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Relationships between retrograde and anterograde amnesia

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RELATIONSHIPS BETWEEN RETROGRADE AND ANTEROGRADE AMNESIA

by

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Abstract

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by

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Remote memory disorders that occur as a consequence of cerebral dysfunction have traditionally been overshadowed by anterograde memory impairment, inasmuch as the magnitude, prevalence, and scope of knowledge that is affected in anterograde amnesia (AA) is usually determined to supersede the parameters of retrograde amnesia (RA). Episodic memory is presumably more vulnerable to neurologic insult than semantic memory which, on the contrary, is considered to be resilient. The severity and extent of forgetting in episodic memory, specifically, for knowledge of public events and contextual facts, have been identified in the form of "temporally-limited" and "temporally-extensive" patterns that loosely correspond to etiologies that are associated with lesions in mesial temporal/limbic midbrain regions

and mammillary-diencephalic regions, respectively. This investigation attempted to describe RA in different etiologies of cerebral dysfunction. Performance measures consisted of a remote memory test (RMQ), encompassing generic and singular facts in addition to public events and personal information that is chronologically-constrained, as well as tests of anterograde memory, naming, general memory, cognitive functioning, and intelligence. Samples of head-injured and mixed etiology brain-damaged patients were carefully matched with intact control subjects; a group of inpatients were evaluated following ECT and performance on the memory battery was compared with Pre-ECT scores. Patients yielded severe remote memory deficits in comparison to normal control performance, that affected temporally-constrained knowledge types, as well as generic and singular categories. Head-injured patients demonstrated severe and extensive RA, irrespective of recovery stage at testing. Additionally, the temporal patterns of Public Chronological forgetting for mixed etiology and Post-ECT subjects were extensive and large. Temporal span for head-injured subjects was deep and robust. All groups displayed impaired performance on discrete anterograde memory tests. Generic recall was not associated with general memory abilities, word retrieval, or intelligence for Post-ECT and mixed

etiology subjects. Singular Factual recall was related to word retrieval. RA was associated with intelligence in head-injured subjects. Findings suggested intra-domain dissociations between knowledge categories after ECT and head injury. Profiles of remote and recent memory are consistent with dual activation-arousal models of RA.

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"From our perspective, the evidence of the heterogeneity of amnesic symptoms also underlines the indivisibility of clinical and experimental neuropsychology."

(in Butters, N., Miliotis, P., Albert, M.S., and Sax, S.D. (1984), p. 141).

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CHAPTER 1

Purpose

Retrograde amnesia (RA) is defined as the dissolution of the ability to recollect information that was acquired prior to the onset of brain damage. It was considered to be an epiphenomenon of anterograde amnesia (AA), which is defined as the impairment in retrieving recent information that is encoded in the span of time that follows an insult to brain. Prior to the 1970s, when the trend in amnesia studies combined experimental and neuropsychological methods, RA was predicated on AA dimensions (Russell & Nathan, 1946). Remote memory impairment after brain damage was considered to be a temporary disorder, that occurred in the context of acute alterations in consciousness, and produced temporally disordered or fragmented memory for past events of an episodic nature, in contrast to the relative stability of well-rehearsed facts and lexical knowledge (semantic memory). RA was characterized by the phenomenon of a temporal gradient of forgetting for knowledge that antedates the onset of an encephalopathy; this is manifested as intact retrieval of older recollections, but deficient recollection for events from the period that approximates the onset of pathology.

The hypothesis that RA which accompanies trauma,

electroconvulsive therapy (ECT), and cerebral disease, has a selective effect upon the retrieval of public events and famous persons, is generated from retrospective data that has been culled from investigations of remote memory performance decrements in amnesics, compared with the performance of intact control subjects. These assessment techniques have been criticized for being constructed by combining items that are classified as episodic and semantic knowledge, as well as for including a bias, whereby over-learned, or, "easy" items are assigned to earlier decades. Contemporary memory questionnaires have been standardized with neurologically-impaired groups, and some investigators believe "... that there is no way of psychometrically enhancing the clinical evaluation of remote or recent memory" (Erickson & Scott, 1977, p. 1137).

The Television Test (Squire & Slater, 1975) was utilized to study amnesics with diverse etiologies of brain damage, particularly, amnesia that is secondary to static versus progressive neuropathology (Levin et al., 1977). The results that were yielded by this approach refuted the proposition that older memories were preserved. Additionally, head-injured patients and groups with chronic pathophysiologic changes, such as

that of Alzheimer's disease (AD), did not reveal significant recognition score differences, as a function of the period in time that the program was aired. These findings contradict the notion that older memories are resilient, since well-rehearsed facts, which are eventually incorporated into semantic memory with the passing of time, can be degraded as a result of brain damage. Also, there is a growing body of literature which proposes that neuropathologically distinctive groups reveal similar remote memory deficits, which suggests that amnesic subtypes could cluster along neurobehavioral dimensions

A comprehensive battery of remote memory tests that was developed by Albert et al. (1979), provided results that agreed with a recent theory that RA could be fractionated according to the degree and scope of remote memory deficits. Two patterns of RA emerged from this investigation:

(1) Brief remote memory losses affecting events that belong to a period preceding the trauma, extending from minutes to several years in the past;

(2) a "temporally-extensive" amnesia that is distinguished by an undifferentiated, or "flat" forgetting curve across several decades preceding the range of years that represent the onset of the encephalopathy.

Post-ECT patients and "classical" amnesics, such as H.M. and S.S. demonstrate the brief temporal gradient of amnesia, whereas alcoholic Korsakoff and post-traumatic amnesics typically display an extensive amnesic gradient, that is noteworthy for sparing of the oldest memories. The remote memory disturbance in dementia reveals a profile of equivalent losses within each decade.

A remote memory questionnaire, the Goldberg-Barnett RMQ, was developed for the purpose of examining patterns of RA, with the idea of expanding the assessment methods that were previously described, for the purpose of challenging the longstanding contention that RA selectively disrupts retrieval of contextual information, leaving recollection for generic and singular knowledge intact (Goldberg & Barnett, 1985). The prevalence and severity of remote memory impairment, relative to AA, among brain-damaged groups, and scope or extent of effects upon types of knowledge, were the variables of interest.

A second objective of this study was to assess patterns of the temporal gradient of episodic memory for subjects in three etiologic variants of amnesia, in comparison to matched normal control subjects.

This thesis was designed to re-examine traditional ideas about effects of RA on knowledge domains in

long-term memory (LTM) in acute and chronic cerebral dysfunction, and to establish RA as a clinical entity that is independent from AA. Moreover,the study attempted to reveal that RA can be more severe and it can affect knowledge domains to an equivalent extent and, perhaps, more extensively than AA.

Literature Review

Characteristics of Retrograde Amnesia

The separation of recent memory and learning from procedural memory, in the form of preserved motor learning with amnesia, was described by Ribot (1882) in an early report of a woman who became amnesic after near-drowning (Dunn, 1845). This account is noteworthy for the description of a confusional state that originated from a loss of information that was acquired during the day preceding the incident. The memory disorder was presented as an AA that occurred simultaneously with normal recall for motor procedures, in this case, preserved ability to learn and execute new skills in dressmaking, although the patient needed to be reminded of unfinished work at the start of every day. Interestingly, emotionally significant events were accurately recalled, yet, extrapersonal or "neutral" recollections were usually forgotten. After this case report was published, there was a proliferation of

anecdotes that described preserved retention for personally-relevant information concurrent with deficient recall for extrapersonal, semantic memory (Korsakoff, 1889; Claparede, 1911).

The theoretical basis for the assumption that AA is not more prevalent than remote memory disturbances after brain injury, was established in 19th century neurology with the Law of Regression (Ribot, 1885). As a consequence of the proliferation of clinical descriptions of head injuries incurred during war, emphasis shifted to post-traumatic amnesia (PTA), and it was accepted at that time that LTM traces are spared after traumatic injury (Russell & Nathan, 1946). As a result, clinical evaluations of memory functioning began to mention patients with AA, whom did not have difficulty with retrieving memories that were encoded prior to injury (Milner et al., 1968; Squire & Slater, 1978). Observations of penetrating head injury cases revealed that memory for events that were established post-injury were adversely affected, without any degree of degradation in the quality or quantity of recollections; this represents PTA without RA. Indeed, it is not uncommon to observe PTA without an accompanying remote memory disturbance and, in fact, it is possible to observe heightened or improved perception of sensory

stimuli during the interval following brain injury, just before the onset of PTA.

Another form of RA is typical for transient global amnesia (TGA), wherein memory loss is restricted to a short, pre-ictal period. The period of RA in TGA extends from hours to as much as years preceding the date of injury, and usually dissipates after several days (Whitty, 1977). Recent accounts of persistent RA in the context of resolving AA, have been provided for patients whose memory disorder conforms to TGA (Roman-Campos et al., 1980; Wood et al., 1980). A rapidly resolving remote memory disorder following head injuries was described by Russell (1935): deficient memory for premorbid events lasted approximately one-minute. This manifestation of short-lived RA has been associated with proactive interference during encoding (Sanders & Warrington, 1971), and has been attributed to non-contextual retrieval of events that resembles confabulation. RA that is distinguished by an extensive remote memory disturbance is purportedly secondary to cognitive dysfunction, irrespective of whether the amnesia was temporally-limited or whether the temporal gradient affected memories that were acquired many years previously (Gudjonsson & Taylor, 1985). However, the sharp demarcation between AA and the temporally-extensive

form of RA, cited in that paper, was connected with psychogenic factors, while the neurologic contribution was minimized.

The cognitive impairments demonstrated by amnesics with Korsakoff-like memory changes appear in the realms of concept-formation, perceptual processing, and conceptual flexibility (Oscar-Berman, 1973; Talland, 1965). The prominence of cognitive deficits in the memory disorder of KD, though, does not appear to apply to memory disturbances that are a consequence of structural damage in diencephalic and mesial temporal structures, as well as after ECT. Thus, the "temporally-extensive" amnesia in KD might, then, be conceived as a temporally-limited portion with superimposed information processing deficits. The brief gradient of amnesia, then, would affect recent premorbid memories, whereas information processing deficits would encompass all types of knowledge in LTM, which implicate consolidation and retrieval processes. Indeed, experimental paradigms have revealed that retrieval of semantic information is deficient and memory search is ineffective in "classical amnesics," such as H.M. and N.A. (Cermak et al., 1978). Additionally, the fact that very remote events are preserved in KD, which creates a sharp temporal gradient, whereas there is no distinctive

boundary between the oldest and more contemporary memories in a picture of classical amnesia, rounds out the picture of functionally distinctive subtypes that correspond to those pathologic variants. In summary, the RA of KD appears to be a combination of a brief temporal gradient, as it is manifested in amnesias originating from mesial temporal-hippocampal pathology, in conjunction with cognitive impairments that impinge on remote memories in a global way (Squire et al., 1984).

There is a semantic processing disorder that has been documented for amnesics without a history of alcoholism, which is separate from a dense AA (Kovner et al., 1981). A group of amnesics with Korsakoff-like symptoms demonstrated semantic organization problems with information for recall, that did not resemble the executive difficulty with processing that was demonstrated by head-injured subjects. The second etiologic group revealed marked retrieval deficits, however, the organization deficit in the Korsakoff group affected several specific executive functions involved in processing the material for effective recall.

Early Ideas About Retrograde Amnesia

The theory that brain injury can selectively disrupt recall for events that are assigned to the time that recently precedes injury, whereas, skills, routines, and

facts that were acquired in the remote past are disrupted to a disproportionately greater degree than recent events, was noted by Dunn (1845). This account was the first detailed description of amnesia, later modified by Ribot, insofar as he adopted Hughling Jackson's (1974) idea of a lower threshold for stimulation that is evidenced by phylogenetically more advanced neural functions, as a consequence of brain damage. This hierarchical conception of functional dissolution in brain damage later became known as the last in/first out principle (Rozin, 1976), or, the "law of regression" by Ribot, whereby recent information and events that are processed for consolidation into LTM, are usually forgotten or degraded, while older memories are stable. Furthermore, according to Ribot, there was a disproportionately greater effect on temporally-constrained knowledge than on non-contextual and lexical information in LTM, which preceded conceptions of a semantic-episodic dichotomy in LTM.

The depiction of amnesia as a graded phenomenon appeared prior to the acknowledgement of RA as a bona fide clinical syndrome in the late nineteenth century. For instance, an account of post-concussive syndrome indicated that the "the effect of the blow on the head not only erased from the memory of the events which

immediately preceded the accident, but also prevented the brain from retaining the impression of those events which occurred immediately afterwards" (Brodie, 1854, p. 56). There is also a description of AA and a brief, temporally-limited RA that was observed in the case of a mild concussion subsequent to being thrown from a horse, "On the following day he had forgotten not only the accident itself but all that happened afterwards" (Brodie, p. 56-57).

A distinction between memory disturbances with a chronic, as opposed to an acute, time course began to appear in mid-nineteenth century neurology case descriptions, concurrently with interest in the etiologic variants of amnesia. For example, amnesia with an acute onset was determined to be connected with heavy metal intoxication, whereas closed head trauma was observed to produce an RA that affected older memories (Winslow, 1860). In contrast, residual memory impairments that emerged during recovery were not distinguished from disturbances with an acute onset and, overall, RA was not distinguished from AA. Moreover, the boundaries between disorders of cognition and memory were blurred, insofar as anomia and post-ictal states were both considered to be "memory" disorders. In summary, the ambiguous quality of the acute post-injury condition, in terms of a lack of

clearcut criteria for demarcating cognitive deficits from recent memory impairment, as well as the tendency to combine remote memory disorders that selectively affect recent events separately from events that were encoded in the distant past, was a heuristic that set the stage for contemporary theories of amnesia as a unitary disorder.

An early neuroanatomical explanation of RA, which was an attempt to validate the apparent difference between retention of very remote occurrences and recent events and new-learning, was offered by Granville (1879). He separated anterograde and retrograde memory disorders in a case that was noteworthy for evidence of AA together with gradual recovery of remote memories, following an encephalopathy (Sharpey, 1879). This patient demonstrated an absence of remote memories at first, succeeded by a progressive restoration of overdetermined skills, such as the ability to play the piano, behavioral attributes that were considered to be "childlike," and a minimal degree of residual RA. Granville emphasized the discrepancy between effects on knowledge types as functions were restored, and proposed three levels of severity of amnesia and their neuropathological correspondences: "effacement" of memory, which was associated with total destruction of brain matter, the return of memory capacities once neurons became

"withered" or "blighted," and a condition whereby neuronal degeneration was reversible, in the event of "suspension of function without arrest of nutrition." This scheme of pathophysiologic processes in brain damage is not dissimilar from current hypotheses about the mechanisms of cell damage that are reputed to contribute to PTA (Ommaya & Gennarelli, 1974), and occur during recovery from head injury (Levin et al., 1985).

During the 1880s, Gowers and Ribot were responsible for characterizing the temporal gradient of remote memory deficits, and establishing the phenomenon as a separate entity from normal forgetting. Specifically, Ribot developed a typology of amnesias that resembled Granville's outline; this scheme dealt with the variables of information registration and "conservation." The course of recovery from PTA as conceived by Ribot, was noteworthy for the primacy of earliest memories, particularly, those that were established during the span of time that recently preceded injury. He proposed that cell complexes, or, "assemblies" mediated associative learning, and that memory imposed a "modification of complex groups of cells" (Granville, 1879). This semi-structural theory was an elaboration of Granville's "deficit" theory of amnesia, however, unlike Granville, Ribot did not directly connect memory disorders with

nutritional deficiency, albeit he agreed with the opinion that memory could be enhanced by dietary supplementation.

The theory that undernutrition could produce cognitive confusion and memory impairment was proposed by Lawson (1879) and supported by Wernicke (1881), who combined general behavioral observations and neuropathology in accounts of the affective and cognitive disturbances that were secondary to hemorrhagic lesions in peri-ventricular areas, later termed "hemorrhagic polio" by Korsakoff (1889). The resulting memory disturbance was distinctive for the preservation of distant memories, with omission and fragmentation of recent events. Furthermore, Korsakoff attributed the cognitive deficits that are related to diencephalic lesions, namely, confabulation, stereotyped questions, and difficulty localizing events to a specific period in time with intact retention of content, to memory failure. Recent perspectives on clinical manifestations of chronic alcoholism with vitamin deficiency are disparate from the earlier perception of KD, insofar as the remote memory disturbance was hypothesized to combine with an encoding deficit and some degree of AA.

Knowledge Types That Are Preserved After Brain Damage

Certain types of knowledge are spared in RA, in the

presence of problems with "working" memory. Patients that conform to the picture of amnesia demonstrate savings across learning trials in a variety of paradigms, such as recognizing configurations of incomplete Gollin figures and degraded photographs of faces, and selecting the anomalous item within a scene (Milner et al., 1973; Warrington & Weiskrantz, 1978). Amnesics are able to acquire perceptual-motor skills (Cermak et al., 1973; Corkin, 1968; Milner, 1962) and cognitive strategies for certain types of problems (Cohen & Corkin, 1981; Cohen & Squire, 1980). Results of these studies revealed performance increments over successive days of learning, although subjects were not familiar with the task.

The fact that skill-learning can be "de-contextualized" from knowledge of the spatial-temporal characteristics of a procedure, supports a model of knowledge systems in LTM, whereby information that is classified as declarative is vulnerable to disruption following brain damage and procedural knowledge is relatively resilient, despite the presence of a dense RA. Temporally-graded amnesia and interference with memory for facts and events (declarative knowledge) represent the effects of a dynamic, mutable consolidation process, that is purported to be responsible for both retrograde and anterograde

memory loss (Milner, 1966; Squire & Cohen, 1979). The idea that a brain region mediating long-term retention of skill learning is resistant to conditions producing RA, evolved from results with learning rates for mirror-reading and consistent retention over one-month for patients that were rendered amnesic after bilateral ECT and unilateral ECT applied to right hemisphere, and depressives (Squire et al., 1984). Not only were patients unable to recognize stimulus words presented in follow-up test sessions administered after ECT, but they did not claim familiarity with the task prior to experiencing the retention trial. Thus, it is conceivable that brain structures which mediate memory systems that are involved in the consolidation of episodic and autobiographical information are separate, yet, functionally interconnected with loci that subserve retention of skills and procedures. These interrelationships are represented by the functional dissociations that are obtained following brain damage.

A typology of amnesia according to etiology also produces functional dissociations between episodic and semantic domains. Specifically, when the remote memory performance of a patient group with static encephalopathy was compared to the performance of a group whose pathology is progressive, namely, Parkinson's Disease,

the double dissociation was represented by severe episodic memory failures that were not correlated with semantic knowledge deficits among KD patients, whereas subjects that manifested PD memory changes yielded uniformly diminished scores in all tasks of the semantic memory battery: word fluency, sentence completion, event sequencing, and producing nouns within a superordinate category. Additionally, PD subjects recalled procedures for semantic tasks, which substantiates the notion that declarative knowledge in LTM is disrupted, yet, procedural knowledge is preserved (Hasher & Zacks, 1979). The authors emphasized the resemblance between the kinds of acquisition and memory failures that were revealed by PD and depressed patients. Nevertheless, PD subjects demonstrated an automatic mode of organizing stimuli for retrieval, in contrast to the aberrant metamemory processes that were noted for depressives.

Finally, the possibility of multiple mechanisms that mediate memory consolidation and retrieval is conceivable, when evidence for episodic-semantic task dissociations between different neuropathologic groups, are combined with theories of memory disruption for amnesic subtypes that implicate neuroanatomical correlates of response-reinforcement contingencies, that are posited to mediate a

transformation of event registration and the processing of content. Therefore, it is plausible that a pathologic process which affects the so-called parallel memory circuits could produce behavioral profiles that resemble a unitary amnesia, insofar as AA overshadows RA. Although AA can appear to be more conspicuous than RA, in fact, types of knowledge in LTM are influenced in a selective way, according to comprehensive measures of remote memory.

The Distinction Between Episodic and Semantic Memory

Psychological theories of RA posit a breakdown in a specific memory process and in memory systems, namely, procedural, episodic, and semantic (Shacter & Tulving, 1982; Tulving, 1985). The concept of a system, as it is proposed by Tulving, involves correlated processes that are systematically related, but not necessarily complements of tasks. However, interference with a single "system" or knowledge type, affects all the activities that are learned and retained as a result of the operation of that system; the systems that are less versatile, due to being phylogenetically "older," can combine with more specialized or adaptive modalities in an additive model.

The typology of memory that is proposed by Tulving includes three subsystems that are stratified in a

monohierarchical arrangement--procedural, semantic, and episodic. Procedural memory is the base of the scheme and contains semantic memory as a subsystem, yet, these two systems are interconnected. The semantic subsystem is the more advanced of the two, by virtue of an ability to form internalizations that are perceptual representations of environmental circumstances (Craik, 1943). On the other hand, procedural memory facilitates the registration of stimulus-response associations, once events are encoded.

Episodic memory depends upon the operation of procedural and semantic systems, whereas semantic memory does not depend upon feedback which is delivered from episodic memory, which includes personally-relevant and temporally-constrained memories. Semantic memory, then, is considered to be adjunctive to the other memory systems, and occurs coincidently with more advanced neural development. Thus, it is conceivable that procedural memory can function independently of the operation of either of the other systems.

Procedural memory encompasses goals and intentional actions; thus, it would be accurate to describe this system as being future-oriented, thereby excluding the requirement of reference to past recollections. This quality prompted Tulving (1985) to correspond procedural

memory to a type of consciousness that is non-knowing or "anoetic" and reflexive, while semantic knowledge pertains to non-personal information about the world, and is dissociated from subjective knowledge, which is a function of the episodic system. Tulving assigned the term "noetic" consciousness to semantic memory. He presumes that this type of knowledge pertains to earlier developmental forms, both phylogenetically and in ontogeny, and prevails following brain damage. The awareness of personal identity, sense of time past, and capacity for recollection, are subsumed in the "autonoetic" consciousness of episodic memory. This class of knowledge can be impaired or lost independently of anoetic and noetic forms of consciousness.

Another model of memory that has a tripartite structure, consists of "associative" memory, which resembles episodic, "representational" memory, which is akin to procedural knowledge, and "abstract" memory, which resembles the semantic system (Oakley, 1981). The associative and abstract systems are considered to be contextual and context-free, respectively. Neural correlates of the first system are located in subcortical structures, representational memory is mediated by neocortical and septo-hippocampal paths, and the

neocortex alone is responsible for processing abstract memory.

A theory of remote memory that departs from the dual-process system that is proposed by Tulving in his book, Elements of Episodic Memory (1983), asserts that episodic memories develop from memory for semantic aspects of the event, namely, individuals, location, actions of agents and the outcome of events, and affective response to the situation (Kihlstrom & Cantor, 1984). Consequently, an impairment in processing any of the above aspects, in the context of normal forgetting or amnesia, would also diminish performance on tasks that assess episodic memory. Thus, this formulation suggests an episodic-semantic interrelationship, and is concordant with Tulving's precaution to learning and memory researchers, "... the omnipresent possibility that identical behaviors and responses are produced by different underlying processes and mechanisms" (Tulving, 1985, p. 396).

The theory of knowledge organization in LTM that is presented above, would be expected to yield an increment in a component of a semantic memory task such as the Generic Factual category of the RMQ, with enhancement of categorical knowledge. This arrangement would be contrasted with relatively minimal disruption of semantic

memories, however, if episodic features were not encoded along with the non-contextual information. Therefore, it is evident that both semantic and episodic systems are intimately related to the types of consciousness that permit reminiscence, awareness of both internal and external developments, and the individual's self-representation in a temporal-spatial context, which incorporates the distinction between noetic and anoetic types of consciousness.

The recollection of autobiographical information has been described in terms of processing the temporal relations of events in episodic memory that are involved with self-representation, in a commentary on Tulving's formulation of the episodic/semantic interaction (McCauley, 1984). According to Tulving's view, the process whereby past events come to have specific personal significance, is not directly by encoding autobiographical facts per se, but is derived from inferences about temporal relations between facts. Thus, it can be expected that personal knowledge in LTM would be separately affected from public event knowledge in neuropathology. Indeed, a selective decrement in autobiographical recall is described subsequent to ECT (Zubin, 1984).

It is proposed that semantic memory precedes episodic

memory in the progression of brain organization of the species, as well as the individual, and as knowledge is consolidated over time. However, the idea that semantic memory is the basis of establishing knowledge in LTM, is challenged by the notion that factual information is multiplied, rather redundantly, as a function of every spatial-temporal framework that describes an event (Seamon, 1980).

Two Forms of Amnesia

The remote memory deficit in patients with medial temporal lesions is relatively less extensive and severe than the form of amnesia that is associated with structural damage along the diencephalic midline, such as in KD. The second type of remote memory disturbance is characterized by a temporally-extensive and severe impairment that is coupled with preserved recent memory, in the form of a normal rate of forgetting and knowledge acquisition. Amnestic disorders are also classified according to regional demarcation, specifically, whether pathology is circumscribed, as it is for the lesion that was sustained by N.A., which was located in basal brain and shifted to the left of midline (Teuber et al., 1968), or, whether damage is multifocal, implicating limbic midbrain structures. Multifocal pathology that results in amnesia has been linked with peri-ventricular regions,

mamillary bodies, and, anteriorly, the medial and dorsomedial thalami (Mair et al., 1979). The remote memory deficits that are evidenced by both N.A. and in amnesics that conform to the neurologic profile of KD are noteworthy for the integrity of memories that are assigned to the distant past (Butters et al., 1984). The similarity between the RA of N.A. and patients with Korsakoff-like memory disturbances also applies to their anterograde memory, insofar as recent memory impairments are relatively milder than remote memory findings.

ECT-Induced Retrograde Amnesia

The RA that follows ECT affects declarative memory, which subsumes episodic and autobiographical information, yet, cognitive functioning is affected in a less estensive way than remote memory (Strain et al., 1968; Squire, 1975; Squire et al., 1975, 1981; Squire & Slater, 1983). Follow-up assessments reveal forgetting in LTM covering a time span that ranges from two-five-months after the last treatment in a series of ECT (Janis, 1950; Squire et al., 1981). There is, however, a subjective sense of memory failure for events that occurred in the distant past, that has been documented to emerge three years after the last ECT (Squire & Slater, 1983). Although comparisons of the degree of forgetting for several types of knowledge, particularly, public events,

content of television programs that were aired in a single season and the chronological order of their appearance, for groups with and without memory complaints on self-rating scales at a long-term follow-up did not yield significant differences in performance, there are reports of subtle, but persistent remote memory deficits. Additionally, it is common for individuals who received bilateral ECT treatments months previously to complain of problems with their memory that disrupt day-to-day functioning, but are not detected with remote memory assessment techniques. Thus, test sensitivity (Squire & Slater, 1975; Squire & Slater, 1978) and the method of comparing retention test scores of treated and non-treated subjects in experimental paradigms, are issues in interpreting the lack of validation of memory self-reports by remote memory tests that are currently used.

The Influence of ECT on Episodic Memory. A preponderance of studies investigated the effcts of ECT on information that is personal or autobiographical, especially the early literature (Janis, 1950; Stieper et al., 1951; Strain et al., 1968; Bidder et al., 1970). However, the trend in remote memory research shifted the focus from personal to public event retrieval, once the data that was obtained with experimental techiques was

combined with clinical techniques. The problem of separating influences on memory from the cognitive sequelae of ECT was critical in determining the length of time that is needed for the consolidation of facts that are preserved in short-term storage into LTM (Squire, 1975).

