ABSTRACT

TRAUMATIC BRAIN INJURY: TRADITIONAL AND NARRATIVE ASSESSMENT TECHNIQUES

by
Sharon M. Katzman-Teller

Traumatic brain injury (TBI) causes impairment of executive functioning, as well as cognitive and language abilities of various degrees. Standard language tests currently focus on very specific language disorders and can not identify language disorders of TBI subjects with high-level language functioning. Although these standard tests can not adequately identify subtle language disorders, these TBI subjects lack cohesiveness in their conversation, which can have a strong effect on socialization.

Through the use of narrative analysis, research in narrative and conversational discourse, which incorporates linguistic, cognitive skills, as well as executive functioning and social abilities, seems to be more appropriately address cohesive discourse of high-level language functioning TBI subjects.

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by
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APPROVAL PAGE

TRAUMATIC BRAIN INJURY: TRADITIONAL AND NARRATIVE ASSESSMENT TECHNIQUES

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This thesis is dedicated to brain trauma survivors everywhere, who struggle to understand who they have become, and to those close to them, who provide patience, love, and support to help them to figure that out.

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CHAPTER 1

INTRODUCTION AND RATIONALE

While there are an extraordinary number of tests available to evaluate the various aspects of cognitive skills and executive functioning of people who have sustained a TBI, no test can properly test the language skills of a specific TBI group. These people, despite the TBI, even severe TBI, can still maintain language skills, showing no deficits on current tests, and yet lack cohesiveness enough to not properly maintain conversation or complex ideas relayed through story telling. Language deficits in TBI individuals are due to impairments of the cognitive processing that support language, rather than specific linguistic deficits, of which current testing is directed. Current research in conversational and narrative discourse analysis, discussed in the second part of this thesis, is very promising as a method to address language deficits of TBI individuals.

The thesis is divided into two main discussions. The first discussion, Chapters 2 through 4, is an expositive overview of TBI, including normal brain functioning and various aspects in the identification of brain injury. This is to allow the reader to fully understand the diverse and extensive differences of TBI from person to person, depending on the location and severity of injury and to begin to appreciate the difficulty in the development of a narrative discourse rehabilitation program. The second part of the discussion, beginning with Chapter 5, Assessment of Brain Injury, outlines only a few of the standard tests used currently to assess brain injury. The latter tests outlined, the cognitive ability scales, such as the Wechsler and Woodcock-Johnson tests, are deficient when considering narrative discourse. When these tests were first developed, narrative discourse was not a consideration for TBI. Although effective for many TBI determinations, these tests don't include methods to address narrative discourse for identification of high-level language deficits.

Chapters 6 and 7, is a discussion concerning of the complex components of language, leading into a discussion of narrative and conversational discourse analysis that can more sufficiently analyze the language disorders of this group of TBI subjects who don't show any language deficiencies on standard tests, yet clearly do, as can be seen, for example, during normal interactive conversation. This language disorder involves interactions by a number of factors resulting from the TBI, making it difficult to pinpoint, but one which can have profound impact for socialization.

Narrative discourse is still being evaluated in research groups of brain injury survivors, and as of yet, not a standard in evaluative techniques.

CHAPTER 2

BASIC BRAIN STRUCTURE AND UNINJURED BRAIN FUNCTIONS

The brain is comprised of the frontal, parietal, occipital, and temporal lobes, as well as the brainstem and cerebellum. Each of the four lobes exists symmetrically in the left and right hemispheres, and each part of the brain has a specific function. (Brain Injury Law Office).

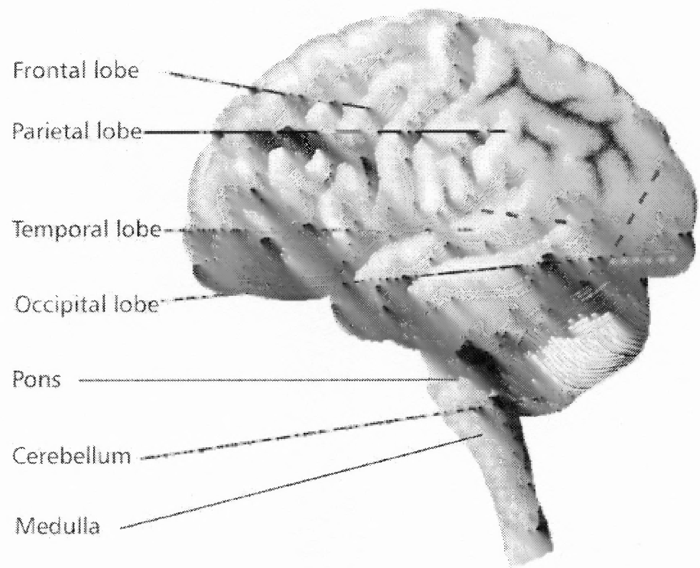

Figure 2.1 Lobes of the brain.
Source: Health Education Assets Library National Digital Library and the Royal College of Surgeons of Ireland Illustrations. 21 Sep 2005 <http://teaching.rcsi.ie/topclass/hEAL_illustrations/images/cns058.jpg>.

The attributes of the left and right hemispheres are described by characteristics of thinking, cognitive style, language, executive capacity, specialized functions, time experience, and spatial orientation.

The left hemisphere is theoretical, analytical, rational, and logical whereas the right hemisphere is intuitive and artistic. Language skills, such as vocabulary, good grammar and syntax, as well as reading, writing, and arithmetic are left hemispheric, whereas imagery and (face) recognition are right hemispheric. The left hemisphere possesses the qualities of initiative, attention to detail, and sense of self, whereas the right hemisphere possesses the qualities to view the "big picture" and the ability for special orientation (Macalester College Department of Psychology).

2.1 Traditional Brain Map

A traditional brain map displays and describes each of the four lobes, each controlling specific functions. In the most basic terms, the frontal lobe, located in the front part of the brain, involves planning, organizing, problem solving, selective attention, personality and higher cognitive functions. The front portion of the frontal lobe (the prefrontal cortex) controls the higher cognitive functions. The posterior (back) of the frontal lobe consists of the premotor and motor areas. The parietal lobe, located behind the frontal lobe at the top of the brain, is the primary sensory region of the brain.

Damage to the right parietal lobe can cause visuo-spatial deficits and create difficulties for a person to find their way around new, or even familiar, places. Damage to the left parietal lobe can cause difficulty in understanding spoken and/or written language. The occipital lobe is located in the back of the brain and processes visual information.

Each temporal lobe is located on each side of the brain. These lobes control the ability to distinguish smells and sounds, helps categorize new information and is involved in short-term memory. The right lobe controls visual memory (pictures and faces), and the left lobe controls verbal memory (words and names).

The brainstem connects to the spinal cord and is responsible for critical functions, such as breathing, digestion, heart rate, and blood pressure. Being connected to the spinal cord, the brainstem houses the fiber tracts passing from peripheral nerves and spinal cord to the other parts of the brain.

The cerebellum is located in the back of the brain and controls balance and muscle coordination. Damage may result in muscle coordination and can create difficulty to a person's ability to perform self-care tasks (Brain Injury Law Office). For a further discussion of injuries related to location of brain injury, refer to Functional Impairments Related to the Location of the TBI, Section 3.5.

2.2 New Model for Brain Functions

While a traditional brain map looks at discrete functions existing in discrete areas of the brain, it is now believed that brain functions are not isolated in discrete areas of the brain. Many functions, including language, emotion, and spatial judgment, are inter-related and share brain systems (Ratey 148).

In general, the front of the brain processes sensory information, while the back of the brain processes motor information. The cerebellum coordinates physical movement as well as movement of thought; thoughts and emotions contribute to motion, giving meaning to movements (Ratey 157). The cerebellum is primarily for balance and coordination (Ratey 162), as well as the integration and the timeliness of processing of information (Ratey 176).

The primary and premotor cortexes are both located in the frontal lobe, where the higher executive functions (thinking and planning) are conducted (Ratey 156). Motor and premotor cortex control specialized movements to the face and limbs (Ratey 163). The sensory cortex contributes input to the motor cortex.

2.3 Brain Functions of Language

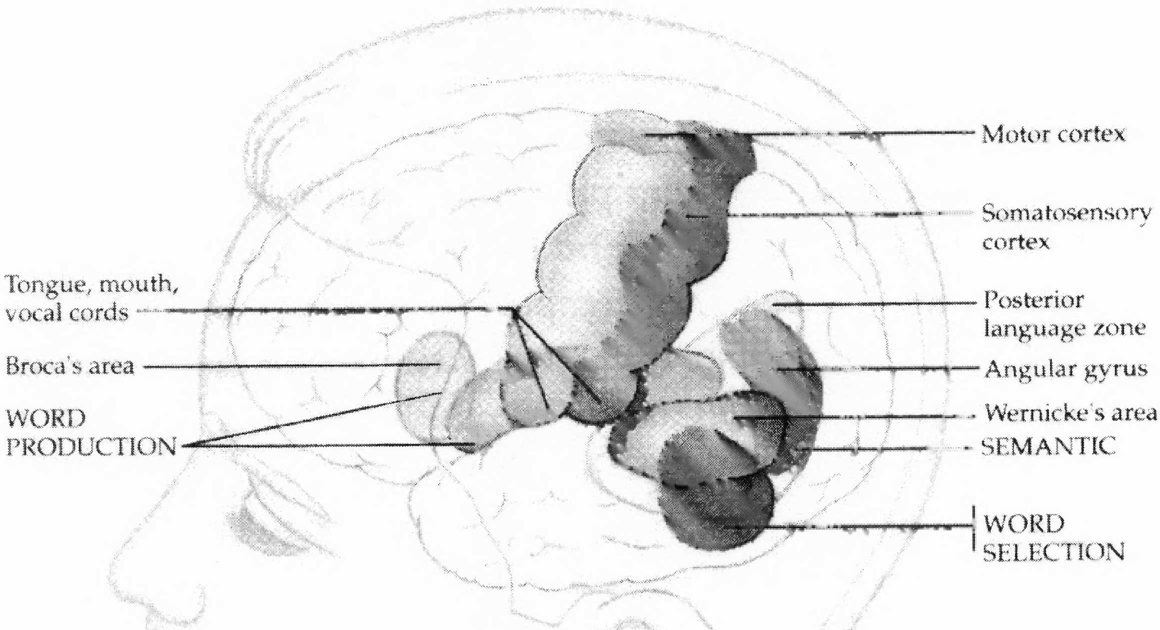

Figure 2.2 Brain map of language functions.
Source: Ratey, John J. A User's Guide to the Brain: Perception, Attention, and the Four Theaters of the Brain. (New York: Vintage, 2002) 268.

