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EFFECTS OF MODE OF PRESENTATION ON HEAD INJURED PATIENTS'
RECALL OF NARRATIVE INFORMATION

The Ohio State University

PH.D. 1986

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EFFECTS OF MODE OF PRESENTATION ON HEAD INJURED
PATIENTS' RECALL OF NARRATIVE INFORMATION

DISSERTATION

Presented in Partial Fulfillment of the Requirements of
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By

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1986

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1986

Dedication:
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Teacher, Friend, Companion

A.M.D.G.

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CHAPTER 1

INTRODUCTION

Each year millions of Americans suffer some form of head trauma. The National Center for Health has reported that approximately 9,760,000 persons, or 4.6% of the population, suffer head injury each year (Caveness, 1977). The seriousness of these injuries vary from mild concussion -- with no loss of consciousness or impairment of cognitive functioning -- to prolonged coma and/or death. While approximately 280,000 of these head injuries occur in the workplace statistics reveal that over three times that number are sustained as a result of motor vehicle accidents (Caveness, 1977). Of those thus injured, many are usually young males in their late teens or early twenties. However, damage to the central nervous system is a major cause of death and disability from birth to mid-adulthood (Trunkey, 1983).

During the Vietnam conflict advances were made in the technology of medical evacuation. Those advances have since been introduced into the civilian sector. Consequently, an increasing number of persons are

surviving even serious head trauma. However, many of these survivors often experience difficulties in adjusting to their deficits.

One area of difficulty is interpersonal relationships. Many serious head trauma patients experience changes in personality (Lezak, 1978). These often manifest themselves as changes in affect or emotion (Brooks & McKinlay, 1983). Friends and family members fail to understand the consequences of head trauma and often withdraw from the patient. Feelings of loneliness and isolation are common experiences for head injury patients (Thomsen, 1974)

Another important area of potential difficulty is adjustment to the cognitive deficits often associated with serious head injury. Studies have shown that these patients suffer from poor attention and/or concentration, have problems with expressive and receptive language, and most commonly, experience deficits in memory (Levin, Benton & Grossman, 1982; Tabaddor, Mattis & Zazula, 1984; van Zomeren & van den Burg, 1985). These cognitive deficits and personality changes have raised numerous questions concerning the quality of life for survivors and their families (Brooks, 1984; Jellinek, Torkelson & Harvey, 1982).

Recovery from serious head injury is a prolonged process. The patient often spends a lengthy period in a rehabilitation facility. This period is often very trying for the family (McKinlay, Brooks, Bond, Martinage & Marshall, 1981). People involved in the rehabilitation of the head injured are becoming increasingly aware of the need to work with the patient's family and/or other significant support system (Bicknell, 1982; Romano, 1974). Likewise, there is an increasing appreciation for the need of a multidisciplinary approach to rehabilitation efforts (Brooks, 1984; Timming, Cayner, Grady, Grafman, Haskin, Malec & Thornsens, 1980).

The cognitive rehabilitation of serious head trauma patients is still a relatively young endeavor, and empirical research is needed to assess the effectiveness of the treatment interventions employed (Schacter, Rich & Stumpp, 1985). This is especially true in light of rising medical costs and the demands of tertiary parties responsible for payment (e.g., insurance companies) to demonstrate treatment progress. If we look at one specific cognitive deficit -- memory -- we can see the problems faced when attempting to conduct research in this area.

First, some theoretical models of human memory may provide us with useful insights when attempting to understand memory dysfunction secondary to Closed Head Injury (CHI). Yet, when taken independently, these models are limited: e.g., Atkinson and Shiffrin (1968) and Craik and Lockhart (1972). Recent attempts to explain human memory, e.g., Tulving (1985), may provide the kind of synthesis needed to better understand these phenomena.

Second, previous research suggests that that some of the treatment interventions currently being used in cognitive retraining programs (e.g., mnemonics) often prove cumbersome outside the laboratory setting (Croovitz, Harvey & Horn, 1979). Lacking generalizability to everyday life, these compensatory techniques appear to be of limited value.

Considering the cost of immediate medical treatment, disability benefits during recovery, the potential of not being able to resume gainful employment, and the toll in interpersonal relationships, continued research in the area of cognitive rehabilitation is imperative. Data gained from such research will be of assistance to counselors, neuropsychologists, occupational therapists and other professionals involved in the treatment of the head

injured patient and his or her family. Hopefully, such information will aid in their efforts to help the patient resume as meaningful and productive a life as possible (Heaton, Chelune & Lehman, 1978).

This study investigated the effect of mode of presentation on head injured patients' recall of narrative information. A selected review of the literature suggests that processing demands may impact on their ability to recall such material. If so, these findings may be of help in assessment situations where these patients often present with receptive and/or expressive language deficits. Also, varying processing demands may prove helpful in designing appropriate cognitive rehabilitation programs.

CHAPTER 2

SELECTED REVIEW OF THE LITERATURE

A large body of literature exists dealing with the cognitive and affective consequences of closed head injury (CHI) and the rehabilitation of these deficits. Likewise, a significant amount has been written concerning human memory and extensive research has been conducted in this domain of cognitive functioning. It would be both impossible and unnecessary to provide a comprehensive review of this literature. Therefore, representative works are reviewed in three areas: the mechanics of CHI and subsequent affective and cognitive sequelae, theoretical models of human memory; relevant research concerning memory deficits and their rehabilitation in CHI patients.

MECHANICS AND SEQUELAE OF CLOSED HEAD INJURY

Mechanics of Closed Head Injury

The human brain weighs only about 1.8 kilograms. Surrounded by delicate membranes and bathed in various fluids, it has a certain freedom of movement within the

skull (Leech & Shuman, 1982). On impact the brain often suffers serious damage as it strikes or rubs against the inside of the skull. This is especially true in the supraorbital plate -- that area of the forehead just above the eyes. Such injuries are often associated with rapid deceleration or acceleration. For example, on impact after a fall or a sudden stop in a moving vehicle. The point of impact is called the coup and rebound striking of an area opposite the original point of impact is called a countrecoup injury (Leech & Shuman, (1982).

Also, rotation of the brain within the skull may cause tearing or shearing of white matter and connecting tracts to the brainstem (Levin, et.al., 1982). Injury to the brainstem is often fatal since many vital functions, e.g., respiration, are regulated here. Thomas and Trexler (1982) offer an excellent summary of the physiological consequences of CHI. These authors point out that severe tearing of neural fiber tracts results from pressure traveling through the cerebral cortex and subcortical regions of the brain. They outline the physiological mechanics of CHI as follows:

1. General increase in cerebral spinal fluid pressure.
2. Bruising and contusion of the cerebral surface.

3. Traveling pressure wave through brain matter producing injury contralateral to sight of original injury.
4. Swelling or edema.
5. Laceration of neural fiber tracts and processes.
6. Laceration of cerebrovascular supply with resulting hemorrhage and/or hematoma.
7. Tearing of brain matter at site of injury.
8. Structural and/or metabolic damage to individual neurons.
9. Unpredictable 'death' of individual neurons.

(Thomas & Trexler, 1982, p. 35)

In many cases of serious head trauma the victim may lapse into unconsciousness. This coma may be brief or may last several days, weeks or even months. A number of measures have been developed to monitor the patient's progress through coma. The Glasgow Coma Scale (Teasdale & Jennett, 1974) and the Ranchos Scale (Malkmus, Booth & Kodimer, 1980), are two commonly used measures. Both scales use behavioral criteria to monitor the patient's progress. Such behavioral norms/criteria are necessary since the patient is often unable to communicate verbally at this time. Thus, responses such as a person's movement towards or away from some stimulus or the tracking of a stimulus by eye movement, are used to assess the degree of purposefulness or intent in the patient's behavior.

Both these scales note that when emerging from coma the person usually goes through some agitation.

This agitation may result from a number of factors. Balance and motor coordination may be impaired. The person may experience problems in sensory perception with stimuli having increased magnitude or amplitude (Waddell & Gronwall, 1984). This can be extremely unsettling for the individual especially when the patient is confused, frightened and may have no recollection of how he or she came to be in the hospital. The person may have problems with expressive and receptive language. This can add to the patient's anxiety when being subjected to various medical procedures and not having the ability to understand what is happening. Emotional responses are often exaggerated secondary to disinhibition and damage to the frontal lobes (Levin, et.al., 1982; Lezak, 1983; Russell, Neuringer & Goldstein, 1970).

Post-Traumatic Amnesia

The period after a person has emerged from coma is often marked by an inability to make use of new information. Thus, the person appears disoriented and confused. This period is called post-traumatic amnesia (PTA) (Russell & Smith, 1961). Length of PTA has shown to be the best indicator for severity of injury and is a good predictor for recovery (Jennett, 1976).

During the period of PTA the patient is unable to retain and make use of new information, a deficit called anterograde amnesia. Likewise, the patient is often unable to remember events prior to the injury, a deficit called retrograde amnesia (Levin, et.al., 1982). This latter process usually resolves itself and shortens to the period of time immediately surrounding the time of injury. Often, the patient will never remember the exact circumstances of his or her injury.

