR Suicide Attempt OR History of schizophrenia OR other psychosis.
SUBSTANCE ABUSE HISTORY:
0. NONE:
No history of problematic ETOH consumption or substance abuse as reported by
significant other. Not intoxicated at time of injury.
1. MILD
History of recreational ETOH or illegal drug use on a consistent basis as reported by family
members or medical record review.
No DUIs Not intoxicated at time of injury
2. MODERATE
No more than one DUI
History of ETOH or substance abuse interfering with work or relationships as reported
by significant other or medical record review.
Intoxicated at time of injury
3. SEVERE:
Greater than one DUI
Multiple attempts at detox, hospitalizations for ETOH or drug abuse
Alcohol interfered with work, school and social relationships as reported by significant other
or medical record review.

PREVIOUS NEUROLOGIC HISTORY:
0. No previous history.
1. Diabetes, HTN, Epilepsy, etc.
2. Previous TBI

B. POST-INJURY VARIABLES:

TYPE OF INJURY
0. Focal
1. Diffuse
2. Mixed

DURATION OF LOC
0. < THAN ONE HOUR
1. > THAN ONE HOUR <14 DAYS
2. >14 DAYS

PRESENCE OF SEIZURES AFTER INJURY
0. No seizure activity after brain injury
1. One seizure after brain injury
2. More than one seizure after brain injury

LUBBEN SOCIAL SUPPORT SCORE: ________________

C. DEPENDENCY OUTCOME VARIABLES
1. CURRENT LIVING STATUS:
4. NURSING HOME
3. ASSISTED LIVING FACILITY/ADULT HOME
2. HOME WITH ASSISTANCE IN ADL’s
1. HOME WITH SUPERVISION IN MEDICATIONS OR FINANCES
0. INDEPENDENT

2. CURRENT EMPLOYMENT STATUS:
5. DISABLED
4. UNEMPLOYED
3. SHELTERED WORKSHOP
2. SUPPORTED EMPLOYMENT
1. PART TIME COMPETITIVE EMPLOYMENT
0. FULL TIME COMPETITIVE EMPLOYMENT
0. HOMEMAKER
0. STUDENT
0. VOLUNTEER

3. NEUROBEHAVIORAL FUNCTIONING INVENTORY (NFI)

Patient Form
CLIENT’s
Self Rating
Depression: _____%
Somatic: _____%
Communication: _____%
Aggression: _____%
Motor: _____%

Average NFI Patient Form Score: ____________

Family Form
OTHER’S
Rating
Completed by: _____
Depression Scale: _____%
Somatic Scale: _____%
Communication Scale: _____%
Aggression Scale: _____%
Motor Scale: _____%

Average NFI Family Form Score: ____________
Appendix C

Neurobehavioral Functioning Inventory - Patient Form

Your Name: Date:

Directions: How often do you CURRENTLY have any of the following problems? Please place an “X” in the box under the label “never,” “rarely,” “sometimes,” “often,” or “always.” PLEASE ANSWER ALL ITEMS.

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Miss or cannot attend work/school</td>
<td>[1]</td>
<td>[2]</td>
<td>[3]</td>
<td>[4]</td>
<td>[5]</td>
</tr>
<tr>
<td>15. Forget if you have done things</td>
<td>[1]</td>
<td>[2]</td>
<td>[3]</td>
<td>[4]</td>
<td>[5]</td>
</tr>
<tr>
<td>17. Hit or push others</td>
<td>[1]</td>
<td>[2]</td>
<td>[3]</td>
<td>[4]</td>
<td>[5]</td>
</tr>
</tbody>
</table>
Appendix C
Neurobehavioral Functioning Inventory -Patient Form: page 2