Acquired language has traditionally understood to exist in the Sylvian fissure, a long groove in each hemisphere of the cortex, separating the temporal from the frontal and parietal lobes. Various language functions are in various parts of these regions.

The new (and evolving) model indicates that language functions are even more distributed and each area is extremely specialized, and that each of these specialized areas are not exactly the same in each person (Ratey 267) and not even fixed within the same person (Ratey 269). It has been proposed that brain systems for word formation/retrieval, grammar/speech production, and semantics are independent systems. Each of these three processing units is then further subdivided into specialized tasks of language function (Ratey 267-268). Each processing unit can have impairments independent of the other. Rather than language being a step process as previously thought, many of these areas are activated in parallel throughout the cortex (Ratey 269).

In aphasics, for example, verbal information with visuals is understood differently than without visuals (Ratey 270). The deficits associated with language production usually include difficulties in sequencing motor skills, implying that language production and motor skills share neural networks. An example is when a person can't explain verbally how to perform an action that involves a sequence of events, but can perform the action if asked to demonstrate physically. Another example is when a person can physically perform simple/individual functions but will not be able to string the individual actions together to perform a sequenced action (Ratey 272).

Language itself, as far as the brain is concerned, consists of the communicative language system, which includes written and spoken language, and a language of thought. These two areas of language can exist independently of one another (Ratey 285-286). The right hemisphere makes strong contributions in the social aspects of language. It plays an important part of human intelligence and social behavior, including syntax and understanding the emotional aspect of speech. Understanding the emotional aspect of language plays as part in understanding another person's mood in conversation, and is an essential part of the understanding of humor and metaphors (Ratey 322), a very complex part of language and communication, and a strong contributor to socialization.

2.4 Remarks

Functions of the brain are very complex. Although sections of the brain can be segmented and identified by function, no one part of the brain works alone. Many parts of the brain work in concert to establish and utilize the higher functions, including language and communication, which contribute to aspects of socialization.

As brain functions are complex, so too are any injuries to the brain. Injury to any part of the brain, discussed in the next chapter, can cause a variety of injuries. Even similar injury types can cause very different functional injuries, as each person's brain map is not exactly the same.

CHAPTER 3

TRAUMATIC BRAIN INJURY

Traumatic brain injury (TBI) is caused an external physical force, not by a degenerative or congenital disorder and results in an impairment of cognitive abilities. TBI can be caused by any severe blow to the head, such as vehicular and sporting accidents, physical abuse, and handguns (Brain Injury Association of America).

3.1 Skull Condition

The condition of the skull after a head injury is described as *open* or *closed.* An open head injury describes a fracture in the skull. A closed head injury is when the skull does not fracture or displace.

There are, however, additional injuries in a closed head injury that are typically incurred. After closed head injury, the brain will swell, and, having no place to expand, the swelling will cause an increase in intracranial pressure and brain tissues to compress, causing additional brain injury (Brain Injury Association of America). Specific injuries related to the location of the injury on the brain are discussed later in this chapter in Section 3.5, Functional Impairments Related to the Location of the TBI.

3.2 Severity Levels of Brain Injury

The extent of brain injury is characterized as mild, moderate, or severe; however, the severity of the injury is not an indication of how significant the consequences will be or the outcome of recovery. For example, a person may sustain a severe injury, but over time make a significant functional recovery, for example, returning to work. Conversely, a person may sustain a mild injury, but the consequences may prevent significant recovery.

The length and depth of coma (unresponsiveness) are widely accepted indices of severity of injury. Depth of coma is determined by the patient's response to outside stimuli. The scale most accepted to determine the depth of coma is the Glasgow Coma Scale (GCS), which measures three key areas of responsiveness: best eye response, best motor response, and best verbal response (Brain Injury Association of America).

Post-traumatic amnesia has also been used to characterize the severity of a head injury. Post-traumatic amnesia is defined as "the patient's capacity to become sufficiently aware of his surroundings to commit them to memory" (Levin, Benton, and Grossman 73-74). This definition of amnesia groups the periods of time where a patient emerges from coma and the confusional phase of recovery, which is the period of time post-coma, but prior to (continuous) memory restoration of ongoing events.

It is widely accepted that the length of post-traumatic amnesia is an indication of the severity of injury. Studies performed by W.R. Russell and reported in 1971 indicates that patients with post-traumatic amnesia of less than one hour is indicative of mild trauma, whereas post-traumatic amnesia of greater than seven days is indicative of severe trauma (Levin, Benton, and Grossman 78). Levin designed a simple test to determine when a patient was out of post-traumatic amnesia, called the Galveston Orientation and Amnesia Test, discussed in Section 5.1.3.

Mild traumatic brain injury occurs when there is a change in the mental status at the time of injury, and the loss of consciousness is very brief, usually a few seconds or minutes, or does not even occur; the person may be only dazed or confused. The testing or scans of the brain may also appear normal; however, the change in mental status indicates that the person's brain functioning has been altered. A GCS score from 13 to 15 usually characterizes a mild traumatic brain injury. Symptoms can be temporary and the majority of people recover after one year (Brain Injury Association of America).

Moderate traumatic brain injury occurs when a loss of consciousness lasts from a few minutes to a few hours, and confusion lasts from days to weeks. The physical, cognitive, and behavioral impairments can last for months or are permanent. Persons with moderate traumatic brain injury generally can make a good recovery with treatment or successfully learn to compensate for their deficits. A GCS score from 9 to 12 usually characterizes moderate traumatic brain injury (Brain Injury Association of America).

Severe brain injury occurs when a continuous unconscious state lasts days, weeks, or months. Depth and duration of unconsciousness and responsiveness can be described as coma, vegetative state, persistent vegetative state, minimally responsive state, akinetic mutism or Locked-in Syndrome; however, the term "coma" is usually accepted as a general state of unresponsiveness, and will used here for further description. A GCS score at 8 or below characterizes a severe traumatic brain injury (Brain Injury Association of America).

3.3 Functional Impairments Related to the Location of the TBI

Functional impairments can vary, depending on the specific hemisphere and lobe that is injured. General patterns of dysfunction are categorized if an injury is on the right or left side of the brain, or throughout both sides of the brain (diffuse brain injury).

Injuries of the right side of the brain can cause visual-spatial impairment, visual memory deficits, left neglect (inattention to the left side of the body), decreased awareness of deficits, altered creativity and music perception, loss of "the big picture" type of thinking, and a decrease in control over the body movements of the left side.

Injuries on the left side of the brain include difficulties in understanding language (receptive language), difficulties in speaking or verbal output (expressive language), catastrophic reactions (depression, anxiety), verbal memory deficits, impaired logic, sequencing difficulties, and a decrease in control over body movements of the right side.

Diffuse brain injury are injuries that are scattered throughout both sides of the brain. As such, a diffuse brain injury can show characteristics of either a right-side or left-side injury, or both. Diffuse brain injuries can also include reduced cognitive speed, confusion, reduced attention and concentration, fatigue, and impaired cognitive skills in all areas (Brain Injury Association of America).

3.4 Changes Caused by TBI

When a brain injury occurs, the affected nerves have difficulty or are unable to carry messages to and from the brain, which results in cognitive, mental, physical, and persona and behavioral changes. These changes can be temporary or permanent. The cognitive changes that can occur are of particular interest when taking into consideration language.

Cognitive changes that occur can include memory, decision-making, planning, sequencing, judgment, attention, communication, reading and writing skills, thought processing speed, problem solving skills, organization, self-perception and overall perception, thought flexibility, safety awareness, and new learning.

Social outcomes of severe closed head injury frequently includes a reduction in social contact, withdrawing to activities promoting isolation, a decline in the number of close friends, and a decrease in social outings, which would otherwise promote socialization (Levin, Benton, and Grossman 71).

3.5 Remarks

This chapter gives a basic outline of traumatic brain injuries with changes that can occur in cognitive, mental, physical, and behavioral functions. Although this chapter only scratches the surface, it is clear that the variety and complexity of injuries, along with increases in severity creating greater cognitive issues, all of which add to difficulties in communication and language. Closed traumatic brain injured individuals, particularly those whose injuries are severe, encounter a greater level of language disorders due to the nature of a closed injury where many functional areas within the brain have been affected and successful use of language involves the coordination between many functional areas within the brain. This is one key element of why the study population used in the research studies presented later in Chapter 7 are used.

The next chapters look current rehabilitation programs with the Traumatic Brain Injury Model Systems and current assessments and tests for brain injury, from the point of the initial injury throughout rehabilitation to determine levels of improvement in all cognitive aspects. Current tests for executive function, intelligence, memory, and cognitive abilities are extensively outlined. This is to show that despite the variety of tests that are available, current testing focuses on very specific individual brain functions, but no existing tests addresses discourse for high-level functioning TBI individuals. This group has sufficiently mastered the basics of language and therefore shows no functional disabilities on these tests. However, this group does have difficulty with the complex functional tasks necessary for conversational and narrative discourse, which involve interactions of a number of brain functions. This difficulty in conversational discourse, for example, can have significant social consequences for these individuals.

CHAPTER 4

REHABILITATION

Rehabilitation channels the body's natural healing abilities and the brain's relearning process, so than an individual recovers as quickly and efficiently as possible. Rehabilitation also involves learning new ways to compensate for abilities that have permanently changed due to brain injury. There is much that is still unknown about the brain and brain injury rehabilitation. Treatment methods and technology are rapidly advancing as knowledge of the brain and brain functions increases. The goal of rehabilitation is to help people regain the most independent level of functioning possible.

Just as each brain injury is unique, so too is each person's rehabilitation process also unique. Rehabilitation programs are individualized for each person's unique needs. Beyond the professional treatment team, the person with a brain injury and his or her family should always be the most important members of the treatment team. Other considerations when planning a person's rehabilitation program should include cultural, religious, social and economic backgrounds.