Although a person has emerged from coma (i.e., appears alert, may be able to converse, answer questions, etc.) the period of PTA may last from less than a few hours to many months. Some people may never emerge from this chronic state of confusion and disorientation. A patient may be visited by a spouse and not remember the visit a few minutes after the spouse leaves the room. Cognitive functioning during this period is difficult to assess since the person's responses are unreliable. Memory processes during PTA are still unclear and many questions remain unanswered (Schacter & Crovitz, 1977).

The Ranchos Scales mentioned earlier includes in its latter stages a recognition that the patient is beginning to resume purposeful, goal directed

behavior. The earlier agitation and confusion have resolved. Such purposefulness may be consistent with or a prelude to the patient's emerging from PTA (Malkmus, et.al.,1980). The patient appears to be responding to the environment with increasing accuracy and appropriateness. The patient becomes more able to make use of environmental cues. For example, he or she may be able to travel to and from therapies with little supervision rather than dependent on another person for transportation.

Assessment of cognitive processes, for example, memory, has been difficult during PTA. Thus, the reliance on behavioral observation and criteria. As a consequence, the means of assessing cognitive functioning during PTA are limited. One instrument is the Galveston Orientation and Amnesia Test (Levin, O'Donnell & Grossman, 1979). Another system has been developed recently which may be a very useful clinical tool in monitoring cognitive changes during the resolution of PTA (Corrigan, Arnett, Houck & Jackson, 1985).

As part of a patient's therapy he or she is engaged in a daily Orientation Group. The group is staffed by a psychologist and an occupational therapist. Patients are asked questions from a number of categories and

domains. For example, orientation to time and place, scheduled events of the day, identities of other group members. Also, patients' behaviors are monitored. For example, the patient's ability to track a game and take his or her turn at the appropriate time. The person is rated on his or her responses to questions and/or appropriate behaviors. When a person is able to respond with consistent accuracy so as to score 2.7 on a scale from 1.0 to 3.0 the patient is believed to have cleared PTA.

Affective and Cognitive Sequelae

Recovery from serious brain injury is often a very slow process, one which is taxing not only for the patient but also for the patient's family (McKinlay, et.al., 1981). There are often a number of very difficult adjustments to make. For example, families may have established roles and patterns of interaction upended: parents no longer able to provide for dependent children, husbands or wives faced with a spouse totally dependent for such basic needs as feeding and toileting. Although these may change as the patient recovers, such dependency and/or other role shifts are the second most commonly noted changes by families of CHI patients (Mauss-Clum & Ryan, 1981).

Studies have investigated differences between the way parents and spouses deal with CHI patients. Some studies have presented evidence which would suggest that parents deal better with these adjustments than do spouses (Thomsen, 1984). This could very well be because a parent's primary mode of interacting with the young patient has been one of caring/protection, and they revert back to this pattern of dependency more easily than do spouses who are used to a relationship of equality and interdependence with the patient.

Other studies, however, have reported considerable distress among parents of unmarried CHI patients (Weddell, Oddy & Jenkins, 1980). Some of this anxiety may stem from apprehension about the patient's long term care. Also, parents may now have the unexpected responsibility of having to make appropriate plans for the patient's future.

Along with these shifts in interpersonal relationships, family members also note changes in the personality and cognitive functioning of the CHI patient (Brooks & McKinlay, 1983). Personality changes may manifest themselves in increased irritability, restlessness or stubbornness (Thomsen, 1974). The patient may show impulsivity, disinhibition and/or poor judgement (Levin, et.al., 1982). These latter

behaviors are symptomatic of damage to the frontal lobes (Lezak, 1983). Lezak (1978) has noted five broad categories of personality change. She lists these as: poor social awareness or judgement, poor self-control or self-monitoring, social dependency and poor ability to plan/organize, inappropriate affect and consequent behavior, and an inability to make use of experience (p.592).

Adjustment to the consequences of CHI appears to be somewhat different than adjustment to other forms of disability. For example, in a study comparing adjustment to CHI and paraplegia, Rosenbaum and Najenson (1976) noted that the families of CHI patients reported more depression and an increased sense of fragmentation of the family unit than did the families of those patients who had suffered paraplegia. These authors concluded that the degree of distress experienced by the families was a result of the decreased social and psychological functioning of the CHI patient. This psychological disability was over and above the patient's actual physical disability. Their conclusion would appear consistent with other research which reports CHI patients as experiencing considerable social isolation and loneliness (Thomsen, 1974).

Family members often experience considerable guilt about their own feelings toward the CHI patient. Many families report caring for the patient as burdensome. This is especially the case when decreased cognitive functioning places demands on the family to provide constant care and/or supervision as is the situation during the period of PTA (Brooks & McKinlay, 1983). Yet, these feelings are in conflict with equally strong desires to provide the loved one with appropriate care.

A number of factors may come into play when considering the interaction between family and CHI patients. Among these might be the patient's age, the type and degree of disability, the family's characteristic coping skills, and the outside support available to the family (Bicknell, 1982). It is not uncommon for families and CHI patients to deny or minimize deficits as a way of dealing with the stress they experience (Romano, 1974). This situation becomes especially delicate when the nature of the patient's injuries are such that he or she does not have a true appreciation of the cognitive deficits and the patient has no obvious physical injuries (Brooks, 1984; Levin, et.al., 1982)

Rehabilitation

Denial and similar responses may reflect a lack of knowledge and understanding of the mechanics of CHI and subsequent deficits (Lezak, 1978). Thus, many authors have suggested that the "patient" must be more broadly defined to include family members as well as the head trauma victim (Bicknell, 1982; Brooks, 1984; Lezak, 1978; Thomsen, 1974). In order to provide such treatment a multidisciplinary approach appears to be warranted (Timming et.al., 1980).

Occupational and physical therapists may work directly with the patient in assisting him or her to overcome disabilities. Yet, these same professionals need to provide the family with necessary information about appropriate ways to help the patient. For example, learning patient transfers so as to allow for maximum mobility and freedom. Often, family members want to help but are afraid of hurting the patient further by doing something "wrong".

Neuropsychologists may provide prognostic information from test results. Furthermore, they can be helpful to the family by explaining the dynamics of head injury, e.g., frontal lobe damage. Families may be helped in learning how deal with new behaviors such as emotional outbursts and/or some socially

inappropriate behavior such as hypersexuality. Counselors may provide long range help with vocational planning. They can also help in giving family members an opportunity to express and explore their own feelings toward the CHI patient. Social workers can help connect the family with support systems available in the community.

It is essential that family members be better informed about closed head injury since many families suffer from poor information. Thus, they often have unrealistic expectations about rehabilitation (Lezak, 1978). Often, out of a sincere desire to be sensitive to family members and to avoid causing them further anxiety, medical personnel avoid terms such as "brain damage". Such well intentioned efforts may actually facilitate a family's denial of the situation.

In order to be present a balanced view of the situation, and not take away appropriate hope, family members must be made aware of the patient's abilities as well as her or her disabilities. This informed, balanced presentation of the realities of CHI is necessary so that families and patients will know what to expect and can begin to make realistic and appropriate plans for rehabilitation.

One area in which this is important is in the rehabilitation of cognitive deficits. Often, especially immediately after injury, family members are concerned with the physical wellbeing of the patient; he or she may be on life support equipment and it may be unclear whether or not the patient will survive. Once the person has emerged from coma and is medically stable the family may focus on the more obvious physical problems such as helping the person to walk again.

Soon, however, as the person clears from PTA and begins to become more and more like his or her old "self", the family begins to take note of affective and personality changes. Family members begin to wonder if these will be temporary or permanent (Brooks, 1984). Along with these changes families also begin to take note of the cognitive changes in the patient (Levin, et.al., 1982). The cognitive deficits noted most often are impairments in memory (Mauus-Clum & Ryan, 1981). As already mentioned, these deficits may be broadly categorized as retrograde and anterograde amnesia. Human memory is a complex phenomenon and a number of theories have been presented to explain its functioning.

MODELS OF HUMAN MEMORY

Fascination with human memory has been noted in writings down through the years. Some of our earliest recorded considerations of the topic indicate an appreciation for the sense of order or logic inherent in the way we remember (Patten, 1972). The process of recall is not seen as a haphazard one. Even some of our more recent attempts at understanding memory show a balance of philosophy and physiology -- the two intellectual parents of modern psychology (Pribram, 1986).

There is a growing appreciation for the complexity of human memory. In their recent collection of articles Squire and Butters (1984) have drawn from various disciplines and perspectives in an attempt to give a broad consideration of the topic. Attempts to construct models of human memory may be divided into one of two general categories: those models attempting to explain the process of memory as a whole, and those which focus on specific domains or types of memory.

Examples of the former are multistore theories or those models which posit levels of processing. Examples of the latter grouping would be models which look at qualitative differences such episodic and

semantic memory. Each of these approaches has value as well as limitations.

Multistore Models

One example of a multistore model would be that suggested by Atkinson and Shiffrin (1968). These authors built on and expanded some of the earlier multistore theories: e.g., Broadbent (1958); Waugh and Norman (1965). In their theory, Atkinson and Shiffrin suggest three stages in the process of memory development: sensory memory, short term memory and long term memory.