Hypotheses about ECT-induced RA implicate consolidation processes and temporal order theories of retrieval failure, yet, it is difficult to attribute dense amnesia and a persistent remote memory deficit solely to a selective deficit in memory retrieval or to consolidation from short-term-long-term storage. Investigations of the effects of bilateral ECT on Television Test performance examined the recollection of television programs that aired during one season, between the years 1957 and 1972 (Squire et al., 1981). Forgetting curves were generated, demonstrating a brief gradient of amnesia after a course of five bilateral treatments, which revealed diminished recall of program titles that were shown during a span of time that extended from one to three years preceding treatment, but not during a period extending from four to seventeen years prior to the year of treatment.

The above results, taken together with data from another study that demonstrated significant impairment in

recall for public events that were restricted to the 1950s and 1960s on a remote memory recognition test, but which selectively interfered with events in the 1960s when testing occurred 24 hours following treatment, suggest that forgetting of public event knowledge after ECT is evidently more extensive than previous estimates. The previous pattern is consistent with delayed consolidation of information that concerns public events, in the presence of preserved intelligence. Recent work by Squire and colleagues (1981) revealed a gradual return of remote memory after several weeks post-ECT, with full recovery after seven months.

The pattern of results that were obtained with the Television Test does not fully agree with Ribot's contention that older memories are stable, while the information that corresponds to a period that approximates the time of treatment is in a labile state. Generally, the details of television programs that were aired during a span of several years preceding treatment were forgotten when testing was done after the fifth treatment, and at a retention test that was administered one week later, although to a lesser extent. In contrast, retention for programs that were aired between three to nine years preceding the first ECT was relatively preserved. Thus, an explanation of forgetting in RA that depends on consolidation is plausible.

ECT Effects on Authobiographical Memory. The first report of personal and autobiographical memory loss after a series of ECT (Janis, 1950) revealed that there are persistent deficits following an average of 17 treatments. The type of information that was adversely affected included details of school and job history, the onset and course of psychiatric illness, facts about relationships, significant childhood experiences, and other major life experiences. The interview and recognition test showed that a small proportion of the patient group had difficulty in recalling personal events during a period that followed the last in a course of ECT by 10 to 14-weeks.

A personal memory questionnaire, the Personal Data Sheet, which split personal memory into subtypes affecting personally relevant data in the remote past and details about circumstances leading up to hospitalization (Strain et al., 1968) was administered to patients following non-dominant unilateral and bilateral ECT. RA for personal memory was pronounced for both patient groups, although the impact of ECT was greater with bilateral treatment. The remote memory deficit was evidenced within days succeeding the last treatment for both placements and persisted until 10-days

post-treatment. It was also noted that the advantage which was shown with bilateral electrode placement disappeared as testing was performed further in time from the last treatment. The period of remote memory that was disrupted by ECT, however, preceded the hospitalization by no longer than one year. Thus, this study did not yield conclusive evidence about the depth of RA with autobiographical knowledge

Finally, Weiner et al. (1984) indicated that recall for individualized personal recollections remained impaired when an assessment was done six months after a course of bilateral ECT; both recent and remote events were impaired to a similar extent. Patients receiving non-dominant ECT, delivered with brief-pulse stimulation, did not display a personal memory impairment when assessed within two to three days after the final ECT. Another study that utilized a personal remote memory inventory (Strain et al., 1968) did not yield significant differences in recall from a pre-treatment baseline, for patients receiving both bilateral and non-dominant, unilateral ECT, at one week, four, and seven months after the final ECT (Weeks et al., 1980).

Amnesia that is noteable for an isolated loss of autobiographical facts is postulated to be a form of the jamais vu phenomenon (Penfield & Rasmussen, 1950), that

is hypothesized to involve a recognition failure that affects judgement of familiarity for personal data (Zubin, 1984). The loss of personal memories subsequent to ECT was compared with retrieval of word associations, measured with recall and recognition measures, inasmuch as the latter was purported to covary with semantic memory functioning.

An early study that examined object naming in children, dysphasics, and patients that were treated with ECT (Rochford & williams, 1962) revealed comparable rates of misidentifying common objects in children and patients with a language disorder, in addition to a strong, direct relationship between the above groups and post-ECT subjects, with respect to object labelling. The results of this study, especially the equivalence between children, whose language is in transition, and adult dysphasics, suggest that a fundamental process mediating language acquisition may be affected by different etiologies of neuropathology, not to mention acute, temporary changes in brain functioning.

The findings that are described above challenge traditional assumptions about RA consequences, insofar as semantic and lexical knowledge were considered to be resilient to alterations in brain functioning, whether they are secondary to encephalopathy or to experimental manipulations, such

as pharmacologic and electroconvulsive treatments.

Neuropathology of ECT-induced Retrograde Amnesia

The morphologic effects that are evidenced with multiple, spaced ECT are equivocal, insofar as the pathology is determined to extend along a continuum of no observable changes to extensive gliosis, widespread edema, minute infarcts, and loss of neurons (Larsen & Vraa-Jensen, 1953; Madow, 1956), however, sustained limbic seizures or multiple convulsions subsequent to ECT are generally the prerequisite for this degree of tissue damage (Weiner, 1984).

Although, it is surprising that neuroimaging techniques have revealed few structural changes in scans that are obtained over repeated treatments, as well as in longitudinal follow-up evaluations. There is, however, evidence for cortical atrophy (Weinberger et al., 1979) and loss of neurons in frontal lobes in the brains of many patients who received a course of ECT, in comparison to normal control subjects (Calloway et al., 1981). On the other hand, the possibility that pre-existing cortical atrophy was responsible for more severe psychopathology, thereby warranting electroshock therapy, was not addressed in the experimental design.

A CT study that compared patient groups with a

history of ECT and age-, sex-matched non-treated pathological and healthy control groups, did not reveal significant ventricular-to-brain ratio differences between patients with a history of ECT and non-treated patients, albeit VBR measures in both patient groups were significantly higher than VBR measures that were obtained for normal control subjects (Kolbeinsson et al., 1986). Likewise, brain tissue changes that are detected with magnetic resonance imagery are transient. The maximum cellular effects of ECT are achieved during a four-to-six-hour period following ECT. The effect eventually dissipates across multiple treatments, but residual structural changes are traced in rostral brain stem. Multiple ECT has a diffuse, but temporary influence on blood-brain barrier permeability (Mander et al., 1987).

The above findings are consistent with the view which is advocated by Zornetzer (1984), in his reply to a summary of current opinions about ECT-related brain damage and neurobehavioral sequelae, that neurochemical changes which are documented for patients that demonstrate clinical improvement simultaneously with significant alteration in memory is a more promising research objective than the pursuit of "brain-damaging consequences of ECT" (Zornetzer, 1984, p. 41). In

Zornetzer's opinion, it would be more beneficial to develop procedures that would replicate the neurochemical alterations which are produced in limbic sites, but, exclude the diverse memory and cognitive disturbances that accompany ECT as it is presently administered.

Retrograde Amnesia As A Consequence of Head Injury

RA occurs after head injury, whether it is manifested as a transient deficit in remembering events preceding the date of injury, or whether it affects memories that can be localized to a point in time that precedes the injury by hours or days. When RA was first recounted in clinical reports, it was assumed that the behavioral manifestation, amnesia for older memories, and the length of PTA, were directly related (Russell, 1932, 1948; Russell & Nathan, 1946; Williams & Zangwill, 1952). However, RA was observed to exceed AA when adjustments in the method of measuring the impairment were made, specifically, by utilizing multiple assessments after concussion, in the form of prospective studies (Sisler & Penner, 1975; Wrightson & Gronwall, 1981). In any case, the accuracy of head-injured patients' discriminations between episodes of RA that last for seconds, as opposed to moments, are dubious. The validity of eyewitness reports that relate the duration of RA are questionable. The check-lists and questionnaires that were developed to

assess effects upon LTM after ECT (Squire et al., 1975), however, provided a modality for empirical descriptions of remote memory deficit, but estimations of PTA were based on patient judgements of the point in time when ongoing events were consciously registered, and the approximate onset of awareness of a period from which memories could be retrieved relatively effortlessly.

Early conceptions of PTA held that the neurobehavioral disorder was actually a composite of disorientation, AA, and RA. Contemporary theories define PTA in terms of the simultaneous presence of AA and disorientation. A phenomenon that is mentioned in reference to PTA are "islands" of normal memory functioning, however, this manifestation is not mentioned in Russell's (1971) description of PTA and RA, "... he has no recollection of any event that occurred since the injury. Furthermore, there is a short period before the injury that he does not remember--the so-called period of retrograde amnesia" (Russell, 1971, p. 1). RA has been separated into two types (Shacter & Crovitz, 1977): a temporary form, which affects memories that were encoded in a time span that lasts from weeks to years preceding the time of trauma, but which steadily dissipates as cognitive status improves; and a permanent type, that is reputed to affect the memories that are constrained to a

few seconds preceding the trauma. Above all, the single most important determinant of RA length was the duration of PTA, in the era of Russell's (1932) case studies. Furthermore, RA length was determined to depend on whether patients were interviewed during or after PTA had resolved, and presence of indications for "shrinkage" of RA during recovery from the post-traumatic confusional state (Symonds, 1949).

The deleterious effects of brain trauma on memory for events predating the incident, which is usually greater than the effects on very remote memories in RA, were recognized by Williams & Zangwill (1952). However contemporary theories of memory disturbances following head injury maintained that RA magnitude depends on parameters of PTA. The investigators observed that memory deficits in recovered head-injured patients were sufficiently disabling to represent a "minor residual disability" (p. 54). Specifically, their study examined the correspondence between PTA and RA in mild-to-moderately head-injured subjects, demonstrating PTA that ranged from hours to nearly two months, and RA that was as brief as seconds, yet, telescoped to affect the span of time that preceded injury by one week. In contrast, retrieval for more remote events, irrespective of whether the estimated length of RA was momentary, was

markedly deficient, which refutes the principle of regression.

The remote memory impairments of RA were distributed into three categories: gaps, defective recollection, and time errors. These qualitative aspects of remote memory were evident after RA had resolved. The RA that was observed in a patient with a frontal skull fracture was noteworthy, in this respect, for difficulty with retrieving information that pertained to the spatial-temporal attributes of events that were acquired in the remote past, thereby disturbing recall of the temporal order of remote memories that occurred in the recent past. The authors suggested that these features were more likely to emerge when there is an RA which lasts longer than a few seconds. Yet, the extent of memory impairment for very remote events was not dependent upon RA duration, as it was generally conceived. These residual remote memory disturbances were temporally extensive and embraced a broad scope of knowledge domains. The underlying mechanism was inferred to be a failure of retrieval, rather than due to a failure of memory consolidation processes.

Retrograde Amnesia is Independent from Post-Traumatic Amnesia. Currently, a series of studies which examined episodic retention with the Television Test (Squire &

Slater, 1978), following moderate and severe head trauma (Levin et al., 1985), contradicted the contention that RA depends on PTA (Levin et al., 1985). There was no evidence for a temporal gradient, either for patients that were tested during PTA or for the oriented brain-damaged group, which is interesting in light of an apparent temporal gradient of forgetting among intact control subjects, whereby recent programs were retained, but programs that were aired in the remote past were inconsistently recalled. Nevertheless, Levin and colleagues admitted that shortening the test and retaining difficult items in the 1977-1979 portion of the Television Test may have artifactually smoothed the forgetting curve, thereby eliminating the temporal gradient. On the other hand, when the remote memory assessment was done after PTA cleared, there was a strong, inverse relationship between performance and the amount of time that had elapsed between injury and testing. These results suggested that a protracted period of post-injury disorientation has a relatively greater impact on the integrity of knowledge in LTM than brief PTA, even after AA has resolved. In summary, these findings demonstrate that head trauma is accompanied by persistent effects on remote memory that can exist independently from the state of deranged memory processes that characterizes PTA.

The condition of disorientation, confusion, RA, and delayed new-learning which is glimpsed subsequent to head trauma, has been compared to the memory disorder in KD,and provides a research focus that deals with the commonality between these two etiologies, in the light of encoding explanations of the amnestic impairment in KD. A memory profile that is remarkable for the preservation of recent memory, that is accompanied by dissolution of very remote memories, including childhood recollections, word meanings and orthographic forms, and to a milder degree, a verbal memory deficit, characterized a patient with RA after severe concussion and loss of consciousness for one week (Rousseaux et al., 1984).

The extended RA in this patient resembled the quality of RA in patients with a prominent, isolated remote memory impairment (Andrews et al., 1982; Goldberg et al., 1981; Roman-Campos et al., 1980), insofar as the deficit affected several decades preceding the date of trauma. The deficit was considered to be broad in scope, since the amnesia affected not only recall for events, but retention of over-learned information and word meanings. They surmised that a considerable amount of the information that is subsumed in "general knowledge," which was related both to professional and personal experiences, was forgotten by this patient.

The nature of this memory deficit was purported to be similar to the semantic deficits that are demonstrated by subjects with left temporal lesions. In addition, WAIS Verbal IQ was significantly below Performance IQ for the patient; this is a pattern that is repeated in a large proportion of accounts of continuous isolated RA that is produced with various etiologies, including post-ictal amnesia, but is the converse of the cognitive picture in KD, wherein Performance IQ is lowered.

The authors attributed this pattern of RA to mesencephalic lesions, specifically, to a circumscribed lesion of ventral tegmentum, which is reputed to be a major locus for the type of chronic RA that was detected in the patient described by Goldberg and colleagues (1981). However, the former report emphasized the role of temporal lobes in mediating deficits in verbal memory and word knowledge.

Attentional Deficits As A Factor in Post-Head Injury RA. The disorders of "mental control" after traumatic head injury include problems in regulating arousal, rate of processing information, vigilance, response inhibition, and the ability to initiate cognitive set shifting (Mesulam, 1985). These are cognitive impairments that have been associated with dysfunction of brainstem ascending fibers that connect to receptor sites

in frontal lobes. Pathophysiologic changes that are noted after brain injury have consistently cited "shearing" effects, that are reputed to originate from acceleration-deceleration that initiates diffuse axonal injury. There is evidence for midbrain foci in pathologic studies of head injuries and, furthermore, there appears to be a direct relationship between the duration of post-traumatic loss of consciousness and the extent of neuronal damage that is affected by the process of diffuse axonal shearing (Gennarelli et al., 1982; Ommaya & Gennarelli, 1974).

The influence of brainstem lesions on neurobehavioral manifestations after concussion, is evidenced in alterations in the brainstem auditory evoked response (BAER) of patients that represent a statistically significant deviation from intact control waveforms, which is not constrained by the severity of injury (Schoenhuber et al., 1983). When the findings that have been discussed in this review are assessed from the perspective of the involvement of the mesencephalic reticular system in activating frontal lobes, via the thalamus as a waystation, then the relationship between derangements from optimal cortical arousal and impairment of higher cortical functioning as a critical factor in the mechanism of RA, becomes a more attractive explanation (Plum & Posner, 1980).

A mild impairment in selective attention after a head injury (Gentilini et al., 1985) is related to the sensitivity of brainstem pathways and their efferent sites to pathologic processes and, furthermore, has been reputed to be responsible for modifications in LTM organization. Thus, "islands" of remote memory that were reported for some head-injured patients by Russell & Nathan (1946), could be interpreted as periodic interruptions of the on-line processing of events. This explanation resembles the profile of cognitive deficits when midbrain structures are damaged, which purportedly affects the "move" component of attentional orienting, which follows from the model of orienting to visual stimuli when parietal lobe is lesioned (Posner et al., 1984).

A difficulty with shifting attention that interferes with orienting to a stimulus that is located in another part of the perceptual field, might be adapted to an attentional hypothesis of the remote memory deficit in Goldberg's (1981) patient, since there was parietal involvement, in addition to the small lesion in the midbrain tegmentum. Patterns of the temporal gradient of amnesia might be affected, in a broad way, by an inhibition of disengaging attention from a familiar stimulus, inasmuch as recent memories are lost, because

attention is not shifted from remote memories that are located in the distant past.

Frontal Lobes in Retrograde Amnesia

The "decontextualizing" effect of frontal lobe lesions was shown for frontal lobectomized patients with the Konorski Paired Comparisons test (Milner & Teuber, 1968), a response alternation task that presents paired and unpaired stimuli in immediate succession, and elicits one response for similar pairings and another for disparate pairings. This task is considered to be contextual, insofar as the presentation of an incongruous stimulus requires the alternative response. The results of an application of this test with frontal lobectomized patients indicated that they could not make recency discriminations and, therefore, produced responses that were correct for prior trials, instead of the response that corresponded to the current stimulus pairing. A modification of the Wisconsin Card Sorting Test, that focuses on the ability to discriminate the order of events by eliciting judgements about the primacy or recency of line drawings and abstract renditions of objects, utilized a recognition paradigm for test stimuli pairings which included judgement of recency. Frontal patients could not determine temporal order, yet, they demonstrated intact recognition of the stimuli (Milner,

1971). The findings that were obtained with the Konorski test, together with temporal judgements, suggest that frontal lobe mechanisms might regulate the registration of knowledge of where an event took place (spatial context), without encoding when the stimulus was registered (temporal context). These attributes of information might be construed as parameters of episodic memory that are coded by frontal cortex (Iversen, 1983), purportedly, in the form of the questions: "Where did it happen?" and "When did it happen?"

A small portion of the dorsolateral prefrontal convexity (DLPFC) in monkey, that is known as the principal sulcus, is implicated in short-term memory processing (Goldman & Rosvold, 1970), particularly in types of spatial tasks that do not involve discrimination between spatial cues. Lesions in homologous regions of frontal lobe in humans disrupt Wisconsin Card Sort performance. Furthermore, patients with lateral convexity lesions reveal a higher rate of perseverative errors in such set-shifting tasks, than groups with lesions in other frontal lobe locations.

The observations of Nauta (1964, 1971) are pertinent to investigations of memory that examine the incidence of perseveration in the test performances of humans and animals with destruction of diencephalic and medial

temporal pathways, due to their emphasis on connectivity between limbic and frontal structures, wherein there are efferents that project separately to brainstem, yet, which converge upon identical sites. These anatomic projections, then, suggest that it is conceivable that the temporally extensive retrograde memory disorder that accompanies limbic forebrain encephalopathy, as it occurs in the amnesia of KD, is more closely related to the type of disorientation in time and/or event sequencing deficit, that is classified as pathognomonic of prefrontal degeneration.

Subcortical Correlates of Remote Memory Impairment

A sharp temporal gradient of forgetting in retrograde memory implicates interference with limbic-prefrontal connections. However, these pathways play an important part in effecting a dissociation between older and more contemporary remote memories, although they are not necessarily sufficient for the expression of a temporal gradient of forgetting in remote memory. Indeed, the dementias are classified according to the degree of subcortical tissue involved and, furthermore, patterns of AA roughly correspond to anatomic loci. But, the dementias are not distinguished on the basis of the type of remote memory deficit, which confers generalized flattening of the forgetting curve across the decades

that are sampled by an event questionnaire (Cummings & Benson, 1984), with the exception of easier access to information by patients with symptoms of PD than for patients with HD (Scholtz et al., 1988).

The process of differentiating amnesias on a cortical-subcortical dimension implies that multiple sclerosis (MS), HD, PD, Wilson's disease, and supranuclear palsy, should manifest similar memory profiles. The memory profiles of these disorders, though, differ from the family of cortical dementias, namely, Alzheimer's disease (AD) and multiple infarct dementia (MID) (Beatty et al., 1988). Disordered processing and memory in subcortical dementias are characterized by slowed mental operations and a progressive, but gradual deterioration of memory functioning. The gnostic processes are usually intact in subcortical disease, which includes praxis, and higher-order associative capacities. This profile contrasts with the cognitive profile in cortical dementias, such as AD. Degeneration in nucleus basalis of Meynert (Chui et al., 1986) has been correlated with cortical degeneration, the onset of cognitive deficits that are consistent with AD, and the emergence of extrapyramidal signs. Also, a subgroup with parkinsonian signs is extant (Leverenz & Sumi, 1986).

Episodic memory deficits are reported in some cases of PD (Huber et al., 1986), however,there is no indication of an amnesic gradient in episodic memory, or, even a pattern of variable losses within decades on the Famous Faces Test (Freedman et al., 1984). The nature of remote memory losses in PD, which affect primarily subcortical paths, contradicts the KD profile, wherein there is a prominent temporal gradient that coexists with extensive anterograde memory deficits.
Therefore, a typology of the dementias that is linked to pathophysiology is conceivable. On the other hand, an analogous structure-function mapping system for amnesias is improbable, inasmuch as there are few reports of clearcut findings that correspond temporal gradient variants with neuroanatomy.

Persistent Retrograde Amnesia

Many patients who display a range of anterograde memory impairment, concurrently reveal relatively severe and extensive RAs, that affect both semantic and episodic memory. Cases with a dense RA that is persistent and extensive are compelling from the standpoint that there may be separate neuroanatomical loci for retrograde and anterograde memory impairment. Roman-Campos and colleagues (1980) presented a residual RA that extended beyond five years preceding the onset of the type of

amnesia that occurs once the recent memory deficit has resolved; this memory disorder also affects events that were encoded in the time span that immediately surrounds the amnestic event. They maintained that the site of destruction was in medial temporal lobes, which are reputed to function as a watershed area between anterior and posterior circulation. Ischemic changes in the vicinity of anterior choroidal artery, which supplies parts of the amygdaloid complex, uncus, and anterior hippocampal gyrus, are associated with TGA. Global disorientation and dense amnesia occur with infarction in terminal branches of the basilar artery--the posterior cerebral artery, which supplies circulation to midbrain, thalami and, distantly, Ammon's horn and floor of the third ventricle. These areas are vulnerable to vertebrobasilar insufficiency (Poser & Ziegler, 1960; Whitty, 1977)

The case of TGA that was distinguished by a selective deficit in remote memory which affected events from more than five years, was preceded by the sudden onset of amnesia and confusion (Roman-Campos et al., 1980). Persistent RA, with complete resolution of recent memory impairment, is posited to reinforce the theory that there are separate loci which mediate processing of the information that is encoded in retrograde and anterograde

memory. An acute onset of disorientation for the spatial-temporal aspects of subjective memories, loss of personal memories for events that occurred prior to 1970, in addition to recall for public events of the 1950s, 1960s, and 1970s that was fragmented, characterized the clinical picture of this 64 year-old woman. In contrast to a severe remote memory disturbance, the Wechsler Memory Quotient was slightly lowered, in a background of high average-range general intellectual functioning, according to the WAIS. A noteworthy aspect of the patient's memory performance was the inability to recall simple commands and routines from one day to the next. The CT scan was normal, but left mid-temporal epileptiform activity was detected on the EEG. The patient's recollections of remote events were characterized by typical features of a dense RA, such as the sense of familiarity, without knowledge of the actual circumstances, and "patchy" recall beginning from the period that included her hospitalization, retrospectively, to a period that preceded the hospitalization by four or five years. The authors labeled this portion of the remote memory deficit as an "island of retrograde amnesia" (Roman-Campos et al., 1980, p. 513), that was surrounded by temporally disorganized and vague recall for events that occurred

within three to ten years before the hospitalization. This zone of degraded memories, which included a demarcated, "island" of dense RA, was believed to represent the selective nature of memory mechanisms that produce RA.

Regional cerebral blood flow studies were performed (Wood et al., 1980), which indicated that the amnesia was consistent with a seizure focus in left medial temporal lobe. Moreover, the remote memory deficit was consistent with the pattern of memory loss that is observed prior to ictal activity, which is followed by resolution of forgetting for the events antedating epileptic activity

The RA of this patient illustrated one of a series of case descriptions that conform to the profile of persistent retrograde memory impairment for events and/or facts from a circumscribed period, that is succeeded by a period of normal memory (Williams & Smith, 1954; Symonds, 1966). CT scan evidence for a lesion that affected ascending reticular fibers in mesencephalic tegmentum, bitemporal structural damage, and a moderate degree of ventricular dilatation in the head-injured patient with an isolated RA (Goldberg et al., 1981), is consistent with the notion that the lesions that were responsible for persistent retrograde memory deficits must have been more extensive than the pathophysiologic alterations of TGA (Roman-Campos et al., 1980).

Neurologic Syndromes With A Temporal Gradient of Forgetting

Historical Background. Ribot (1882) depicted a memory disorder that was noteable for better retention of the events that are assigned to an individual's distant past, than for events that occurred in the period closely preceding brain injury. This phenomenon was confirmed, nearly a century later, in studies with head-injured subjects and patients undergoing ECT. Subsequently, experimental and clinical techniques were combined in studies that discerned variants of amnesic gradients in RA: the temporally-limited type was observed in both animals and humans after ECT, and a temporally-broad gradient of amnesia characterized the remote memory disturbance of alcoholic Korsakoff and post-encephalitic subjects (Butters et al., 1984; Cohen & Squire, 1981; Rose & Symonds, 1960).

The different patterns of forgetting for chronologically-constrained information that were displayed by neuropathologic groups were not questioned, until neuropsychologists began to evaluate AA with experimental methods, particularly interference and changes in the serial learning curve in short-term memory. Once the pathology of amnesias with dense AA was delineated, and these regional "correspondences" were

combined with the knowledge that the extent of hippocampal and temporal gyrus involvement determined the integrity of short-term retention and new-learning, then a typology of the amnesias was developed that could specify the extent and magnitude of forgetting of events that are encoded in remote memory, according to the proportion of hippocampal-temporal dysfunction/mammillary-thalamic dysfunction. This heuristic is considered to be an inroad into developing techniques for establishing RA as a heterogeneous construct, that subsumes a class of disorders with site-specific functional impairments, in the manner of apraxias (Benson, 1979; Liepmann, 1979), dyscalculias (Levin, 1979), and the aphasias (Benson & Geschwind, 1980).

The differentiation of RAs on the basis of the extent of pre-morbid forgetting was the focus of interest in descriptions of brief, temporally-limited amnesias subsequent to a head injury. Memory failure extended from several months before the onset of injury to nearly one year preceding the incident, but the lapse was temporary. The span of time in the remote past that was affected by RA was reported to "shrink" to several days duration, in the context of protracted AA, which impeded retrieval for post-traumatic events within 24 hours

(Russell & Nathan, 1946). In an earlier study, Russell (1932) presented findings with closed head injury patients that revealed an RA of 30-minutes duration for 86% of hospital admissions, simultaneously with an extensive AA. The latter extended beyond 24 hours for 40% of these patients. As a result, Williams & Zangwill (1952) classified post-traumatic RA in head-injured patients with qualitative variables, "gaps" and "distortions," that were in the sub-acute stage once the recent memory deficit resolved, or, when RA was assessed to be minimal. They identified six cases of deficient retrieval for information that was localized to a period beyond the expected duration of RA. The remote memory impairments in these cases were distinguished by dissociation of event recall from remembering temporal attributes of events. One patient who demonstrated a marked difficulty in recalling the chronological aspects of past events, incurred a "frontal fracture" (Williams & Zangwill, 1952, p. 55). They concluded that deficient recall for serial ordering information is not unusual as a consequence of mild head injury. The notion of selective deficits of types of knowledge in LTM as an approach to classifying retrograde memory disorders, is further substantiated by results from the PD population that indicate a variable degree of retrieval failure for

information about temporo-spatial location and events (Sagar et al., 1986), as well as evidence for the deleterious effect of ECT on well-rehearsed personal memories from the distant past (Janis, 1950).