4.1 Traumatic Brain Injury Model Systems

The Traumatic Brain Injury Model System (TBIMS) program was created and funded by the National Institute on Disability and Rehabilitation Research (NIDRR) in 1987 to demonstrate the benefits of a coordinated system of neurotrauma and rehabilitation care and conduct innovative research on all aspects of care for those who sustain traumatic brain injuries. The Centers are currently located at 16 sites throughout the United States that provide comprehensive systems of brain injury care to individuals who sustain a traumatic brain injury, from acute care through community re-entry. The mission of the TBIMS is to improve the lives of persons who experience traumatic brain injury, their families and communities by creating and disseminating new knowledge about the course, treatment and outcomes relating to their condition (Traumatic Brain Injury National Data Center).

4.2 JFK Johnson Rehabilitation Institute Traumatic Brain Injury Model System

Of the 16 TBI Model Systems in the United States, New Jersey is very fortunate to have one of them - the JFK-Johnson Rehabilitation Institute Traumatic Brain Injury Model System in Edison, with the Center for Head Injuries, consisting of the Brain Trauma Unit (BTU), the Cognitive Rehabilitation Department, and the Extended Recovery Unit (ERU). The JFK Johnson Rehabilitation Institute exemplifies a Model System for brain injury recovery and is outlined to show the current model for brain trauma rehabilitation. Narrative discourse, however, is not used as a typical analysis technique here, or at any other model system.

The Center for Head Injuries provides continuous care throughout all phases of recovery, which includes acute rehabilitation with the BTU and extended rehabilitation with the ERU, a transitional living program and an outpatient cognitive rehabilitation program.

The BTU provides an interdisciplinary rehabilitation to brain-injured adults and represents the first phase of brain injury rehabilitation after physical stabilization has been achieved. This first phase is geared toward the evaluation and improvement of mobility, daily living activities, communication and cognitive skills. Therapy programs include physical therapy, occupational therapy, speech therapy and neuropsychology, as well as social workers that will meet with the patient and family. Recreation therapy activities are included when appropriate.

Therapy programs are developed based on comprehensive evaluation by an interdisciplinary team. The developed therapy program provides a structured, therapeutic environment in combination with individual treatment plans to address awareness, behavior and safety.

An important aspect of recovery is the understanding of the process. To this end, education, training, and support are provided for the patient and family.

The Cognitive Rehabilitation Department consists of a Comprehensive Neurorehabilitation Program and an Intensive Cognitive Rehabilitation/Transitional Living Program. The Intensive Cognitive Rehabilitation Program is for patients who have made good physical recovery, but require a highly integrated program of neurorehabilitation. This program addresses the development of compensations for acquired cognitive deficits, psychosocial adjustment and life satisfaction and return to productive functioning.

Neuropsychology services provides treatment primarily to patients who have achieved some degree of independent community functioning, such as returning to work or school, but still require specialized rehabilitation services. The primary services include cognitive remediation, psychotherapy and vocational counseling, as well as speech, occupational, and physical therapy.

The Cognitive Rehabilitation Department offers programs in comprehensive neurorehabilitation and an intensive cognitive rehabilitation program. The comprehensive neurorehabilitation program includes speech and language, occupational, and physical therapy, neuropsychology, and cognitive educational/vocational therapy. The cognitive rehabilitation program establishes an appropriate life objective or social role within the family and community and a level of meaningful, productive activity, as well as to help the patient achieve a level of awareness of limitations, strengths and needs so that the person is destination ready, having acquired the self knowledge and awareness of functional compensations for deficits that will enable them to function successfully within an appropriate community setting.

The ERU provides extended inpatient treatment to those who have ongoing issues related to their brain injury. A few of the services provided include cognitive therapy, neuropsychological services, patient and family training, education and counseling services, physical and occupational therapy, and speech and language therapy (JFK Johnson Rehabilitation Institute).

CHAPTER 5

ASSESSMENT OF BRAIN INJURY

By using the combination of results from neurological assessments, clinical examination, imaging scans, and lab work, diagnosis for TBI can be made. Along with injury occurring to the brain at the time of the accident, further injury to the brain can also occur as the brain swells immediately following the initial injury, due to intracranial pressure causing the compression of brain tissues, in the case of a closed head injury. Because the condition of the brain and body changes throughout the recovery process, it is important for the health team to constantly monitor for any abnormalities and to provide treatment as soon as possible. Some tests and blood work may be to assess life-threatening conditions, while other assessments are used to monitor a person's recovery progress. Every brain injury is unique when considering proper rehabilitation; therefore, test selection is made on an individual basis.

Indications that are tested to assist assessment and monitoring a patient's condition include intracranial pressure, arterial blood gas, which measures the levels of oxygen and carbon dioxide in the blood, which determine breathing efficiency, measurement of electrolytes (sodium, potassium, chloride, bicarbonate, urea nitrogen, and creatinine) necessary for bodily functions, and angiogram, which can show the integrity of the arteries and veins in the head and neck (Brain Injury Association of America). Imaging scans include Computed Tomography (CT or CAT) Scan and Magnetic Resonance Imaging (MRI) to provide detailed brain structure information, Event Related Potential (ERP) determination and Electroencephalography (EEG) examine electrical brain functions, and Regional Cerebral Blood Flow (RCBF), Positron

Emission Tomography (PET) Scan, and Single Photon Emitting Computerized Tomography (SPECT) Scan, which are radioisotope-imaging techniques that show blood flow, metabolism, and chemistry, with better spatial resolution than electrical brain function determinations (EEG and ERP), with PET and SPECT specifically determining subcortical activity (Gordon 63-70). Along with determination scales, a few of which are listed below, a patient's injury can be fully assessed.

There are a large number of determination scales and assessment tests that are utilized in various areas, including, but not exclusively, initial determination of brain injury severity, amnesia, memory assessment, intelligence and higher cognitive (executive) function determination, academic achievement, language and communication tests.

5.1 Early Determinations for Brain Injury Severity and Orientation

5.1.1 Glasgow Coma Scale (GCS)

The Glasgow Coma Scale is most commonly used to indicate the severity of a brain injury. The Glasgow Coma Score tests three response categories, eye response, verbal response, and motor response. Each response category is scaled, and the best patient response for each category is assigned a number. The total of the three response parameters is the Glasgow Coma Score. GCS is scored between 3 (the worst) and 15 (the best) (British Trauma Society).

The response categories and the best patient response parameters for each category are listed in Table 5.1 below.

Table 5.1 Glasgow Coma Scale Response Categories

Best Eye Response	Best Verbal Response	Best Motor Response
1. No eye opening	1. No verbal response	1. No motor response
2. Eye opening to applied pain stimuli	2. Incomprehensible sounds	2. Extension to pain
3. Eye opening to verbal command	3. Inappropriate words	3. Flexion to pain
4. Eyes open spontaneously	4. Confused	4. Withdrawal from pain
	5. Orientated	5. Localizing pain
		6. Obeys commands

Source: British Trauma Society. Glasgow Coma Score. 02 Jul 2003 <http://www.trauma.org/scores/gcs.html>.

When assessing a patient's response condition, it is more meaningful to break the number down into its response categories, instead of stating a total number. For example, it is more meaningful to understand a patient's condition by reporting E3V3M5 = GCS 11 instead of GCS of 11. This example of E3V3M5 represents a patient's best eye response as eye opening to verbal command (eye response 3), the best verbal response as inappropriate words (verbal response 3), and the best motor response as localizing pain (motor response 5). However, it is accepted to report a composite score. As discussed in more detail earlier (Severity Levels of Brain Injury, Section 3.3), a score of 13 or higher indicates a mild brain injury, a score of 9 to 12 indicates a moderate injury and a score of 8 or less indicates a severe brain injury (British Trauma Society; Brain Injury Association of America).

The composite score of the GCS taken at the initial onset of the TBI (within the first 24 hours) and rate of change in the score over time can be indicative of outcome. For more details, refer to Early Indications of Outcome, Section 5.1.

5.1.2 Rancho Los Amigos Scale (RLAS)

The Rancho Los Amigos Scale is used to determine a level of cognitive functioning and is based only on the observation of the patient as the patient responds to environmental stimuli. The Rancho Los Amigos Scale was designed to measure and track an individual's progress early in the recovery period. The original scale, developed in 1972 and outlined below, in Table 5.2, details Levels I-VIII of response. The descriptions of patient response levels are abbreviated in detail compared to the actual scale.

Table 5.2 Ranch Los Amigos Scale Patient Response Levels

Level:	**Patient Response Description:**
I	**No Response:** completely unresponsive to any stimuli.
II	**Generalized Response:** Reacts inconsistently and nonpurposefully to stimuli in a non-specific manner, including gross body movements, and/or vocalization. Often, the earliest response is to deep pain.
III	**Localized Response:** Reacts specifically, but inconsistently, to stimuli. He/she may follow simple commands in an inconsistent, delayed manner such as closing his/her eyes, squeezing or extending an extremity.
IV	**Confused/Agitated:** Heightened state of activity with severely decreased ability to process information. Behavior is frequently bizarre and non-purposeful relative to his immediate environment. Verbalization is frequently incoherent and/or inappropriate to the environment. He/she is unable to perform self care (feeding, dressing) without maximum assistance.
V	**Confused, Inappropriate Non-Agitated:** Appears alert and is able to respond to simple commands fairly consistently; however, with increased complexity of commands or lack of any external structure, responses are non-purposeful, random, or, at best, fragmented toward any desired goal. He/she may show agitated behavior, as a result of external stimuli, and usually out of proportion to the stimulus.
VI	**Confused, Appropriate:** Shows goal-directed behavior, but is dependent on external input for direction. Responses may be incorrect due to memory problem, but they are appropriate to the situation.
VII	**Automatic, Appropriate:** Appears appropriate and oriented within hospital and home settings, goes through daily routine automatically, frequently robot-like, with minimal-to-absent confusion, but has shallow recall of what he has been doing. He/she shows increased awareness of self, and interaction in the environment. He/she has superficial awareness of his condition, decreased judgment and problem-solving and lacks realistic planning for his future.
VIII	**Purposeful, Appropriate:** Alert and oriented, is able to recall and integrate past and recent events, and is aware of, and responsive to, his/her culture. He/she may continue to show a decreased ability, in abstract reasoning, tolerance for stress, judgment in emergencies or unusual circumstances. His/her social, emotional, and intellectual capacities may continue to be at a normally decreased level, but functional in society.