Sensory memory is very shortlived, less than a second. Our bodies are bombarded with hundreds of pieces of sensory data each second. Most of these go unnoticed. Recent research has suggested that our brains actually may be processing this information but doing so without our awareness or consciousness. Modern technology enables us to observe and monitor the human brain transforming sensory input into electrical impulses (Karlin, 1970; Pritchard, 1981). Results from this research also suggest that people who have suffered serious or even mild head trauma may experience some dysfunction in this process (Panicolaou, Levin, Eisenberg, Moore, Goethe & High, 1984; Rowe & Carlson, 1980; Waddell & Gronwall, 1984).

In the Atkinson and Shiffrin model what is important in sensory memory is attending to the sensory stimulus. In attending to sensory data it enters into short term memory; it becomes "coded". The process of attention may be in and of itself a complex one.

Pribram and McGuinness (1975) suggest that three separate neural systems may be involved in attention. The first is arousal, defined as physiologic responses to stimuli. Arousal is believed to be controlled by the amygdala. The second is activation, defined as the readiness to respond to a stimulus. Activation is believed to be controlled by the basal ganglia of the forebrain. The third part of the process is effort, defined as a coordination of arousal and activation. Effort is believed to be governed by the hippocampus.

Information registered in short term memory is held there for a brief period of time -- about 20 seconds. However, research suggests that the amount of information we attempt to retain in short term memory correlates negatively with the amount of time we are able to retain it (Murdock, 1961). In order for information from short term memory to be stored in long term memory an additional process, rehearsal, is needed.

Once information has been stored in short term memory, according to the Atkinson and Shiffrin model, one can recall it to awareness at some future time. The actual process of recall is unclear. While this theory explains how we form memory, it also offers two possible suggestions as to how we might forget.

The first is that the memory is intact, i.e., stored in long term memory, but we are unable to recall it. This would be a problem in retrieval. Some authors would hold that all information, once stored in memory, is potentially available for recall (Myer & Myer, 1982). Shiffrin (1975), in a later revision of this theory, suggests that recall may not occur because of some failure to associate or connect new information with information stored previously. This revision sees short term and long term memory as a more unified process.

A second possibility suggested by this theory is that a person is not able to recall a memory because it does not exist -- the information was never coded properly and so never stored. As already mentioned, some research suggests that CHI patients experience some degree of dysfunction in sensory processing. This debate between failure in the encoding or retrieval processes is a complex one (Houston, 1981).

Levels of Processing Theories

A second model exemplifying those theories attempting to analyze the process of memory as a whole is the levels of processing theory of Craik and Lockhart (1972). This model is both very different from as well as somewhat complementary to that of Atkinson and Shiffrin. This apparent paradox is in that the Craik and Lockhart theory also places considerable emphasis on the mode by which we process information.

Craik and Lockhart took issue with multistore models on a number of points. For example, they argued that the theories did not make adequate distinctions between limitations in processing and limitations in storage. They believed that capacity for processing was influenced by the mode of processing involved, a consideration they claimed was not given adequate attention in the earlier model. Recent research would suggest an interaction effect between the type and number of tasks attempted (Wickens, Kramer, Vanasse & Donchin, 1983). Furthermore, Craik and Lockhart saw mode of processing (i.e., encoding) as important to the process of retrieval as well in that it provided a possible association/connection between old and new information. Shiffrin (1975) appears to have conceded

this point in his later revision of the original theory.

The Craik and Lockhart model suggests that memory function depends on the depth or complexity of analysis required by a stimulus. Previous experience (i.e., memory) provides the cognitive structures by which we can identify (i.e., encode) a new stimulus. Thus, the levels of processing model presents memory as a dynamic, interactive process. The memory trace provides the ability to respond to a stimulus -- not unlike the notion presented by Pribram and McGuinness (1975) when they suggest that reasoning is dependent on activation, a predisposition to respond to a sensory stimulus (i.e., arousal).

The levels of processing model has not been without its critics. For example, Baddeley (1978) noted that the model lacked appropriate ways to measure for depth of processing. Also, he pointed out that the model necessitated the introduction of new concepts to explain evidence which contradicted the theory, and so violated the basic principle of parsimony.

Baddeley also cited research which suggested that people are able to remember information which required very little analysis. One study cited, (Kleiman, 1975), involved subjects reading information while

repeating a series of numbers aloud. According to the levels of processing theory, the recitation of the distractors would prevent the subvocalization necessary when reading the target material -- thus negatively impacting on the subjects' ability to process the target materials adequately since reading would require a greater depth of analysis (semantic) than verbalization (phonemic).

Kleiman found no interference. The verbalization slowed down judgements about whether words rhymed but it did not negatively impact on the ability to make judgements about word meaning. Phonemic judgements were more influenced than were semantic ones -- a finding in apparent contradiction to what the Craik and Lockhart theory would predict. Kleiman did, however, find that when one increased the number of words processed semantically judgement about meaning was slowed. Kleiman concluded that his findings suggested that articulation is a more important part of reading than would be suggested by the depth of processing model. Rather than some preliminary stage, articulation may serve as a possible means of focusing, and so complements the reading process rather than interfering with it.

Some recent research would suggest that we are able to remember information even when we have not attended to it (i.e., been aware of the stimulus) (Eich, 1984; Jacoby & Witherspoon, 1982). Such findings would add to evidence suggesting that the human brain is processing more information than we are aware of at any given time. As such, some means of focusing might prove helpful in certain processing situations, as suggested by the Kleiman study, or in the presence of some dysfunction in sensory processing.

An important part of the memory process in both the Atkinson and Shiffrin model and the model proposed by Craik and Lockhart is attention. It is explicit in the former and implicit in the latter. Attention allows for sensory information to be coded or may facilitate the use of cognitive structures/schemas to identify and analyze data. Thus, attention appears to be an important element for both encoding and/or retrieval as suggested by these two theories. Deficits in attention and concentration are quite common in CHI patients (van Zomeran & van den Burg, 1985).

Theories Dealing with Types of Memory

A second group of theories concerning human memory focus not on the process of memory itself, but on distinctions between various types of memory. In a

recent article Tulving (1984) suggests that "no profound generalizations can be made about memory as a whole, but general statements about particular kinds of memory are perfectly possible" (p.385).

Within this grouping of theories a traditional distinction exists between two types of memory: semantic and episodic (Tulving, 1972). Semantic memory is usually defined as the recollection of general rules, principles or associations. Thus, it represents a form of "common" knowledge. Episodic memory, on the other hand, is usually defined as recollection of specific events from one's own experience, a form of personal or "subjective" knowledge. It has been suggested that episodic memories are "located" in time (i.e., personal experiences and their contexts) and semantic memory is "timeless" since it is not so bounded (Schacter & Tulving, 1982).

This distinction has particular relevance when considering CHI patients. As already mentioned, in retrograde and anterograde amnesia, the patient demonstrates significant impairment of episodic memory. A peculiar characteristic of PTA is that it may not be part of one's experience. The patient often speaks about the time when he or she emerges from PTA as the time when he or she "wakes up," in effect having no

functional recollection of that period of time between the injury and the 'clearing of PTA. Thus, this part of the person's experience appears to be lost forever. This is unlike the rest of episodic memory which will return for the most part once retrograde and anterograde amnesia have resolved.

During PTA, however, the CHI patient is often able to make use of semantic memory, even if with some degree of inconsistency. For example, the patient may be able to recite the alphabet, write, perform simple computations or read. However, even though the patient may have a very rewarding session in speech therapy, he or she may not remember the session a half hour later or recognize the speech therapist. Episodic memory has a distinctive autobiographical quality -- an awareness of the self as actively involved in a particular context (Schacter & Tulving, 1982). Thus, as will be discussed in the next section, it is possible for PTA patients (i.e., amnesics) to learn without having the awareness of learning. This distinction between semantic and episodic memory has proven very helpful in attempting to understand the memory deficits associated with CHI (Cermak, 1984).

In the article cited earlier, Tulving (1985) expands on the traditional distinction of semantic and

episodic memory. He suggests the existence of three categories of memory: procedural, semantic and episodic. Procedural memory can function independently of the other two. It is a means by which the individual can construct world models or schemas. Of specific interest is his proposition that episodic memory may be a specialized subsystem of semantic memory,

Episodic memory requires consciousness or self-knowing. This self-awareness is distinct from the general "knowing" traditionally associated with semantic memory. Thus, his refinement of the traditional dichotomy may provide a theoretical framework from which one might begin an attempt to articulate and conceptualize the memory deficits we observe in CHI patients during and after PTA.

RESEARCH IN COGNITIVE REHABILITATION OF MEMORY DEFICITS IN CHI PATIENTS

The previous discussion of the dynamics and sequelae of CHI, and some of the theoretical models available to explain human memory will hopefully help provide a context for a consideration of some of the research that is being conducted in the rehabilitation of memory deficits experienced by CHI patients.

Schacter and Crovitz (1977) offer an excellent review of research investigating memory function after CHI. Family members report numerous cognitive changes such as poor attention/concentration and receptive and expressive language deficits (Newcombe, 1983). The most common deficit, however, is memory (Mauss-Clum & Ryan, 1982). As already indicated, there is disagreement as to whether failure in memory represents a lack of appropriate encoding or failure in retrieval of information properly encoded.