27. Forget people’s names. [1] [2] [3] [4] [5].
29. Inappropriate behavior or comments. [1] [2] [3] [4] [5].
32. Stomach bloated. [1] [2] [3] [4] [5].
33. Forget what you have read. [1] [2] [3] [4] [5].
34. Difficulty thinking of the right word. [1] [2] [3] [4] [5].
35. Break or throw things. [1] [2] [3] [4] [5].
39. Lose track of time, day, or date. [1] [2] [3] [4] [5].
41. Scream or yell. [1] [2] [3] [4] [5].
42. Muscles tingle or twitch. [1] [2] [3] [4] [5].
43. Sit with nothing to do. [1] [2] [3] [4] [5].
44. Ringing in ears. [1] [2] [3] [4] [5].
45. Forget to do chores or work. [1] [2] [3] [4] [5].
### Appendix C

Neurobehavioral Functioning Inventory - Patient Form: page 3

| 46. Speech doesn’t make sense. | [1] | [2] | [3] | [4] | [5]. |
| 47. Rude to others. | [1] | [2] | [3] | [4] | [5]. |
| 49. Scared or frightened. | [1] | [2] | [3] | [4] | [5]. |
| 50. Poor appetite. | [1] | [2] | [3] | [4] | [5]. |
| 52. My writing is hard to read. | [1] | [2] | [3] | [4] | [5]. |
| 53. Threaten to hurt others. | [1] | [2] | [3] | [4] | [5]. |
| 54. Trip over things. | [1] | [2] | [3] | [4] | [5]. |
| 55. Concentration is poor. | [1] | [2] | [3] | [4] | [5]. |
| 56. Lose train of thought. | [1] | [2] | [3] | [4] | [5]. |
| 57. Forget phone numbers. | [1] | [2] | [3] | [4] | [5]. |
| 58. Lose way, get lost. | [1] | [2] | [3] | [4] | [5]. |
| 60. Confused. | [1] | [2] | [3] | [4] | [5]. |
| 61. Read slowly. | [1] | [2] | [3] | [4] | [5]. |
| 63. Talk too fast or slow. | [1] | [2] | [3] | [4] | [5]. |
| 64. Forget to turn off appliances. | [1] | [2] | [3] | [4] | [5]. |
| 65. Difficulty enjoying activities. | [1] | [2] | [3] | [4] | [5]. |
| 69. Forget to take medication  
(If none prescribed, respond ‘never’.) | [1] | [2] | [3] | [4] | [5]. |
| 70. Can’t get mind off certain thoughts. | [1] | [2] | [3] | [4] | [5]. |

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Appendix C

Neurobehavioral Functioning Inventory-Patient Form: page 4

73. Late for appointments. [1] [2] [3] [4] [5].
74. Trouble falling asleep. [1] [2] [3] [4] [5].
75. Trouble hearing. [1] [2] [3] [4] [5].
76. Food doesn’t taste right. [1] [2] [3] [4] [5].
77. Loss of interest in sex. [1] [2] [3] [4] [5].
79. Easily angered or irritated. [1] [2] [3] [4] [5].
81. Numbness in hands or feet. [1] [2] [3] [4] [5].
82. Tire easily during physical activity. [1] [2] [3] [4] [5].
### Appendix D

**Neurobehavioral Functioning Inventory - Family Form**

Your Name:  
Your Relationship to person with Brain Injury:  
Date:

Directions: How often does the patient CURRENTLY have any of the following problems? Please place an “X” in the box under the label “never,” “rarely,” “sometimes,” “often,” or “always.” PLEASE ANSWER ALL ITEMS.

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
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</table>

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Neurobehavioral Functioning Inventory-Family Form: page 2