Source: Centre for Neuroskills, Traumatic Brain Injury Resource Guide. Rancho Los Amigos (Original and Revised). 28 Nov 2003 <http://www.neuroskills.com>.

The revised scale, developed in 1974, provides greater detail of the levels, including needed assistance levels. The revised version also expands the last original level of Purposeful, Appropriate (Level VIII) to three levels (Levels VIII to X) which detail specific levels of independence/assistance, including tolerability/reaction levels. However, the original scale is still used in many facilities (Centre for Neuroskills Traumatic Brain Injury Resource Guide).

5.1.3 Galveston Orientation and Amnesia Test (GOAT)

The GOAT is a test to measure amnesia and disorientation of the individual post-injury and to determine the end of the post-traumatic amnesia period (Levin, Benton, and Grossman 92). Previously, the post-traumatic amnesia period was determined through retrospective interview of the patient (Levin, Benton, and Grossman 75). The GOAT consists of 10 questions that test the individual for basic biographic data (name, address, birthdate), geographic orientation (current location), times (date of hospital admittance, current time, day, month, year) and events before and after the injury (Levin, Benton, and Grossman 92). It is recommended to administer the test once a day; a graph of serial GOAT scores presents an unambiguous record of orientation and recovery. A score of consistently above 75 indicates that the patient is out of post-traumatic amnesia (PTA) (Levin, Benton, and Grossman 95). Results indicating post-traumatic amnesia greater than two weeks are consistent with scans indicating diffuse close head injury (Levin, Benton, and Grossman 96).

5.1.4 Early Indications of Outcome

It is very difficult to determine a patient's outcome after severe head injury, but there are several factors that provide some insight to allow for reasonable conjecture to the level of recovery. As with any serious injury, the age of the individual is an important factor to the outcome of the injury. Mortality increases exponentially as the age of the individual at the time of the injury increases. Another important indication of the patient's recovery from a severe closed head injury is the changes in the summed score of the Glasgow Coma Score over time from the initial injury (24 hours). During the first week of recovery, among the three indices of the Glasgow Coma Score (eye, verbal, and motor responses), changes in the motor response is the strongest indication of recovery.

Raised intracranial pressure (> 20 mm Hg) can also be a strong early indication of outcome. Individuals that had raised intracranial pressure that could not be controlled had a high morality rate. Even those individuals with raised intracranial pressure that could be controlled had a lower quality of survival (Levin, Benton, and Grossman 40).

5.2 Executive Function Determination

Higher-level cognitive functions, such as planning, cognitive flexibility (spontaneous and reactive), decision making, and judgment (including unfamiliar situations) are called executive functions; cognitive operations, such as working memory play a significant part. Cognitive flexibility allows a person to consider situations, for example, from various view points. Spontaneous and reactive flexibility requires generation of responses and the ability to change a predisposed reaction to consider new possibilities (Spreen and Strauss 171).

There are a variety of tests for executive function, each activating different cognitive abilities. The Wisconsin Card Sorting Test is a test of higher cognitive (executive) functions, which includes planning and organization, reasoning and abstraction, and self regulation (Hebben and Milberg 107).

The test was originally developed in 1948 by E. Berg and D. Grant. This test assesses the ability of the patient to form abstract concepts, the ability to shift cognitive strategies as a response from one set of parameters to a new set of parameters. This test is a measure of executive function because it requires strategic planning, the development of problem-solving behavior, and the ability to provide feedback to a shifting set of parameters, develop goal-orientated behavior, and modulate responses. The most recent version of the WCST was published in 1993.

The test consists of four stimulus cards, each with a different pattern: one red triangle, two green stars, three yellow crosses, and four blue circles. The patient is given two packs of cards (64 cards per pack, 128 cards total); the response cards have similar designs as the stimulus cards, with variations in color, shape, and number. The subject is told to first sort the response cards by color. After 10 correct responses, sorting principle shifts, and the subject is then told, without prior warning, sort by shape. After 10 correct responses, the sorting principle again shifts without prior warning to number. After 10 correct responses, the sorting series (color, shape, and number) repeats. The test is complete when the sorting series has been completed twice (for a total of 6 category shifts) or the patient has exhausted all 128 cards.

An abbreviated version (WCST-64) utilizes only one deck of response cards instead of two, cutting the administration of the test by half. The WCST-64 retains all the features of the standard WCST and is considered to be comparable. There is also a computerized version available. Scoring for all test versions is equivalent, but each version uses its own normative data (Spreen and Strauss 219-221).

Factor analysis of the WCST consists of three factors. Factor I reflects executive and memory function and problem-solving ability, called concept formation/perseveration. This reflects two aspects of executive function: the ability to recognize the possible sorting concepts (percent conceptual level responses, categories completed, total correct responses); and the inability to shift from an incorrect response set (perseverative errors, perseverative responses, total errors). Factor II is comprised of scores that seem to measure the ability quickly and efficiently test hypotheses and discover the correct dimension; and maintain correct responding, represented by the score of nonperseverative errors. Factor III consists primarily of Failure to Maintain Set (Greve, Ingram, and Bianchini 598).

If a subject scores high in Factor I, it would be indicative that the subject is unable to shift to a correct sorting principle and thus produces a high number of perseverative responses and completes few categories. If a subject scores high in Factor II, it would be indicative that the subject is inefficient or unsuccessful in problem solving, while attempting to test different hypotheses, meaning the subject would not be responding inflexibly and the subject would be constantly shifting response set while generating large numbers of nonperseverative errors. If a subject scores high in Factor III, it would be indicative that the subject has discovered the correct sorting principle but has difficulty producing a completed run of ten consecutive correct responses (Greve, Ingram, and Bianchini 607-608).

5.3 Achievement, Intelligence, Memory, and Cognitive Ability Scales

General achievement tests are assessments of achievement, such as reading and math and can determine the presence and pattern of learning disabilities, along with a person's academic strengths and weaknesses (Hebben and Milberg 115). Cognitive ability tests determine ability in retrieval, processing, reasoning, and memory (Fairleigh Dickinson University). Although the entire test is complex and can show many aspects of cognitive ability, there is no part of the test that includes narrative discourse. High-language level functioning adults that have sustained a TBI can do extremely well on tests such as these and these test results can end up showing no language deficits, even if one may exist. Three test groups most commonly used are outlined here. These tests are the Wide-Range Achievement Test (WRAT), the Wechsler Scales (Intelligence and Memory Scales), and the Woodcock-Johnson (WJ) Tests.

5.3.1 Wide-Range Achievement Test (WRAT)

The Wide-Range Achievement Test (WRAT) is a general achievement test in the areas of reading, decoding, spelling and arithmetic (Hebben and Milberg 117). The WRAT is the most frequently used test of academic achievement, originally published in 1936, and has since been revised numerous times. The latest revision is the WRAT3, published in 1993. The test measures reading, specifically word recognition and pronunciation, spelling and arithmetic. Spelling includes copying marks, writing one's name, and writing single words from dictation. Arithmetic includes counting, reading number symbols, and performing written computations. There are two alternate test forms that cover the three categories. The clinician can administer either test form, or both tests on a combined form.

This test provides a quick and general assessment of a patient's disabilities. It does not provide specific determination of a patient's difficulties in the test areas of reading arithmetic and spelling. For example, reading comprehension is not assessed, only letter and word recognition (Spreen and Strauss 164-165).

5.3.2 Wechsler Adult Intelligence Scale (WAIS) and Memory Scale (WMS)

Wechsler Adult Intelligence Scale (WAIS) is designed as a general neuropsychological test of intelligence and higher cognitive functions for adults ($\geq$16 years), and involves a process-orientated approach to neuropsychological analysis. David Wechsler originally developed the test in 1955. The WAIS scores Verbal IQ, Performance IQ, and Full Scale IQ and is a general test of cognitive ability, defined by Wechsler as, "... the global capacity of the individual to act purposefully, to think rationally, and to deal effectively with his environment" (NOVA Southeastern University Center for Psychological Studies). The WAIS consists of 14 subtests divided into two parts, verbal and performance. The complete intelligence scale will only be discussed briefly.

The WAIS is one of the most frequently used measures in neuropsychological batteries providing information regarding the overall level of intellectual functioning. It also provides information of a person's strengths and weaknesses and the presence or absence of significant intellectual disabilities. The most current version is the WAIS-III, published in 1997 (Spreen and Strauss 90). The WAIS-III is co-normed with the Wechsler Memory Scale (WMS-III), discussed in the next section, to allow for assessment of a patient's intelligence quotient (IQ) and memory quotient (MQ) (Spreen and Strauss 92).

The WAIS-III consists of 14 subtests in two categories, seven subtests each in Verbal and Performance categories, listed below. The subtests by category are outlined below in Table 5.3.

Table 5.3 WAIS-III Verbal and Performance Subtests

Verbal	**Performance**
Information (general, factual, academic, and cultural)	Picture Completion (identification of a missing piece of a story)
Digit Span (number sequences, forward and backward)	Picture Arrangement (order pictures in a story to create a cohesive story)
Vocabulary (definitions)	Digit Symbol – Coding
Arithmetic	Block Design (duplicate block pattern to a given pattern)
Comprehension (social knowledge, practical reasoning, and the meaning of proverbs)	Matrix Reasoning (match geometric shapes)
Similarities	Symbol Search
Letter-Number Sequencing	Object Assembly

Sources: Niolon, Richard. Psychpage.com Resources. Introduction to the WAIS-III. 17 Feb 2004 < http://www.psychpage.com/learning/library/intell/waistest.html>.
Lemoyne University Psychological Dept. PSY 448: Clinical Neuropsychology WAIS-III Wechsler Adult Intelligence Scale (Third edition) Handout. 17 Feb 2004 <http://web.lemoyne.edu/~hevern/psy448/448documents/wais_iii.html>.

From the combination of verbal and performance subtests, four factor-based index scores can be calculated, and the combination of index scores provides IQ scores, verbal, performance, and full scale, as shown below in Figure 5.1.