Poor attention in CHI patients may be a contributing factor in poor memory. Such deficits appear to be well documented (Brooks, 1984; Levin, et.al, 1982; Lezak, 1983; Russell, et.al., 1970; van Zomeran, 1981). Research findings to date suggest some interesting possibilities for the remediation of attention deficits with CHI patients.

Memory Failure

Forgetting in short term memory may be due to decay, displacement or interference (Crowder, 1976). Distractor tasks are often used to hinder rehearsal and so prevent transfer of information from short term to long term memory. The displacement and interference hypotheses suggest that the content of the distractor is important in that the information in the distractor

task may inhibit rehearsal by either replacing the information or causing some confusion about the information.

Much of memory research with CHI and other subjects makes use of these principles. In one often cited study, Corballis (1966) looked at how the mode of processing information might impact on decay. Using nine digit series, 24 subjects were presented the stimulus materials both visually and aurally. The results of this study were inconclusive. In one condition, with gradually increasing interdigit intervals, the subjects appeared to rehearse more effectively when using the visually presented material. In a second condition, when the interdigit intervals decreased, no consistent difference was noted between the two modes of presentation. Corballis concluded that there was little evidence within modalities to support the decay theory.

A number of studies have attempted to look at the possible influence of interference on memory. In one study, Baddeley (1966a) found that short term memory was impaired for word sequences with acoustically similar words. However, recall was not affected with words that were semantically similar. Such results would appear contradictory to the Craik and Lockhart

(1972) levels of processing model in that acoustic (i.e., phonemic) similarities would be processed less intensely than semantically similar words.

In a second study, Baddeley (1966b) attempted to replicate these findings with long term memory. Four lists of 10 words that were either semantically or acoustically similar were presented to subjects over four trials. The acoustically similar words were learned more slowly, but showed less decline in recall than did the semantically similar words. Baddeley saw these results as suggestive that short term memory and long term memory may use different encoding systems.

Another possible explanation could be that the acoustically similar words were more difficult to learn because they were similar and demanded greater vigilance on the part of the subjects to tell them apart. Thus, the processing demands were increased. Such an explanation would be a variation of the model suggested by Craik and Lockhart, but still consistent with their basic position. The results of these two studies are consistent with the hypothesis that interference inhibits rehearsal. However, when controlled for adequately, interference might actually facilitate recall by demanding greater attention.

Numerous studies suggest that CHI patients show less impairment of short term memory as compared to impairment of long term memory. For example, Baddeley and Warrington (1970) measured CHI patients' recall on a number of tasks. Using free recall, CHI patients showed relatively little impairment for an immediate recall of lists of nouns, but increased impairment at a delay recall for the same stimuli.

Similar differences between short term and long term memory for CHI patients were found in a later study by Brooks (1975). A group of 30 severely impaired head injury patients were compared to a control group on an auditory vocal digit span and a free recall memory task. Free recall for the CHI patients was less impaired at short term recall than at long term recall. The CHI patients also produced fewer semantic errors at short term recall, suggesting that proper encoding had occurred.

Learning by Amnesic Patients

Evidence from a number of studies clearly suggests that CHI and other amnesic patients are able to learn. However, the type of material to be learned appears to be important. Brooks and Baddeley (1976) found that five amnesic patients showed significant impairment in verbal long term memory, but considerably less

impairment for perceptual-motor learning. These authors concluded that deficits in amnesia may be less global than first expected.

In a recent study, Schacter (1983) observed an amnesic patient play golf. The patient showed an inconsistent ability to translate mnemonic techniques learned in the laboratory to his playing of golf. Yet, the patient was quite able to remember the general rules of the game and was able to engage in the activity without apparent difficulty. What is of interest is that the patient's difficulty in applying mnemonic strategies on the golf course were quite similar to those he evidenced in the laboratory setting.

Amnesic patients appear able to learn under a classical conditioning paradigm even though they may have no recollection of the actual learning. Weiskrantz & Warrington (1979) used a compound auditory and visual signal as the conditioned stimulus and an air puff as the unconditioned stimulus. Two subjects, one alcoholic Korsakoff patient and one encephalitic patient, both learned the conditioned response. The response was an eye blink -- observed on video tapes of the patients' reaction to the stimuli.

This learning without awareness has been reported elsewhere. Eich (1984) reports that a speech shadowing

task was learned while listening to verbal material presented through stereo headphones. Participants in the study learned materials presented to the right (shadowed) ear suggesting some semantic analysis of the information even without overt attention. The authors, making note of the inconsistency of their results with the Craik and Lockhart model, cited the importance of the recall demand to "bring back" the materials which might otherwise have been forgotten if no such recall demand had been made.

Processing and Recall Demands

The importance of processing demands has been suggested in various research findings. For example, Murray (1965) found that subjects demonstrated an increased ability in the immediate recall of consonants when they voiced the consonants aloud. Recall ability using this voiced processing mode was greater than when the consonants were either whispered, mouthed or read silently by the subjects. This superior recall appeared to be unaffected by recall demands: more vocalized stimuli were recalled under written than spoken recall.

While processing mode appears to impact on recall ability, so do recall demands. Amnesic patients appear to do well when given some cued recall (Warrington &

Weiskrantz, 1974). When examining amnesic patients' recall under four different recall modes Graf, Squire and Mandler (1984) found that they did better in a word completion recall task than they did in either free, cued or recognition recall tasks. They cite conflicting findings for amnesics' performance under a cued recall condition, and suggest that maybe the type of learning being required may influence relative effectiveness of recall task.

The suggestion offered by Graf and colleagues may be helpful in understanding why mnemonic techniques appear to have little generalizability outside the laboratory setting (Crovitiz, Harvey & Horn, 1979; Schacter, 1983). It appears that such techniques may be imposed on material without adequate consideration to the type of material and the appropriateness of the technique. Some mnemonic devices can be extremely complicated in themselves, and require a considerable degree of abstract thinking.

Some materials may lend themselves better to recall by having some inherent consistency or linking. Examples of such materials might be sentences or paragraphs. Such materials have their own built-in cues; one part of the sentence or paragraph may help

recall other parts. Random lists of words, letters or numbers would lack this inherent consistency.

Research using narrative information with Kosakoff patients has shown some interesting results in this regard (Talland, 1965; Talland & Ekdahl, 1959). These studies made use of narrative materials commonly used in memory assessment: e.g., Wechsler Memory Scale, the Cowboy Story. Using a recognition recall task, these experimenters found that the extent of memory disturbance was inconsistent. Also, subjects tended to recall very few items of information and their recall of the materials consisted of the barest outline form. They appeared to understand the ideas of the story line, but had marked difficulty in remembering correct phrases.

Some similar research is based on Luria's idea of "inner dialogue" (Luria, 1982). Luria noted that children tend to vocalize their problem solving strategies. As we grow older, this vocalization becomes internalized and provides us with the procedure necessary to accomplish some particular task. As already noted, CHI patients often suffer from poor judgement and problem solving skills.

Results from a study with a CHI patient suggest that verbalization might help focus and facilitate

problem solving (Webster & Scott, 1983). These two researchers trained a CHI patient to vocalize various statements that would help him sustain attention. After some time the subject learned to use the statements subvocally.

The patient was evaluated before and after training on his performance on a number of neuropsychological instruments. One of these was the Logical Memory subtest of the Wechsler Memory Scale. The subject was presented with the paragraphs by having them read to him or being asked to read them himself either silently or aloud. Recall showed marked improvement with the training strategy.

In this study it is interesting to note that the researchers attempted various processing modes for the Logical Memory subtest. However, the authors may have failed to control adequately for changes in recall performance resulting from different processing modes. In fact, they report that recall was better when the patient read the paragraph aloud, even without use of the verbalization technique. It would appear that the overt or silent reading of the materials may have lead, in and of itself, to increased attention/focusing.

The Webster and Scott (1983) study was based on some earlier research with non-head-injured patients.

Meichenbaum and Goodman (1971) had used a similar training technique with 15 impulsive children. The five students taught the self-instructional training procedure showed a marked decrease in the number of errors they made on cognitive assessment instruments. Also, in a later study, Meichenbaum and Cameron (1973) used a similar training technique with schizophrenics. Their results indicated that the five schizophrenic patients taught the self-instructional training procedure showed marked improvement in digit symbol substitution and digit recall tasks, as well as improvement in verbal interaction.

A recent study investigated the effects of silent and overt study on head injured patients' ability to recall visual information (Arnett, 1984; Arnett & Corrigan, 1986). Head injured patients were presented with a picture and asked to study it. In one condition they were asked to study the picture silently. In a second condition they were asked to vocalize their study. A free recall was taken after a brief distractor task.

The head injury patients exhibited a significant increase in the amount of information they were able to recall about the picture under the overt study mode. The investigators suggested that the overt study may

have produced increased brain arousal, facilitated attention, or may have acted as a practice retrieval. An interesting finding was that control subjects (spinal cord injury patients) demonstrated a decrease in the amount of information about the pictures they were able to recall using the overt study. The authors suggest that such overt rehearsal may have served to interfere with encoding in some way.

Summary

Considering the apparent importance of mode of processing, it might be asked what, if any, effect various processing demands would have on CHI patient's recall of narrative information.