Contemporary studies (Sanders & Warrington, 1971; Levin et al., 1985) propose that characteristic temporal patterns of forgetting emerge in the sub-acute phases of recovery from CNS damage.This speculation is supported by artificially inducting a temporal gradient, via rehearsing or repeatedly recalling personally-relevant or meaningful events that are restricted to the remote past. In this way, information is eventually incorporated into semantic memory. Thus, the more "vulnerable" portion of the forgetting curve, which is posited to represent the process of memory consolidation, is a residual effect, that is observed as a temporally-limited pattern of forgetting in remote memory.

Summary

Design

This study attempts to challenge longstanding assumptions about the relationship between retrograde and anterograde amnesia, which conjecture that AA is preeminent, whereas RA is less severe and not as prevalent as AA. Another assumption about RA is that brain damage

interferes with memory for events and facts that pertain to personal experiences as well as public events, whereas semantic memory remains intact. Therefore, this thesis proposes that the incidence and severity of remote memory deficits might be comparable to anterograde memory deficits in patients with different etiologies of neurologic dysfunction. Secondly, it is hypothesized that RA extends to information that is classified as generic and singular, thereby, extending the limits of its influence from personalized and phenomenological types to semantic knowledge.

The temporal pattern of episodic memory, which is observed to be differentiated in the "pure" amnesias, but not in dementia syndromes, has been noted to separate amnestic disorders. This typology of remote memory disorders posits the existence of functional variants that are related to interference with pathways located along the midline, specifically whether lesion loci implicate the hippocampal-limbic (posterior) sites, or mammillary-thalamic (anterior) sites (Squire, 1980), will be examined for subjects in the etiologic groups and matched control subjects. The parameters that

will be assessed are the severity and prevalence of deficits for the types of knowledge mentioned above, and the depth of the amnesic gradient with public chronological knowledge, in each patient group. The expectation is that the temporal span of forgetting in remote memory will extend further for head-injured patients, as a consequence of widespread pathophysiologic effects.

Finally, it is proposed that a somewhat temporally-limited pattern of forgetting will be evidenced on the RMQ by patients with mixed pathologies of brain damage.

In summary, this thesis examines the dimensions of remote memory impairment, and the relationships with AA, cognitive functioning, and IQ. Graded effects on the ascending activation paths which modulate retrieval and consolidation, together with changes in cortical-thalamic paths, are hypothesized to result in RA variants. According to this theory, then, the RA that results from diffuse brain insult is expected to affect hippocampal and reticular-mammillary circuits, which are posited to mediate processing of both personal events and neutral facts. In contrast, RMQ deficits of Post-ECT and mixed patient groups, wherein pathology is

probably located in the reticular-hippocampal circuit, amygdaloid nuclear complex, and fornix, is predicted to affect episodic memory.

Hypotheses

Subgroups of patients with brain damage representing focal, as well as multifocal or "widespread" lesions, were evaluated with a remote memory questionnaire that is composed of categories that were constructed to discern the magnitude of deficit in forms of generic and episodic knowledge, in addition to a battery of tests that probe general recent memory functioning, new-learning, recent memory, naming, and intelligence. The assumptions that are challenged in this investigation are, first, that RA rarely occurs without AA and,secondly, that the severity of RA is strongly correlated with the severity of the AA that accompanies neuropathology. The third assumption that is challenged herein, concerns the premise that episodic memory is selectively disrupted, whereas subsets of semantic knowledge, namely, generic and singular, are expected to be affected in a minimal way for the patient groups.

Finally, this thesis will examine the extent of forgetting on the Public Chronological category of RMQ for patients from different etiologic groups, with the objective of obtaining characteristic patterns.

CHAPTER 2

Method

Sample Selection

Initial Selection Criteria. The patient groups were comprised of 10 depressed, non-psychotic inpatients that were scheduled to undergo a course of bitemporal ECT within three days; 13 head-injured inpatient and outpatient subjects with Glasgow Coma Scale (GCS) ratings that are predominantly in the mild and severe range (n = 5, for each rating), in addition to three inpatients whose admission GCS ratings were in the moderate range; and, a group of mixed etiology brain-damaged subjects (n = 8) who were selected for rehabilitation due to severe memory difficulty and psychotherapy, because they were identified as amnesic. The selection criteria for subjects included: (1) minimum age 20, to insure that there is a sufficient fund of factual, public, and autobiographical knowledge from which to measure deficiency; (2) completion of primary school education; and (3) the absence of an acute medical condition, psychosis and, with respect to subjects who were scheduled for ECT seizure disorder or identified neuropathology.

Normal Control Subjects

Subject Selection. Normal control subjects were

recruited for participation in the study via personal references. Individuals were questioned for the presence of acute medical conditions (e.g., cardiac arrest or disease); endocrinologic dysfunction; epilepsy; concussion or severe head injury with loss of consciousness; developmental learning disabilities; and, suggestion of congenital or early structural damage. The screening procedure for intact subjects also included a background inquiry, which probed substance usage and psychiatric history. Normal controls were matched to head-injured and mixed brain-damaged subjects on the basis of age, sex, and years of education. The "control" values for ECT patients were pre-ECT baseline scores on tests that were selected for this group.

Patient Subjects

The demographic characteristics of the 31 subjects in this investigation are displayed in Table 1. Selection variables are described as follows for the three patient groups, in tandem with their matched controls.

ECT. The characteristics of this sample are listed in Table 2. The mean age of the 10 subjects in this sample was 69.8 years (range 52-86 years). The sex distribution was seven females and three males. The mean educational attainment of the sample was 9.6 years (range 4-16 years). These subjects are distinguished by the

Table 1

Sample Characteristics

Group	Age[a]	Sex		Handedness	Education[a]
		Female	Male		
			Electroconvulsive Treatment (ECT)[b]		
	69.8 8.7	7	3	Right	9.6 3.4
			Head-injured		
Patients[c]	43.4 13.5	4	9	Right = 9 Left = 3	12.9 1.2
Controls[c]	43.8	4	9	Right	13.5 2.0
			Mixed brain damage		
Patients[d]	49.5 15.0	2	6	Right = 7 Left = 1	12.7 2.3
Controls[d]	46.5 14.5	2	6	Right	12.9 2.2

[a] *M* value

SD value

[b] *n* = 10

[c] *n* = 13

[d] *n* = 8

Table 2

Demographic and Clinical Features of ECT Patients

	Age	Education	Sex	Duration of psychiatric condition[a]	Suspected neuropsychologic dysfunction (+/-)[b]
RR	65	12	F	1 year	-
EA	71	11	F	20 years	-
NB	70	8	F	1 year	-
NK	63	13	M	1 year	+
CM	75	12	F	1 year	-
SH	68	8	F	1 year	+
JC	79	6	M	2 years	+
CS	52	4	F	3 years	+
HC	86	6	M	2 months	-
EE	69	16	F	9 years	-

[a] Number of years between the approximate date of onset of severe depression, i.e., first hospitalization, and year that testing was done.

[b] Referral for neuropsychological evaluation as a part of the pre-ECT work-up.

fact that half stopped attending school before high school. All patients were right-handed. Median length of their psychiatric condition was two years, ranging from two months to nine years. The subjects were middle-class whites who were admitted to the psychiatry division of Montefiore Hospital (Bronx, NY). Neuropsychological testing was ordered for four patients, due to the suspicion of organic brain dysfunction, in view of patterns that were detected from serial mental status assessments, an abrupt onset of deterioration in day-to-day activities that was reported by relatives, attending physician, and acquaintances; and minimal or non-response to antidepressant medication trials.

Head-injured Patients. The demographic characteristics of this group are shown in Table 3. The mean age of the 13 subjects was 43.4 (range 26-62 years). There were four females and nine males; three patients in this group were left-handed.

The mean number of years of education for patients was 12.9 (range 11-18 years). With one exception (G.M.), patients in this group completed high school. The mean Full Scale IQ score for head-injured patients was in the average-range (M = 94.4, range 82-138). The mean estimated pre-morbid IQ score (Wilson et al., 1979) was 106.6 (range 91-129). The mean score on the Mattis

Table 3

Demographic and Clinical Features of Head-injured Patients

	Age at injury	Education	Premorbid IQ estimate	Sex	IQ	Severity[a]
J.L.	43	14	115	M	89	Severe
J.M.	61	12	105	F	83	Mild
E.C.	33	12	91	M	61[b]	Severe
R.B.	45	13	112	M	84	Severe
E.M.	48	12	97	F		Mild
G.M.	28	11	93	M	82	Moderate
C.D.	26	12	106	M	96	Mild
M.F.	62	18	129	F	138	Moderate
D.N.	38	12	121	F	111	Moderate
L.W.	36	16	106	M	84	Mild
T.M.	35	12	108	M	91	Severe
M.M.	41	12	102	M	90	Severe
T.C.	62	12	101	M	91	Mild

[a] According to Glasgow Coma Scale (GCS) score (Teasdale & Jennett, 1974), which rates unsconsciousness as a composite of three responses to stimuli that induce wakefulness in the absence of brain damage: Eye opening, Motor response, and Verbal response.

[b] Mild aphasia.

Dementia Rating Scale (DRS) was 134.9 (range 121-144), which is in the brain-damaged category for this test. There were four patients whose scores fell below the cut-off for generalized cognitive impairment, which is in the demented range (121-129) and two patients whose scores (135, 137) were within the "brain-damaged," but not demented, category. The Information subtest of the Wechsler Adult Intelligence Scale-Revised version (WAIS-R) yielded M = 9.4 (range 6-16) and Vocabulary subtest M = 9.5 (range 6-16).

There were five patients with mild head trauma, based on admission Glasgow Coma Scale (GCS) scores of 13-14, three patients with moderate injury (GCS 9-12), and five patients with severe (GCS 6-8) head trauma. Over half of these patients incurred mild-to-moderate injuries secondary to falls. Patients who incurred severe head injuries (J.L. and E.M.) experienced impact to windshield or assault (patients E.C., R.B., and T.M.). Cases are described in Table 4.

Mixed Brain-damaged Patients. The eight patients in this group were allocated to subgroups on the basis of whether a focal lesion (AF) or widespread tissue damage (AW) was visible in CT scan, or presumed on the basis of the etiology of brain damage. The pathology and demographic characteristics of patients with

Table 4

Etiology and Neuropathology of Head Injuries

Patient	Etiology	Lesion Location
J.L.	Motor vehicle accident	Right posterior cerebral artery hemorrhage
J.M.	Fall from ladder;cervical dislocation	Right parietal & right mesial temporal
E.C.	Assault	Right frontal epidural hematoma and large fronto-parietal contusion
R.B.	Assault	Right frontal subdural hematoma; Right temporo-parietal contusion
E.M.	Motor vehicle accident	Slight concussion
G.M.	Fall from forklift	Right subdural hematoma
C.D.	Fall from subway platform	Left temporo-parietal hematoma, rule-out left posterior frontal hematoma
M.F.	Fall, with impact to occiput	No visible lesion
D.N.	Thrown by horse	Left temporo-parietal contusion; resolved to left temporal
L.W.	Gunshot	Right anterior temporal lobe resection
T.M.	Assault	Hemorrhage into right lateral ventricle
M.M.	Fall down stairway	Right fronto-parietal subdural hematoma; left ventricular shift, dilation of left lateral ventricle
T.C.	Fall to side-walk	Small right fronto-parietal subdural hematoma

heterogeneous etiologies of brain damage, excluding head trauma, is described in Table 5. Patients are assigned to subgroups with focal and widespread neuropathology.

The mean number of years of education for patients with mixed etiologies of brain damage was 12.7 (range 9-16 years). The mean Full Scale IQ score was 97.7 (range 86-120 IQ). The distribution of IQ scores for this group was not significantly different from the range of IQ scores of head-injured patients. The mean DRS score for patients was 132.5 (range 121-144); this score is in the range that is typical for dementia. Five patients were classified as non-demented, but they yielded scores that suggest brain damage (DRS score 135-144), and three patients (J.K., S.F., and J.R.) obtained scores that fell below the cut-off for dementia. The WAIS-R Information subtest $\underline{M}$ = 10.7 (range 7-16), and Vocabulary subtest $\underline{M}$ = 11.4 (range 8-16).

Most of the mixed etiology patients had a recent onset of neurologic impairment, with several exceptions: patient D.V., whose first generalized seizure occurred five years before testing; patient J.R., whose first abnormal EEG was recorded within a 20-year span, preceding memory testing, and S.F. who revealed diffuse brain damage, that was secondary to an hypoxic episode that occurred eight years prior to testing.

Table 5

Demographic and Clinical Features of Mixed Brain Damage Patients

	Age of Onset	Education	FS IQ	Length of Illness	Etiology, lesion location
			Focal damage (AF)		
D.H.	48	16	120	1	Subarachnoid hemorrhage, L posterior comm. artery; infarction in L temporo-parietal region
M.N.	36	12	86	1	Petit mal epilepsy
D.V.	33	12	94	5	Temporal lobe epilepsy
			Widespread damage (AW)		
J.R.	40-44	13	89	13-17	Korsakoff disease
J.K.	74	12	115	1	Communicating hydrocephalus
S.F.	34	12	93	8	Brain hypoxia, secondary to cardiac arrest
F.P.	68	9	98	1	Pituitary adenoma; infarction around posterior left sylvian fissure; diffuse vascular disease
L.R.	32	16	87	1	Huntington's disease

Control Subjects. The age of intact control subjects who were matched to head-injured subjects was M =43.8 (range 22-68). There were four females and nine males; all intact subjects were right-handed. The number of years of education was M = 13.5 (range 12-18 years). Information and Vocabulary subtests of the WAIS-R were administered to normal control subjects, however, these individuals did not receive either DRS, WMS, or the balance of WAIS-R subtests. WAIS-R Information subtest M = 12.0 (range 8-15), and Vocabulary subtest M = 11.6 (range 8-14).

The intact normal controls of the comparison group for mixed brain-damaged subjects yielded an age M = 46.5 (range 29-75). There were two females and six males; all intact controls were right-handed. The number of years of education was M = 12.9 (range 9-16 years). As stated above, intact matched controls did not receive the DRS, WMS, or balance of WAIS-R subtests. WAIS-R Information subtest M = 12.0, SD = 2.4, and Vocabulary subtest M = 11.6, SD = 2.2, for the normal control subjects that were matched to mixed brain-damaged patients.

Materials

The Goldberg-Barnett Remote Memory Questionnaire (RMQ) was the first measure in the memory test battery, and it was administered to all subjects. This test was

designed to assess the parameters of RA, namely, the prevalence, severity, and scope of the remote memory disturbance, as well as the gradient of forgetting with respect to event memory, for the different etiologic groups of brain-damaged subjects. The complete Wechsler Adult Intelligence Scale, Revised version (WAIS-R) was administered to brain-damaged subjects. However, intact normal controls who were matched to experimental subjects and ECT patients, received the Information and Vocabulary subtest of WAIS-R. A description of each test, information about reliability and validity, and patterns of results demonstrated by amnesics is provided below.

Retrograde Amnesia Evaluation

Goldberg-Barnett Remote Memory Battery (RMQ) (Goldberg & Barnett, 1985). This is a questionnaire that consists of 224 questions which assess four knowledge domains representing memory: Generic Factual, Singular Factual, Chronological Public, and Chronological Personal. The first category taps knowledge that is categorical and concerns attributes of common objects, the second evaluates non-contextual knowledge about the world, and the latter two are related to memory for well-known events, and personal data, respectively. Sample items are provided in Table 6. The test is administered in questionnaire form, whereby the subject

Table 6

Description of the Remote Memory Questionnaire

(1) Generic Facts (40 questions)

Examples:
What is the color of snow?
How many sides does a square have?
On what part of the body does one place a hat?

(2) Singular Facts (40 questions)

Examples:
Who was Rembrandt?
In what country is Tokyo?
What is produced by General Motors?

(3) Public Chronological Events (76 questions)

Organized by decades (1920s through 1930s).

Each subject receives only questions that pertain to events between his age of 15 and the onset of disease.

Examples:
What was Sputnik? (1950s)
What was the Bay of Pigs Affair? (1960s)
what was the Kent State incident? (1970s)

(4) Personal Chronological Events (68 questions)

Examples:
When did you take your first job?
Where did you go on your honeymoon?
In which hospital was your first child born?

is requested to retrieve information by a non-cued recall procedure (see Appendix A).

The instrument is a modification of prior remote memory assessment techniques, insofar as memory for both events and non-contextual knowledge is evaluated, in contrast to previous measures that were restricted to episodic recall (Seltzer & Benson, 1974; Squire & Slater, 1975). The Goldberg-Barnett Remote Memory Questionnaire assesses recall of past events with 76 questions pertaining to public chronological information from the 1920s, through the early 1980s.

The Personal Chronological category consists of a pool of 68 questions, addressing recall of autobiographcial information, that are pre-selected according to past and present circumstances of the individual, for instance, whether or not the subject is married, owns a car, has grandchildren, the name(s) of childrens' school, etc. Next of kin or a close friend was also obtained and questioned, for the purpose of validating subject responses

There are 40 questions about familiar objects and routine events that represent semantic knowledge, yet, which do not encroach on lexical or word retrieval ability (Generic Factual information) and another 40 questions that assess knowledge for several types of

information, including over-learned historical knowledge (country led by Queen Victoria?), geographic facts (the capital of Italy?), and general fund of knowledge (from what is a lightbulb made?).

The results of this study reveal that the Remote Memory Questionnaire is sensitive to cerebral dysfuncion and provided RA profiles, with respect to severity, scope, and temporal gradient of episodic impairment, for patient groups with different etiologies of brain damage that demonstrated significant deficits in recent memory and learning.

Anterograde Memory Tests

The Wechsler Memory Scale (Wechsler & Stone, 1945) and two modality-specific memory tests were administered following the RMQ: Kimura Recurring Figures Test (KRFT) and Buschke Selective Reminding Test (BSRT), which assess design recognition and list-learning for mixed category nouns, respectively. The memory tests were interspersed with measures of naming, global cognitive, and intellectual functioning, for the purpose of examining anterograde-retrograde memory deficit relationships, as well as to ascertain whether intellectual functioning is related to patterns of impairment for knowledge types in remote memory. The tests are standard anterograde assessment methods. Test

descriptions, reliability, and validity information are provided in the next section.

Kimura Recurring Figures Test (KRFT): (Kimura & McGlone, 1979). The KRFT is comprised of 160 3 X 5-inch cards, with either a simple "geometric" or, meaningful design, and a "nonsense" figure, which is an asymmetrical pattern that is not amenable to a strategy for improving retention, such as verbal encoding. The stimuli are 20 cards, with geometric or nonsense figures. After studying each card in succession, the patient is shown the remaining cards in the pack, one by one, for three seconds each. This stimulus set contains seven groups of eight of the original 20 designs interspersed within 84 unique design cards. The task is to identify cards that the subject has seen previously. A false affirmative response is a misidentification of a distractor design as target, specifically, as a card that was included among the set of original stimuli. Misrecognitions are subtracted from accurate recognitions to obtain a total score, effectively correcting for guessing (Brooks, 1974).

Kimura (1963) did not obtain a significant difference between the performance of right and left temporal-lobectomized patients on the KRFT, but right temporal-lobectomized subjects yielded nearly double the

number of false positive responses as left temporal-lobectomized subjects. Also, patients in the left temporal removal group recognized nonsense figures more frequently than right temporal lobectomy patients. Surprisingly, geometric designs were recognized more frequently following ablation of either temporal lobe.

Newcombe (1969) administered the KRFT to a group of patients in their forties, with lateralized lesions incurred in head injury and confirmed the higher rate of recognition for the left hemisphere-lesioned patients in comparison to age-matched normal controls. In fact, net mean scores on the KRFT for three left hemisphere-damaged groups exceeded the control group mean score. KRFT recognition scores of head-injured groups were lower than the performance of intact subjects, although none of the differences achieved statistical significance, due to a general tendency toward overinclusive errors in this task that was demonstrated by brain-damaged subjects. The latter response characteristic was noted by Brooks (1974). However, the incidence of false positive errors gradually diminished across successive blocks of 20 items in the 140 test cards, when incremental learning was assessed. A net score increase, which was created by a diminution in false positive errors across trials in both right- and left-lobectomized patients, emerged when

20-item response blocks were examined (Brooks, 1972, 1974). Furthermore, this pattern was continuous across prospective studies with these patients.

A group of older, severely head-injured subjects tested six months after the date of injury, yielded not only lower net scores than age- and education-matched controls, but a slower rate of learning across 20-card blocks than intact controls (Brooker & George, 1984). These subjects, who revealed a preponderance of right temporal damage, displayed impairment only in "initial learning" (Brooker & George, 1984, p. 250).

Lastly, education has been determined to influence intact individuals' performance on the KRFT. A German study administered a slide version of the test to healthy individuals, distributed into seven age groups (20-30 years, up to 65 years)(Rixecker & Hartje, 1980). Comparisons between age groups, for T-score transformations of net scores for individuals, did not yield significant differences. However, university-educated normal subjects fared better than those who had achieved 9-13 years of education. A complete item analysis, using Kuder-Richardson reliability formula, yielded $r = .94$ for this group.

Buschke Selective Reminding Test (BSRT): (Buschke & Fuld, 1974): Cumulative sum recall, Number of items learned, (Long-term storage - Long-term retrieval),

Recognition. This procedure was selected to measure new-learning and recent memory, not only because it is widely used in clinical research for the purpose of measuring memory impairments in dementia, head injury, and aging (Caine et al., 1977; Levin et al., 1979; Hannay & Levin, 1985; Macartney-Filgate & Vriezen, 1988), but because scores are separated into measures of short-term and long-term storage/retrieval, and there is a means of assessing verbal learning (Buschke, 1987).

Stimuli were 10 nouns selected from different categories, thereby composing a mixed composition, namely, clothing, animals, and objects that, were matched to target nouns in the non-categorical version of the BSRT. The stimulus nouns were selected for their agreement with Buschke's original stimuli, with respect to values for imagery (Toglia & Battig, 1978) and frequency of occurrence (Thorndike & Lorge, 1944). A pool of words was generated such that two lists of 10 words could be assembled, each with imagery and frequency values that are equivalent to the original Mixed List (Buschke & Fuld, 1974)

Selective reminding is a free recall technique, whereby the subject is reminded to produce target nouns. Immediately after the subject has exhausted recall for that trial, the tester recites all the words the patient

omitted in that trial. Reminding and recall procedures are alternated until the entire list is produced. Therefore, the technique tends to facilitate learning by focusing attention on non-retrieved items.

The non-categorical administration was selected to assess recent memory, inasmuch as categorical lists (e.g., animals, clothing), that evidence total recall after three selective reminding trials for normal individuals (Buschke & Fuld, 1974), would mask differences between intact controls and brain-damaged subjects on tests of anterograde memory functions. The sum of total recall over 10 trials, which is the cumulative sum of number of words that were recalled in each trial was entered into the data analysis. List learning, otherwise represented as the number of words retrieved in consecutive trials (CLTR), was also examined for subjects and matched normal controls.

BSRT Indicates Memory Impairment After Brain Damage. CLTR, together with Sum Recall (SR), were entered into an analysis that was designed to evaluate intercorrelations between three popular objective verbal memory measures, for patients with suspected or documented neuropathology (Macartney-Filgate & Vriezen, 1988). The subject sample consisted preponderantly of head-injured adults, in their early 30s. A correlational analysis was performed with

Wechsler Memory Scale (WMS) scores and CLTR and SR measures from the BSRT and Rey Auditory Verbal Learning Test (AVLT). The results demonstrated uniformly strong, positive associations between these scores and all WMS subtests, although the strongest association was between SR and difficult ("hard") associates from WMS Associate Learning subtest. Furthermore, the final recall trial of the 15-word list on the Rey AVLT, which requires repetition of all words after every recall trial, as well as the trial that is designated the "proactive interference" measure, which involves delayed recall of the first list, following recall of a second word list, were moderately correlated with the BSRT measures. These findings enhance the construct validity of BSRT, insofar as other techniques of assessing new learning, retrieval, and the integrity of encoding and retaining verbal stimuli provide scores that are significantly related to performance on the BSRT.

The BSRT appears to have utility in resolving etiologies on the basis of storage-retrieval patterns, in view of a study that showed a distinctive improvement across BSRT trials in the "long-term storage" (LTS) measure, whereby patients with a head injury that was rated moderate in severity sustained a 1-word lag behind

the LTS curve that was generated by patients with mild head trauma. The latter group achieved nearly total recall on the 10th-12th trials (Levin et al., 1979).

The BSRT was chosen as a measure of anterograde memory functioning, because it is conceived as a reliable technique for evaluating retrieval, due to the fact that, "... processing can be controlled to induce patients to carry out specific kinds of processing in a way that coordinates encoding and retrieval" (Buschke, 1987, p. 336).

Wechsler Memory Scale (WMS): Mental Control, Logical Memory, Visual Reproduction, Associate Learning (Wechsler, 1945). Criticisms of the WMS have concerned the restricted standardization sample, the equivocal nature of the test's validity, due to questions about the processes that are represented by component subtests, and the significance of the Memory Quotient (MQ), which has been challenged as an indicator of anterograde memory processes, due to its strong relationship to Full Scale IQ on the WAIS-R among normal individuals (Prigatano, 1978). Erickson & Scott (1977) provided information on reliability and validity of the test, which detracts from the power of this test for clinical purposes. In fact, the strength of the WMS as a diagnostic tool derives from the validity of the MQ-IQ discrepancy in neurologic

groups and a high reliability for indicating short-term verbal memory deficits, especially for left temporal lobectomized patients.

The subtests of the WMS that were selected to represent short-term memory capacities were: (A) Mental Control, which evaluates immediate attention and the capacity to sustain concentration; (b) Logical Memory, requiring recall for "ideas" contained in 2 detailed passages read to the patient; (c) Visual Reproduction, which resembles the Benton Visual Retention Test, insofar as complex geometric designs are briefly exposed, then the subject is required to recall the stimulus; and, (d) Associate Learning, wherein 10 noun pairs are presented, then the first associate in each pair is presented, as a retrieval prompt, in order to elicit the noun associate. The procedure is repeated three times, for the purpose of generating a learning curve.

Application of WMS for Memory Assessment in Amnesia. The WMS has high alternate-form reliability when Form I is administered after treatment (r = .80) (Stinett & Digiacomo, 1970). The majority of studies of test-retest reliability of one form, suggest that WMS subtests are stable over repeated testings with several patient groups. There is test-retest stability of the MQ after age correction, even in older groups (Prigatano, 1978).