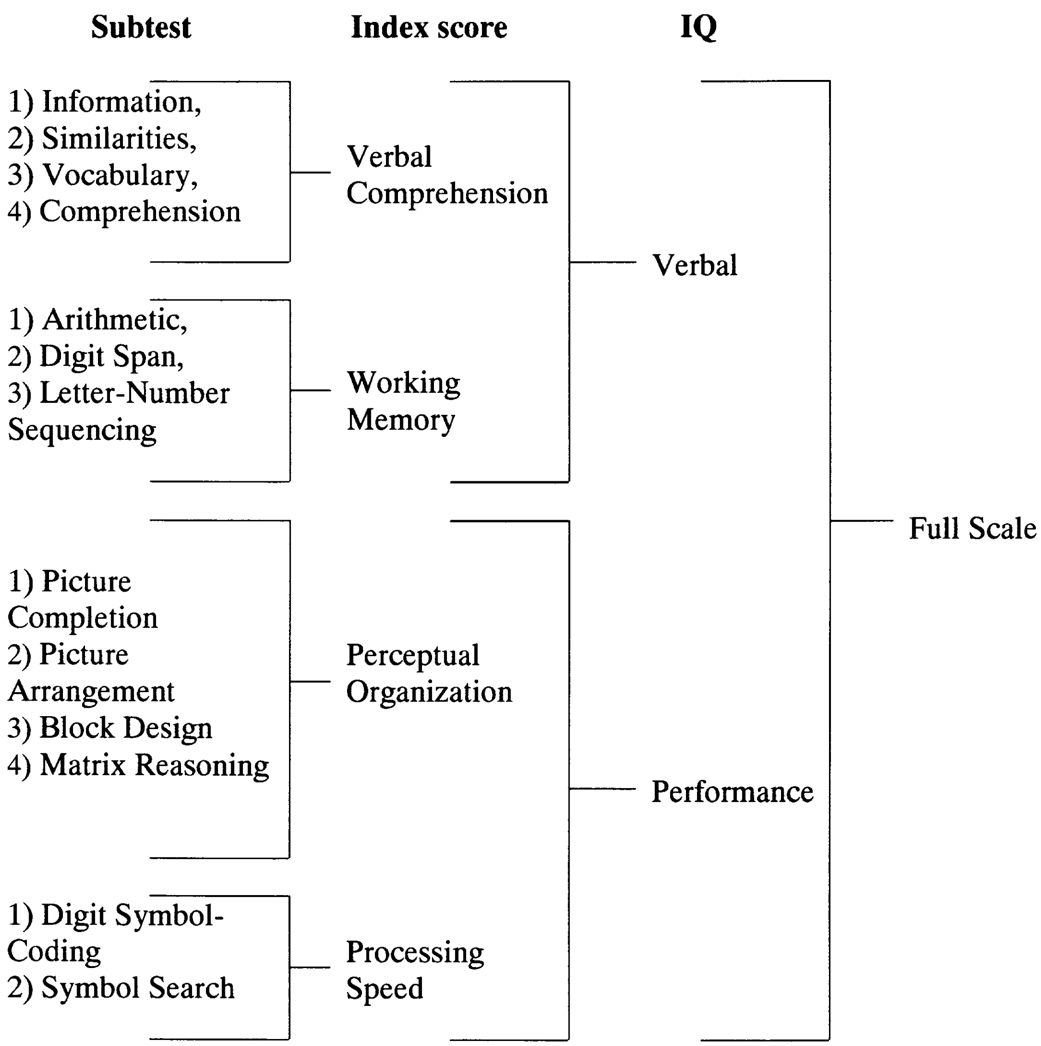

Figure 5.1 Contribution of verbal and performance subtests in the WAIS-III to index score and IQ determinations.
Source: Harcourt Assessment Inc. 04 Jul 2004.
<http://harcourtassessment.com/hai/Images/resource/library/ppt/waispres.ppt>. Adapted from Slide 8.

The Verbal subtests (and IQ scores) are more predictive of scholastic achievement and basic language skills than the Performance IQ scores. The Full Scale IQ score is more reflective of overall performance in daily living activities.

Verbal Comprehension factor measures verbal knowledge and comprehension, in part from formal education. It reflects the application of verbal skills to unique situations. Perceptual Organization factor measures perceptual and organizational factors and reflects the ability to interpret and organize visual information (Spreen and Strauss 98).

The Wechsler Memory Scale (WMS) was originally published in 1945. There has been a major revision (WMS-R), which was published in 1987, and the current revision (WMS-III) has been published in 1997. The WMS-III is a widely used and accepted test of attention and memory skills (Spreen and Strauss 373, 401).

The WMS-III can be categorized into three memory testing groups: verbal, nonverbal, and mental control tasks. Both the verbal and nonverbal portions of the test, for each given subtest category, consist of immediate and delayed recall testing. The immediate testing consists of the subject responding immediately after the task is presented, and the delayed recall testing consists of a 30-minute delay, between the time the task is presented and the subject is questioned for a response. The test also consists of a recognition task where the subject is asked to identify items as being part of the original test. For the mental control subtests, the subject completes sequences, such as the alphabet, numbers, or combination of numbers and letters. The tests, by group, are shown below in Table 5.4.

Table 5.4 WMS Subtest Categories and Category Tests

Verbal Subtests	Non-Verbal Subtests	Mental Control Subtests
Stories	Faces	Mental Control
Word Pairs	Family Pictures	Digit Span
Word List	Drawings	Spatial Span
		Letter-Number Sequencing

Source: Coastline Community College. Cognitive Retraining: Attention/Concentration & Memory, WMS-III. 18 Feb 2004 <http://vcs2.ccc.cccd.edu/crs111/wms.htm>.

There is current research for co-norming of WAIS and WMS. Unlike the four-factor model in the WAIS-III, which provided a better description of intelligence than previous versions, administration of both Wechsler Tests (Adult Intelligence and Memory) allows a more complete description of cognitive abilities. A six-factor determination can be made, including, verbal comprehension, perceptual organization, auditory, visual, and working memory, and processing speed (Tulsky and Price 149).

5.3.3 Woodcock-Johnson Tests of Achievement (WJ-ACH) and Cognitive Abilities (WJ-COG)

The Woodcock-Johnson Achievement Test is a wide-range screening test that measures achievement in reading, math, written language and general knowledge in science social studies, and humanities. The WJ-III ACH is subdivided into two test batteries, the Standard Battery, and the Extended Battery. The Standard Battery consists of 12 subtests, and the Extended Battery consists of ten tests, which provide a more comprehensive assessment in reading, math, and written language.

Table 5.5 Subtests of WJ-ACH Standard and Extended Batteries

Standard Battery Subtests	**Extended Battery Subtests**
Letter-Word Identification	Word Attack (use of phonetic and structural analysis skills)
Passage Comprehension (word completion)	Reading Vocabulary (Synonyms and Antonyms)
Reading Fluency	Picture Vocabulary
Math Fluency	Oral Comprehension
Calculation	Quantitative Concepts
Applied Problems	Spelling of Sounds
Spelling	Editing
Writing Fluency	Punctuation and Capitalization
Writing Samples	Sound Awareness
Story Recall (immediate and delayed)	Academic Knowledge
Understanding Directions	

Source: Fairleigh Dickinson University/Dumont/Willis. Woodcock-Johnson Tests of Achievement (WJ III). 17 Feb 2004 <http://alpha.fdu.edu/psychology/woodcock_ach_descrip.htm>.

Cluster scores are also used to generate more comprehensive information in a general subject area based on a particular combination of subtests. Across six general cluster groups, there are ten cluster scores derived from the Standard Battery, and eight cluster scores derived from either the Extended Battery subtests, or the combination of subtests from both the Standard and Extended Batteries. Cluster scores are in reading, oral language, math, written language, and two areas of academic knowledge and skills. (Riverside Publishing)

The Woodcock-Johnson Test of Achievement battery is co-normed with the Woodcock-Johnson Test of Cognitive Abilities, which consists of 20 tests (14 core and six supplemental) across seven broad cognitive factors. Cognitive factors are in areas of Comprehension-Knowledge, Long Term Retrieval, Visual Processing, Auditory Processing, Fluid Reasoning, Processing Speed, and Short-Term Memory (Fairleigh Dickinson University).

5.4 Remarks

The tests described in this chapter are just a sampling of the tests are available, but presents a picture of the lack of testing that would adequately test complex communicative skills, particularly, conversation and narrative skills. The tests that would be most adequate to this incorporation of narrative discourse are the Achievement, Intelligence, and Cognitive Ability Scales (Section 5.3). The cognitive ability scales do incorporate some verbal subtests with stories, but at best requires the CHI individual to recall stories told to them or to provide simple yes/no responses to questions based on the stories. Otherwise, the language skills tested mostly involve singular components of language, such as word lists. The WJ-III Achievement Test Standard Battery does have the subtests Writing Fluency and Writing Samples, although these have limited narrative aspects. Writing Fluency does use a stimulus picture, similar to Story Generation, which is a story elicitation procedure used in narrative discourse analysis, discussed in Chapter 7; however, the subject is only required to write simple sentences based on this stimulus picture and is given three words to incorporate, instead of developing complete narratives based on the stimulus picture. The Writing Samples test only requires written responses to given questions. None of these tests involve story creation or conversational skills, with which many higher-level functioning TBI individuals have difficulty and would be necessary for social interactions.

The following chapter, Chapter 6, begins the discussion about discourse, first to understand the components of cohesive discourse and the subtleties of normal dialogue, which is then followed by how a person's ability for dialogue is affected by the brain injury and the effect of executive functioning on communication. Executive functioning deficits, significantly affected by brain injury, play an important role on communicative abilities as language deficits in TBI individuals are due to impairments of the cognitive processing that support language.

Understanding these basic concepts regarding the components of cohesive discourse and dialogue is important for the following discussion of conversational and narrative discourse research, which includes many of these ideas. The initial discussion, Cohesion in Text (Section 6.1), forms the theoretical basis of much of the research and analysis methods discussed later in narrative and conversational discourse.

CHAPTER 6

FROM SINGULAR WORDS TO DISCOURSE

6.1 Cohesion in Text

Once English extends past a single sentence, it is important that text integrates to become a unified whole and not just a collection of unrelated sentences. By definition, text is a linguistic term that refers to any passage, of any length, written or spoken, that form a unified whole. There are properties of text that allow a collection of unrelated sentences to become a cohesive, unified whole (Halliday and Hasan 1). These linguistic features can be identified to contribute to the unity and texture of a text (Halliday and Hasan 2). An important part of texture is the cohesive relationship between words. Cohesion occurs when one word or phrase (an element) is dependant on another to give its meaning. This single pair of related words is called a tie (Halliday and Hasan 3). Various forms of ties are reference, substitution, ellipses, conjunction, and lexical cohesion. Text can be analyzed from these ties, which can be used to explain the differences between texts (Halliday and Hasan 4).