Common measures of memory often use a standard mode of presentation. The experimenter reads the materials and then asks the person to recall what he or she can remember. Consistent with those findings suggesting that reading material silently might help focus attention, and thus compensate for possible deficits, one modification might be to have a person read some materials while having other materials read to him or her and look for any differences in recall. Consistent with those studies suggesting that reading materials aloud might profit by creating additional processing via the auditory as well the visual channel a third

modification, making use of more than one processing channel, might be used for the same materials.

One might also ask if such differing modes of processing would effect patient's recall of the information over time. This question would be consistent with research suggesting more significant impairment in the long term vs. short term recall of such information by CHI patients. This is especially interesting for narrative information.

Such information would be more consistent with the type of information a CHI patient would have to recall in the non-laboratory setting. Also, such materials might offer their own built-in cues. If processing demands could be shown to make a significant difference in CHI patients' ability to recall narrative information, such data might be helpful in a number of areas.

For example, such information might be helpful in developing training programs and compensatory techniques: patients could be trained to repeat important information to help remember it. Also, given that CHI patients often present with expressive and/or receptive language deficits, if no significant differences were to result from processing mode then clinicians might be able to deviate from standard

administration requirements and adapt test materials to the particular deficits of the patient, and do so without compromising the validity of the test results.

CHAPTER 3

METHODOLOGY

Participants

Participants in this study were drawn from the inpatient population of the rehabilitation unit of a teaching hospital affiliated with a large mid-western university. The total number of participants (24) were equally divided between a "treatment" group comprised of 12 closed head injury (CHI) patients, and a "control" group constituted of 12 spinal cord injury (SCI) patients.

Patients included in the CHI group were selected from those patients who had suffered diffuse brain damage: e.g., injury associated with a motor vehicle accident (MVA). The diffuse nature of the injury was verified by medical report, physician evaluation and/or CT scan. The CHI group was thus defined so as to assure brain damage secondary to rapid acceleration or deceleration and/or the shearing of neuronal fibers. To assure that only patients with diffuse damage were included in the study any patients who had suffered a cerebrovascular accident (CVA) or other lateralized or

focal trauma were excluded. Also, involvement in the study was limited to those patients between the ages of 18 and 45. The latter age was selected as an upper boundry to control for the possible effects of aging on cognitive functioning (Reitan, 1967).

Spinal cord injury patients were selected as a comparison group since they are often very similar to CHI patients in age, level of education and other demographic variables. The two patient samples were matched for the following variables: sex, handedness, age, level of education and time post injury (TPI). The CHI group consisted of eight males and four females. The SCI group contained six males and six females. Nine CHI patients were right handed and three were left handed. Ten SCI patients reported being right handed and two were left handed. Handedness was used as a rough guage of language dominance (Lezak, 1983).

Ages ranged from 18 to 45 for the CHI group, $M=29.42$, $SD=8.49$. Ages for the SCI patients ranged from 19 to 39, $M=26.53$, $SD=5.69$. Educational level was measured in terms of final grade/year of school attended. Educational level for the CHI group ranged from 8 to 14 years, $M=11.58$, $SD=1.50$ and educational level for the SCI group ranged from 10 to 18 years,

M=12.17, SD=1.86. Time post injury was measured in weeks.

Patients in the CHI group ranged from 4 to 57 weeks, M=16.58, SD=13.40. Members of the SCI group had TPI ranges from 1 to 25 weeks, M=9.67, SD=7.24. Due to their lengthy period of rehabilitation, SCI patients are a good comparison group to CHI patients in that they help to control for the possible effects of long term hospitalization on memory (Arnett & Corrigan, 1986).

Also, the length of PTA was computed for the CHI group. Length of PTA was determined through daily monitoring of patients' performance in Orientation Group (Corrigan, et.al., 1985). Duration of PTA ranged from 2 to 56 weeks, M=14.17, SD=13.99. This variable was not applicable for the SCI group.

Patients were contacted in person by the experimenter and invited to take part in the study. Each person was allowed to read, or had read to him or her, a description of the study (Appendix A), and was encouraged to ask questions. If the patient agreed to take part in the study s/he was asked to sign a consent form. (Appendix B). The format for this form was simplified so as to accomodate the level of cognitive functioning of the CHI patients.

Stimulus Materials

The stimuli for this study were three short paragraphs commonly used in the clinical assessment of memory: The Babcock Story Recall Test, The Portland Paragraph, and the Logical Memory Subtest of the Wechsler Memory Scale (Form II). These were selected for their similarity of content and semantic style (Lezak, 1983). Also, they have been employed in previous research with head injury patients (Brooks, 1976; Lezak, 1983; Russell, et.al., 1970). Narrative paragraphs are used in memory assessment since they demand recall of more data than people a normally able to recall, somewhat analagous to a "superspan test" (Lezak, 1983).

The Babcock Story Recall Test is a brief paragraph consisting of 21 units of information (Babcock, 1930). (Appendix C). This paragraph is often included in batteries to assess memory (Lezak, 1983; Rapaport, Gill & Schafer, 1968). In the normal population correlation between immediate recall score on the Babcock and full scale I.Q. on the Wechsler-Bellevue has been .50 ($p < .01$), and correlation between delay recall score and full scale I.Q. has been .31 ($p < .05$) (Rapaport, Gill, and Schafer, 1968).

The Portland paragraph also consists of 21 units of information. (Appendix D). Although it was specifically designed as a companion for the Babcock, norms are not available for this instrument (Lezak, 1983). Norms are available for the Babcock, however (Rapaport, et.al, 1968; Rennick, 1972).

An advantage offered by both the Babcock and the Portland Paragraph is their procedure for standard administration. The stimulus paragraph is presented and then a recall is taken. The participant is then told that the stimulus will be presented a second time and that another recall will be taken. It was decided to maintain this format and to use it as standard for the initial presentation of all three stories.

Like the Babcock, the Wechsler Memory Scale has long been used to assess memory (Lezak, 1983; Rapaport, et.al, 1968). Form II (paragraph B) was used in the present investigation (Stone & Wechsler, 1945). This form consists of 23 units of information. (Appendix E). Prigatano (1978) cites undated estimates for alternate-form reliability coefficient for Forms I and II of the Wechsler Memory Scale as .83. Likewise he cites research with depressed patients suggesting a test-retest correlation .80.

Russell (1975) has adapted the instrument and provided norms for both an immediate and delayed recall. Russell (1975) found corrected correlations for semantic recall of the paragraphs to be .83 for short term and .88 for 1/2 hour delay. Norms are available for both the original format and for the Russell modification (Rennick, 1972; Russell, 1975; Wallace, 1984; Wechsler, 1945).

In summary, the Logical Memory Subtests of the Wechsler Forms I and II have been shown to be comparable. Likewise, the Babcock and Portland are reported as being comparable. Clinically, the Wechsler and the Babcock have been used together for the assessment of memory deficits and have likewise shown themselves to be comparable (Erickson & Scott, 1977). Thus, considering the equivalence of these instruments and their administration in accordance with standardized procedures, any variations in recall performance may be assumed to be a result of differences in mode of presentation.

Mode of Presentation

Each story was presented to the participants in one of the following three modes: overt passive, covert active, or overt active. All stories were presented counterbalanced for both order and processing mode.

The overt passive mode is similar to the standard administration of these instruments. The experimenter read the paragraph to the participant who was then asked to recall what s/he could remember from the paragraph. Thus, the participant processed the information by means of the auditory channel.

In the covert active mode, the participant was given one of the paragraphs and asked to read it silently. The participant was then asked to recall the information. Thus, in this mode, the participant processed the material visually. In the final, overt active mode, the participant was given a paragraph and asked to read it aloud. Again the participant was asked to recall the information. This time he or she processed the material by means of both the auditory and visual channels.

To control for any possible rehearsal under the covert active processing mode, the materials were divided into three approximately equal segments each consisting of about seven units of information. These segments were typed on three standard (i.e., 8 1/2 X 11) sheets of paper and the print enlarged X3 by means of Xerox reproduction. This was to help any participants who might have visual deficits. These enlarged, segmented paragraphs were used with all

participants for all modes of presentation as standardized stimuli.

Recall Conditions

The participants were asked to recall the information from the paragraphs at three different times. The first, as per standard administration, was immediately after the first presentation of the material (Babcock, 1930; Lezak, 1983; Wechsler, 1945). After this initial presentation of the material the person was informed that the materials would be presented again and that there would be a later recall. Approximately 20 minutes later (delay recall) the person was again asked what information he or she could remember. A third recall of the information was taken after 48 hours.

Procedure

After the participant had been informed of the study and had agreed to take part in it he or she met with the experimenter. Two experimenters were involved in this study. To control for any possible experimenter effect, participants in the study were randomly assigned to each experimenter. Each experimenter was involved in the testing of 12 CHI participants. Spinal Cord Injury patients were divided eight and four between the two experimenters.