In contrast, half of the subjects in a group of adults with neurological dysfunction, gained five or more points over a two-week test-retest interval, whereas matched healthy control subjects displayed a 10-point test-retest score improvement. In that study, reliabilty coefficients for WMS subtests were moderately high, in groups of intact and neurological adults, especially for Mental Control (r = .79); Information (r = .75); and, Visual Reproduction (r = .80). There were, however, weak relationships between test-retest scores of the Associate Learning and Logical Memory subtest (r = .68 and r = .62, respectively)

A summary of factor analysis studies of the WMS by Mayes (1986), points to two or three major factor loadings: "attention and concentration" which is comprised of Mental Control and Digits Forward/Backward, and "memory," which loads onto the Logical Memory, Associate Learning, and Visual Reproduction components. These subtest clusters were derived from performance by a combined pool of neurological and psychiatric patients, with an age range of 15-85 years, and yielded the factors: "Memory," which is a composite of Information, Orientation, Logical Memory, Visual Reproduction, and Associate Learning, in addition to a "Freedom-from-Distractibility" factor, that was composed

of attention and concentration subtests (i.e., Mental Control and Digits Forward/Backward)(Davis & Swenson, 1970). Items of the Mental Control subtest were associated with Digit Span, and the combined performance contributed to 31% of the total variance. These subtests composed a factor that was termed "Freedom-from-Distractibility," while passage learning, design memory, and Hard Associates from the Associate Learning subtest comprised a cluster that accounted for 37% of the variance. A third cluster was detected by Dujovne & Levy (1971) for neurologic and psychiatric patients, that was composed of "easy" and "hard" associates, to which they assigned the term "Associative Flexibility."

Additionally, there is evidence for a relationship between "hard" associate recall and recall for episodic information, whereas "easy" associate learning is reputed to require intact retention of both episodic and semantic memory (Wilson et al., 1982). Evaluating recall of rare and frequent word pair associates separately, facilitates differentiation between a pseudodementia syndrome, that is secondary to depression, and dementia, inasmuch as depressives have difficulty with the effortful retrieval of low frequency associates, whereas high frequency associates are typically recalled without difficulty. In

summary, depressives yield extreme differences between frequent and rare associates, whereas neurologic patients should be expected to manifest small differences between high and low frequency associate scores, by virtue of findings that implicate semantic deficits and episodic retrieval deficits in dementia (desRosiers & Ivison, 1986).

Other subtests of WMS have recently been found to differentiate between organicity and depression. For instance, Digit Span is strongly related to the degree of cognitive dysfunction, in the negative direction (r = -.76), and the delayed version of passage recall is moderately and negatively related to patients' scores on mental status screening tests (r = -.52). Depression affects these WMS subtests to a minimal degree, but brain-damaged patients who were also depressed, revealed substantial deficits on these tests (Gass & Russell, 1986). Previous studies have documented MQs in the 70s for Korsakoff patients (Victor et al., 1959), diminished post-operative MQs for left temporal lobectomy compared to right temporal lobectomy patients (Milner, 1968) and, broadly speaking, larger (Full Scale - MQ) values. The IQ-MQ discrepancy and the pronounced MQ diminution is typical of left medial temporal dysfunction. MQ drops after bilateral ECT when retesting is done within a

24-hour period (Fromholt et al., 1973). Yet, unilateral nondominant ECT influences WMS verbal measures in a non-significant way, however, ECT that is applied to the dominant hemisphere or bilaterally lowers performance on WMS verbal subtests to an extensive degree, albeit transiently. Conversely, retention of verbal stimuli from the WMS is not affected when anterior brain regions are stimulated (Gottlieb & Wilson, 1965).

Diffuse brain damage does not significantly affect the MQ. However, the cases that were included in these studies were distinctive for demonstrating chronic functional deterioration. The bulk of these studies were done in the 1950s, preceding brain imaging technology, thus, structural localization is, at best, equivocal. Tne mean MQ was generally in the 90s for patients with neuropathology that was secondary to different etiologies, however, this performance range was not only characteristic of brain-damaged subjects, since matched controls yielded equivalent scores (Parker, 1957).

On the other hand, the validity of the MQ for diagnosing AA in elderly subjects is questionable (Erickson & Scott, 1977), but normative corrections for WMS scores exist (Hulicka, 1966). A comprehensive study of WMS performance in elderly groups (Margolis & Scialfa, 1984) utilized data that was culled from previous studies

of recent memory in healthy elderly subjects and older patients with identified neurologic disease (Bigler et al., 1980), and compared their performance with scores of subjects in the 20 year-old range from Wechsler's (1945) database. The analyses indicated broad differences between age groups, that were distributed into five categories: 20s, 40s, 50 to 75, 70s, and 80 to 92 years. Essentially, older subjects exceeded the performance of younger groups in subtests that probed orientation and personal information items, but performed significantly below healthy young adults with respect to Visual Reproduction and Associate Learning. The largest age-related differences on the WMS were demonstrated in the subtests: Associate Learning, Digit Span, Mental Control, and Logical Memory.

Broadly speaking, however, comparisons of WMS subtest scores with normative values from elderly standardization groups have not yielded valid profiles of attention and memory for elderly, neurologic and psychiatric populations. For instance, there is a significant relationship between education and MQ for a hospitalized geropsychiatric group, with an age range of 66 to 88 years (Piersma, 1986), whereby educated individuals obtained higher total scores on WMS than less-educated individuals, as well as large admission-to-discharge total score changes over a period of one month.

Retrospective evaluations of WMS scores for depressives, reveal substantial gains from an evaluation done at admission to pre-discharge re-testing (Piersma, 1986). Depressed inpatients demonstrate significant decrements in both verbal and visual WMS subtests, in contrast to matched normal controls, irrespective of age (Stromgren, 1977; Breslow et al., 1980). Specifically, depressives without neurologic disease and no history of ECT, displayed a diminution in the "Mental Control" factor, which is determined to consist of the WMS subtests, Orientation, Mental Control, and Digit Span Forward, in contrast to the performance of demographically comparable intact control subjects (Breslow et al., 1980).

It is evident from the aforementioned findings that age and psychiatric condition exert a considerable effect upon both recent and remote memory functioning, therefore a design wherein large groups of depressed inpatients that are scheduled for ECT are matched to inpatients with medical conditions, and entered into analyses, following treatment, along with scores of depressives receiving pharmacotherapy, would have been unwieldy and statistically less powerful than the post-to-pre-ECT comparisons that were utilized for this investigation.

Other Tests

Dementia Rating Scale (DRS)(Mattis, 1976). This is a brief, but comprehensive measure of mental status that can be administered when alterations in behavior or cognitive functioning raise the question of dementia. The advantages of this technique in relation to other measures of overall cognitive functioning are the scale's validity, insofar as it includes the domains that are sensitive to degenerative conditions, the fact that administration time is brief, and that extraneous materials are not required. Additionally, exclusion criteria for successful performance on an initial item of a section is an effective time-saving feature.

The five areas that are covered by the Scale consist of (I) Attention, which includes digit sequencing and following simple single and multi-step commands; (II) Initiation and Perseveration, which taps verbal fluency, confrontation naming, repetition, and a motor-graphomotor component;(III) Construction; (IV) Conceptualization, which consists of simple analogous and inductive reasoning; and (V) Memory, which evaluates both verbal and non-verbal retention with recall and recognition formats.

WAIS-R Information and Vocabulary subtests were administered to all intact control subjects for purposes of matching normal subjects to brain-damaged patients. These tests provided an indication of fund of general knowledge and lexical ability. Furthermore, scores on the Information and Vocabulary subtest have been hypothesized to be resilient to acute brain injury (Russell, 1972), which qualifies these measures for subject matching.

The complete WAIS-R was administered to every head-injured and mixed etiology brain-damaged subject, in order to establish a level of general intellectual functioning (Smith, 1966; Russell, 1972). The Boston Naming Test (Kaplan et al., 1976) was administered to all patients for the purpose of measuring the integrity of lexical retrieval, with the objective of assessing relations between naming and retrieval on the RMQ.

Boston Naming Test (Goodglass & Kaplan, 1983). This is a test of word retrieval, which presents objects as line drawings. It is a modification of the Visual Confrontation Naming subtest of the Boston Diagnostic Aphasia EXamination, insofar as the former features items that can be rank-ordered according to the frequency of the word that corresponds to the illustration. The objects that were selected consist of 60 illustration of

graded difficulty, beginning with "bed" and ending at "abacus." Stimuli are nouns that do not have alternative names. In the event that illustrations are misperceived or not recognized, semantic or category cues that are unique to items may be provided as prompts to facilitate retrieval. Also, if the subject does not spontaneously name the object with 20 seconds, but recognizes the illustration, a phonemic cue is offered. The categories of responses of the Boston Naming Test are:

1. Number of items named spontaneously.
2. Number of items named with self-correction.
3. Number of items named subsequent to stimulus cue prompting.
4. Number of stimulus cues provided.
5. Number of phonemic cues provided.
6. Total number of correct responses, including total spontaneous initial naming + number of items named subsequent to stimulus cues.

The Boston Naming Test (BNT) is moderately correlated (r = .62) with the Aphasia Severity Rating Scale of the Boston Diagnostic Aphasia Examination, a language assessment method that is composed of eight ordinal scales. The BNT measures processes that are distinctive from the lexical and language processing skills that are tapped by WAIS-R Verbal scale subtests, in view of the

weak, non-significant correlations between BNT and WAIS Vocabulary (r = .46), and Verbal IQ (r = .27).

Word retrieval is known to remain stable in aging until the 70s, at which time there is a sharp decline (Albert et al., 1988). BNT performance is highly correlated with the Clinical Dementia Rating (r = .81) for subjects who were identified with symptoms of Alzheimer's dementia (Knesevich et al., 1986). Moreover, longitudinal administrations of the BNT revealed that subjects with the lowest scores invariably progressed to more severe dementia than the sub-group of subjects that evidenced a mild dementia and attained higher BNT scores.

WAIS-R Information subtest (Wechsler, 1981). This subtest of the WAIS-R Verbal scale is composed of 29 questions which, "...gives the subject's range of information...often indicates alertness of a person to the world around him, " and "...presupposes a normal or average opportunity to receive verbal information" (Matarazzo, 1972, p. 197). The items probe general facts, such as "name three presidents of the United States since 1945" and "at what temperature does water freeze?"

This WAIS-R subtest was selected for the matching procedure, so that the knowledge base of demographically matched normal subjects could be determined and patients

with an equivalent knowledge base could be selected. The Information subtest was one of the two measures chosen for this purpose, because it is the WAIS-R subtest that is most strongly associated with Full Scale IQ (r = .87). thus, it is surmised that Information provides a sense of general intellectual capacities. Additionally, there are stronger correlations between Information scores of normals and subtests of the Performance Scale, than with another "neutral" subtest, such as Digit Span. Test-retest reliability for Information is high: r = .97.

WAIS-R Vocabulary subtest (Wechsler, 1981). This subtest of the Verbal Scale assesses learning ability, fund of knowledge and estimates "the general range of ideas" (Matarazzo, p. 197). Items are arranged in rank order of difficulty, based on the frequency of occurrence and the extent of abstract attributes; there is a high proportion of verbs. The subtest is unique from other WAIS-R components, insofar as performance does not decline with age: The number of words that are accurately defined by 25-50 year-old individuals is constant. However, difficult words are "passed" more frequently by older than younger individuals. Vocabulary is strongly related to general intelligence in normals: r = .86 for ages 25-34; r = .87 for ages 45-54 (Wechsler,

1981). Lastly, this measure has traditionally been considered to be a reliable indicator of intellectual functioning subsequent to brain damage, insofar as performance in this subtest does not deviate by a significant amount from the pre-morbid level (Lezak, 1981).

The total number of correct responses for subtests of the WAIS-R were transformed into scaled scores. Then, these standardized scores were entered into statistical analyses.

Wechsler Adult Intelligence Scale-Revised (WAIS-R)(Wechsler, 1981). The WAIS-R is a test of intellectual abilities that measure skills which cluster into 3 groups, according to hierarchical cluster analysis (Silverstein, 1985): "Verbal Comprehension," composed of Information, Vocabulary, Comprehension, and Similarities; "Perceptual Organization," which consists of Block Design and Object Assembly for most age groups; Picture Completion for half of the age groups; and, "Freedom from Distractibility," which consists of the cluster of Digit Span and Arithmetic for nearly all age groups, in addition to Digit Symbol, for one age group. This cluster resembles a "Memory factor," that was derived from an earlier factor analysis (Wallbrown et al., 1974). Variables such as educational background and academic

skills, contribute to WAIS-R performance in normal adults (r = .70, for the relationship between adult IQ and years of schooling)(Matarazzo, 1972).

The WAIS-R is purported to detect cerebral dysfunction with considerable accuracy, in terms of its usefulness in detecting unilateral and diffuse hemispheric dysfunction by virtue of Verbal-Performance discrepancies. Left-hemisphere-lesioned patients demonstrate Performance IQ advantages and right- or bilaterally-damaged groups demonstrate relatively lower Performance IQ (Bornstein, 1983). The magnitude of difference between the two scales that is pathognomonic of left hemisphere involvement has been found to average only 4.9 points, but the Verbal IQ-Performance IQ split averages 10.7 points for patients who are detected to bear right unilateral brain damage.

Procedure

The battery of tests, which consisted of the RMQ, recent memory tests and, for brain-damaged subjects, the Dementia Rating Scale and WAIS-R, were administered following a background interview and personal data-gathering, for the purpose of selecting questions for RMQ Personal Chronological recall. A description of the tests and their application followed, which lasted for 10-minutes. The introductory portion of testing

ended with presentation of the informed consent document (Appendix B) to all subjects and, if the individual requested, aspects of the procedure were explained by the tester. Patient subjects were informed that the results of tests would be submitted to their attending physician; also, brain-damaged outpatients were informed that test results would be incorporated as part of the diagnostic work-up that preceded the implementation of a rehabilitation program (Kovner et al., 1981).

The battery was administered by J. Barnett to all patients and control subjects, thereby eliminating the issue of inter-rater agreement for response to RMQ items. The tests were administered according to standard procedures, for those instruments that are commonly utilized for cognitive and memory assessment. A single order of administration was established, however, the battery was administered in two sessions so that fatigue effects and, consequently, alteration in the subjects' drive level, were minimized. Thus, memory tests, the BNT, and DRS comprised the first session, which was followed by a second session that was scheduled to occur within two days, for administering the WAIS-R. The memory and cognitive measures composed a two-hour session, excluding the IQ test, which was completed in 1 hr 45 min. All told, the administration time for the battery did not exceed three hours.

Two equivalent forms of the BSRT and two counterbalanced orders of administration of the items in each RMQ category, were generated for this study. Also, each patient received a different sequence of RMQ categories, which was identical to the sequence that was administered to matched normal controls. Likewise, subjects scheduled for ECT received identical orders of RMQ categories in pre- and post-ECT test sessions and the same item order within each category, but alternate forms of the BSRT and WMS, which are equivalent in difficulty level, were administered following ECT. This precaution was taken to prevent the possibility that stimuli could be retained over the two-week pre-to-post-ECT interval. The order of RMQ category administration was counterbalanced across subjects, together with the two versions of items that composed each category, which consisted of alternative pseudorandomized item orders. Subjects were assigned the next order of category administration, as they presented for testing. Matched normal subjects were given the same order of the RMQ, as well as the same equivalent BSRT and WMS forms. Questions evaluating autobiographical memory were pre-selected according to the subjects's circumstances, therefore, different items might be administered to patients and their controls, according to each

individual's personal experiences. The tests in the battery are listed below, in their order of administration:

First session: (1) Remote Memory Questionnaire (RMQ)
(2) Kimura Recurring Figures Test (KRFT)
(3) Boston Naming Test (BNT)
(4) Buschke Selective Reminding Test (BSRT), Mixed List
(5) Dementia Rating Scale (DRS)
(6) Wechsler Memory Scale (WMS), Form I or II

Second session: (7) Wechsler Adult Intelligence Scale-Revised version (WAIS-R)

Subjects that were scheduled for ECT were presented with the RMQ and neuropsychological tests (KRFT, BSRT, and BNT) two days preceding the first treatment in a series of eight to ten. These subjects were next retested with the same test battery immediately after the fifth treatment, once post-ictal disorientation had resolved, but not longer than 45-50 minutes after the convulsion, which insured global disorientation. Brevity in testing was the objective, therefore, indices of global memory (WMS) and cognitive functioning (DRS, WAIS-R) were intentionally excluded from the battery. At

the completion of testing, normal control subjects were paid $15.00, and summaries of test findings with impressions of memory and cognitive functioning were provided to treatment teams for depressed inpatients.

Statistical Analyses

Analyses were conducted using the SPSS statistical package (SPSS, Second Edition, 1975). An two-tailed alpha level of .05 was used as the criterion for rejecting the null hypothesis in the comparisons that were performed in this investigation, unless otherwise indicated.

Inasmuch as the variance of age and education of patients was high, both intra- and inter-group differences were analyzed with matched sampling techniques, utilizing a parametric measure for the ECT sample, Spearman rho, for the purpose of examining relationships between remote memory and anterograde memory, interrelationships between RMQ categories, and between RMQ and cognitive, intellectual skills for the etiologic groups.

Analyses will be presented for each pathological group in order to describe the prevalence and degree of RA, as well as the relationship between AA and RA, and relationships between remote memory, intelligence and cognitive measures. Finally, the temporal gradient of forgetting with RMQ Public Chronological items will be

presented for each patient group. These analyses were selected not only to delineate the dimensions of RA, AA, and their interrelationship, and the relationship of these conditions to cognition and intellectual functioning, but also to investigate the usefulness of a new remote memory test. This technique would be utilized to "finetune" profiles of remote memory disturbance that accompany various forms of neuropathology.

Thus, results are reported for the following dimensions, based on patient and control data:

(1) Prevalence of anterograde amnesia.

(2) Prevalence of retrograde amnesia.

(3) Relationship between prevalences.

(4) Severity of retrograde amnesia.

(5) Severity of retrograde amnesia in comparison to anterograde amnesia.

(6) Correlation between anterograde amnesia and retrograde amnesia.

(7) Scope of retrograde amnesia.

(8) Structure of retrograde amnesia construct.

(9) Correlations between retrograde amnesia, cognitive functioning, and intelligence.

(10) Correlations between retrograde amnesia, word retrieval, and general knowledge.

(11) Temporal patterns of remote memory disturbance.

Performance on RMQ categories was represented as Percent Correct, which is composed of: total raw score (0-2 points)/number of category items administered. The denominator of this ratio was fixed at 40 for the two Factual categories, Generic and Singular, but the number of items from the Public Chronological category varied with the extent of knowledge that is established during the years between the patient's 15th birthday and the date of onset of encephalopathy or acute insult. Thus, all items that dealt with information which would be encoded during the years of the decade that contained the individual's fifteenth birthday, and the years preceding that year, were excluded from the inquiry. Similarly, items from the years that followed the date that trauma was incurred, or, the estimated onset of neuropathology, were eliminated.

Percent Correct scores were analyzed with dependent and independent contrasts, correlational analyses, and were converted to $\underline{Z}$-scores ($\underline{M}$ = 0, $\underline{SD}$ = 1), to establish the prevalence of anterograde and retrograde memory impairment and to assess the relationship between RA and AA for the groups. Transformation of the Percent Correct scores into standard scores was accomplished with the formula, (Percent Correct for patient - Mean Percent Correct for matched normal controls)/(Standard Deviation

of Mean Percent Correct for matched normal control group). The scores of ECT patients were transformed into standard scores with the formula, (Post-ECT Percent Correct - Pre-ECT Mean Percent Correct)/(Standard Deviation of Pre-ECT Mean Percent Correct).

Patient standard scores that were at or below -1.5 Z-scores from the mean were classified as deficient, therefore, these scores represented prevalence data. This parameter is presented in this study by the rank order listing of Z-scores that fall in the "pathological" range. Z-scores for anterograde memory (Busum) and retrograde memory (RMQ) scores were then subjected to paired comparisons, which yielded the relationship between prevalences of retrograde and anterograde amnesia. Patient RMQ Z-scores that were classified in the impaired range, were compared with anterograde memory scores that also indicated deficiency, via paired group t-tests.

The severity of remote memory deficits were compared with the severity of anterograde memory deficits for each patient group, with simple t-tests for correlated Z-scores. Correlational analysis, done with Spearman Rank Correlations, because of small sample sizes and the lack of adherence of the Z-scores to a normal distribution, were conducted for the purpose of examining correlations between RA and AA.

The scope of RA was evaluated with independent sample t-tests for patient and control group Percent Correct recall scores for every category of the RMQ.

The structure of the RA construct was ascertained with non-parametric correlations (Spearman Rank Correlations) between categories of the RMQ.

Finally, relationships between RA, AA, and cognitive/intellectual performance were obtained with a parametric correlation, Pearson r.

The temporal extent of forgetting utilized sum correct scores for Public Chronological sections (1920s through 1980s), that include the decade subsequent to that of the patient's 15th birthday, through the year that corresponds to the onset of neuropathology. The total correct score for the items was divided by the number of items that were administered (Percent Correct) on the basis of age and date of injury or ECT. Mean scores for decades were compared with the mean Percent Correct scores for those decades that were achieved by matched normal controls. Independent t-tests were done, contrasting the performance of patients and controls, by decade. Remote memory "forgetting curves" for patient groups and matched intact control groups are presented in the figures.

CHAPTER 3

Results

Subject Variables

Since none of the test scores were found to be significantly associated with the variables age, sex, or education, then group comparisons for these data were not done. The absence of significant correlations between test performance and the demographic variables precludes an analysis of covariance of RMQ scores and age. There were, however, moderate-to-strong direct relationships between anterograde memory measures and education for patients that were assessed following ECT. Results of analyses, done with Spearman Correlation coefficient appear in Table 7.

It was not expected that RMQ performance would be so closely related to patients' educational attainment: there was a moderately strong relationship between Generic Factual retrieval and years of education for subjects who were scheduled for ECT (Pre-ECT baseline evaluation), that persisted across treatment. Thus, this finding implies that there is a sub-category of semantic knowledge which is resistant to an acute brain injury, in individuals with more education. On the other hand, for patients with heterogeous etiologies of brain damage, educational attainment was noted to be strongly related

Table 7

Relationship between Memory/Cognitive Performance and Matching Variables

Tests	Age	Education	Sex[a]
Pre-ECT			
Generic Factual		.65, p = .02	
Boston Naming, spontaneous correct		.55, p = .05	
KRFT, recognition, number of hits		.67, p = .02	
BSRT, number of items learned		.73, p = .01	
Post-ECT			
Generic Factual		.64, p = .02	
Boston Naming, number of phonemic cues	-.56, p= .05		
Head injury[b]			
Wechsler Memory Scale, Memory Quotient (MQ)			.60, p = .05
WAIS-R Verbal IQ		.49, p = .05	
Performance IQ			.70, p = .006
Full Scale IQ			.64, p = .012
Mixed brain damage[b]			
RMQ Public Chronological		-.64, p = .04	
RMQ Personal Chronological		.73, p = .03	
Boston Naming, Correct All Ways[c]	.67, p= .03		
KRFT, recognition, number of false affirmatives	-.72, p= .03		.85, p = .003
BSRT, items learned	-.87, p= .002		
Memory Quotient (MQ)[d]		-.64, p = .04	
Mental Control			-.69, p = .03
Visual Reproduction		.70, p = .03	
WAIS-R Verbal IQ	.71, p = .02		-.76, p = .01
Full Scale IQ	.69, p = .03		-.76, p = .01

[a]Male = 1, Female = 2.

[b]Matched normal controls were excluded from the analysis.

[c]Spontaneous + self-correct + correct with stimulus prompt + correct with phonemic cues.

[d]Pearson r correlational analysis.

retrieval of personal knowledge, whereas a moderately strong, inverse relationship between education and retrieval of episodic knowledge was shown among patients with mixed brain damage. These results could realistically be explained in the frame of a chronic progression of pathophysiologic processes that would disrupt event encoding and, consequently, memory processing. Individuals with higher education would be more attuned to the cognitive concomitants of their neurologic condition, therefore, they would be more likely to practice personal facts, which would overshadow an orientation to day-to-day events and recent facts. Indeed, this explanation is borne out in results that point in the direction of moderately strong, negative correlations for general anterograde memory capacities, according to the MQ, simultaneously with the emergence of a strong, positive association between public event retrieval and educational attainment for amnesics with mixed etiology of neuropathology.

In contrast, moderate-to-strong positive correlations between scores on the BSRT and KRFT, with education at the Pre-ECT evaluation, did not carry-over across ECT. Thus, it is assumed that the protective function of education with respect to recent and remote memory, following neuropathology due to trauma or disease, was inactivated for depressives who received ECT.

Furthermore, older subjects with mixed neuropathology yielded higher response thresholds for KRFT stimuli; there was a strong, inverse relationship between False Affirmative rate on KRFT and age, albeit these subjects displayed verbal learning impairment. There was a tendency for females in the mixed brain damage group to obtain lower WAIS-R Verbal and Full Scale IQ scores than males. The fact that Mental Control scores for females fell below that of males with mixed brain damage, suggests that attention-concentration was compromised to a greater extent among females. However, the IQ advantage for head-injured females suggests that ascending reticular pathways from brain stem, which are hypothesized to mediate attention-arousal, or modulatory cortical circuits, were influenced to a greater extent by ECT than following head injury. Nevertheless, the sex differences in memory and cognitive functioning are described for small samples.

Group Performance on Remote Memory Test Categories

RMQ scores for patients and controls, presented in Table 8, reveal substantial discrepancies between mean correct recall scores of pathological and normal individuals for the two brain-damaged groups, as well as between Post-ECT and Pre-ECT baseline RMQ scores for episodic knowledge.

Table 8

Group Performance on Remote Memory Questionnaire (RMQ)

Types of Knowledge		Patient Group					
		ECT		Head injury		Mixed	
		Post-	Pre-	Patient	Control	Patient	Control
Generic Factual	M	91.87	95.0	92.5	98.25	96.5	98.0
	SD	2.2	1.5	5.8	.6	1.2	.6
Singular Factual	M	69.35	74.45	79.0	90.75	86.75	90.5
	SD	6.3	8.2	4.2	3.6	5.3	4.4
Public Chronological							
	M	46.72	56.12	61.8	83.7	66.9	86.4
	SD	16.9	19.8	17.2	14.2	13.9	11.0
Personal Chronological							
	M	68.05	82.37	73.7	92.4	81.0	94.6
	SD	13.6	17.45	15.6	9.4	11.2	4.6

Note. The values represent mean percentages of correctly recalled RMQ items.

The results that were described above confirm the theory that recall for knowledge that is temporally-constrained is vulnerable to forgetting following brain damage. Additionally, mean percent recall scores of head-injured and ECT subjects on Singular and Generic Factual categories, suggest that the remote memory impairment after acute and chronic neuropathology impinged upon semantic knowledge, to a significat degree.

Group Performance on Other Neuropsychological Tests

Verbal Anterograde Memory Tests. Differences between groups for other neuropsychological tests were analyzed by dependent *t*-tests for Pre-ECT (baseline) and Post-ECT scores, and with independent sample contrasts for head injury and mixed brain damage groups. The group means and results of analyses performed on scores from the BSRT, KRFT, and WMS subtests appear in Table 9.