Cohesion is a semantic concept that refers to the relationships of meanings within a text, thus defining the text. Cohesion is expressed through a sequential hierarchy of language or levels of coding. The hierarchy of coding begins with meaning (semantic), which leads to the lexicogrammatical (wording – grammar and vocabulary), which lead to the phonological and orthographic systems (speech sounds of language and system of spelling/writing) of language. The types of cohesion (or ties, outlined above) can be defined as grammatical cohesion and lexical cohesion. Ties that categorized as reference, substitution, or ellipses are categorized as grammatical cohesion, lexical at the other end of the cohesion spectrum, and conjunction in the middle (Halliday and Hasan 6). Therefore, cohesion is not discourse. Although a semantic concept, discourse is a structural unit, the structure of an episode, or topic. Cohesion is the relationship within discourse, linking the structure within the discourse (Halliday and Hasan 10).

The first tie form, the reference tie, is a pair of items that share a semantic relationship. These can be of various grammatical functions (noun, determiner, adjective, adverb) where one is defined by the other. References can take several forms as well, including personal, demonstrative, and comparative (Halliday and Hasan 31). Personal reference is as it seems, a reference to a specific person stated earlier (eg, *he*, *she*, or *they*). A demonstrative reference is a reference of proximity or location (eg, *here* or *there*). A comparative reference is one of comparison by either contrast or similarity (eg, *another*, *additional*, *other*, or *different*) (Halliday and Hasan 37-39).

Another type of tie form is substitution and ellipses. Substitution is the direct replacement of one item for another. Substitution is a similar tie to reference. The difference being that reference is a relationship between meanings (semantic), whereas substitution is a relationship between linguistics (lexicogrammatical) (Halliday 89). Ellipses are similar to substitution in that an ellipse is a lexicogrammatical relationship that is substitution by zero, meaning something left unsaid, or something understood (Halliday and Hasan 142).

A conjunction is a cohesive tie that relates the sequence of events or conditions, either before or after, for example, the succession of time, (eg, *before*, *after*, or *followed by*) (Halliday and Hasan 227). Several forms of conjunction as cohesive ties exist, including additive (eg, *and*) (Halliday and Hasan 244), adversative (eg, *but*), and casual (*therefore* or *consequently*), which works in combination with additive or adversative conjunctions denoting a result or reason (Halliday and Hasan 256), or temporal (eg, *then* or *next*) denoting a specific sequence of events (Halliday and Hasan 261).

The last type of cohesion is lexical, which differs from reference, substitution, ellipses, and conjunction. The aforementioned are grammatical cohesive ties. Lexical cohesion refers to the cohesion obtained by the selection of vocabulary (Halliday and Hasan 274). Lexical cohesive ties can be reiterative, (Halliday and Hasan 279) or collocational (Halliday and Hasan 284). Reiterative lexical cohesive ties can be repetition, a synonym, a superordinate, a general noun, or a personal reference. A superordinate and a general noun are similar; both are nouns of general reference (grouping); the subtle difference between the two lies in the level of generality (Halliday and Hasan 278). Collocational lexical ties are a pair of items that exist through regular association, including not only synonyms and superordinates, but also pairs of opposites, including complementaries, and antonyms, or pairs of words from an ordered series (eg, days of the week) (Halliday and Hasan 285).

This analysis of cohesive ties is quite brief; a much greater breakdown of each category exists and in much greater detail. Even between cohesive ties, there is overlap and others show extremely subtle differences. This differentiation is discussed in detail by Halliday and Hasan.

Many cohesive ties exist in narratives, and looking at this view of cohesive components forms the basis of using this breakdown of narrative to detect the subtle communicative deficits that exist in people that have sustained a TBI.

6.2 Communication and Dialogue

Human communication, regardless of the method (written, oral, etc) requires a certain competence, of all parties. This competence of communication occurring between normal (uninjured) individuals requires to be explained, at least theoretically, before one can understand the breakdown in communication that occurs with brain-injured individuals. This "competence theory of human intentional communication" (Bara, Tirassa, and Zettin 8) is outlined using oral communication, and is compared to individuals specifically of a closed head injury. This group is unique in that there can be subtle communication difficulties, even after other cognitive issues have been resolved.

Dialogue, from the aspect of the communication receiver, involves five logical phases of thought. These are: 1) Understanding of the literal meaning of what was communicated, 2) understanding of the (communication generator's) meaning of the communication, 3) understanding the communicative intention, 4) the reaction, and 5) the response generation.

After an initial communication, the receiver defines the literal meaning of the speaker, then proceeds to understand the originator's meaning. This incorporates shared beliefs or mutual knowledge between the parties involved, which is a crucial component to help a receiver define subtle inferences that are implied. Shared beliefs can range from mutual knowledge between two people or a group of people to communal social conventions. The communicative effect is the impact on the receiver's mental states (beliefs) based on the communicative intention of the originator. The reaction phase is a preparatory phase for the last phase of response generation, where the intentions of the response are decided. This leads to response generation, where the response it actually uttered (Bara, Tirassa, and Zettin 16-18).

6.2.1 Effects to Dialogue from Head Injury

Injuries from a closed head injury are very typically diffuse where a range of subsystems is affected. Basic communication skills of closed head-injured individuals are relatively intact; however discourse is "often confused and disorganized, with frequent intrusion of inappropriate associations, stereotypical perseverations, insinuations, or indirect contextual references" (Bara, Tirassa, and Zettin 19). One theory states this is more of an issue with comprehension of complex communication, rather than a response generation issue. Complex communication is when the literal meaning of what is said and the intended meaning do not correspond, such as irony and sarcasm. Communication failures and lack of recovery can occur. A communication failure is when there is a failure of accurately conveying a message from the originator to the receiver of the communication, the meaning of the communication is misunderstood, or when it is not understood at all. In order to recover from a communication failure, one must not only realize that something is wrong, but to be able to identify what has gone wrong in order to plan an appropriate response (Bara, Tirassa, and Zettin 29-30).

Communication failures and recovery from failures requires planning, a cognitive function impaired with head injury. The impact of behaviors, intentions, and decisions has a strong effect on communication of head-injured individuals. Breakdowns in communication (communication failures and lack of recovery) have a significant impact of the lack of social interaction of head-injured individuals (Bara, Tirassa, and Zettin 11).

Developing a strategy for recovery requires planning, which is a particular cognitive function impairment of closed-head injured individuals (Bara, Tirassa, and Zettin 30).

6.2.2 Executive Functions and Communication

After the occurrence of severe TBI, communication deficits can be linked directly with deficits in executive functioning. These deficits include self awareness and goal setting, planning, self directing and initiating, self inhibiting, self monitoring, self evaluation, and flexible problem solving. Each of these categories of executive functions plays an important role in successful communication.

With regard to communication, these executive function deficits (decreased abilities) can be defined as follows:

- Self awareness and goal setting: insight of the cognitive and verbal deficits and the implications/personal adjustments necessary with respect to communication.
- Planning: knowledge of the steps necessary to complete a task and the ability to sequence and organize these steps.
- Self directing/initiating: ability to initiate an activity (or topic of conversation), without prompting, even with having all the necessary resources available.
- Self inhibiting: ability to initiate verbal behavior that is impulsive, relevant, and socially appropriate.
- Self monitoring: ability to monitor the (social and communicative) context of a behavior or verbal utterance.
- Self evaluation: ability to objectively evaluate performance.
- Flexible problem solving: ability to revise a plan and consider alternatives when presented with new information.

(Coelho, *Discourse Analysis* 72-73; Coelho, Liles, and Duffy, *Impairments of discourse abilities and executive functions*)

6.3 Remarks

Standard communication between two people can be very complex; the dynamics and flow of narrative and conversational discourse requires competence of both parties, including the use of executive functioning, to remain cohesive and interesting. Executive functioning is an important component in TBI deficits and has significant impact on narrative and conversational discourse. The following chapter discusses current research in narrative and conversational discourse for high-level language functioning adults, which can provide a more accurate picture of actual discourse deficits for this subgroup of TBI individuals.

As will be discussed in detail later in Research Results of Narrative Discourse (Section 7.4), specific cohesive ties and the lack of complete story episodes in story generation can show aspects of reduced linguistic processing ability and compensatory attempts for linguistic deficits common to CHI individuals. Also discussed in detail later in Research Results of Conversational Discourse (Section 7.6), conversational analysis reveals specific differences in conversation between CHI and non-CHI individuals where CHI individuals show difficulty initiating and sustaining conversation, which ultimately make conversations awkward and social situations difficult.

CHAPTER 7

DISCOURSE RESEARCH

Adequate communication (discourse) is a complex and shifting linguistic balance with varying emphasis of linguistic markers (described in Cohesion in Text, Section 6.1) to form cohesive text, whether spoken or written. Types of discourse include conversational, descriptive, procedural, and story narrative, which incorporate linguistic, cognitive, and social abilities (Coelho, Liles, and Duffy, *Discourse analyses with closed head injured adults*; ---, *The use of discourse analysis*; Liles, Coelho, Duffy, and Zalagens). Conversational discourse and narrative discourse are the areas of discourse being researched and having the greatest potential of application with respect to TBI.

The strength of macrolingustic research in conversational and story narrative discourse is that it is more reflective of a closed head injury subject's ability to interact effectively in a social setting (Coelho, *The use of discourse analysis*). It has been argued that standard test batteries can indicate deficits in closed head injury subjects; however, these linguistic deficits can be seen in naming and word-finding (Hinchliffe) and do not reflect real situations which involve more than naming objects and word finding. The characteristics of executive functioning play a significant part in a real conversation, for example, and conversational and story narrative discourse is more reflective of real situations. Story narrative discourse requires an individual's understanding and creation of logical relationships of people and events (episode organization), which is a cognitive function.

Developing a single model however is not possible due to several factors that can cause extreme variability in the results, including distinct pathologies, variability in the severity, location of injury (left- or right-brain damage), age range, socioeconomic status, and methods of study. The discourse analysis designed needs to be adequate and specific to each specific group, with these variables in mind (Coelho, *Discourse production deficits*).