At the initial session the participant was again reminded of the format of the study and that no deception was being used. Also, the participant was invited to ask any questions and allowed to withdraw from further involvement if he or she wished to do so. After these preliminaries, the participant was given the following instructions. I AM GOING TO SHOW OR READ TO YOU THREE SHORT PARAGRAPHS. I WANT YOU TO READ OR LISTEN CAREFULLY. I WILL ASK YOU WHAT YOU CAN REMEMBER FROM EACH OF THE STORIES. TRY TO DO THE BEST YOU CAN; NO ONE IS EXPECTED TO BE ABLE TO REMEMBER EVERYTHING. The participant was then administered one of the stories according to the appropriate counterbalancing for order and mode of presentation.

Participants' responses were audiotaped for evaluation later. No cues were given to the the participant; the information was recalled by means of a free recall. However, to control for any possible interference among the stories the participant was asked: TELL ME WHAT YOU REMEMBER ABOUT THE "WAR/STORM/FLOOD" STORY. This inquiry format was standard for both the delay and 48 hour recall. No such inquiry was used at immediate recall since the participant had just been presented with a specific stimulus paragraph.

After the immediate recall the participant was instructed as follows: I AM GOING TO HAVE YOU LISTEN (OR READ) THE MATERIAL AGAIN. I'M GOING TO ASK YOU AGAIN LATER WHAT YOU CAN REMEMBER. For the next twenty minutes the participant was asked some questions to gain necessary demographic data. For example, the person's age, level of education, date of injury. A participant was reminded that he or she could refuse to answer any question. Also, during this time a brief verbal distractor task was used.

The participant was given a sheet of paper on which seven letters had been written. The participant was asked to construct as many words from these letters as possible. The same seven letters were used with all participants. After approximately 20 minutes the person was again asked to recall information from the three stories. The total time needed for this initial session was approximately 30 minutes.

Two days later (48 hours) the participant met with the experimenter for the second and final session. The participant was asked what information could be recalled from the stories. Again a standard form of inquiry was used: TELL ME WHAT YOU REMEMBER ABOUT THE "WAR/STORM/FLOOD" STORY. As in the initial session, participants' responses were audiotaped for later evaluation.

After having responded to the request for recall, the participant was administered the three subtests of the reading cluster of the Woodcock Language Proficiency Battery (Woodcock, 1984b). To help assure that participants' reading levels were about the same, their reading scores were entered into the data analysis as a covariate. Administration was according to the standard procedure for the Battery and took about 20 minutes (Woodcock, 1984a).

The reading cluster of the Woodcock consists of three subtests: Letter-Word Identification, Word Attack, and Passage Comprehension. A person's reading level is determined by the total performance on the three subtests (Woodcock, 1984b). Reliability and validity information as well as norms are available (Woodcock, 1984a).

After completing the Woodcock Language Proficiency Battery the participant was asked if he or she had any questions. The participant was informed of the general purpose of the study and reassured that no deception had been used. The second session, like the first, took approximately 30 minutes.

Evaluation and Analysis of Data

The participants' audiotaped responses were evaluated by 2 Master's level graduate students at the

V.A. Medical Center in West Haven, Ct. Both raters were blind as to the purpose of the study, group membership of the participants, as well as mode of presentation and order of recall. Raters were asked to evaluate the responses on the basis of semantic rather than verbatim recall of the information. Although this measure of recall has not been standard in research with these instruments, research suggests that they are comparable in the language functions they assess (Mills & Burkhart, 1980). Pearson R correlation for the two raters was .96. When the raters disagreed on a particular response the mean of their scores was entered as the participant's score for that item.

The data were analyzed as a 2 X 3 X 3 factor between and within subjects mixed design model with reading level included as a covariate (Myers, 1979). The first factor was Group. This factor had two levels: CHI or SCI. The second factor was Mode of presentation. This factor consisted of three levels: overt passive, covert active and overt active. The third factor was Recall. This factor too consisted of three levels: immediate, delay and 48 hours. The covariate score was the participant's total score on the reading cluster of the Woodcock Language Proficiency Test.

The SPSS-X statistical program for ANOVA was used for analysis of the data. When appropriate, post hoc analyses were conducted using the Tukey method. The dependent variable was units of information recalled correctly. If a person recalled a unit of information but associated it with the wrong story the recall was not counted as correct. The following hypotheses were specifically investigated:

- 1) Closed head injury patients will recall fewer units of information than will the SCI patients under all conditions of Mode and Recall.
- 2) All participants (i.e., both CHI and SCI patients) will recall more units of information in immediate recall, less in delay recall, and least in 48 hour recall.
- 3) Closed head injury patients will recall more units of information when using the overt active Mode than in either of the other two Modes. However, no prediction is made as to the relative effects of the other two modes on the number of information units CHI patients will recall. No prediction is made in regard to the effect of processing Mode on SCI patients' recall of units of information.
- 4) Closed head injury patients will recall fewer units of information than will the SCI patients in each of the Recall times.

5) Closed head injury patients will recall fewer units of information than will the SCI patients under all three Modes. However, it is expected that this difference will be least under the overt active Mode because of the benefit of processing the material through multiple sensory channels. No prediction is made about the relative effects of the other two Modes on CHI patients' recall of units of information.

6) Spinal cord injury patients will recall fewer units of information under the overt active Mode. This hypothesis is expected consistent with the findings of Arnett and Corrigan (1986). No prediction is made in regard to the relative effects of the other two processing Modes on SCI patients' recall of units of information.

Hypotheses were formulated in light of previous research findings suggesting possible importance of processing demands and clinical observation of CHI patients' difficulty with attention/concentration. Also taken into account were research findings suggesting more significant impairment in short term rather than long term recall for CHI patients. Finally, hypotheses were developed consistent with clinical determination that the CHI patients had cleared PTA, and that the assessment of cognitive

functioning and the initiating of cognitive rehabilitation were appropriate at this time in their treatment.

CHAPTER 4

RESULTS

Demographic Variables

The CHI and SCI groups were compared on five demographic variables: sex, handedness, age, level of education and time post injury (TPI). The participant sample consisted of 14 males and 10 females; the CHI group was comprised of eight males and four females, the SCI group was comprised of six males and six females. Handedness was determined by patient self report and medical records. The total sample consisted of 19 right handed and five left handed individuals, with nine right handed and three left handed participants in the CHI group and 10 right handed and two left handed individuals in the SCI group.

Multiple t tests indicated that there were no significant difference between the two groups as to age, education and TPI (Hays, 1981). The ages of the CHI group varied from 18 to 45 years, $M=29.42$, $SD=8.49$, and those for the SCI group ranged from 19 to 39, $M=26.58$, $SD=5.68$. Educational levels for the CHI group ranged from 8 to 14 years, $M=11.58$, $SD=1.50$, and those for

the SCI group ranged from 10 to 18 years, $M=12.17$, $SD=1.86$. Time Post Injury for the CHI group ranged from 4 to 57 weeks, $M=16.58$, $SD=13.40$, and that for the SCI group ranged from 1 to 25 weeks, $M=9.67$, $SD=7.24$.

Length of PTA was determined for members of the CHI group, and was assessed by patients' performance in daily orientation group (Corrigan, et.al., 1985). Length of PTA ranged from 3 to 56 weeks, $M=14.17$, $SD=13.99$. Correlation between duration of PTA and total number of items recalled by members of the CHI group was $-.36$, which was not statistically significant ($p<.05$).

Analysis of Variance

Based on our 2 X 3 X 3 model, cell totals, means, and standard deviations were computed for each group for each mode of presentation and recall time. These are presented in TABLE 1 on page 60. It should be noted that in some cases standard deviations for the CHI group are greater than respective cell means. This suggests a skewed distribution. However, this sample is believed to be a good representation of the larger population of head injured patients from which it was drawn. Furthermore, the F test is robust for such a skewed sample (Hays, 1981).

An analysis of variance (ANOVA) was conducted based on a 2 X 3 X 3 factor mixed within and between subjects

TABLE 1
Cell Totals, Means and Standard Deviations

Grp/Mode/Recall		Immed	Delay	48 Hour	Total
	OvPas	T= 27.50	T= 24.00	T= 28.00	T= 79.50
		M= 2.29	M= 2.00	M= 2.33	M= 2.21
		SD= 2.72	SD= 2.54	SD= 3.32	SD= 2.88
CHI	CovAc	T= 65.00	T= 29.00	T= 28.50	T=122.50
		M= 5.42	M= 2.42	M= 2.38	M= 3.40
		SD= 4.70	SD= 2.03	SD= 2.10	SD= 3.50
	OvAc	T= 35.50	T= 14.00	T= 26.00	T= 75.50
		M= 2.96	M= 1.17	M= 2.17	M= 2.10
		SD= 3.02	SD= 1.56	SD= 2.51	SD= 2.55
	Total	T=128.00	T= 67.00	T= 82.50	T=277.50
		M= 3.56	M= 1.86	M= 2.30	M= 2.60
		SD= 3.83	SD= 2.15	SD= 2.70	SD= 3.60

Grp/Mode/Recall		Immed	Delay	48 Hour	Total
	OvPas	T= 99.00	T=113.50	T=104.00	T=316.50
		M= 8.25	M= 9.46	M= 8.67	M= 8.79
		SD= 3.57	SD= 3.33	SD= 3.71	SD= 3.57
SCI	CovAc	T=103.50	T= 91.00	T= 83.00	T=277.50
		M= 8.63	M= 7.58	M= 6.92	M= 7.71
		SD= 4.02	SD= 6.09	SD= 5.51	SD= 5.32
	OvAc	T= 96.50	T= 99.50	T= 92.50	T=288.50
		M= 8.04	M= 8.29	M= 7.71	M= 8.01
		SD= 4.27	SD= 4.70	SD= 4.16	SD= 4.39
	Total	T=299.00	T=304.00	T=279.50	T=882.50
		M= 8.31	M= 8.44	M= 7.76	M= 8.17
		SD= 3.97	SD= 4.90	SD= 4.58	SD= 4.51

n=12 per cell

design with the inclusion of reading level as a covariate (Myers, 1979). This analysis demonstrated that reading level accounted for a significant portion of the variance ($p < .001$). Also, a main effect for group (Factor 1) proved significant ($p < .001$). However, neither of the other two Factors (Mode or Recall) accounted for a significant portion of the variance. Likewise, no significant 2-way or 3-way interactions were found among any of the Factors (i.e., Group/Mode, Group/Recall, Mode/Recall, or Group/Mode/Recall). The results of this analysis are presented on the next page in TABLE 2.