There were statistically significant performance decrements on the BSRT for head-injured and mixed brain-damaged patients. The first group revealed a significant impairment in verbal learning, revealed as lower total recall, $t(24) = 2.66$, $p < .01$, and stored fewer items in long-term storage that are retrieved in a consistent way, or, "learned," $t(24) = 2.97$, $p < .01$, than matched normal control subjects. Similarly, patients

Table 9

Group Performance on Anterograde Memory Tests

Tests		ECT Pre-	ECT Post-	Head injury Controls	Head injury Patient	Mixed Control	Mixed Patient
BSRT							
Busum	M	64.8	51.5[a]	84.5	71.1[b]	79.4	58.1[c]
	SD	13.0	12.3	9.6	15.4	17.0	9.5
Bulearn	M	2.7	1.7	9.6	6.1[d]	6.5	2.9
	SD	1.9	3.2	2.6	3.4	4.2	2.9
KRFT[e]							
Kimhit	M	31.0	27.9	35.6	34.8	31.6	30.9
	SD	10.2	11.6	8.3	11.7	10.7	6.4
Kimfalse	M	11.8	8.4	11.9	16.7	7.6	11.0
	SD	10.4	10.2	6.6	14.7	4.6	6.5
Wechsler Memory Scale		Normative Values[f] 20-29 years	40-49 years	Head injury		Mixed	
Memory Quotient	M	105	90.71	101.0		95.9	
	SD	10.0	20.1	22.8		11.6	
Mental Control	M	7.5	6.6	6.8		7.7	
	SD	2.0	1.9	2.3		1.5	
Logical Memory	M	9.3	8.1	7.8		6.6	
	SD	3.1	2.5	2.6		2.2	
Visual Reproduction	M	11.0	8.3	8.1		7.4	
	SD	2.7	3.1	4.7		3.8	
Associate Learning	M	15.7	13.9	11.8		11.0	
	SD	2.8	3.1	4.3		3.4	

[a] $t = 1.98$, non-significant.

[b] $t = 2.66$, $p < .01$.

[c] $t = 3.07$, $p < .01$.

[d] $t = 2.97$, $p < .01$.

[e] No values were statistically significant.

[f] Age-adjusted values for younger individuals with mean Full Scale IQ 102.9, SD = 5.5, and older group mean Full Scale IQ 102.9, SD = 6.6.

with heterogeneous etiologies of brain damage displayed significant decrements on the BSRT, in comparison to the performance of matched normal control subjects, $t(14) = 3.07$, $p < .01$. However, patients with mixed brain damage yielded scores that did not differ from the performance of normals for list-learning, $t(14) = 2.0$, n.s. No significant differences were obtained for any group with respect to recognition of BSRT list items, or on the KRFT. These results were not anticipated, given the sensitivity of those measures to mesial temporal lobe dysfunction and the high incidence of bitemporal structural lesions among brain-damaged subjects who participated in this study. It is noteworthy, however, that a non-significant trend was reported for traumatically-injured patients with lateralized lesions by Newcombe (1969), whereby left-hemisphere-lesioned patients obtained slightly higher KRFT scores in comparison to the scores of groups with right hemisphere lesions and matched control subjects, although none of the group differences achieved statistical significance. Additionally, brain-injured patients yielded approximately the same rate of false positive errors as matched normal control subjects, although normals achieved higher net total scores (Brooks, 1974).

The fact that the two brain-injured groups were not

distinguished from normals by their WMS Memory Quotient mean scores, is consistent with the idea that the MQ has low validity for the purpose of differential diagnosis (Lezak, 1983). The age-adjusted sum of WMS subtest scores for head-injured and mixed brain damage groups was essentially in the average-range, although the distribution of scores for head-injured patients was highly variable. Mixed etiology brain-damaged subjects, though, demonstrated diminished scores in logical Memory, Visual Reproduction, and Associate Learning, yet, these scores were not significantly lower than the age-adjusted mean values for these subtests. Additionally, both brain-injured groups yielded Mental Control scores that were comparable to normative values. Associate Learning was the single WMS subtest that was significantly lowered, relative to normative values, and only for head-injured subjects.

Other Verbal Tests. Group means from the WAIS-R Information and Vocabulary subtest and the Boston Naming Test (see Table 10) suggest that this head-injured patient sample was impaired in lexical ability, fund of knowledge, and visual confrontation naming, in view of statistically significant differences between patient groups and their matched control cohort. Paired contrasts between mixed etiology brain-damaged subjects

Table 10

Group Performance on Other Verbal Tests

Test		Patient Group			
		Head-injured		Mixed brain damage	
		Patient	Control	Patient	Control
WAIS-R[a]					
Information	M	9.4[b]	12.1	10.7	12.0
	SD	2.5	3.1	2.9	2.4
Vocabulary	M	9.5[b]	12.4	11.4	11.6
	SD	3.0	3.1	2.4	2.2
Boston Naming Test Spontaneous Correct	M	58.2[c]	70.1	67.7	66.4
	SD	9.7	8.9	8.5	6.7
Number stimulus cues	M	2.6[b]	.9	1.2	1.1
	SD	4.8	2.5	1.4	1.3
Number of phonemic cues	M	18.8[d]	6.9	9.2	13.1
	SD	6.7	7.7	6.0	6.2
Correct with phonemic cues	M	9.5[d]	3.7	5.4	7.4
	SD	2.7	3.3	3.5	3.1
Total correct	M	59.1[c]	70.5	68.7	66.6
	SD	9.4	8.3	8.8	6.7

[a]Age-corrected value.

[b]$p = .03$.

[c]$p = .003$.

[d]$p = .00$.

and intact control subjects, however, were not significant. It is important to emphasize, though, that the lexical ability of mixed brain-damaged patients is greater than among head-injured subjects: average and high average-range general knowledge, vocabulary, and word retrieval characterized the mixed etiology group's performance. Furthermore, patients in the mixed brain damage group required fewer stimulus and phonetic cues to facilitate confrontation naming than did head-injured subjects.

The results thus described suggest that lexical skills of patients who are considered to display "classical" amnesia were considerably above head-injured patients' Vocabulary and word retrieval scores, although this pattern should be interpreted in the light of the preponderance of older subjects in the mixed etiology group.

Cognitive Tests. The Dementia Rating Scale scores for patients, and WAIS-R subtest and composite scores are presented in Table 11. Mean DRS scores for both groups suggest diffuse cognitive dysfunction, mean summary scores approximated the cut-off value (135) for a dementia. Seven patients obtained demented-range scores.

WAIS-R subtest and total scores were in the average-to-low average-range, relative to normative values.

Table 11

Group Performance on Cognitive Tests

Test	Patient Group			
	Head injury		Mixed brain damage[a]	
	M	SD	M	SD
Dementia Rating Scale[b]	134.6	8.0	132.5	8.1
WAIS-R[b]				
Verbal IQ	95.0	12.1	100.0	12.9
Performance IQ	91.7	19.4	95.0	12.1
Full Scale IQ	93.2	16.3	97.7	12.9
WAIS-R subtest[c]				
Information	9.4	2.5	10.7	2.9
Digit Span	9.6	3.1	10.1	3.2
Vocabulary	9.5	3.0	11.4	2.4
Arithmetic	8.7	3.6	9.9	2.2
Comprehension	8.8	2.9	10.6	2.1
Similarities	9.4	3.5	9.7	1.6
Picture Completion	8.3	3.0	9.4	2.2
Picture Arrangement	10.1	4.3	9.8	2.7
Block Design	9.1	2.5	9.7	2.2
Object Assembly	8.8	2.9	9.0	2.2
Digit Symbol	7.3	2.8	8.2	2.0

[a]Values are based on $n = 8$.

[b]Values are based on $n = 11$; values are age-adjusted scaled scores on WAIS-R and for DRS, raw score, 144 total points.

[c]Values are based on $n = 12$.

The Digit Symbol subtest mean score for head-injured subjects was -1.7-Z, relative to the normative value for normal subjects, ages 25-34 (M = 10.2, SD = 2.7). Capacity to sustain attention, psychomotor speed, and visual associative memory are the functions tapped by this subtest. Digit Symbol is reputedly the most sensitive WAIS indicator of brain damage (Golden, 1981, p. 93).

Prevalence of Anterograde Amnesia

The occurrence of anterograde memory performance deficits among patients in comparison to matched controls was examined, for all etiologic samples.
The incidence of a score on an anterograde memory test that is 1.5 or more standard deviations below matched control mean values, was utilized to assess the prevalence of recent memory impairment in each patient group. Head-injured subjects revealed a greater incidence of impaired scores on the BSRT than other groups. Specifically, there was a greater proportion of head-injured subjects yielding pathologic-range Z-scores than there were in the ECT and mixed brain damaged goups (see Table 12).
It deserves emphasis, though, that small sample sizes and a moderate standard error for means of these Z-scores preclude relative statements about prevalence of AA.

Table 12

Prevalence of Anterograde Amnesia

ECT	Head injury	Mixed brain damage
-2.6	-4.0	-2.0
-1.7	-3.7	-1.7
-1.7	-3.2	-1.6
	-3.0	
	-3.0	
	-2.7	
	-2.1	

Note. Z-scores for BSRT based on normal control group performance, and baseline scores for the ECT group.

These results suggest that anterograde memory impairment was indeed present in each group. Additionally, there was a large proportion of head-injured patients with impaired Z-scores, in comparison to other etiologic groups.

Prevalence of Retrograde Amnesia

A matrix of RMQ category Z-scores of patients, according to etiologic groups (see Table 13) reveals, again, that head-injured subjects yielded a relatively higher incidence of pathological scores. In addition, there were dissociations between sub-categories of knowledge, insofar as mixed group subjects demonstrated a more extensive range of impairment in one RMQ episodic category, Personal Chronological, than in the other category.

Overall, the fact that there was a preponderance of brain-damaged patients with pathological scores in all RMQ categories, indicates that RA is characterized by deficits in subdomains of episodic and semantic knowledge. In contrast, patients that were evaluated following ECT revealed a large proportion of impaired scores on Personal recall, while deficits in Generic and Public Chronological knowledge were infrequent

Table 13

Prevalence of Retrograde Amnesia

RMQ Category	Patient Group ECT	Head injury	Mixed
Generic Factual	-4.0	-5.2	-4.1
	-1.7	-3.6	-2.6
	-1.7	-2.8	-1.9
Singular Factual		-3.8	-2.7
		-2.4	
		-2.1	
		-2.0	
		-1.9	
Public Chronological	-1.6	-3.3	-4.0
		-3.3	-2.8
		-2.8	-2.1
		-2.5	-1.8
		-2.2	-1.6
		-1.7	
Personal Chronological	-1.8	-4.4	-5.6
	-1.6	-4.0	-5.6
	-1.5	-3.7	-5.0
	-1.5	-3.0	-2.3
		-2.7	
		-2.3	
		-1.9	

Note. Z-scores based on normal control group performance on categories of the Remote Memory Questionnaire (RMQ) that are -1.5 Z-scores.

and the incidence of impairment in singular Factual recall did not significantly differ from pre-treatment values.

Relationship between Prevalence of Retrograde and Anterograde Amnesia

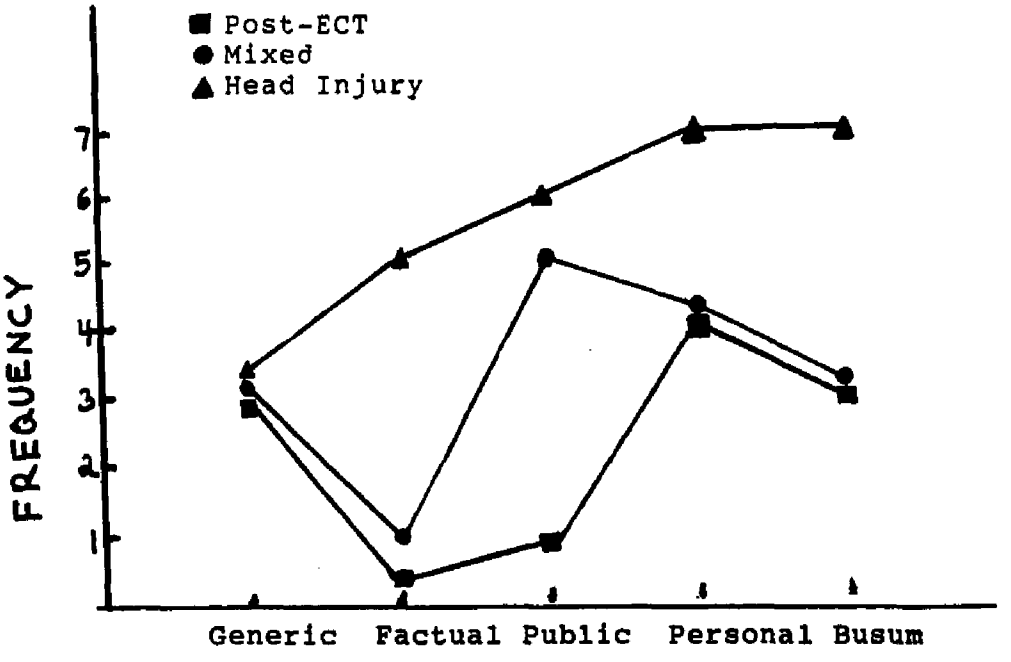
A comparison of RMQ and Busum Z-scores (see Figure 1) shows that the incidence of pathological scores in both Public and Personal knowledge is similar to the incidence of anterograde memory impairment. Furthermore, the incidence of impaired performance on the Generic Factual category was comparable to the prevalence of verbal learning deficits, at least for the mixed and ECT groups. Nevertheless, a comparison between standard values on different constructs does not imply statistical equivalence.

Severity of Retrograde Amnesia

The median of pathological Z-scores on the BSRT for head-injured subjects was below the median Z-score values for Generic Factual and Personal Chronological retrieval (Md = -3.6 and -3.0, respectively) on the RMQ. Similarly, mixed brain-damaged subjects demonstrated

Figure 1

Prevalence of Anterograde and Remote Memory Deficits in ECT and Brain-Damaged Groups[a]



[a]Number of Z-scores that are ≥ -1.5-Z for Post-ECT group, head-injured group, and patients with mixed etiologies of brain damage.

Generic = RMQ Generic Factual knowledge

Factual = RMQ Singular Factual knowledge

Personal = RMQ Personal Chronological knowledge

Busum = Aggregate sum of items recalled across 10 trials of the BSRT.

severely diminished scores in these domains: Generic Factual Md = -2.6 and Personal Chronological Md = -5.3.

In contrast, median Z-scores for RMQ categories yielded by patients treated with ECT, clustered near the cut-off score for pathological performance. In sum, these results suggest that Post-ECT RA is less severe than the RA that was revealed for patients with identified structural pathology.

Severity of Retrograde Amnesia Compared to Anterograde Amnesia

ECT. The degree of remote memory impairment for these patients was equivalent to the severity of AA, according to results of t-tests for Z-scores of correlated samples, comparing the BSRT measures "Busum" and "Bulearn," and the KRFT measures "Kimhit" and "KimFalse" (see Table 14).

Head injury. The results of correlated t-tests between RMQ and Busum Z-scores indicates that the severity of remote memory deficit was equivalent to recent memory impairment (see Table 15), most prominently for knowledge domains that assess episodic information. Furthermore, recent memory and Personal Chronological retrieval for these subjects were strongly associated (r = .71).

Mixed brain damage. The severity of remote memory

Table 14

Severity of Retrograde and Anterograde Amnesia After ECT

	Retrograde Memory Test	
RMQ Category	M	SD
Generic Factual	-.84	1.45
Singular Factual	-.10	.76
Public Chronological	-.47	.85
Personal Chronological	-.82	.78
	Anterograde Memory Test	
BSRT		
Busum	-.87	.99
KRFT		
Kimhit	-.30	1.14
Kimfalse	-.32	.98

Table 15

Severity of Retrograde and Anterograde Amnesia after Head Injury Relationship

	Retrograde Memory Test	
RMQ Category		
	M	SD
Generic Factual	-1.0	1.8
Singular Factual	-1.3	1.2
Public Chronological	-1.6	1.3
Personal Chronological	-1.9[b]	1.7

	Anterograde Memory Test	
BSRT		
	M	SD
Busum[a]	-1.8	1.5

[a]Total cumulative recall of ten trials.

[b]Pearson correlation coefficient = .71, $p = .009$.

impairment was approximately equivalent to the severity of AA for these patients, except for the greater degree of impairment in autobiographical memory (see Table 16).

In summary, an examination of severity data for the groups suggests that remote memory deficits tend to be milder than anterograde memory deficits, with the exception of the pronounced Public and Personal recall scores that were revealed by mixed brain-damaged patients in comparison to matched control values.

Relations between Retrograde Amnesia and Anterograde Amnesia

The relationships between RMQ Z-scores and recent memory performance, which is represented by Busum, were subjected to Spearman Rank correlational analysis. A correlation coefficient matrix is presented (see Table 17), and indicates that remote memory scores were not significantly related to recent memory performance, with one exception--there was a strong direct relationship between Busum scores and personal event recall for head-injured subjects. Although RMQ category Z-scores were not related to Z-scores on the AA measure, it is not logical to infer that the null hypothesis is confirmed, that is, that in view of the lack of significant relationships between the preponderance of RMQ scores for patients and respective recent learning scores, then RA is presumed independent from AA.

Table 16

Severity of Retrograde and Anterograde Amnesia in Mixed Brain Damage Relationship

	Retrograde Memory Test	
RMQ Category		
	M	SD
Generic Factual	-1.0	1.8
Singular Factual	- .3	1.3
Public Chronological	-1.8	1.2
Personal Chronological	-3.0	2.4
	Anterograde Memory Test	
BSRT		
	M	SD
Busum	-1.2	.5

Table 17

Correlations among Remote Memory Tests and Recent Memory[a]

	Spearman Rank Correlations		
	Patient Group		
	ECT	Head injury	Mixed
RMQ Category			
Generic Factual	-.2	.02	-.4
Singular Factual	-.3	-.1	.3
Public Chronological	-.4	.1	.2
Personal Chronological	-.2	.7[b]	-.3

[a]BSRT as recent memory measure, specifically, Busum.

[b]$p = .009$.

Scope of Retrograde Amnesia

The results that are presented in Table 18 substantiate the idea that RA affects knowledge in an extensive way. These results disconfirm the hypothesis that remote memory losses in RA are constrained to contextual or episodic memory, inasmuch as independent *t*-tests for *Z*-scores, which are based upon matched normal control performance, indicated significant impairments in both Generic and Singular Factual scores on the RMQ for patients. Moreover, there was a dissociation between recall for semantic knowledge for ECT subjects, whereby retrieval of Generic Factual information was markedly deficient, yet, retrieval of Singular Factual information was relatively preserved.

In contrast head-injured patients demonstrated a deficit in Singular Factual recall when their performance was contrasted with matched normal control subjects. Thus, the pattern of findings that is described above does, indeed, conform to a functional dissociation, insofar as certain etiologies yielded selective impairment of semantic knowledge retrieval, simultaneously with mild or relatively negligible effects on episodic retrieval.

The head-injured and mixed brain-damaged groups revealed Public and Personal Chronological retrieval

Table 18

Scope of Retrograde Amnesia on RMQ

	Patient Group		
	ECT[a]	Head injury[b]	Mixed brain damage[b]
RMQ Category			
Generic Factual	2.41[c]		
Singular Factual		3.08[e]	
Public Chronological		3.53[f]	3.11[g]
Personal Chronological	2.72[d]	3.56[f]	3.16[g]

[a]Post- and Pre-ECT paired contrasts, utilizing Percent Correct recall values.

[b]*t*-test for independent samples, with Percent Correct recall values.

[c]$p = .04$.

[d]$p = .02$.

[e]$p = .005$.

[f]$p = .002$.

[g]$p = .008$.

deficits that were considerably more severe than for the Post-ECT group. The remote memory impairment for ECT subjects, however, affected only autobiographical recall.

Relations between RMQ Categories: Structure of the RA Construct

Significant inter-relationships were found between RMQ semantic knowledge recall scores and episodic knowledge recall for ECT and head-injured samples. A Spearman rank correlational analysis of patient Z-scores, that were derived from matched normal control performance (see Table 19), reveals that the two semantic categories, Generic and Singular Factual knowledge, were strongly related for head-injured patients. Post-ECT and mixed brain-damaged samples, in contrast, did not demonstrate significant relationships between Factual categories of the RMQ. Public Chronological recall was strongly and mildly correlated with Singular Factual knowledge for subjects in the ECT and head-injured groups, respectively. Personal Chronological recall was moderately correlated, in a positive direction, with Generic Factual recall exclusively in the Post-ECT sample.

Thus, it is reasonable to assume that subdomains of knowledge that are considered to be functionally related, are observed to be invulnerable to changes that accompany

Table 19

Interrelationships between RMQ Categories

	Generic Factual	Singular Factual	Public Chronological	Personal
Generic Factual		.43	.35	.63[b]
		.74[c]	.06	-.08
		.25	.39	.12
Singular Factual			.75[a]	.35
			.48[d]	-.06
			.49	-.33
Public Chronological				.59
				.02
				-.39

Note. Correlations represent performance of: ECT, head injury, and mixed brain damage groups, in top-bottom order. Analyses were done with Spearman Rank Correlation Coefficient, using Post-ECT Percent Correct score, for ECT patients, and Percent Correct score for patients, compared to matched control subjects' Percent Correct scores, for head-injured and mixed brain-damaged patients.

[a] $p = .01$, two-tailed.

[b] $p = .05$, two-tailed.

[c] $p = .004$.

[d] $p = .048$, one-tailed.

recovery from traumatic injury. However, the correlational data from mixed neuropathology and ECT subjects hints at dissociations within knowledge categories. It then follows that etiologies which are expected to yield multiple lesion sites might influence activation-arousa mechanisms in a graded way.

The evidence for strong, positive relationships between performance on episodic and semantic categories of the RMQ for patients who were assessed after post-ictal confusion had passed, suggests that knowledge organization in LTM is somehow "sensitized" to changes that alter intra-domain associations.

Relationships between Retrograde Amnesia, Cognitive Functioning, and Intelligence

The next set of analyses examined relations between cognitive functioning (DRS score), general memory capacities, represented in the Wechsler Memory Scale, intellectual functioning measured with the WAIS-R, and remote memory, according to the RMQ.

The results of a parametric correlational analysis indicate that recall for episodic knowledge was directly associated with general cognitive abilities for the head-injured sample, but not the other groups. Subjects

with a history of head trauma yielded strong, positive relationships between DRS performance, and recall for Personal and Public Chronological items: r = .72, p = .004 and r = .53, p = .004, respectively. These results suggest that the RMQ categories that are considered "episodic" are more sensitive to the diffuse cognitive sequelae of head injury, than the information that is subsumed in the Singular Factual category of the RMQ. The mixed etiology group, though, did not reveal significant relationships between any knowledge type that is subsumed in the RMQ and measures of cognitive functioning.

However, recall for information that is considered episodic on the RMQ was moderately-to-strongly related to general anterograde memory functioning, on the WMS, for both brain-injured groups: r = .79, p = .01 and r = .6, p = .03, with respect to mixed brain-damaged and head trauma groups. In contrast, neither of the RMQ categories that include forms of semantic knowledge were significantly correlated with MQ performance for those groups. This data suggests that retrieval for both Personal and Public event knowledge is linked to the integrity of recent memory to a greater extent than Factual knowledge retrieval.

A strong association between prose recall and paired

associate learning, with Public Chronological recall (r = .73 and r = .72, p = .02) was demonstrated by mixed brain-damaged subjects. Yet, there was a strong negative relationship between immediate recall for designs, with the Visual Reproduction subtest of WMS, and Generic Factual retrieval (r = -.73, p = .02). The positive correlation between immediate recall for verbal stimuli and recall for public events among mixed etiology brain-damaged subjects confirms the profile of a "pure" amnesia.

Finally, head-injured patients displayed mild-to-moderate correlations between RMQ recall and WAIS-R performance, on the basis of Verbal, Performance, and Full Scale IQ: r = .54, p = .03 with Verbal IQ; r = .61, p = .018 with Performance IQ; and, r = .6, p = .016 with Full Scale IQ. Subjects with heterogeneous etiologies revealed a moderate positive relationship between Factual recall and Performance IQ (r = .6, p = .04). Lastly, there were moderate relationships between WAIS-R scale attainments and recall for autobiographical information, as follows: r = .49, p = .05 with Verbal IQ; r = .53, p = .04, with Performance IQ; and, r = .54, p = .04, with Full Scale IQ. These results substantiate the expectation that semantic knowledge retrieval and intelligence, assessed with the WAIS-R, are interrelated.

Additionally, autobiographical recall seems to be related to cognitive-intellectual abilities for individuals who have incurred serious head injuries in the past.

Relationship between Retrograde Amnesia, Word Retrieval, and WAIS-R Information/Vocabulary

Spearman rank correlations were performed with RMQ Percent Correct scores, total correct items on the Boston Naming Test, and Information and Vocabulary age-scaled scores of the WAIS-R, to determine whether remote memory, as assessed by RMQ performance, is related to word retrieval, fund of information, and word knowledge. The analyses revealed moderate-to-strong associations between word retrieval and Singular Factual knowledge for patients in Post-ECT, head injury, and mixed brain-damaged groups: in that order, $r = .72$, $p = .02$; $r = .58$, $p = .03$; $r = .82$, $p = .01$ (one-tailed). Singular Factual recall and fund of knowledge were moderately related for head-injured subjects, $r = .69$, $p = .02$.

The data discussed above suggest that Generic and RMQ categories that assess episodic recall in patients who have been treated with ECT, and those that bear structural brain damage which is secondary to various etiologies, is not interrelated with lexical skills and general knowledge. The results do, however, indicate that Singular Factual retrieval appears to be associated with

naming in any type of neuropathology. However, head-injured patients evidenced a pattern whereby recall for facts that are over-learned, in other words, the knowledge that is represented by the Singular Factual RMQ category, is not only associated with naming ability, but also with fund of information.

Temporal Depth and Pattern of Remote Memory Deficit

ECT. The Percent Correct recall scores for each decade that was included in the Public Chronological knowledge category of RMQ is presented, by patient, in Table 20. The forgetting curves that are generated by patients in the Post-ECT group indicate an extensive temporal deficit which includes items that pertain to events that occurred as far back as the 1940s for several patients, whose performance is compared to their matched normal control forgetting curve

When pairs of Pre- and Post-ECT Percent Correct recall scores for decade subdivisions of the Public Chronological category of RMQ were subjected to paired t-tests, there were significant contrasts between patients and matched normal subjects for the 1980s, $t(9) = 2.4$, $p = .04$ and the 1970s, $t(9) = 2.4$, $p = .04$. The temporal gradient of remote memory impairment following ECT is displayed in Figure 2. The mean percent recall scores for Public Chronological knowledge, by decades, are shown in Table 21.