The location of injury can have a significant impact on the type of analysis that would be effective. TBI individuals with left-brain damage might show a linguistic break down at the word and sentence level, whereas for individuals with right-brain damage, this breakdown might occur at the level of larger language units, cohesion within and between sentences, both local (thematic overlap between adjacent sentences, eg, referential cohesion) and global (thematic coherence across a discourse) (Davis and Coelho 508). Because of this, the study population used across all narrative and conversational analysis studies presented is high-level language CHI individuals. Details of the characteristics of this study population are discussed in Section 7.2.

7.1 Definitions of Discourse Types

Different types of discourse include descriptive, procedural, conversational, and story narrative. Descriptive discourse is the listing of static information (eg, concepts, attributes and relations). Procedural discourse is a step-by-step description (instructions or directions) for performing a specific function in a specified order. Conversational discourse is communicating thoughts, ideas, and feelings in a cooperative interaction. Narrative discourse communicates actions and events unfolding over time (Coelho, *Discourse Analysis* 56-57).

7.2 High-Level Language CHI Study Population

Because narrative and conversational deficits can differ among TBI individuals, the same population of high-level language CHI individuals were used across all studies presented. The following discussion defines a high-level language CHI individual and the inclusion criteria used for this population across studies.

Subjects that have recovered from TBI, although possessing adequate abilities in sentence grammar, may lack the cohesive discourse abilities due to deficits related to the TBI. This group of TBI subjects is nonaphasic, and possesses a high-level language function, which means that no significant deficits were shown on traditional language tests. The lack of cohesive discourse abilities, regardless of abilities in sentence grammar, can make their communication unclear and lacking in organization, adding to difficulties in conversation and socialization. To verify that the speech disorders being tested are cognitive functions, subjects must have no significant visual perception deficits, have no significant hearing loss, have no significant language disorders (aphasia), and have no significant motor speech disorder (dysarthria).

In comparison to this group with high-level language function, another group of TBI subjects have significant communication difficulties due to the TBI. This group is considered to have low-level language functions. Two significant disorders that cause communication difficulties caused by brain injury are aphasia and dysarthria. Aphasia is a language disorder, commonly the result of focal damage to areas of the brain primarily responsible for language functions that results in a loss in the expression and reception of language. Examples include the inability to name familiar objects, impairments in the comprehension of oral commands, and disorders in reading and writing. Dysarthria is a deficit in motor speech production, commonly due to damage to parts of the central or peripheral nervous systems responsible for the movement and coordination of the muscles used in speech production. Symptoms include imprecise articulation (slurred speech), reduced or accelerated rate of speech, a decrease in volume, and a tendency to monotone speech (Sohlberg and Metzlaar). Further discussion of subjects with low-level language functions is beyond the scope of this paper, but narrative discourse research within this population, addressing their specific communication needs, is also occurring.

Although some specifics in CHI study population may differ slightly depending on the specifics of the study, generally, a CHI subject of high-language function is outlined as the following:

- No significant visual perception deficits
- No significant hearing loss
- Non-aphasic (verified by a standard aphasia determination test)
- No significant motor speech disorder
- Rancho Los Amigos score of VII or higher

7.3 Narrative Discourse Story Elicitation and Analysis Procedures

The story elicitation and analysis procedures discussed in this section are used across all the narrative discourse studies presented. (Coelho, Liles, Duffy, *Discourse analyses with closed head injured adults*; ---, *The use of discourse analysis*; Liles, Coelho, Duffy, Zalagens).

Narrative discourse procedural tasks, story elicitation procedures, consist of Story Retelling and Story Generation. Subject-generated stories were taped and transcribed for analysis. To analyze cohesiveness, the transcriptions of subjects' stories from both story elicitation tasks are analyzed at the sentence level, cohesion across sentences, and cohesion of story grammar. For comparison to normal subjects actual scores are converted to *z* scores. CHI subject scores within a range of ±1.65 are considered within normal limits and within the ±5% of normal distribution.

7.3.1 Story Elicitation Procedures

Story Elicitation procedures consist of Story Retelling and Story Generation. For the story retelling task, subjects were shown a filmstrip with a straightforward story. After viewing the filmstrip, the subjects were instructed by the clinician, "Tell me the story you just saw." For the story generation task, subjects were shown a picture of a painting (for example, a Norman Rockwell; one that is interpretive and can generate a number of different stories through that single picture.

7.3.2 Sentence-Level Analysis

Sentence production is measured using *T Units*, which are defined as "an independent clause plus any dependent clauses associated with it" (Liles, Coelho, Duffy, and Zalagens 358), roughly equivalent to a sentence. This can be analyzed further to look at *Total Number of T Units* and *Number of Dependent (Subordinate) Clauses Per Unit*. The former is a measure of the verbal output productivity of the subject, and the latter measures the complexity of the sentence-level grammar created (Liles, Coelho, Duffy, Zalagens 358).

7.3.3 Across-Sentence Analysis

Cohesion between sentences is determined by the frequency of cohesive markers or ties, which are defined in five categories: Reference, Lexical, Conjunctive, Ellipsis, and Substitution, which are discussed in detail in the previous discussion, Cohesion in Text. The *adequacy* of these cohesive ties is determined to by Complete or Incomplete. A cohesive tie is considered complete if the information referred by the tie is easily found and unambiguous. The cohesive tie is considered incomplete if the information referred by the tie is not in the text. An *error* is determined if the information referred by the tie is ambiguous (Liles, Coelho, Duffy, Zalagens 359).

7.3.4 Story Narrative Discourse Analysis

The same measurement procedures are used to analyze both stories, which are analyzed for sentence production, cohesion between sentences, and story episode structure.

Sentence production and cohesion between sentences are described in the previous sections, Sentence-Level Analysis and Across-Sentence Analysis. Story episode structure was a *count of complete episodes*, which consists of three components: an *initiating event*, an *action*, and a *direct consequence*. The components must be logically related to each other to be considered part of the same episode. An episode was complete if it consisted of all three related components.

7.4 Research Results in Narrative Discourse

Several studies in narrative discourse were analyzed. For illustrative purposes, only one study for narrative discourse is presented in detail (Liles, Coelho, Duffy, Zalagens). However, all studies used the same methods for story elicitation and the same analysis procedures.

For the study presented in detail, four CHI subjects were used. All met criteria for high-language function CHI subjects as outlined in Study Population, Section 7.2. Age ranged from 20 to 29 years, education ranged from high school graduate to college graduate, and time of testing ranged from five to 14 months after the injury. The control group consisted of 23 college sophomores ranging in age from 18 to 22 years. Narrative discourse story elicitation and analysis procedures are as previously presented in Sections 7.3.1 through 7.3.4.

Table 7.1 Number of *T* Units and Subordinate Clauses per *T* Unit

	Total *T* units	
Group	**Retelling**	**Generation**
Control	19.4	9.3
CHI	19.0[a]	13.0[b]
	Subordinate Clauses per *T* unit	
Group	**Retelling**	**Generation**
Control	0.11	0.59
CHI	0.08	0.24

Note: Data are presented as mean values.

[a] Three of four had a mean score of 17.3 (21, 18, 13)

[b] Three of four had a mean score of 7.6 (7, 8, 8)

Source: Liles, Betty Z., Carl A. Coelho, Robert J. Duffy, and Mary Rigdon Zalagens. "Effects of elicitation procedures on the narratives of normal and closed head-injured adults." J Speech & Hearing Disorders 54 (1989) 360. Adapted from Table 1.

At the sentence level, CHI and control groups both produced more total *T* units in story retelling than story generation. For the control group, the mean total T units were more than double (19.4 vs. 9.3) in Retelling than Generation. For the CHI group, the mean score retelling was 19.0, with three of four subjects having a mean score of 17.3. For story generation, although the total *T*-unit score for the CHI group was 13.0, (the same) three of four CHI subjects had a mean score of 7.6. The mean total *T* units for CHI subjects then are also more also than double (17.3 vs. 7.6) for Retelling than Generation, showing that the two groups handled the two tasks similarly. Although within the normal range, the three of four CHI subjects had a decreased number of total *T* units in story generation compared to the control group (7.6 vs. 9.3). Both groups used more complex sentences (more subordinate clauses per *T* unit) in story generation than story retelling

(0.59 vs. 0.11 for the control group and 0.24 vs. 0.08 for the CHI group). Although statistically within the normal range, all CHI subjects had a mean number of subordinate clauses per *T* unit (in story generation) less than half to that of the control group (0.24 vs 0.59).

Table 7.2 Cohesive Ties Used by Category (Referential, Lexical, and Conjuctive) for Story Elicitation (Retelling and Generation)

Retelling				
		Cohesive category		
Group	**Total cohesive ties**	**Reference**	**Lexical**	**Conjunctive**
Control	2.51	1.62	0.30	0.60
CHI	2.64	1.56	0.37	0.72
Generation				
		Cohesive category		
Group	**Total cohesive ties**	**Reference**	**Lexical**	**Conjunctive**
Control	2.86	2.08	0.19	0.59
CHI	2.81	1.05	1.14	0.63

Note: Data are presented as mean values.

Source: Liles, Betty Z., Carl A. Coelho, Robert J. Duffy, and Mary Rigdon Zalagens. "Effects of elicitation procedures on the narratives of normal and closed head-injured adults." J Speech & Hearing Disorders 54 (1989) 360. Adapted from Table 2.

When analyzing across sentences, there were a comparable number of total cohesive ties between the control group and the CHI group for both story retelling (2.51 vs. 2.64) and story generation (2.86 vs. 2.81) as well as across all three cohesive categories (reference, lexical, and conjunctive) for story retelling. It is very important to note, however, that there were differences in the proportional use of cohesive ties and differences in the patterns of cohesion for story generation, particularly for the referential and lexical cohesive categories. These pattern differences appear to be related to CHI subjects' reduced linguistic processing ability and their compensatory attempts for their linguistic deficits. While story retelling showed similar proportions of Referential, Lexical and Conjunctive ties to the control group, story generation showed a distinct difference in the use of ties between the two groups. In story generation, CHI subjects showed a decrease in referential ties and an increase in lexical ties. These lexical ties were rarely integrated and usually constituted incomplete ties. This reflects CHI subjects inability to organize their language for story development and difficult for CHI subjects to create complete episodes in the story generation task, as can be seen in Table 7.3.