As already indicated, length of post traumatic amnesia (PTA) was not a relevant variable for the Spinal Cord Injury patients. However, for the CHI group, the correlation between duration of PTA and scores on the reading cluster was $-.14$. This correlation was not statistically significant ($p < .05$).

Furthermore, since reading level accounted for a significant portion of the variance, a post hoc analysis was conducted using the Tukey method to determine if the two groups differed significantly on this covariate. The difference between the mean scores of each group for the reading cluster of the Woodcock Language Proficiency Test was 14.67 . This proved not to be significantly

TABLE 2
Analysis of Variance

Source of Variation	SS	DF	MS	F
Covariate: Woodcock	1309.37	1	1309.36	103.36**
Main Effects	959.33	5	191.87	15.16**
Time	34.45	2	17.28	1.36
Mode	10.82	2	5.41	0.43
Group	914.06	1	914.06	72.15**
2-Way Interactions	134.57	8	16.82	1.33
Time/Mode	54.50	4	13.62	1.08
Time/Group	30.70	2	15.35	1.21
Mode/Group	49.37	2	24.67	1.95
3-Way Interactions				
Time/Mode/Group	2.39	4	0.60	0.05
Explained	2405.66	18	133.65	10.55**
Residual	2495.71	197	12.67	
Total	4901.37	215	22.80	

** $p < .001$

different (Crdiff.: 17.04, df[2,22], $q=2.95$, $p<.05$).

Woodcock Language Proficiency scores for the two groups are presented below in TABLE 3.

TABLE 3
Woodcock Reading Cluster Scores

	Subtest D Word Iden	Subtest E Word Attk	Subtest F Pas Comp	Cluster Total
CHI	M=177.42 SD= 7.87	M=165.92 SD= 6.21	M=166.25 SD= 10.47	M=509.58 SD= 22.29
SCI	M=181.50 SD= 6.13	M=167.92 SD= 4.91	M=174.92 SD= 6.17	M=524.25 SD= 15.44

Hypotheses Results

The analysis revealed that hypothesis one was supported. There was a significant difference ($p<.001$) between the two groups as measured by the units of information recalled under all Modes of presentation and Recall times.

Hypothesis two was not supported. Recall time did not account for a significant portion of the variance in the model. Cell means indicate that CHI patients recalled the most number of units of information during immediate recall, next highest at 48 hour recall, and least number of units at delay recall. Spinal Cord Injury patients

recalled the most number of units of information at delay recall, slightly fewer at immediate recall (mean difference 0.13), and least at 48 hour recall. These differences did not prove statistically significant within either group. Thus, hypothesis four was likewise not supported. Those differences which did exist between the two groups were a result of the significant main effect for group and not from any group/recall interaction.

Hypothesis three was also not supported. Mode of presentation did not account for a significant portion of the variance in the model. A comparison of cell means indicates the CHI group recalled the most number of units of recall when using the covert active mode, the next highest when using the overt passive mode, and the least using the overt active mode (mean difference between the overt passive and overt active modes was .11). Spinal Cord Injury patients recalled the most number of units of information when using the overt passive mode, the next highest when using the overt active mode, and the least number of units were recalled when using the covert active mode. These differences did not prove statistically significant within either group. Thus, hypothesis five was not supported. As with hypothesis four any differences were a result of the group main effect and not from any group/mode interaction.

Likewise, hypothesis six was not supported. SCI patients did not recall significantly fewer units of information when using the overt active Mode. Thus, the finding of Arnett and Corrigan (1986) that overt active rehearsal may interfere with controls' recall of pictorial information was not replicated when the recall was for verbal (i.e., narrative) information.

CHAPTER 5

DISCUSSION

The results of this study are consistent with a large body of research examining memory deficits in CHI patients (Schacter & Crovitz, 1977). The CHI patients in this study showed significant impairment ($p < .001$) in their ability to recall units of information from three instruments commonly used in the assessment of memory. This impaired functioning was not significantly effected by variations in the mode in which the materials were presented, and the consequent processing demands.

Mean performance for the CHI group indicated a significant level of impairment (Rennick, 1972). It should be noted that data from this study need to be interpreted with caution when comparing participants' performance to normative data. This caution is warranted for a number of reasons. With regard to norms for performance on the Wechsler, administration of this instrument was not according to standard administration for this instrument (Russell, 1975; Reitan, 1945). Administration was consistent with the

standard administration for the Babcock Story Recall Test (Babcock, 1930; Rapaport et.al., 1968). Also, only one of the two paragraphs in the Logical Memory subtest was used. Therefore, the norms for performance on the Wechsler may be used only as a guideline for comparison. Furthermore, since no significant effect based on differences between the instruments was expected, cell totals, means and standard deviation were computed on basis of mode and recall and not by specific instrument.

As mentioned in chapter 3, no norms are published for the Portland. However, it is comparable to the Babcock, and so those norms may be used as a guide (Lezak, 1983). Normals are expected to recall a total of about 24 to 30 items for both immediate and delay recall of the Babcock (Rennick, 1972). Closed head injury patients in this study recalled a mean of 5.42, well below that norm and consistent with severe impairment (total recall in this range: <10). It is interesting to note that the SCI patients recalled a mean total of 16.7 units of information. According to the Rennick (1972) norms, this would be consistent with a moderate level of memory impairment (moderate impairment range: 17 to 10).

This unexpectedly low performance for the SCI control sample may be explained by the effects of long term hospitalization on memory. It was to control for this effect that SCI patients were selected as a comparison group. If such is the case we might expect an even more marked difference between CHI patients and non-hospitalized groups for the same task. Another possible explanation is that SCI patients may experience some impairment of their cognitive functioning as a result of damage to their spinal cord.

Norms for the Wechsler also indicate a severe impairment in memory for the CHI group. Again, CHI patients recalled nine unit items. This number represents twice their mean total for immediate and delay recall since, as noted earlier, only one of the two paragraphs was used in this study. This performance is consistent with a scale score of 4 (Rennick, 1972). Also, the CHI group showed an approximate 50% decrease in the number of unit items they were able to remember in delay vs immediate recall. This would suggest the presence of significant memory impairment. Normative data predict an 80% retention between the two recall times (Russell, 1975).

Spinal Cord Injury patients' performance on the Wechsler was somewhat better than their performance on

the Babcock. They had a total mean recall for immediate and delay of 17 unit items, a scale score of one (Rennick, 1972). However, the standard administration was not used, and so these results must be interpreted with caution. Also, the units of information remembered between immediate and delay recall by this group was almost 100%, well within the range expected.

The above results would be consistent with the significant difference between the two groups on their ability to recall the information from the stimulus paragraphs. However, the degree of significance ($p < .001$) was unexpected.

The lack of significant differences between the two groups on the demographic variables would suggest that the two groups were very comparable on the dimensions assessed. The two groups also showed no significant difference in their level of reading, even though this covariate accounted for a very high portion of the variance in the recall task ($p < .001$). Considering that the two groups appeared evenly matched, it is interesting to speculate on what would happen to the analysis of variance if the level of reading were to be removed as a covariate.

This question is in keeping with the opinion of some researchers in neuropsychology who believe that the inclusion of covariates as a control for possible differences between groups may actually result in loss of important data (Adams, Brown & Grant, 1985). Considering the high level of significance between the two groups on their recall performance, as well as the lack of significant difference on any demographic variables and no significant difference in reading level, it was decided to re-analyze the data without including reading level as the covariate. This was undertaken to explore if any changes might result in significance levels for either main effect or interactions. The results of this second analysis are reported in TABLE 4.

No changes were noticed in significance for main effects or interactions. The only main effect remained Group ($p < .001$). No other factor achieved significance nor was any interaction effect found to be significant. Changes were noted in the F values for each of the factors and interactions, although most of the changes were slight. The results of this analysis were very robust for the F value of the Group main effect when compared to the same F value in the original analysis.