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29. Inappropriate behavior or comments.  [1]  [2]  [3]  [4]  [5].
32. Stomach bloated.  [1]  [2]  [3]  [4]  [5].
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50. Poor appetite. [1] [2] [3] [4] [5].
52. My writing is hard to read. [1] [2] [3] [4] [5].
53. Threaten to hurt others. [1] [2] [3] [4] [5].
54. Trip over things. [1] [2] [3] [4] [5].
55. Concentration is poor. [1] [2] [3] [4] [5].
56. Lose train of thought. [1] [2] [3] [4] [5].
57. Forget phone numbers. [1] [2] [3] [4] [5].
58. Lose way, get lost. [1] [2] [3] [4] [5].
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63. Talk too fast or slow. [1] [2] [3] [4] [5].
64. Forget to turn off appliances. [1] [2] [3] [4] [5].
65. Difficulty enjoying activities. [1] [2] [3] [4] [5].
67. Uncomfortable around others. [1] [2] [3] [4] [5].
69. Forget to take medication (If none prescribed, respond 'never'.) [1] [2] [3] [4] [5].
70. Can’t get mind off certain thoughts. [1] [2] [3] [4] [5].
73. Late for appointments. [1] [2] [3] [4] [5].
Appendix D

Neurobehavioral Functioning Inventory- Family Form: page 4

74. Trouble falling asleep. [1] [2] [3] [4] [5].
75. Trouble hearing. [1] [2] [3] [4] [5].
76. Food doesn't taste right. [1] [2] [3] [4] [5].
77. Loss of interest in sex. [1] [2] [3] [4] [5].
79. Easily angered or irritated. [1] [2] [3] [4] [5].
81. Numbness in hands or feet. [1] [2] [3] [4] [5].
82. Tire easily during physical activity. [1] [2] [3] [4] [5].
Appendix E

Lubben Social Network Scale

Family networks.

Q1. How many relatives do you see or hear from at least once a month?

0-zero
1-one
2-two
3-three or four
4-five to eight
5-nine or more

Q2. Tell me about the relatives with whom you have the most contact. How often do you hear from that person?

0-<monthly
1-monthly
2-a few times a month
3-weekly
4-a few times a week
5-daily

Q3. How many relatives do you feel close to? That is, how many of them do you feel at ease with, can talk to about private matters, or can call on for help?

0-zero
1-one
2-two
3-three or four
4-five to eight
5-nine or more

Friends networks

Q4. Do you have any close friends? That is, do you have any friends with whom you feel at ease with, can talk to about private matters, or can call on for help? If so, how many?

0-zero
1-one
2-two
3-three or four
4-five to eight
5-nine or more

Q5. How many of these friends do you hear from at least once a month?

0-zero
1-one
2-two
3-three or four
4-five to eight
5-nine or more

Q6. Tell me about the friend with whom you have the most contact. How often do you see or hear from that person?

0-<monthly
1-monthly
2-a few times a month
3-weekly
4-a few times a week
5-daily

Confidant relationships

Q7. When you have an important decision to make, do you have someone you can talk to about it?

Always  Very Often  Often  Sometimes  Seldom  Never
5  4  3  2  1  0

Q8. When other people you know have an important decision to make, do they talk to you about it?

Always  Very Often  Often  Sometimes  Seldom  Never
5  4  3  2  1  0

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Appendix E

Lubben Social Network Scale: page 2

Helping others
Q9a. Does anybody rely on you to do something for them each day? For example: shopping, cooking, dinner, doing repairs, cleaning house, providing child care, etc.
NO-if no, go on to Q9b. YES-if yes, Q9 is scored “5” and skip to Q10.
Q9b. Do you help anybody with things like shopping, filling out forms, doing repairs, providing child care, etc.

<table>
<thead>
<tr>
<th>Very Often</th>
<th>Often</th>
<th>Sometimes</th>
<th>Seldom</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Living arrangements
Q10. Do you live alone or with other people?

5. Live with spouse
4. Live with other relatives or friends
1. Live with other unrelated individuals (e.g. paid help)
0. Live alone

TOTAL LSNS SCORE: ________

SCORING:
The total LSNS score is obtained by adding up scores from each of the ten individual items. Thus, total LSNS scores can range from 0 to 50. Scores on each item were anchored between 0 and 5 to permit equal weighting of the ten items.
References


*Neuropsychology, 9*(1), 80-90.


*Neuropsychology, 7*, 296-305.


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