Table 7.3 Percentage of Complete and Incomplete Cohesive Ties

	Complete cohesive ties	
Group	**Retelling**	**Generation**
Control	98	94
CHI	96	77
	Incomplete cohesive ties	
Group	**Retelling**	**Generation**
Control	1.5	5
CHI	3	22[a]

Note: Data are presented as mean values.
[a] Three of four subjects had a mean score of 15 (14, 14, 17)

Source: Liles, Betty Z., Carl A. Coelho, Robert J. Duffy, and Mary Rigdon Zalagens. "Effects of elicitation procedures on the narratives of normal and closed head-injured adults." J Speech & Hearing Disorders 54 (1989) 362. Adapted from Table 3.

Both CHI and control groups approached the tasks similarly. For story retelling, both groups literally retold to the story presented in the film, with effort to retell the story in its entirety, while for story generation, both groups focused on the event presented without extensive elaboration. Clearly, story generation is a more difficult task than story retelling and realistic that both groups would use less sufficient cohesion for a more difficult task. However, the CHI group has significantly less complete cohesive ties than the control group (77 vs. 94) and significantly more incomplete cohesive ties than the normal group in story generation, the more difficult task. The score for the CHI group for incomplete cohesive ties for story generation (22), is comprised of three of four of the CHI being similar with mean incomplete cohesive ties of 15 (mean z score of 1.4). One had incomplete cohesive ties for story generation at 42, a z score of 5.36. For most of the group, although within the normal range, the CHI group had an increase of incomplete cohesive ties compared to the normal group.

This increase in incomplete ties can be accounted by the CHI group's increased use of lexical ties and decreased use of referential ties, is also indicated by the CHI group's significantly less complete episodes in the story generation task. Three of four of the CHI group had no complete episodes, a significant z score of -1.79.

7.5 Conversational Discourse Analysis Procedures

Conversational discourse analysis, in conjunction with narrative discourse analysis, can develop an overall picture of language deficits with CHI individuals. Analysis procedures presented in this section are used across in both studies analyzed (Coelho, Liles, Duffy, *Analysis of conversational discourse in head-injured adults*; Coelho, Youse, Le).

Conversational discourse is an important discourse type to study in TBI subjects due to the socialization difficulties that this group experiences, in which conversational discourse plays an important role. Conversational discourse consists of 15-minute conversations with a speech-language pathologist (examiner), which are recorded and analyzed.

The components of conversational discourse analysis include *turns* composed of an *utterance*, which are further composed of (*speaker-initiated) obliges and comments*, and *response*, and *topic initiation* (*novel topic* and *smooth shift*).

An oblige is an utterance in which a response is required by the listener, and a comment is an utterance which does not require a response. Responses were categorized based on the appropriateness of the conversation, as *adequate plus*, *adequate*, *inadequate*, or *ambiguous*. An adequate plus response was one that not only adequately provided the information requested, but one that elaborated and provided more information. An adequate response provides the requested information without any elaboration. An inadequate response was one that was insufficient or irrelevant information to the speaker initiated utterance. An ambiguous response is one in which the information was unclear in that it can't be determined whether the response was sufficient to the speaker-initiated utterance. Turns in a conversation related to the alternations between each subject and the researcher. In a conversation, number and length of turns were related. A higher number of turns indicated shorter utterances, whereas a lower number of turns indicated longer (more descriptive) utterances.

7.6 Research Results in Conversational Discourse

Several studies in conversational discourse were analyzed. Similar to narrative discourse, only one study for conversational discourse is presented in detail (Coelho, Youse, Le). However, both studies used the same analysis procedures as presented in Section 7.5 and use the same study population criteria, as presented in Section 7.2.

For the study presented in detail, 32 CHI subjects were used. All met criteria for high-language function CHI subjects (outlined in Study Population, Section 7.2). Age ranged from 16 to 69 years (mean 31.7 years), years of education ranged from 10 to 21 years (mean 13.2 years), and time of testing ranged from one to 99 months after the injury (mean 12.8). Socioeconomic status (SES) was measured using the Hollingshead scale and the group was evenly distributed between professional (n=11), skilled worker (n=10) and unskilled worker (n=11). The normal group consisted of 43 hospital workers who were native English speakers and matched as closely as possible to the CHI group with respect to age, education, and SES. The control group's age ranged from 16 to 63 years (mean=31.9 years), years of education ranged from 11 to 22 years (mean=14.2 years), and the SES distribution was 15 professionals, 10 skilled workers, and 18 unskilled workers. Conversational discourse analysis procedures as previously discussed.

For each 15-minute conversation, the middle 6 minutes were analyzed, but selected so the analyzed section began with the initiation of a new topic. Analysis categories as previously discussed. Data for each conversation before analysis of variance consisted of tallies for each analysis category. Data from CHI and control groups were compared as well as the pathologist's interaction with each group. Analysis included using *Years of Education* as a covariate to compensate for an overrepresentation of low-educated young males in the CHI group. An alpha level of .01 was used to compensate for Type I errors.

Table 7.4 Comparison of Conversational Measures between the CHI and Normal Groups

Analysis Category		**Group: CHI**	**Group: Control**
Turns		25.1	26.4
Speaker-initiated	Obliges	3.6	6.8
	Comments	20.9*	38.2*
Responses	Adequate	28.6	23.6
	Adequate Plus	45.9*	31.8*
Topic Initiation	Novel Introductions	0.5	1.0
	Smooth Shifts	27.9	29.3

Notes: Data are presented as mean values. "*" indicates a significant value ($p < .01$).

Source: Coelho, Carl A., Kathleen M. Youse, and Karen N. Le. "Conversational discourse in closed-head-injured and non-brain-injured adults." Aphasiology 16 (2002): 666. Adapted from Table 4.

When comparing the CHI and normal groups (Table 7.4), CHI individuals were more passive in their conversations, as can be seen in the reduced number of obliges and comments (comments were statistically significant) and reduced topic initiations. The CHI group produced significantly greater Adequate Plus responses. However, although many responses were rated as *Adequate Plus* and by definition contained more information than was requested, the information, although not necessarily inappropriate, did not facilitate a continued exchange of information in the conversation.

Table 7.5 Comparison of Conversational Measures between the Examiner and each Study Group (CHI and Control)

		Examiner with Group	
Analysis Category		**CHI**	**Control**
Turns		25.2	26.5
Speaker-initiated	Obliges	77.1*	57.0*
	Comments	22.1*	37.5*
Responses	Adequate	2.5	4.4
	Adequate Plus	0.5	2.5
Topic Initiation	Novel Introductions	8.3	6.7
	Smooth Shifts	49.1*	40.5*

Notes: Data are presented as mean values. "*" indicates a significant value ($p < .01$).

Source: Coelho, Carl A., Kathleen M. Youse, and Karen N. Le. "Conversational discourse in closed-head-injured and non-brain-injured adults." Aphasiology 16 (2002): 667. Adapted from Table 5.

For comparison between each group (control and CHI, Table 7.5) and the examiner, the examiner had significantly greater obliges and significantly fewer comments with the CHI group than the normal group. The examiner had significantly greater smooth shifts with the CHI group than the normal group. Taking into consideration the examiner's role in conversations with the CHI group, because of the CHI group's overall lower level of topic initiation and contribution of the overall flow of the conversation, the examiner's role was more compensatory, as can be seen in the examiner's increased use of obliges and topic initiations.

The other study analyzed (Coelho, Liles, Duffy, *Analysis of conversational discourse in head-injured adults*) showed that the CHI group had more turns per conversation, shorter utterances per turn, and a lower number of Adequate Plus responses. This showed that the CHI group showed more difficulty initiating and sustaining conversations than the normal group. In normal conversation, prompts are used by both parties to find common areas of interest and to create opportunities to further the conversation. These conversations are typical for TBI individuals in that they were less interesting, less appropriate and were made with much more effort. Compared to this study, previous studies showed a greater number of turns with shorter duration per turn for TBI individuals. In this study, the number of turns and turn duration were comparable to the normal group. The real difference was in the flow of the conversations. Similar to other studies in this regard, the CHI individuals were more passive in the conversation and dependent on the examiner to maintain the momentum of the conversation. This can be seen from the speaker-initiated data, specifically the number of obliges and comments. This made the conversations awkward and in normal social situations would not sustain a social interaction, as it would not allow common interests to be explored or the conversational partner to talk about themselves.

CHAPTER 8

CONCLUSIONS

Discourse and conversational analyses are more appropriate than standard tests for detecting the complex interactions of language for people with TBI with a high-level language skills, as discourse analysis can differentiate subtle communication deficits that standard test cannot. An adequate discourse analysis procedure should be comprised of a variety of discourse tasks to allow analysis on multiple levels, including cohesion at the sentence level, cohesion between sentences, and cohesion at the episode level.

Although both elicitation story procedures are important, story generation can distinguish subtle communicative disorders better than story retelling because of the difficulty of the task and the stronger influence on the use of executive functioning, an important factor in communicative skills, and a significant cognitive deficit in TBI. When considering episode (story narrative) discourse, it is logical that there would be a correlation with executive function. An episode involves an action and a conclusion to that action, similar to executive functioning, which involves goal formulation, planning, and problem solving. Conversational discourse also involves executive functioning, primarily "self" functions, including self awareness, self directing/initiating, self inhibiting, and self monitoring. Strong indices for TBI conversations include (speaker-initiated) obliges, comments, smooth shifts, and the adequacy of responses.

Even after all initial rehabilitation programs have been completed and TBI individuals with high-level language skills involve themselves with the mainstream, subtle communicative disorders can have a strong impact on personal relationships and interactions within society. While high-level language functioning TBI individuals may, to a degree, be able to handle a conversation in a normal social setting, their conversations, particularly with people that are unaware of their injuries, can be considered non-interactive, passive, inappropriate, and even of a rambling nature. These qualities can be revealed in narrative discourse analysis, with the increase of incomplete cohesive ties and decrease of complete episodes, and conversational discourse analysis with the increase of obliges and comments on the part of the conversational partner to carry the conversation.

With the use of narrative and conversational discourse, a clearer picture of a TBI individual's communicative disorders can be determined. Conversational and narrative discourse is an appropriate addition for analysis for this specific subgroup of TBI individuals in order to better develop a reasonable rehabilitation program to address and improve these subtle communicative deficits.

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