TABLE 4
Analysis of Variance without Covariate

Source of Variation	SS	DF	MS	F
Main Effects	1739.83	5	347.97	22.78**
Time	34.45	2	17.28	1.13
Mode	10.82	2	5.41	0.35
Group	1694.56	1	1694.56	110.93**
2-Way Interactions	134.57	8	16.82	1.01
Time/Mode	54.50	4	13.62	0.89
Time/Group	30.70	2	15.35	1.01
Mode/Group	49.37	2	24.69	1.62
3-Way Interactions				
Time/Mode/Group	2.39	4	0.60	0.04
Explained	1876.79	17	110.40	7.28**
Residual	3024.58	198	15.28	
Total	4901.37	215	22.80	

** $p < .001$

While no significant main effect was noted for mode of presentation, the results suggest some interesting possibilities. It would appear that having a patient read some stimulus material does not produce greater recall of that material. Thus, Kleiman's (1975) suggestion that articulation may be a complement to reading was not supported by the data and remains open for further discussion and investigation. If the silent reading of the materials did in fact assist in focusing attention on the material this did not result in any significant overall performance on the recall task. The benefit of this mode for non-head injured populations is likewise unclear given the inconclusive mean differences for all three modes for the SCI patients.

Another interesting possibility is that there may have been an unintentional confound using this mode. In an attempt to control for possible covert rehearsal by breaking the paragraphs into segments of seven units of information, it may be that this allowed for consolidation of information via chunking (Miller, 1956). This possibility appears even greater when one considers that the mean difference between the CHI and SCI groups for immediate recall under the covert active mode was the only non-significant difference in the cell

matrix. However, if this in fact did occur, chunking likewise produced no significant difference on the CHI patients' overall performance on the recall task.

If the results of this study were to be replicated, it suggests that a reliable assessment of memory functioning can be achieved using our current instruments in a number of different modes presentation. This would have important clinical significance when considering that CHI patients often present deficits in expressive and receptive language. Thus, a tester could adjust administration to compensate for the particular deficits of the individual patient being tested. Another possible implication of these results is that the standard mode of presentation may be reliable and independent of any significant effects due to processing demands. Both of these hypotheses seem plausible considering the absence of any interaction effects among the factors.

The lack of significant main effect for recall was unexpected. Spinal cord injury patients' recall was very consistent across all three recall times. The slight mean increase in delay recall may be explained by the fact that the standard administration calls for the stimulus paragraphs to be presented twice. It would be reasonable to expect this double exposure to produce some benefit.

The decrease in mean number of units of information recalled by CHI at delay would be consistent with those studies showing more pronounced short term memory deficits in this population. The slight increase in mean units of information remembered at the 48 hour recall (less than .5) is in all likelihood to to chance.

Limitations of this Study

While the number of participants involved in this study was small, it is consistent with many clinical studies investigating this population. This small N may have contributed to the lack of significant correlations between length of PTA and total number of units of information recalled, or length of PTA and reading level for the CHI group.

The suprisingly small number of units recalled by the CHI group may reflect the possibility that some of these patients had yet to clear PTA. While the monitoring system developed by Corrigan and colleagues (1985) appears reliable, their findings have yet to be replicated in another setting. Another measure to assess whether of not CHI patients had cleared PTA, e.g., the Galveston Orientation and Amnesia Test (Levin, et.al., 1979), may have proven more reliable.

Also, the somewhat poor performance of the SCI group needs further investigation. As already suggested, their performance may have shown the influence of long term hospitalization on memory. Poor performance may have resulted from depression secondary to adjustment to their disabilities. Effects of depression on test performance is well documented (Lezak, 1983). In the absence of any rewards or incentives, the SCI patients may not have been motivated to perform well on the task. It should be noted that the failure to replicate the trend noted in the Arnett and Corrigan study may have been due, in part, to the quality of the materials being used: the pictures may have been more interesting than the stories and have increased arousal in the control group. Finally, the poor performance of the SCI group may suggest some possible cognitive deficits secondary to spinal cord injury. Further research would be needed to investigate this hypothesis.

The results of this study warrant replication. If replication were to support these preliminary findings it would be of clinical importance in helping people working in the assessment and rehabilitation of memory deficits associated with closed head injury. It would allow greater freedom in the administration of test

materials without negatively impacting on the reliability of test results. Thus, a number of possible deficits might be accomodated. Also, researchers using common assessment tools would be able to rely on established norms without having to make adjustments for changes in mode of presentation (i.e., of administration) of stimulus materials.

CHAPTER 6

SUMMARY

This study investigated the effect of mode of presentation on head injured patients' recall of narrative information. Twelve closed head injury (CHI) patients and a comparison group of 12 spinal cord injury (SCI) patients from the inpatient rehabilitation unit of a large mid-western university teaching hospital participated in this study. The two groups were matched on demographic variables such as age, level of education, time since injury, and length of hospitalization.

Participants from both groups were administered three short paragraphs taken from clinical instruments commonly used to assess memory function. The stories were counterbalanced for order and mode of presentation. Each of the three paragraphs was presented in one of three modes.

The first was the overt passive mode. This is similar to the standard administration of these materials. The participant had the story read to him or her. The participant processed the information by means of the auditory channel. The second form of

presentation was the covert active mode. Under this condition the participant read the story silently. The material was thus processed by means of the visual channel. The third form of presentation was the overt active mode. Under this condition the participant read the story aloud, and so processed the information by means of both auditory and visual channels.

Recall was taken at three times using a free recall format. The first recall was taken immediately after the initial presentation of the story. A second recall was taken after a 20 minute delay, and a third recall was taken after 48 hours. Also, reading level for all participants was assessed by means of the Reading Cluster subtest of the Woodcock Language Proficiency Battery.

An analysis of variance (ANOVA) on a 2 X 3 X 3 mixed within and between subjects design revealed that the two groups differed significantly ($p < .001$) as to the number of units of information they were able to recall from the stimulus paragraphs. Neither mode of presentation nor recall time proved a significant factor. Likewise, no interaction effects among the factors were found. Reading level also proved significant ($p < .001$). However, a post hoc analysis using the Tukey test indicated that the two groups did not differ significantly on this variable. Re-analysis of the data without inclusion of

reading level as a covariate revealed no significant changes for factor or interaction effects.

Results of this study suggest that it might be possible to vary the mode of presentation of test materials when assessing memory functioning in head injured patients. This variation appears possible without compromising reliability of test results. These findings may have clinical importance considering the receptive and expressive language problems often experienced by head trauma patients. Replication of these findings appear warranted to assess their utility in the clinical setting.

Appendix A

Description of Study

I am doing a study of how well people remember information from a short story. People who agree to take part in it will be asked to meet with a person conducting the study for two sessions. Each session will last for about a half hour. The sessions will be a few days apart. You would be given three short stories: one would be read to you, another you would be asked to read silently, and a third you would be asked to read aloud.

You would be asked what you remember about the stories at three different times. You would be asked to do the best you could; no person would be expected to be able to remember everything about each story. You would also be asked to take a short reading test. This test would be to see that people taking part in the study read at about the same level. Your answers would be audiotaped and scored; all audiotapes would be erased as soon as they were scored. You would also be asked a few questions about yourself: for example, your age, how far you went in school, etc.

You do not have to take part in this study if you do not want to do so; your treatment here is in no way connected with or dependent on whether or not you agree to take part in the study. If you should choose to take part you would not have to answer any question you did not want to, and you would be free to stop taking part at any time. Of course, it would be helpful if you would do both sessions. No one will try to trick or hurt you in any way, or at any time, during the study. No one will know who takes part in this study, what will be done, or how well a person might do in it.

If you have any questions, please feel free to ask them. If you are willing to take part in the study please read the form attached to this description and sign it. Please have a witness do the same.

Appendix B
Consent Form*

I have been told about the experiment that is being done by Al Agresti. The title of this study is "Effects of Mode of Presentation on Head Injured Patients' Recall of Narrative Information. I know that Al Agresti is doing this study under the direction of Richard K. Russell, Ph.D. as part of Al's graduate work here at O.S.U. I have been able to ask any questions I want about the experiment, and I know that I can stop taking part at any time. I agree to take part in this study.

Signature of Participant

Date

Signature of Witness

Date

*Adapted from Arnett (1984)

Appendix C

The Babcock Story Recall Test

December 6./ Last week/ a river/ overflowed/ in
a small town/ ten miles/ from Albany./ Water covered
the streets/ and entered the houses./ Fourteen
persons/ were drowned/ and 600 persons/ caught cold/
because of the dampness/ and cold weather./ In
saving/ a boy/ who was cuaght/ under a bridge,/ a man/
cut his hands.

Appendix D

The Portland Paragraph

Two/ semi-trailer trucks/ lay on their sides/
after a tornado/ blew/ a dozen trucks/ off the
highway/ in West Springfield./ One person/ was
killed/ and 418 others/ were injured/ in the Wednesday
storm/ which hit an airport/ and nearby residential
area./ The governor/ will ask/ the President/ to
declare/ the town/ a major disaster area.

Appendix E

Wechsler Logical Memory Subtest Form II: Paragraph B

Many/ school children/ in northern/ France/ were
killed/ or fatally hurt/ and others/ seriously
injured/ when a shell/ wrecked/ the schoolhouse/ in
their village./ The children/ were thrown/ down a
hillside/ and across/ a ravine/ a long distance/ from
the schoolhouse./ Only two/ children/ escaped
uninjured.

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