Table 20

Breakdown of Temporal Patterns by Decade for ECT Group[a]

	Decades of Public Chronological									
	1980s[b]		1970s[c]		1960s		1950s		1940s		1930s	
Case										
1	2	71	26	93	34	80	29	100	79	100	55	91
2	10	13	11	49	31	31	47	60	57	79	55	64
3	0	0	10	9	30	30	34	24	26	23	38	37
4	0	4	2	57	30	31	33	36	24	59	55	66
5	2	32	25	70	51	59	59	90	68	68	55	55
6	41	61	50	65	66	65	50	60	79	89	65	64
7	1	12	32	40	51	51	58	47	79	46	100	100
8	2	12	64	48	80	80	80	79	69	69	64	64
9	0	1	25	25	29	29	33	23	23	12	55	36
10	2	12	48	48	51	59	58	47	68	68	73	73

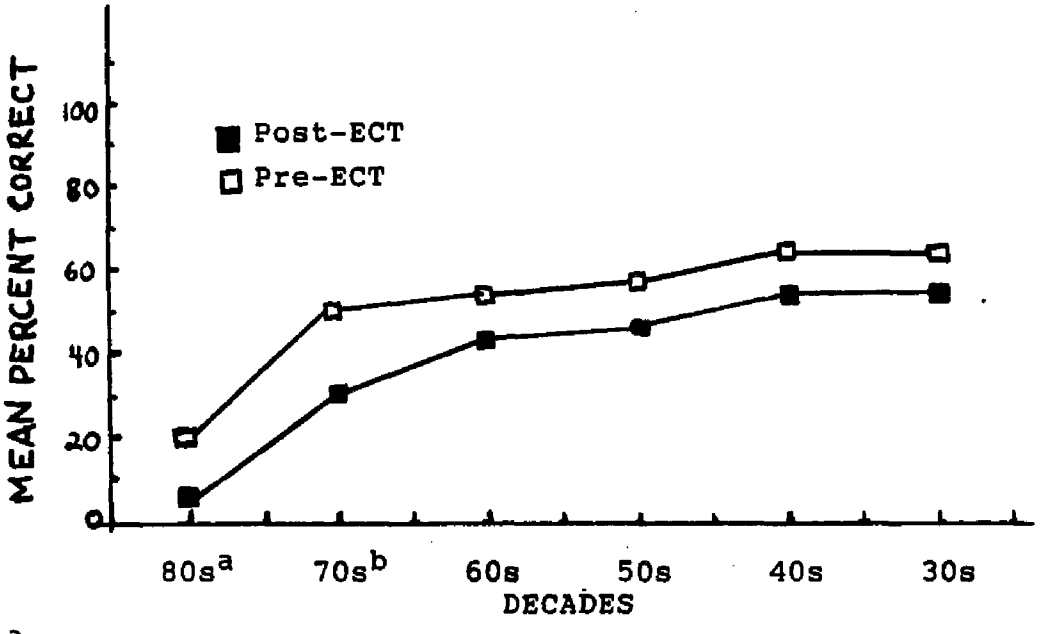
[a]Total Percent Correct, for Pre- and Post-ECT testing, right and left columns, respectively.

[b]Wilcoxon Signed-Ranks Test for matched pairs yielded a significant value for Pre-ECT with Post-ECT comparison, $Z = -2.67$, $p = .008$, two-tailed.

[c]Comparison between Post- and Pre-ECT Percent Correct performance is significant, $p = .04$.

Figure 2

Temporal Patterns of Amnesia for Public Chronological Knowledge in ECT Group



[a]Comparison between Post- and Pre-ECT percent correct performance is statistically significant ($p = .04$).

[b]Comparison between Post- and Pre-ECT Percent Correct.

Table 21

Public Chronological Knowledge Recall for ECT Subjects

		Decades of Public Chronological						
		1980s	1970s	1960s	1950s	1940s	1930s	1920s
Post-ECT	M	6	29.3	45.3	48.1	57.2	57.2	70.5
	SD	12	19.7	17.6	16.2	23.7	9.7	14.9
Pre-ECT	M	21.8	50.4	51.5	56.6	61.3	61.1	65
	SD	25.1	23.4	20.3	26.5	27.6	17.1	20

Head injury. Group means for head-injured patients and normal controls are displayed for Public Chronological knowledge by decade, in Table 22. Correlated *t*-tests for patient and matched control performance in each decade (see Figure 3) yielded a temporally-extensive pattern of remote memory disturbance, which extended to the 1950s. Results of paired contrasts for the 1980s, 1970s, 1960s, and 1950s revealed statistically significant differences, as follows: $t(12) = 2.2$, $p = .05$; $t(12) = 3.1$, $p = .009$; $t(10) = 2.5$, $p = .03$ and, $t(6) = 2.7$, $p = .03$, respectively.

Mixed brain damage. The temporal extent of forgetting for Public Chronological information reached to the 1960s (see Table 23). The mean Percent Correct Recall scores for patients and matched normal controls (see Table 24) were significantly different for RMQ items in the 1980s, $t(4) = 2.9$, $p < .05$, and the 1970s, $t(6) = 4.5$, $p < .01$.

Paired contrasts for the items that are included in the Public Chronological category 1960s and 1950s subdivisions did not reveal significantly lower scores for patients, in comparison to matched normal subjects' scores, $t(6) = 2.2$, $p > .05$, and $t(4) = 1.8$, $p < .2$. Thus, the evidence that the differences between performances of

Table 22

Public Chronological Recall After Head Injury

		Decades of Public Chronological					
		1980s	1970s	1960s	1950s	1940s	1930s
Patient	M	42.8[a]	57.4[b]	58.5[c]	55.9[c]	68	58.7
	SD	29.8	29.1	16.8	19.3	11	22.1
Control	M	67.9	83.6	81.2	82.7	78.3	67.3
	SD	22.3	11.2	18.2	18.3	28.5	18.9

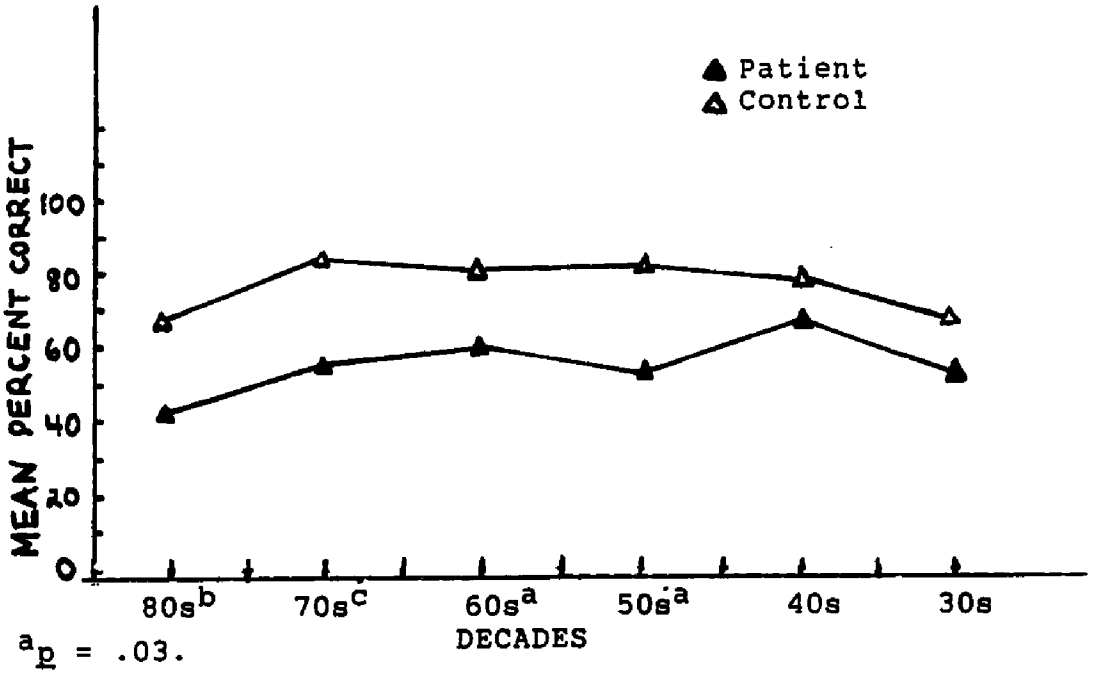
[a] $p = .05$.

[b] $p = .009$.

[c] $p = .03$.

Figure 3

Temporal Patterns of Amnesia for Public Chronological Knowledge in Head Injury



[a] $p = .03$.

[b] $p = .05$.

[c] $p = .009$.

Table 23

Temporal Patterns for Mixed Brain Damaged Group

Case		Decades of Public Chronological 1980s[a]	1970s[b]	1960s[c]	1950s[d]
1	Patient			39	61
	Control			86	100
2	Patient		69	68	94
	Control		88	86	100
3	Patient	62.5	54	57	89
	Control	75	88	89	89
4	Patient		50	65	55
	Control		95	92	100
5	Patient	60	77	82	
	Control	50	65	61	
6	Patient	50	88	86	89
	Control	65	85	75	89
7	Patient	25	50	77	
	Control	80	81	89	
8	Patient	25	42		
	Control	70	65		

Note, Values represent total Percent Correct.

[a]Paired t-test, $p < .05$.

[b]Paired t-test, $p < .01$.

[c]$p > .05$.

[d]$p < .2$.

Table 24

Public Chronological Recall in Mixed Brain Damage

		Decades of Public Chronological			
		1980s	1970s	1960s	1950s
Patient	M	44.5[a]	61.4[b]	67.7	77.6
	SD	16.4	15.6	14.9	16.2
Control	M	68	81	82.6	95.6
	SD	10.3	10.8	10.1	5.4

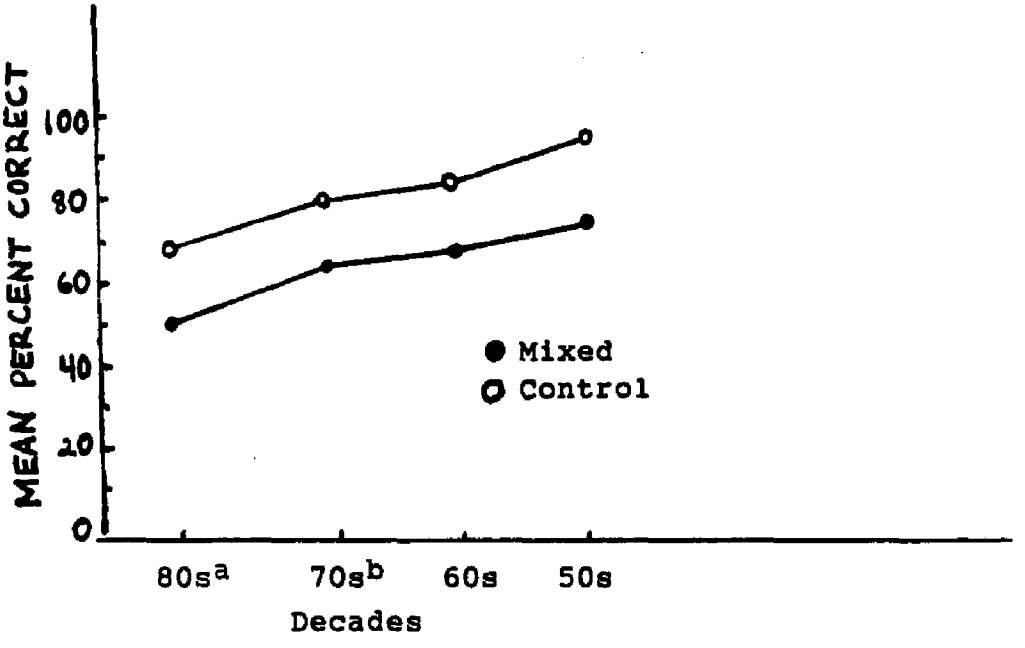
[a] $p < .05$.

[b] $p < .01$.

brain-damaged patients and their matched controls did not affect recall for information that occurred in the years later than two decades preceding the onset of pathology in each case (see Figure 4), supports the conclusion that the group with mixed etiologies of brain damage was characterized by a less extensive temporal pattern of forgetting in remote memory than the head-injured group.

Figure 4

Temporal Patterns of Amnesia for Public Chronological Knowledge in in Mixed Brain Damage



[a] $p < .05$.
[b] $p < .01$.

CHAPTER 4

Discussion

Characteristics of Retrograde Amnesia in ECT and Brain-damaged Samples

Results of comparisons between patients and matched controls confirmed a basic premise of this thesis, namely that types of semantic knowledge that are established in LTM, are affected to the same extent as contextual knowledge in RA following brain damage or ECT.

Thus, not only did patients in different etiologic groups demonstrate approximately equivalent losses in RMQ Public and Personal Chronological knowledge, in comparison to normal control levels, but there was also significant forgetting of semantic knowledge, namely, Singular Factual information, which was pronounced for subjects with head injury. However, retrieval of Generic Factual knowledge, as expected, was relatively stable.

The contention that remote memory deficits are as prevalent as recent memory impairment was valid for all three patient samples. This hypothesis was borne out with respect to both episodic and semantic memory. Moreover, the magnitude of deficit for the knowledge types that are evaluated with the RMQ for these samples were comparable and, even more severe, than concomitant

anterograde memory deficits. The prediction that RA might be manifested without a substantial AA was revealed in correlational analyses involving RMQ and anterograde test standard values, precluding the close association between autobiographical recall and performance on anterograde measures in the head-injured sample. As expected, results of these analyses are consistent with reports describing profound and dissociated RA (Goldberg et al., 1981, 1982; Roman-Campos, Poser, & Wood, 1980), that manifests with a slowly resolving AA. The fact that both semantic and episodic knowledge in LTM were not associated, for the most part, with recent memory in samples with acute and chronic etiologies of neuropathology, suggests that cerebral mechanisms which mediate the storage and retrieval of remote memory are distinctive from anatomical substrates that are responsible for consolidation/retrieval of recent memory.

Also, this study yielded functionally distinctive patterns with the RMQ for patient samples, which suggests that this instrument is a sensitive indicator of selective deficits in LTM but, more importantly, the data support the parallel circuit model of limbic structures, which provide phasic modulation of activation-arousal in the retrieval of information from remote memory (Goldberg, 1984). The head-injured and mixed brain

damage samples revealed a relatively more profound remote memory deficit, in comparison to matched normal subjects, than the sample assessed shortly after bitemporal ECT. Thus, it is conceivable that there is a pathophysiologic basis for the functional distinction yielded by these groups on the RMQ which could be explained by an influence on ascending reticular paths that activate limbic circuits in the latter two samples. These changes may involve subcortical structures, in an extensive way, in contrast to ECT effects, which are predominantly restricted to bitemporal neocortex. Additionally, the dissociations between, as well as within, the contextual and non-contextual categories of RMQ are further evidence for a "multivariate" model of RA, whereby there would be adjacent, but interactive long-term storage systems. Although this investigation did not attempt to correlate lesion location with selective impairments on the RMQ, it is not implausible to suggest that the orthogonal reticulo-limbic circuits of Goldberg's (1984) model could be assigned to context-dependent and context-independent knowledge domains, on the basis of the proposed mammillary-reticular/hippocampal-reticular dichotomy. Thus, the extensive and profound RA that was displayed by head-injured subjects is hypothesized to encompass both systems, albeit in a graded way, in contrast to the

pattern revealed by the heterogeneous etiology subject group, wherein the remote memory deficit encompassed categories that concern interaction with the external environment and personal identity--Public and Personal Chronological knowledge. The evidence for higher internal coherence after head injury for semantic knowledge, represented by Generic and Singular Factual categories on the RMQ, in the abstract, speaks to a prominence of the circuit which is responsible for homeostatic regulation (mammillary system) as a consequence of acute brain injury. This inference is reasonable, in the face of evidence for disproportionately severe Public and Personal Chronological deficits that were detected for head-injured subjects, thereby implicating the hippocampal-tegmental component of the limbic-reticular LTM circuit. The disparate nature of RA that was displayed by Post-ECT subjects is, theoretically, in agreement with the concept of interrelationships among anatomical circuits that mediate semantic and episodic memory, insofar as Generic and Singular Factual retrieval was significantly associated with both episodic knowledge categories on the RMQ. The unique quality of the ECT sample is further emphasized by the lack of a significant magnitude of AA, the low prevalence of RA, and a less severe remote memory deficit

than the type that was displayed by brain-lesioned subjects.

Changes in Recent Memory, Lexical, and Cognitive Functioning

There was a significant degree of anterograde memory loss in the head-injured sample, but less extensive anterograde memory loss was shown by patients with different etiologies of brain damage. The absence of AA after ECT was not anticipated, yet, the lack of significant contrasts might be an artifact of low baseline test scores, wherein mean scores on both BSRT measures (Busum, Bulearn) were below values for all matched normal controls. Also, ECT subjects revealed a different demographic composition, in terms of: older mean age, a preponderance of females, and lower educational attainment. Furthermore, four of the ten subjects were suspected to manifest multiple cognitive deficits.

Similarly, although KRFT performance was moderately diminished in all patient samples, in comparison to intact control performance, patient-matched control pair-wise comparisons were not found to be significant. These subjects were considered amnesic on the basis of informal evaluations of short-term retention, and, in view of severe ECT-induced disorientation which typically

resolves to an AA. The minimal AA that was manifested after ECT was not related to significant cognitive impairments, which could effectively override recent memory loss, if these were extensive. In summary, pre-eminence of a mild and circumscribed RA, in the presence of subtle AA, implicates the ventral tegmental path to a greater extent than neocortex.

The MQ for brain-lesioned subjects was essentially unchanged, in view of the proximity of mean MQ values for these samples to mean scores of standardization groups with average intelligence. However, WMS subtests were diminished; specifically, the paired-associate learning scores were lowered in both brain-damaged groups, whereas Logical Memory and Visual Reproduction were significantly lower only in the mixed etiology sample. Thus, it is inferred that new-learning was compromised in subjects with head injury and mixed brain damage, in conjunction with deficient verbal and visual recall. This pattern of results conforms to the traditional pattern of AA.

Head-injured subjects, however, revealed significant performance decrements on the WAIS-R according to statistical comparisons with matched normal controls, namely, on Information and Vocabulary subtests. In addition, the head-injured group showed markedly diminished word retrieval. Mixed brain-damaged patients'

performance on the cognitive measures and naming test were essentially equivalent to matched normal subjects, although the fact that there were more elderly subjects in this group, as well as its small n, could have artifactually increased these values. In any case, diminutions in mean scores of tests of general knowledge, vocabulary, and naming for head-injured patients, in comparison to normal control test performances were found to be associated with RMQ performance, particularly with respect to recall of Singular Factual and Public Chronological knowledge. The fact that WAIS-R subtest scores obtained by head-injured subjects were in the average-range, according to age-adjusted, standardization values, argues against a background of diffuse cognitive dysfunction in this group. Digit Symbol was the only significantly diminished WAIS-R subtest score in both samples with documented lesions. This result corroborates the impression of a moderate degree of cognitive dysfunction, in view of mean DRS scores that approximate the dementia cut-off value, together with diminished associative learning and attention, that was revealed with the WMS.

Prevalence of Anterograde Amnesia

More than half of the head-injured group evidenced a considerable magnitude of AA, relative to normal control

anterograde memory performance. The extent of the discrepancy from matched control values for head-injured subjects argues for contributions from numerous brain sites that are involved in the consolidation and retrieval of verbal stimuli.

In any case, although the range of impairment for head-injured subjects was greater than for ECT and mixed brain damage subjects, the small sample size of the other two groups may have deflated mean standard scores. Strictly speaking, however, it is clear that AA differs qualitatively in neurologic groups (Squire, 1981; Butters et al., 1984) according to these results.

Prevalence of Retrograde Amnesia

The highest incidence of retrograde memory impairment was shown by head-injured subjects. There were significant deficits in all knowledge types that are evaluated on the RMQ. A similar, albeit, more selective profile, was also demonstrated in the mixed etiology sample. ECT patients showed specific remote memory deficit profiles, wherein Personal Chronological and Generic Singular knowledge was affected. However, a small proportion of Post-ECT subjects showed borderline recall for Singular Factual knowledge, in contrast to a higher proportion of brain-injured subjects, with a more severe Singular recall deficit.

The RMQ values for patients support the proposal that RA can be differentiated, inasmuch as episodic and, to a lesser degree, semantic memory is affected in dissimilar ways, between groups that differ in etiology of brain damage.

The extensive remote memory impairments that were exhibited by head-injured subjects implicate a confluence of hippocampal-diencephalic-neocortical and mammillary-hypothalamic-cingulate circuits, that are postulated to exert diffuse effects on brain activation-arousal (Nauta, 1958). The extent and severity of neuropathology that characterized both brain-injured samples may be presumed to represent neurobehavioral signs of prefrontal and ventral tegmental dysfunction, with functional concomitants of episodic and semantic memory loss. However, it is also possible that a single brain lesion could be related to persistent RA, with minimal anterograde memory impairment, in view of interconnectivity of small and distant loci that are associated with isolated, continuous RA (Markowitsch, 1984).

Relationship between Prevalence of Anterograde Amnesia and Retrograde Amnesia

RA was found to occur as often as AA in all subject groups in this study. The incidence of semantic and

episodic impairment supports the hypothesis that the incidence of RA, which affects both classes of knowledge, is as frequent, if not more prevalent than AA in these etiologic groups. This was the case for head-injured and mixed etiology brain-damaged groups, with respect to Public and Personal Chronological RMQ categories.

Severity of Retrograde Amnesia

The patient groups that revealed the most profound impairment in remote memory were the head-injured and mixed brain-damaged populations, whereas subjects who were evaluated with the RMQ following ECT yielded relatively minimal deficits, except for the severe Generic Factual impairment in one subject. These results are essentially consistent with global dysfunction of midbrain circuits after structural damage.

Severity of Anterograde and Retrograde Amnesia

AA was relatively more severe after head trauma, followed by the severity of AA in the ECT sample. The median standard score for anterograde impairment in the mixed etiology sample was below the other two.

The profile of RA severity measures, though, was similar for brain-injured patients, inasmuch as both semantic and contextual categories were severely diminished, especially autobiographical recall. The distinctive pattern of remote memory deficits after ECT

is consistent with the theory that modification of transmission in neocortical and mesial temporal circuits was responsible for the profound changes in recent memory processing, while subcortical paths that mediate activation-arousal, as far as it affects RA, are relatively intact. The reverse would then be expected to occur in samples that are characterized by structural brain damage, that is, for head trauma, tumor, and encephalopathy.

Profiles of Severity of Anterograde Amnesia in Comparison to Retrograde Amnesia

One of the basic assumptions that was proposed in this thesis, and which is emphasized in previous studies (Goldberg & Barnett, 1985, 1986) is that the incidence of remote memory impairment approximates that of AA and, moreover, the severity and extent of impairment is substantial. This is evident when standard values of RMQ category scores were entered into statistical comparisons with verbal and, for ECT subjects, non-verbal test standard values. In fact, head-injured patients demonstrated a strong association between retrieval of one Chronological category and verbal anterograde memory. Also, the extent of impairment in autobiographical recall actually exceeded the verbal anterograde memory impairment for mixed etiology subjects.

In summary, the results that are reviewed above are consistent with a dense RA, in the context of minimal AA, for brain-damaged subjects. Moreover, the selective effects on knowledge domains in LTM, whereby recall of events that are constrained by spatial-temporal attributes is dissociated from factual or non-contextual knowledge types, implicates separate effects on temporal coding mechanisms that are reputedly located in prefrontal cortex (Sagar et al., 1985). The profile of minimal RA joined with pronounced, but heterogeneous effects on knowledge types in LTM, characterizes the RA that accompanies unilateral brain damage. The anatomical basis for this RA profile is a dual circuit, that consists of ascending projections from amygdala and mediodorsal thalamic nucleus (the hippocampal-reticular memory system).

Relations between Retrograde and Anterograde Amnesia

The question of interconnectivity between neural circuits that regulate anterograde and remote memory was investigated by examining correlations among standard scores. The single, strong association between Personal Chronological recall and verbal anterograde memory ability is in agreement with the idea of a relationship between autobiographical recall and semantic retrieval, that is independent from recall for public events and

Factual knowledge. This result agrees with the opinion that autobiographical memory becomes less context-dependent with successive recollections of personal information (Neisser, 1986). The strong association between verbal retrieval and autobiographical recall demonstrated by head-injured subjects, then could be construed as being related to impaired arousal, which depends predominantly on the integrity of prefrontal regions (Dall'Ora et al., 1989).

Scope of Retrograde Amnesia

The similarity between remote memory profiles for head-injured and mixed etiology brain-damaged subjects, insofar as there were deficits in knowledge retrieval for both context-dependent and non-contextual RMQ categories, suggests that plastic changes in brain structures modulating retrieval of information that is related to internal milieu (semantic), as well as species-specific (episodic) knowledge, are involved in RA. In contrast, the minimal influence of ECT on LTM retrieval, which is represented by Generic and personal knowledge deficits, is consistent with earlier work (Strain et al., 1968; Weiner et al., 1984), and suggests that hippocampal and, to a certain extent, mammillary systems are exerting a non-specific influence on neocortex.

The Retrograde Amnesia Construct According to Interrelationships Among RMQ Knowledge Types

Mild-to-moderate interrelationships between RMQ categories were demonstrated by head-injured and Post-ECT patients. Results pointing to a dissolution of the episodic-semantic relationship among ECT subjects, contrasted with a strong association between Factual knowledge types among head-injured patients, speaks to a disruptive effect upon structures that are responsible for the organization of knowledge in LTM, to a greater extent than upon dynamic consolidation-retrieval processes. Therefore, although ECT did not affect knowledge retrieval in a specific way, nor with the same scope and magnitude as that observed in head-injured and mixed brain damage samples, there were subtle changes in LTM, that were apparent in the pattern of correlations between the knowledge classes that are included in the RMQ.

The Relationship between RA and Cognitive/Intellectual Functioning

The interdependence between remote memory, specific cognitive abilities, and intelligence, was substantiated by scores on these measures in head-injured subjects. Mixed etiology brain-damaged subjects revealed significant correlations between recent memory and public event retrieval. Thus, it is inferred that the presence of cognitive impairment and, in the mixed etiology group, anterograde memory impairment, implicate

dysfunction of activation-arousal regulatory mechanisms, which manifests as a dense RA. Certainly, the evidence for moderately strong relationships between IQ scales, both domains of semantic knowledge on the RMQ, and autobiographical recall in the head-injured sample, suggests that a multiplicity of systems that mediate LTM retrieval might contribute to RA in this population.

Additionally, the evidence from all patients for strong associations between Singular Factual recall, object naming, and general knowledge on the WAIS-R, suggests that the knowledge that is tapped by Factual categories is not "pure memory," but is based on a verbal representational system (Paivio, 1971). This constellation of deficits, namely, verbal anterograde memory impairment, remote memory deficits, and semantic processing failure, has been connected to dysfunction in retrieval mechanisms within left temporal lobe (Barr, 1988).

Temporal Patterns of Public Chronological Knowledge

The expectation that the extent and degree of forgetting of Public Chronological knowledge would conform to a temporally-limited pattern after ECT (Squire et al., 1976; Corkin, 1984), but extend more distantly in the remote past for the brain-injured samples, was confirmed, insofar as ECT subjects

demonstrated significant forgetting, relative to matched normals, that did not extend beyond two decades preceding treatment whereas, the forgetting curve for head-injured subjects extended as far back as the 1950s.

Although, the mixed brain-damaged sample revealed a depth of forgetting in remote memory that was comparable to Post-ECT patients' temporal span, the magnitude of the patient-control discrepancy was greater for brain-damaged patients. Moreover, examination of forgetting curves in patients with focal (AF) and diffuse (AW) pathology, revealed that the former revealed an incremental curve for AF patients, while a "flat" forgetting curve was displayed by patients with widespread pathology.

Implications for Studies in Retrograde Amnesia

This investigation has confirmed assumptions that challenge the tenet which posits that: RA can be predicted from impairments in recent memory and new-learning (AA); that the deficits of RA are equivalent to the deficits of AA; and, that RA selectively affects episodic knowledge in LTM, but that semantic knowledge is spared. The Remote Memory Questionnaire produced patterns of deficit which conform to functional dissociations between etiologies of brain damage. These distinctions were found between RMQ categories representing semantic and episodic knowledge, as well as

within these categories. The value of the RMQ as a brief, but sensitive technique for detecting remote memory deficits after either acute or chronic neuropathology is revealed by evidence for variants of remote memory disorder, in terms of the parameters of interest: prevalence, severity, and scope of impairment, in addition to the depth of the episodic retrieval impairment. Therefore, this instrument can be utilized to identify individuals with subtle memory disorders, irrespective of the type of neuropathology, whom may evade detection on standard screening instruments such as the WMS, an anterograde test. Furthermore, a profile of RA that delineates the integrity of semantic knowledge recall separately from language functioning, public event recall, and personal information recall, can be compared with other objective measures of RA (Seltzer & Benson, 1974; Squire & Slater, 1975; Albert et al., 1979; Borrini et al., 1989).

It is posited that retrieval difficulty for knowledge that depends on a spatial-temporal context, as well as context-independent information retrieval, is associated with dysregulation in combinations of parallel mesencephalic-limbic circuits that activate cortical arousal mechanisms.

Additionally, the prevalence and severity of RA, as well

as the scope of impairment, and the extensive temporal patterns shown by some groups, suggest widespread pathophysiologic effects that influence medial temporal memory consolidation circuits and, in turn, neuronal networks for activation-arousal, that are located in the neocortex.

Conclusions

This study was designed to re-examine hypotheses about the structure of RA, and the nature of its relationship to AA, cognitive abilities, word retrieval, lexical ability, and intelligence. A remote memory assessment form was developed, based on the idea that heterogeneous neurologic groups would reveal differentiated profiles of RA, with respect to prevalence, magnitude, breadth of long-term knowledge domains that are affected and the pattern of the temporal extent of forgetting.

These results suggest that the boundaries between knowledge domains that are personally-relevant and non-contextual are changed after acute and chronic brain injury, insofar as subdomains may become interrelated after a brain insult. The extent and severity of this effect depends on selective alterations in neuranatomical systems, which are suspected to modify the phasic activation that originates from ascending reticular networks.

The investigation yielded: profiles of the knowledge deficits in LTM for etiologic variants; some degree of interconnectivity between remote memory deficits on the RMQ and anterograde memory, lexical, cognitive, and intellectual functions, according to widely utilized assessment methods; and, estimations of the magnitude and depth of forgetting in remote memory, for Public event knowledge.

Appendix A

THE GOLDBERG - BARNETT

REMOTE MEMORY QUESTIONNAIRE

REMOTE MEMORY QUESTIONNAIRE

TABLE OF CONTENTS

REMOTE MEMORY QUESTIONNAIRE

Rationale for the Instrument

Investigation of memory functions is central to neuropsychological, behavioral, neurological, and neuropsychiatric diagnosis. A large number of instruments have been developed to document various forms of memory deficit.

There is an abundance of instruments capable of assessing the subject's capacity for new learning and to document and measure the disintegration of this capacity, i.e., anterograde amnesia. Very few instruments are available, however, to assess the subject's remote memory, and to document and measure retrograde amnesia, i.e., the ability to retrieve and utilize the information which is presumed to have been learned by the subject long before the onset of the pathological condition.

Considerable amount of evidence has been accumulated that both the incidence and the severity of retrograde amnesia had been substantially underestimated in various clinical populations. It has become clear that new instruments for systematic assessment of remote memory are needed in order to arrive at accurate neurocognitive assessment.

To the extent that techniques for assessing remote memory exist, they are limited to the assessment of chronologically coded memory for events. There are no instruments, to the best of our knowledge, that assess the ability to retrieve overlearned knowledge, which does not have an intrinsic temporal component, i.e., memory for facts.

Furthermore, the existing batteries tend to be long and/or region-dependent. In order to fill what we perceive to be a critical gap in the neuropsychological testing repertoire, we designed the Remote Memory Battery which systematically assesses four types of knowledge presumed to have been available to the subject before the onset of the disease:

(1) Knowledge of general facts, which lack intrinsic temporal quality and represent information about whole classes of entities (e.g., Tomatoes are usually red).

(2) Knowledge of specific facts, which lack intrinsic temporal quality and represent information about individual entities (e.g., London is the capital of the United Kingdom).

(3) Knowledge of public events, which have intrinsic temporal quality, i.e., they occurred in time, and represent information stored by most members of this culture (e.g., Johnson succeeded Kennedy as President of the United States).

(4) Knowledge of personal events which have intrinsic temporal quality, i.e., they occurred in time, and represent information about the subject's own life (e.g., I attended Public School No. 5 in Chicago).

The purpose of the battery is to provide a compact instrument for the assessment of the integrity of remote memory in general and for describing patterns of retrograde amnesia (i.e., relationships among various domains of remote memory).

Description of the Instrument

The battery consists of four types of questions sampling the following domains of knowledge:

(1) Generic factual information (total of 40 questions),

(2) Singular factual information (total of 40 questions),

(3) Public chronological information, i.e., information for public events (total of 76 questions),

(4) Personal chronological information, i.e., information for personal events (total of 68 questions).

Every subject receives each question from categories (1) and (2).

Category (3) is organized chronologically: There are 10 questions related to the 1920's; 11 questions related to the 1930's; 9 questions related to the 1940's; 9 questions related to the 1950's; 14 questions related to the 1960's; 13 questions related to the 1970's; 10 questions related to the 1980's. Each subject receives only those questions which pertain to events which took place at the time when the subject was 15 years-old or older.

Category (4) contains an exhaustive number of questions covering various possible life events and circumstances. Every particular subject receives only those questions which are relevant to his life circumstances. For instance, a person with only a grade school education does not receive the question regarding the name of one,s college.

To the extent that this questionnaire is used as a test of retrograde amnesia, the questions pertaining to events which took place after the onset of the patient's condition should be excluded from categories (3) and (4).

Administration and Scoring

Each item should be typed in block letters on separate 3 X 5 cards. When the questionnaire is given to patients, they should be instructed to read each item from the card while the examiner delivers the same question from a master list.

In the scoring sheet record the individual's actual answer under the "RESPONSE" column. Answers to the items are rated on a three-point scale. Score "1" represents a correct answer, score "0.5" represents a partial or a wrong but generically related answer (when applicable) and "0" represents a wrong answer or a "don't know" (i.e., D.K.) response. Inquiry is necessitated when responses are ambiguous or when the examiner is unclear about assigning a score. In scoring subjects' responses consult the scoring guides which offer examples.

Below are scoring sheets for each section of the battery. Scoring guides are provided for categories (1) through (3). The accuracy of responses to items in category (4) (personal chronological) is determined by verifying the answers with a knowledgeable family member. Approximate answers (e.g., the subject supplies the date February 25 when the actual date, according to a nearest relative's report, is February 23) receive a value of 0.5.

REMOTE MEMORY QUESTIONNAIRE

Administration and Scoring (continued)

The samples represent actual subject responses obtained in the course of piloting this questionnaire on 26 psychiatric and brain-damaged patients and 26 normal controls.

The total raw score and the percentage of correct responses, as well as the equivalent measures for "what," "when," "where," "who," and "how many" questions in the first two categories should be entered at the bottom of each score sheet. A summary sheet is also provided.

REMOTE MEMORY QUESTIONNAIRE

Administration and Scoring (continued)

The samples represent actual subject responses obtained in the course of piloting this questionnaire on 26 psychiatric and brain-damaged patients and 26 normal controls.

The total raw score and the percentage of correct responses, as well as the equivalent measures for "what," "when," "where," "who," and "how many" questions in the first two categories should be entered at the bottom of each score sheet. A summary sheet is also provided.

REMOTE MEMORY QUESTIONNAIRE

SUMMARY SHEET

(1) Generic factual items

Total score _____

Percent correct score _____

Total score for I (what questions) _____
Percent correct score for I _____

Total score for II (when questions) _____
Percent correct score for II _____

Total score for III (where questions) _____
Percent correct score for III _____

Total score for IV (how many questions) _____
Percent correct score for IV _____

(2) Singular factual items

Total score _____

Percent correct score _____

Total score for I (who questions) _____
Percent correct score for I _____

Total score for II (what questions) _____
Percent correct score for II _____

Total score for III (where questions) _____
Percent correct score for III _____

(3) Public chronological items

Total score _____

Percent correct score _____

1920's Total _____
1920's Percent correct _____

1930's Total _____
1930's Percent correct _____

1940's Total _____
1940's Percent correct _____

1950's Total _____
1950's Percent correct _____

1960's Total _____
1960's Percent correct _____

REMOTE MEMORY QUESTIONNAIRE

SUMMARY SHEET

1970's Total _____
1970's Percent correct _____

1980's Total _____
1980's Percent correct _____

REMOTE MEMORY QUESTIONNAIRE

SECTION I. GENERIC FACTUAL ITEMS

RESPONSE SHEET FOR GENERIC FACTUAL INFORMATION

SCORING GUIDE FOR GENERIC FACTUAL ITEMS

REMOTE MEMORY QUESTIONNAIRE

RESPONSE SHEET FOR GENERIC FACTUAL INFORMATION

	ITEM NO.	QUESTION	RESPONSE	SCORE
I	1	What is the color of grass.		1 .5 0
	2	What is the color of snow.		1 .5 0
	3	What is the color of tomatoes.		1 .5 0
	4	What is the color of coal.		1 .5 0
	5	What is an omelette made of.		1 .5 0
	6	What is the taste of sugar.		1 .5 0
	7	What is the taste of lemon.		1 .5 0
	8	What is the shape of a wheel.		1 .5 0
	9	What is the hottest season.		1 .5 0
	10	From what is a lightbulb made.		1 .5 0
	11	Which animal barks.		1 .5 0
	12	Which animal meows.		1 .5 0
	13	Which creatures have fins.		1 .5 0
	14	From which plant do we get wood.		1 .5 0
	15	What travels on a track.		1 .5 0
	16	What do we wear on our hands in winter.		1 .5 0
	17	In what season are children on vacation from school.		1 .5 0
II	18	When do leaves turn yellow.		1 .5 0
	19	When do you see the moon in the sky.		1 .5 0
	20	When do birds fly to the south.		1 .5 0
	21	When do flowers bloom.		1 .5 0
	22	When does one have breakfast.		1 .5 0
	23	When does a kettle whistle.		1 .5 0
	24	When does one ski.		1 .5 0
III	25	Where do fish live.		1 .5 0
	26	Where do you see clouds.		1 .5 0

REMOTE MEMORY QUESTIONNAIRE

RESPONSE SHEET FOR GENERIC FACTUAL INFORMATION

ITEM NO.	QUESTION	RESPONSE	SCORE
27	Where is soil found.		1 .5 0
28	From which animal do we get milk.		1 .5 0
29	On what part of the body does one place a hat.		1 .5 0
30	Where do you take a bath.		1 .5 0
31	Where do potatoes grow.		1 .5 0
IV 32	How many months are there in one year.		1 .5 0
33	How many sides does a square have.		1 .5 0
34	How many items are there in a dozen.		1 .5 0
35	How many wings does an airplane have.		1 .5 0
36	How many tails does an animal have.		1 .5 0
37	How many toes are on a foot.		1 .5 0
38	How many cents are in one dollar.		1 .5 0
39	How many poles does a flag have.		1 .5 0
40	How many wheels does a bicycle have.		1 .5 0

Total Score _____

Percent Correct_____

Subtotal I ____ Subtotal III_____

Percent I _____ Percent III_____

Subtotal II _____ Subtotal IV_____

Percent II_____ Percent IV_____

REMOTE MEMORY QUESTIONNAIRE

SCORING GUIDE FOR GENERIC - FACTUAL ITEMS

	1 point	½ point	0 point
1. What is the color of grass?	green; bluish-green	yellow(?in general) yellow	----------
2. What is the color of snow?	white; dirty (Q) usually white	----------	----------
3. What is the color of tomatoes?	red; green when unripe, but usally red; orange	yellow	----------
4. What is the color of coal?	black; shiny and black	----------	----------
5. What is an omelette made of?	eggs, cheese, milk, green peppers or ham, can include vegetables	eggs and cheese (anything else?) that's all	don't know
6. What is the taste of sugar?	sweet	----------	----------
7. What is the taste of lemon?	sour	----------	bitter, tart, tangy
8. What is the shape of a wheel?	round	----------	----------
9. What is the hottest season?	summer	July or August (yes, but these months are included in which season?) don't remember the name	----------
10. From what is a lightbulb made?	glass and filament; glass, wire, paint on the inside	gas and glass (anything else?) that's all I can say	don't know
11. Which animal barks?	dog	----------	----------
12. Which animal meows?	cat	----------	----------
14. From which plant do we get wood?	trees; ash, oak (Q) trees	birch (Q) I don't know the group of plants	eggplant
13. Which creatures have fins?	fish; whales, dolphins, sharks (Q) fish	lizards (Q) that's all I can say	frogs

REMOTE MEMORY QUESTIONNAIRE

SCORING GUIDE FOR GENERIC - FACTUAL ITEMS

	1 point	½ point	0 point
15. What travels on a track?	trains (Q)trolley; trains and horses (Q) trolleys	trains (Q) I don't know	boats,wagons
16. What do we wear on our hands in winter?	gloves; mittens and gloves	----------	----------
17. In what season are children on vacation from school?	summer	----------	spring; fall
18. When do leaves turn yellow?	fall; end of summer	summer (Q) middle of summer	winter, spring
19. When do you see the moon in the sky?	at night; the evening	all the time (Q) on clear nights and days	----------
20. When do birds fly to the south?	winter; November, December (which season?) winter	fall	spring
21.When do flowers bloom?	spring and summer	August (Q) I don't know	winter
22.When does one have breakfast?	morning; early afternoon, if you wake up late (Q) generally in the morning	----------	----------
23.When does a kettle whistle?	when the water is boiling	when it's hot (Q) that's all	when it's full (Q) when it has hot water
24.When does one ski?	when it's cold (Q) when it snows	in cold weather (Q) that's the best answer	----------
25.Where do fish live?	in the ocean (Q) waters; lakes, seas (Q) the water	----------	in grottos (Q) in caves; in the zoo (Q) don't know
26.Where do you see clouds?	sky; heaven	----------	----------

REMOTE MEMORY QUESTIONNAIRE

SCORING GUIDE FOR GENERIC - FACTUAL ITEMS

	1 point	½ point	0 point
27. Where is soil found?	ground; earth	flowerpot (Q) not sure	on the floor (Q) don't know where else
28. From which animal do we get milk?	cows (others?) goats; goats and cows	cows, pigs	sheep
29. On what part of the body does one place a hat?	head	----------	----------
30. Where do you take a bath?	bathtub	----------	----------
31. Where do potatoes grow?	in the earth; the ground; in dirt	in a field (Q) everywhere in fields	on a vine; don't know
32. How many months are there in one year?	twelve	----------	----------
33. How many sides does a square have?	four	----------	----------
34. How many items are there in a dozen?	twelve	----------	----------
35. How many wings does an airplane have?	two	four (Q) two in the back and two in the middle	one
36. How many tails does an animal have?	one	----------	----------
37. How many toes are on a foot?	five; ten (Q) Oh, five on one foot	----------	----------
38. How many cents are there in one dollar?	one hundred	----------	----------
39. How many poles does a flag have?	one	----------	----------
40. How many wheels does a bicycle have?	two; one in back and one in the front (Q) two	----------	four

REMOTE MEMORY QUESTIONNAIRE

SECTION II. SINGULAR FACTUAL ITEMS

RESPONSE SHEET FOR SINGULAR FACTUAL INFORMATION

SCORING GUIDE FOR SINGULAR FACTUAL ITEMS

REMOTE MEMORY QUESTIONNAIRE

RESPONSE SHEET FOR SINGULAR FACTUAL INFORMATION

	ITEM NO.	QUESTION	RESPONSE	SCORE
I	1	Who was the author of Hamlet.		1 .5 0
	2	Who was Newton.		1 .5 0
	3	Who was Charles Dickens.		1 .5 0
	4	Who was Sherlock Holmes.		1 .5 0
	5	Who was Sitting Bull.		1 .5 0
	6	Who was the first president of the United States.		1 .5 0
	7	Who was Mozart.		1 .5 0
	8	Who was Robin Hood.		1 .5 0
	9	Who was Mark Twain.		1 .5 0
	10	Who was Christopher Columbus.		1 .5 0
	11	Who was Abraham Lincoln.		1 .5 0
	12	Who was Rembrandt.		1 .5 0
	13	Who wrote the Illiad.		1 .5 0
II	14	What is the ship "Mayflower" famous for.		1 .5 0
	15	What is "Ma Bell."		1 .5 0
	16	Napoleon was the emperor of which country.		1 .5 0
	17	What is produced by Mobil.		1 .5 0
	18	What is the Sahara.		1 .5 0
	19	What is Everest.		1 .5 0
	20	What is a peso.		1 .5 0
	21	What is produced by Warner Brothers.		1 .5 0
	22	What is the Vatican.		1 .5 0
	23	What is the Pentagon.		1 .5 0
	24	What is produced by Seiko.		1 .5 0
	25	What country did Queen Victoria lead.		1 .5 0

REMOTE MEMORY QUESTIONNAIRE

RESPONSE SHEET FOR SINGULAR - FACTUAL INFORMATION

	ITEM NO.	QUESTION	RESPONSE	SCORE
	26	What is the capitol of Spain.		1 .5 0
	27	What is produced by General Motors.		1 .5 0
	28	What is the capitol of Norway.		1 .5 0
	29	What is produced by RCA.		1 .5 0
III	30	Where does the president of the United States live.		1 .5 0
	31	In what country is Tokyo.		1 .5 0
	32	Where is the Nile.		1 .5 0
	33	Where is the Golden Gate Bridge.		1 .5 0
	34	Where is the Great Wall.		1 .5 0
	35	Where is the Eiffel Tower.		1 .5 0
	36	Where is Alaska.		1 .5 0
	37	Where is the Coliseum.		1 .5 0
	38	Where is Westminster Abbey.		1 .5 0
	39	In what country is Cairo located.		1 .5 0
	40	In what country is Paris located.		1 .5 0

Total Score _____

Percent Correct_____

Subtotal I_____

Percent I_____

Subtotal II_____

Percent II_____

Subtotal III_____

Percent III_____

REMOTE MEMORY QUESTIONNAIRE

SCORING GUIDE FOR SINGULAR - FACTUAL ITEMS

	1 point	½ point	0 point
1. Who was the author of Hamlet?	Shakespeare; William Shakespeare	an Englishman, two hundred years ago	Charles Dickens
2. Who was Sir Isaac Newton?	scientist who invented the law of gravity	lived a long time ago in England (Q) don't know what he did	a general
3. Who was Charles Dickens?	English author	musician or composer	an actor; royalty in England
4. Who was Sherlock Holmes?	a fictional detective; detective in English books	character in a play or a book (Q)can't say more	politician (Q) English; a prime minister
5. Who was Sitting Bull?	an Indian chief; head of the Sioux tribe, defeated General Custer	in a war (Q) don't remember exactly who he was	a bull that can sit up
6. Who was the first president of the United States?	George Washington; Washington	crossed the river; chopped down that cherry tree, can't think of his name	Abraham Lincoln
7. Who was Mozart?	composer(Q) classical music; wrote music	bandleader (Q)don't know what kind of music	a famous European person
8. Who was Robin Hood?	robbed from the rich and gave to the poor; a robber who had a "band of merry men," with Friar Tuck	a gangster, a hood; a criminal (Q)don't know any more; a book (Q) can't say	an Englishman; an actor in a play
9. Who was Mark Twain?	American writer; wrote Huck Finn (Q) Englishman?	an artist (Q) I couldn't tell you	river boat captain; political figure
10. Who was Christopher Columbus?	discovered America; sailed to America in 3 ships ... Nina, Pinta Santa Maria	A sailor (Q) was a European	claimed that the world was flat
11. Who was Abraham Lincoln?	freed the slaves (Q) president; 16th president of the United States	an American politician (Q) had a long beard	a poet; a scientist
12. Who was Rembrandt?	an artist; a painter, Dutch	----------	very old times, a famous man (Q) can't remember what he did
13. Who wrote the Illiad?	Homer	The Odyssey	Longfellow

REMOTE MEMORY QUESTIONNAIRE

SCORING GUIDE FOR SINGULAR - FACTUAL ITEMS

	1 point	½ point	0 point
14. What was the ship "Mayflower" famous for?	landing at Plymouth Rock (Q) Pilgrims; brought English to America	brought Columbus over; Plymouth Rock (Q) I don't know	a war ship; trading (Q) with Africa
15. What is "Ma Bell"?	was the telephone company	a large corporation (Q) don't know what product	a bell which rings; a French song
16. Napoleon was the emperor of which country?	France; Italy (Q)France	Waterloo	India
17. What is produced by Mobil?	oil, gasoline	gasoline (Q) nothing else; tires; cars	it's a city, but I don't know what it produces
18. What is the Sahara?	a desert	a city in Africa	a piece of land (where?) I don't recall
19. What is Everest?	a high mountain (Q) tallest in the world	a mountain (Q) what is unique about it?) I'm not sure; a national landmark; a country in the orient	a desert; a battery
20. What is a peso?	Mexican coin; currency (Q) Mexican	money (of which nation?) I don't remember	a small piece of something
21. What is produced by Warner Brothers?	films, records; films	cartoons (what else?) I couldn't tell you	----------
22. What is the Vatican?	headquarters of the Catholic church; seat of Catholicism; where the Pope stays (Q)head of the Catholics	a church; a Catholic church; a museum	a painting
23. What is the Pentagon?	where chiefs of the U.S military meet; military decisions are made there	political officers meet there (Q) government talks; a fort; an installation (Q) weapons are kept there; a building in Washington	a restaurant; a museum

REMOTE MEMORY QUESTIONNAIRE

SCORING GUIDE FOR SINGULAR - FACTUAL ITEMS

	1 point	½ point	0 point
24. What is produced by Seiko?	watches	electronic items	stereos; cameras; computers; consumer goods (Q) I don't know
25. What country did Queen Victoria lead?	Britain	London (Q)London	France; Italy
26. What is the capitol of Spain?	Madrid	Barcelona; Toledo	Paris; Berlin
27. What is produced by General Motors?	trucks, autos (Q) refrigerators	automobiles (Q) that's all	motors; machines (Q) I'm not certain which kind
28. What is the capitol of Norway?	Oslo	----------	Sweden
29. What is produced by RCA?	televisions, radio, records; televisions (Q) records	radios (Q) no	books
30.Where does the president of the United States live?	Washington (Q) D.C. the White House	Texas, on a ranch In Washington (Q) don't know what his house is called	New York
31.In what country is Tokyo?	Japan	China; the orient (Q) China	Russia; Egypt
32 Where is the Nile?	Egypt; Africa (Q) North Africa	somewhere in the Sahara desert; in the African jungle	in Europe
33. Where is the Golden Gate Bridge?	California; out west (Q) in San Francisco	Los Angeles; a city on the west coast (Q) don't know	China
34. Where is the Great Wall?	China	Japan; near Russia	in Berlin; Germany; Israel-- the praying wall
35. Where is the Eiffel Tower?	France; Paris, France (Q) Paris	in Europe (which city?) I don't really know	Italy; Rome
36. Where is Alaska?	a state next to Washington; above Canada and the United States	up north (Q) a state, but I'm not sure where	Japan; in Russia

REMOTE MEMORY QUESTIONNAIRE

SCORING GUIDE FOR SINGULAR - FACTUAL ITEMS

	1 point	½ point	0 point
37. Where is the Coliseum?	Rome; Italy (in which city?) I'm not sure	----------	Nassau county, Long Island; New York City (no, the one in ancient times?) don't know
38. Where is Westminster Abbey?	London; England (in which city in England?) don't know	Europe (Q) can't say exactly where	in the southern part of the United States; in a museum (Q) don't know
39. In what country is Cairo located?	Egypt; Africa (in which nation?) Egypt	Africa (in which nation?) Asia	the Nile (Q) don't know; Europe
40. In what country is Paris located?	France	_____	Italy; Germany

REMOTE MEMORY QUESTIONNAIRE

SECTION III. PUBLIC CHRONOLOGICAL ITEMS

RESPONSE SHEET FOR PUBLIC CHRONOLOGICAL INFORMATION

SCORING GUIDE FOR PUBLIC CHRONOLOGICAL ITEMS

REMOTE MEMORY QUESTIONNAIRE

RESPONSE SHEET FOR PUBLIC CHRONOLOGICAL INFORMATION

	ITEM NO.	QUESTION	RESPONSE	SCORE
(1920's)	1	The "Charleston" was popular at one time. What is it?		1 .5 0
	2	Who was Buster Keaton.		1 .5 0
	3	What was a Stutz Bearcat.		1 .5 0
	4	Who were Leopold and Loeb.		1 .5 0
	5	Who was Tom Mix.		1 .5 0
	6	Who flew the "Spirit of St. Louis."		1 .5 0
	7	Who was Mary Pickford.		1 .5 0
	8	Who wrote the tune "Rhapsody in Blue."		1 .5 0
	9	Who was the german shepherd dog that appeared in many films.		1 .5 0
	10	What was the "Teapot Dome" incident.		1 .5 0
(1930's)				
	1	Who was Caruso		1 .5 0
	2	Where was the 1939 World's Fair held.		1 .5 0
	3	What was a Packard.		1 .5 0
	4	What famous woman pilot disappeared in a world-round flight.		1 .5 0
	5	Francisco Franco was the leader of which country.		1 .5 0
	6	Who was the president that followed Harding.		1 .5 0
	7	Who was the radio character that played the "All American Boy."		1 .5 0
	8	Which science fiction character was played by Buster Crabbe.		1 .5 0
	9	From what famous family was a baby kidnapped.		1 .5 0
	10	Who was John Dillinger.		1 .5 0
	11	Where did the "St. Valentine Day's Massacre" occur.		1 .5 0

REMOTE MEMORY QUESTIONNAIRE

RESPONSE SHEET FOR PUBLIC CHRONOLOGICAL INFORMATION

ITEM NO.	QUESTION	RESPONSE	SCORE
(1940's)			
1	Who was known as the "King of Swing."		1 .5 0
2	Who was Mussolini?		1 .5 0
3	Who was Gene Autry.		1 .5 0
4	Where did the Hindenburg airship crash.		1 .5 0
5	Who was Winston Churchill.		1 .5 0
6	Who succeeded Franklin Delano Roosevelt as president.		1 .5 0
7	Who was Tokyo Rose.		1 .5 0
8	Who was Omar Bradley.		1 .5 0
9	Where was the first atomic bomb dropped.		1 .5 0
(1950's)			
1	What was Sputnik.		1 .5 0
2	Who was Elvis Presley.		1 .5 0
3	Who was Adlai Stevenson.		1 .5 0
4	Who was Joseph McCarthy.		1 .5 0
5	Who was Mitch Miller.		1 .5 0
6	Who was Douglas MacArthur.		1 .5 0
7	For what were the Rosenbergs tried and convicted.		1 .5 0
8	Whom did Grace Kelly marry.		1 .5 0
9	What famous person was nicknamed "Ike."		1 .5 0
(1960's)			
1	What was the Missile Crisis.		1 .5 0
2	Whom did Richard Burton marry.		1 .5 0

REMOTE MEMORY QUESTIONNAIRE

RESPONSE SHEET FOR PUBLIC CHRONOLOGICAL ITEMS

ITEM NO.	QUESTION	RESPONSE	SCORE
3	What did Lieutenant Calley do.		1 .5 0
4	Who was Nehru.		1 .5 0
5	Who was Ed Sullivan.		1 .5 0
6	Who was Lee Harvey Oswald.		1 .5 0
7	What was the "hula hoop."		1 .5 0
8	What did Mickey Mantle do.		1 .5 0
9	What were the Black Panthers.		1 .5 0
10	Who was Kruscheff.		1 .5 0
11	Where was John F. Kennedy assassinated.		1 .5 0
12	Who was Angela Davis.		1 .5 0
13	What was the Bay of Pigs affair.		1 .5 0
14	What was the name of the Montreal World's Fair.		1 .5 0
(1970's)			
1	Who was Patty Hearst.		1 .5 0
2	What were "The Waltons."		1 .5 0
3	Who was George McGovern.		1 .5 0
4	Who was Idi Amin.		1 .5 0
5	What was Watergate.		1 .5 0
6	Who is Henry Kissinger.		1 .5 0
7	Who was President Ford's vice president.		1 .5 0

REMOTE MEMORY QUESTIONNAIRE

RESPONSE SHEET FOR PUBLIC CHRONOLOGICAL INFORMATION

ITEM NO.	QUESTION	RESPONSE	SCORE
8	What was "Butch Cassidy and the Sundance Kid."		1 .5 0
9	Who was Spiro Agnew.		1 .5 0
10	Who was Golda Meir.		1 .5 0
11	What part of the country does Jimmy Carter come from.		1 .5 0
12	Who had an automobile accident in Chappaquidick.		1 .5 0
13	What was the Kent State incident.		1 .5 0
(1980's)			
1	What volcano erupted in the state of Washington.		1 .5 0
2	What was the recent war between a Latin American and a European country.		1 .5 0
3	Who is John Hinkley, Jr.		1 .5 0
4	From what country is Lech Walesa.		1 .5 0
5	What was the Hostage Crisis.		1 .5 0
6	Who is James Watt.		1 .5 0
7	Which countries were implicated in the attempted assassination of Pope John Paul.		1 .5 0
8	What is "E.T.: The Extraterrestrial."		1 .5 0
9	What is a Walk Man.		1 .5 0
10	What is Pac Man.		1 .5 0

REMOTE MEMORY QUESTIONNAIRE

SCORING GUIDE FOR PUBLIC CHRONOLOGICAL ITEMS

	1 point	½ point	0 point
1920's			
1. The "Charleston" was popular at one time. What is it?	a dance in the roaring twenties; the dance	a band many years ago (Q) I don't know	a river
2. Who was Buster Keaton?	actor in comic films; actor in silent movies... a funny man	an actor (Q) I'm not sure which kind of movies	a fighter
3. What was a "Stutz Bearcat"?	sportscar; car, a sports model	car; a luxury car	a dance; an animal; never heard of it
4. Who were Leopold and Loeb?	both murdered a young boy; they killed one person's cousin, had kidnapped him	did something bad; stood trial for a crime	a comedy team
5. Who was Tom Mix?	cowboy actor (Q) in old films; had a horse in the movies	cowboy (Q) can't tell you more	an athlete
6. Who flew the "Spirit of St. Louis"?	Lindbergh	----------	Amelia Earhart; Eddie Rickenbacker
7. Who was Mary Pickford?	actress many years ago; starlet of talkies; America's Sweetheart (Q) actress	an entertainer (Q) I don't know what she did	a character (Q) don't know, in a story?; an Englishwoman
8. Who wrote the tune "Rhapsody in Blue"?	George Gershwin; Gershwin	Ira Gershwin	Count Basie
9. Who was the German shepherd dog that appeared in many films?	Rin Tin Tin	----------	Lassie
10. What was the Teapot Dome incident?	scandal over an oil drilling on federal lands that were set aside for future drilling by the Navy; somebody went in and start	a scandal (Q) that's all I know; something to do with the government many years back	when they poured the tea into Boston Harbor

REMOTE MEMORY QUESTIONNAIRE

SCORING GUIDE FOR PUBLIC CHRONOLOGICAL ITEMS

	1 point	½ point	0 point
10. (continued)	ed drilling when they weren't supposed to; during Harding's time, government made money by secretly selling oil reserves		
1930's			
1. Who was Caruso?	famous singer; opera singer; sang popular songs and opera	an entertainer	a baseball player
2. Where was the 1939 World's Fair held?	Queens; New York	a city in the United States (Q) I don't know which	in Britain
3. What was a Packard?	a high class car years ago, like a Cadillac	car (Q) not sure which type	football team
4. What famous woman pilot disappeared in a world-round flight?	Amelia Earhart	----------	Ann Morrow Lindbergh; Florence Nightingale
5. Who was Francisco France?	leader of Spain before the World War; Spanish general; dictator in Spain	a military leader (Q) cannot tell you what the country was	movie actor from France
6. Who was the president that followed Harding?	Coolidge	----------	Franklin Roosevelt
7. Who was the radio character that played the "All-American Boy"?	Jack Armstrong; John Armstrong; Armstrong	----------	Arthur Godfrey... the crooner; wasn't that a television program
8. Which science fiction character was played by Buster Crabbe?	Flash Gordon	Tarzan; the actor that played against the evil emperor "Ming"	Buck Rogers

REMOTE MEMORY QUESTIONNAIRE

SCORING GUIDE FOR PUBLIC CHRONOLOGICAL ITEMS

	1 point	½ point	0 point
9. From what famous family was a baby kidnapped?	the Lindbergh's	mother was Ann Morrow (Q) I can't remember	Etan Patz (years ago?) oh, I don't know
10. Who was John Dillinger?	gentleman gangster; a bank robber; a criminal, but it was said that he never killed anyone	a bad person (Q) can't remember what he did; an evil person... the rest I can't remember	politician; made guns (Q) don't know
11. Where did the "St. Valentine's Day Massacre" occur?	Chicago	----------	New York; San Francisco
1940's			
1. Who was known as the "King of Swing"?	Benny Goodman	----------	Tommy Dorsey;Glenn Miller
2. Who was Benito Mussolini?	dictator from Italy during the war (Q) WW II; "Il Deuce... the Italian dictator	a politician (Q) can't recall	a singer; an entertainer
3. Who was Gene Autry?	cowboy actor; played guitar, rode a horse (Q) in the movies;owns a baseball team-- the California Angels, was an actor in the old days	a cowboy (Q) I don't know too much about him	a dancer; an artist (Q) made paintings
4. Where did the Hindenburg airship crash?	Lakehurst, New Jersey; in New Jersey	New York;America; Long Island	Germany; in Europe
5. Who was Winston Churchill?	leader of England; prime minister of Engl.	diplomat in the second world war (Q) not sure; a politician	an actor in plays
6. Who succeeded Franklin Delano Roosevelt as president?	Harry Truman; Truman	----------	Hoover; Eisenhower
7. Who was Tokyo Rose?	she tried to persuade our troops to join with	a spy; an actress	a character in a book (Q) don't know

REMOTE MEMORY QUESTIONNAIRE

SCORING GUIDE FOR PUBLIC CHRONOLOGICAL ITEMS

	1 point	½ point	0 point
7. (continued)	Japan during the 2nd World War; spoke over a microphone -- Japanese woman who told American soldiers they were losing the war		
8. Who was Omar Bradley?	general; general during world war two	military man (Q) I don't know his rank or anymore about him	a governor; a politician
9. Where was the first atomic bomb dropped?	Japan (Q) Hiroshima	in the East, the orient (Q) not sure of which city; in the sea of Japan	Iwo Jima; in Germany
1950's			
1. What was Sputnik?	the first satellite; spacecraft sent up by Russia in the early 60's ... for observation	a dog that was sent into space; a missile; a rocket	a doll with long hair; like a beatnik
2. Who was Elvis Presley?	singer (what type of music?) rock and roll; played guitar and sang, was in movies, did everything	hip shaker (Q) a movie star (Q) that's all he did	----------
3. Who was Adlai Stevenson?	governor of Illinois; ran for presidency and was defeated; intelligent man who ran for president against Eisenhower	politician	in the newspapers (Q) I can't say
4. Who was Joseph McCarthy?	a senator in the fifties that investigated communism; blacklisted actors for communism (what was his position?) senator; led a committee to investigate corrupt business (Q) communism	senator (Q) I don't know; a bad person, a politician, but I can't tell you any more about him	ran for president against Nixon
5. Who was Mitch Miller?	had a television show, "Sing along with Mitch"; he had a beard... I rem-	an "M.C." (master of ceremonies);	don't know

REMOTE MEMORY QUESTIONNAIRE

SCORING GUIDE FOR PUBLIC CHRONOLOGICAL ITEMS

	1 point	½ point	0 point
5. Who was Mitch Miller? (continued fron page four)	ember that he had a beard, had a singing group on television	a bandleader	a movie actor
6. Who was Douglas MacArthur?	General in the Korean War; he was dismissed by Eisenhower and led the troops during the Korean War	Famous military man (in which war?)the first world war; a genaral (Q) I don't know the war in which he served	politician (Q) I'm not sure; he was a comedian on the radio years back
7. For what where the Rosenbergs tried and convicted?	Spying (Q) They tried to smuggle secrets to Russians; espionage having to do with atomic information	Secrets (Q) giving secrets to Russians	murder; kidnapping
8. Whom did Grace Kelly marry?	the Prince of Monaco; Prince Rainier; Rainier	a member of royalty (Q) I forget who he was exactly	another actor; I can't recall
9. What famous person was nicknamed "Ike"?	President Eisenhower	a president, can't think of which one	----------
1960's			
1. What was the Missile Crisis?	Kruscheff started placing missiles in Cuba aimed at the US, Kennedy ordered them to be removed --Russia had to back down	It was in the sixties-- Russia was going to fire rockets at us (Q) I can't tell you anymore	Some country started a war where they tried to fire missiles
2. Whom did Richard Burton marry?	several people (but whom was the more well known person?) Elizabeth Taylor	----------	a blonde woman, but I don't know her name (whom else?) I don't know
3. What did Lieutenant Calley do?	gave the order to execute women and children in a Vietnamese village; murdered innocent people in the Viet Nam War.	murdered some people; a war criminal, but I don't know what he did	shot a soldier in the head; killed his wife and children, then went on trial for it

REMOTE MEMORY QUESTIONNAIRE

SCORING GUIDE FOR PUBLIC CHRONOLOGICAL ITEMS

	1 point	½ point	0 point
4. Who was Nehru?	Prime minister (or head of state) of India; succeeded Gandhi	a leader (of which nation?) I'm not sure... Arabia?	an Israeli head of state; a collar was named after him, but I don't know who he was
5. Who was Ed Sullivan?	a television personality who hosted a variety show on Sunday night; he had the Beatles on his show and other acts for the first time... was a T.V. show on once a week	entertainer (Q) don't know, but he also wrote a column in the paper	writer; T.V. actor (Q) I really don't know much more about him
6. Who was Lee Harvey Oswald?	assassinated Kennedy; Shot J.F.K. and was then shot by Jack Ruby, a restaurant owner	a murderer (Q) was put in prison (Q) don't know, but it was a famous person	someone in Washington
7. What was the hula hoop?	a toy, a ring that you rotated with your belly and hips	a toy, but I don't remember how kids played with it	a dance
8. What did Mickey Mantle do?	center-fielder for the Yankees during the early sixties	sportsman (Q) I don't know; a football-player	----------
9. What were the Black Panthers?	a revolutionary group that wanted to overthrow the government, Angela Davis was one; violent group	Black people (Q) involved in a robbery-- the Brinks truck in New York	they were a group that murdered someone (Q) I really don't know all the details
10. Who was Kruschaff?	premier of Russia; the leader of Russia who met with Nixon	a foreign man(Q) Russia?	leader of Italy
11. Where was John F. Kennedy assassinated?	Dallas, Texas; Texas (specifically in which city?) Dallas	San Antonio, Texas	Washington

REMOTE MEMORY QUESTIONNAIRE

SCORING GUIDE FOR PUBLIC CHRONOLOGICAL ITEMS

	1 point	½ point	0 point
12. Who was Angela Davis?	a revolutionary who supported communism; she was a Black Panther out in California, and a college professor	a political person, but I'm not sure who she was; shot a guard and was involved in a robbery-- she ran around with some group of radicals	a politician; a singer
13. What was the Bay of Pigs Affair?	Cuban nationals went from Florida to Cuba to overthrow Castro; the Cubans who were thrown out and came to this country went by boat to try to remove the communists from Cuba	Castro was involv- in some struggle, I'm not too sure exactly what it had to do with; an invasion (Q) in Kennedy's time, but I don't know any more	a war that took place last year (Q) South America
14. What was the name of the Montreal World Fair?	Expo; Expo '67	----------	----------
1970's			
1. Who was Patty Hearst?	she participated in a bank robberyand was also kidnapped by an activist group; she's married to her body-guard now (Q) radicals in the sixties captured her and turned her into a revolutionary; she was that rich newspaper man's daughter who became a criminal (Q) politically involved	young lady, part of a violent period of uprising, daughter of Randolph Hearst (Q) part of that movement where people were fighting society	----------
2. What were "The Waltons"?	a family on television (Q) around the second world war; John-Boy that family on a farm	they were in a fictional story (Q) I don't know what it was about; like the story of "The Little House on the Prairie"	a play; a family in the government

REMOTE MEMORY QUESTIONNAIRE

SCORING GUIDE FOR PUBLIC CHRONOLOGICAL ITEMS

	1 point	½ point	0 point
3. Who was George McGovern?	ran for office against Richard Nixon; a Democrat who ran for the presidency	a politician (Q) I don't know, a senator (Q) I don't remember him well	an actor; a comadian; famous man
4. Who was Idi Amin?	crazy guy in Africa, was a tyrant and got involved with the Entebbe raid with Israel	the president of an African country (Q) can't tell you more about him; a mad man in Israel?	an Indian chief?; Israeli person
5. What was Watergate?	a conspiracy where President Nixon sent men to break into Democratic headquarters; ten minutes of tape were deleted, concerned Nixon spying on the Democrats	a scandal (Q) Richard Nixon did something bad	a political mix-up (Q) don't know the details; a dam that broke
6. Who is Henry Kissinger?	Secretary of Foreign affairs under Nixon; a political figure who was an embassador	Kennedy's Secretary (Q) I don't know, someone in the government; somebody who's involved with international politics; a writer	----------
7. Who was President Ford's vice president?	Rockefeller; Governor Rockefeller	----------	----------
8. What was "Butch Cassidy and the Sundance Kid"?	a film with Robert Redford and Paul Newman (Q) cowboys; in the movies several years ago, was a western	cowboys (Q) a novel; show on television (Q) cowboys and horses	there was a scam, a sting with that actor, Redford; a gangster film; he was a fighter
9. Who was Spiro Agnew?	Nixon's vice president; he was a crook, dishonest and got involved in Watergate, in Nixon's time	a politician; he swindled the government out of money	never heard of him

REMOTE MEMORY QUESTIONNAIRE

SCORING GUIDE FOR PUBLIC CHRONOLOGICAL ITEMS

	1 point	½ point	0 point
10. Who was Golda Meir?	Premier of Israel; the female leader of Israel	a woman from Germany; a female in the news (Q) I don't know who she was	never heard of her
11. What part of the country does Jimmy Carter come from?	the southern part of the country (Q) ah, Georgia; Georgia	the south (Q) don't know for sure ...	Washington, D.C. (Q) I don't know
12. Who had an automobile accident in Chappaquidick?	Senator Kennedy (Q) Edward; Ted Kennedy	one of the Kennedys (Q) Robert	----------
13. What was the Kent State incident?	some soldiers fired on college students at Kent State -- they were protesting the war, they killed a couple of them; the National Guard fired on some college students who were against the war	a girl crawling over the bodies, at a college; a massacre (Q) don't know anything more about it	a murder (Q) I don't remember
1980's			
1. What volcano erupted in the state of Washington?	Mount St. Helen's; St. Helena	----------	Vesuvius; Mount Everest
2. What was the recent war between a Latin American and a European country?	Falklands; the countries were England and Argentina -- something islands; the islands around Argentina with England	this was in South America (Q) over that island	Nicaragua; Chile and the U.S.

REMOTE MEMORY QUESTIONNAIRE

SCORING GUIDE FOR PUBLIC CHRONOLOGICAL ITEMS

	1 point	½ point	0 point
3. Who is John Hinkley, Jr.?	the one who tried to assassinate President Reagan	killed J.F.K. (Q) he was the one who shot Kennedy; he was a murderer, I know that (Q) I don't know who he killed	a senator in the government; the son of an actor
4. From which country is Lech Walesa?	Poland	----------	----------
5. What was the Hostage Crisis?	Iran took Americans from the embassy over there and kept them for 400 days. Jimmy Carter tried to get them out; Americans were kept hostage in Iran, they worked in the embassy and we got them out after a long time	Iran and the United States (Q) that's all I can say ... it happened four years ago	they took hostages in Cuba
6. Who is James Watt?	Reagan's Secretary of the Interior -- he had to resign because he insulted ethnic groups; Secretary of "something" in office under Reagan who said a lot of stupid things and he was forced to resign or just was fired, who knows	always opened his mouth, with racial slurs (what was his position?) don't really know, but he was a famous man	the inventor of electricity -- Watt, the light bulb
7. Which countries were implicated in the attempted assassination of Pope John Paul?	Bulgaria; Bulgaria and Turkey	----------	United States
8. What is "E.T.: The Extra-terrestrial"?	funny-looking creature from outer space with a	a film (Q) I never saw it, can't say	sounds like something from another planet

REMOTE MEMORY QUESTIONNAIRE

SCORING GUIDE FOR PUBLIC CHRONOLOGICAL ITEMS

	1 point	½ point	0 point
8. (continued)	big head and a skinny body (Q) a film; space creature, ugly-looking thing that became the friend of some children		
9. What is a Walk-Man?	radio with headphones that you carry around; tape-player that you strap to your side	a stereo system (Q) I've never seen it, so I can't describe it	a man that walks around
10. What is "Pac Man"?	a video game (Q) a big, round thing eats little ghosts on the screen	game (Q) something the kids play ... my grandchildren have it hanging in their room	a worker, someone that packs items

REMOTE MEMORY QUESTIONNAIRE

PUBLIC CHRONOLOGICAL SUMMARY SCORES

*Total Score_____

*Percent Correct_____

1920's Total_____

1920's Percent Correct_____

1930's Total_____

1930's Percent Correct_____

1940's Total_____

1940's Percent Correct_____

1950's Total_____

1950's Percent Correct_____

1960's Total_____

1960's Percent Correct

1970's Total_____

1970's Percent Correct_____

1980's Total_____

1980's Percent Correct_____

* Only the items postdating the subject's fifteenth birthday are included in the score. In the case of an acute brain insult for which the approximate date of injury is known the score is composed only of those items which predate the lesion, from the age of fifteen.

REMOTE MEMORY QUESTIONNAIRE

SECTION IV. PERSONAL CHRONOLOGICAL ITEMS

RESPONSE SHEET FOR PERSONAL CHRONOLOGICAL INFORMATION

SCORING GUIDE FOR PERSONAL CHRONOLOGICAL ITEMS

RETROGRADE AMNESIA BATTERY

RESPONSE SHEET FOR PERSONAL CHRONOLOGICAL INFORMATION

ITEM NO.	QUESTION	RESPONSE	SCORE
General			
1	What was the street name of where you first lived as a child.		1 .5 0
2	What was your father's occupation.		1 .5 0
3	What was your mother's occupation.		1 .5 0
4	What was the name of your elementary school.		1 .5 0
5	What was the name of your junior high school.		1 .5 0
6	What was your first job.		1 .5 0
7	During what year did you buy your latest car.		1 .5 0
8	What was the name of your high school.		1 .5 0
9	Where did you go on the first vacation by yourself.		1 .5 0
10	When did you take your first job.		1 .5 0
11	What was the make of your second car.		1 .5 0
12	What was the name of your graduate school.		1 .5 0
13	What was the name of the firm at which you were first employed.		1 .5 0
14	What was the color of your first car.		1 .5 0
15	What was the name of your college.		1 .5 0
16	What was the make of your third car.		1 .5 0
17	What was the color of your second car.		1 .5 0
18	What is the most recent appliance that you have bought.		1 .5 0
19	What was the make of your first car.		1 .5 0
20	What was the color of your third car.		1 .5 0
Married**			
1	What is your father-in-law's first name.		1 .5 0
2	Where did you go on your honeymoon.		1 .5 0

RETROGRADE AMNESIA BATTERY

RESPONSE SHEET FOR PERSONAL CHRONOLOGICAL INFORMATION

ITEM NO.	QUESTION	RESPONSE	SCORE
3	What was your husband (or wife's) occupation when you met him (or her).		1 .5 0
4	What is your mother-in-law's first name.		1 .5 0
5	Who was best man at your wedding.		1 .5 0
6	What was the name of the rabbi/priest officiating at your wedding.		1 .5 0
7	Where did you meet your husband (or wife).		1 .5 0
8	What was the address of your first home, after you were married.		1 .5 0
9	What was the date of your wedding.		1 .5 0
10	Who was the maid of honor at your wedding.		1 .5 0
11	What is (was) your father-in-law's occupation.		1 .5 0
12	Where did your wedding take place.		1 .5 0
13	What was your mother-in-law's occupation (state occupation early in or prior to marriage, if she cared for the home during marriage).		1 .5 0
Younger parents			
1	In which hospital was your first child born.		1 .5 0
2	When was your youngest (or only) son's bar mitzvah.		1 .5 0
3	What is your second child's birthday.		1 .5 0
4	In which hospital was your youngest child born.		1 .5 0
5	When was your youngest (or only) child christened.		1 .5 0
6	In which hospital was your second child born.		1 .5 0
7	What is your youngest child's birthday.		1 .5 0

RETROGRADE AMNESIA BATTERY

RESPONSE SHEET FOR PERSONAL CHRONOLOGICAL INFORMATION

ITEM NO.	QUESTION	RESPONSE	SCORE
8	What is your first child's birthday.		1 .5 0
Older parents			
1	Where does/did your first child go to college.		1 .5 0
2	What is your oldest son's occupation.		1 .5 0
3	What is your youngest son's address.		
4	What is your oldest daughter's occupation.		1 .5 0
5	Where does your second child go to school (high school or primary).		1 .5 0
6	When did your oldest son get married.		1 .5 0
7	What is your youngest daughter's address.		1 .5 0
8	What is the occupation of your youngest son's wife.		1 .5 0
9	Where does your second child go to college.		1 .5 0
10	What is your oldest daughter's address.		1 .5 0
11	When did your youngest son get married.		1 .5 0
12	What is the occupation of your youngest daughter's husband.		1 .5 0
13	What is your oldest son's address.		1 .5 0
14	What is your oldest daughter's telephone number.		1 .5 0
15	What is the occupation of your oldest son's wife.		1 .5 0
16	What is your youngest son's occupation.		1 .5 0
17	When did your oldest daughter get married.		1 .5 0
18	What is your youngest daughter's occupation.		1 .5 0
19	What is your oldest son's telephone number.		1 .5 0
20	What is the occupation of your oldest daughter's husband.		1 .5 0

RETROGRADE AMNESIA BATTERY

RESPONSE SHEET FOR PERSONAL CHRONOLOGICAL INFORMATION

ITEM NO.	QUESTION	RESPONSE	SCORE
21	Where did your first child go to school (high school or primary).		1 .5 0
22	Where does/did your second child go to college.		1 .5 0
Grandparents			
1	What is the age of your oldest grandchild.		1 .5 0
2	Where does your youngest grandchild go to school or college.		1 .5 0
3	How many grandchildren do you have altogether.		1 .5 0
4	What is the age of your youngest grandchild.		1 .5 0
5	Where does your oldest grandchild go to school or college.		1 .5 0

Total Score_____

Percent Correct_____

** When the subject is unmarried, inquire into the wedding, offspring, etc. of siblings or close friends.

Appendix B

Sample

Informed Consent for Research Participation

Title of Study: Relationship between retrograde and anterograde amnesia.

Principle Investigators: Elkhonon Goldberg and Jacqueline Barnett

Clinical Affiliation: Montefiore Hospital and Medical Center,

Albert Einstein College of Medicine, Bronx, NY.

PATIENT CONSENT FORM FOR THE STUDY OF ECT EFFECTS ON MEMORY

Patient's Name _____ Age _____ Chart No. _____

1) I am between the ages of 18 and 70 and depressed. I have agreed to undergo electroconvulsive therapy as a treatment for my depression.

2) Before the beginning of this treatment, I will be asked to undergo interviews that will not be of direct benefit to me. These procedures are outlined as follows:

a) naming a set of pictures;
b) learning a word list;
c) learning a set of pictures;
d) answering four questionnaires:

- general properties of things (e.g., what is the shape of an apple);
- knowledge of general facts (e.g., what is the capital of England);
- important events (e.g., who was President during the Great Depression);
- personal events (e.g., what was the name of my grade school).

3) After treatment with ECT, I will undergo the same interviews.

4) I have been told that the results of this study are expected to improve our general understanding of the effects of ECT. I have also been told that the results of this study may or may not benefit me directly. Hopefully, they will benefit persons with a similar problem in the future since it is important to know what the effects of this procedure on memory are, if any. Once this is established, it may be of benefit to other patients like me.

5) I have been given the opportunity to ask any questions I wish regarding the purpose and procedures of this study in which I will participate.

6) I have been told that I may refuse to participate in this study and that my refusal to participate will not prejudice in any way my further treatment or my future relationship with the hospital and its doctors.

7) I have been informed that any medical or personal information concerning me used in this investigation will be kept confidential.

3) I have been told that there are no physical risks or potential for physical injury involved in these interviews.

Patient's Signature _____ Date _____

Signature of Professional Who Discussed Study With Patient _____ Date _____

Signature of Witness _____ Date _____

Appendix C

Samples of Public Chronological category responses

Patient J.R.

RMQ Item	Patient response
What was the Bay of Pigs Affair?	"Cuba...fighting."
Who was John Dillinger?	"...killing everybody."
What part of the country does Jimmy Carter come from?	"south" (state?) "don't know"
Where was the 1939 World's Fair held?	"Chicago."
Who was Lee Harvey Oswald?	"Assassinated Truman."
Who was Tokyo Rose?	"War...I heard Tokyo Rose."
Who was Joseph McCarthy?	"Senator, politics."

Samples of Singular Factual category responses

RMQ Item	Patient response
Who was Mark Twain?	"Wrote kids' stories."

Who was Robin Hood?	"Wrote kids' stories."
What is produced by General Motors?	"Automobiles."

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