THE DISSOCIATION BETWEEN TACIT AND REFLECTIVE MEASURES OF MEMORY

by

Dawn Witherspoon, B.Sc.

A Thesis

Submitted to the School of Graduate Studies

in Partial Fulfilment of the Requirements

for the degree

Doctor of Philosophy

McMaster University

 September, 1983

The Dissociation Between
Tacit And Reflective Measures of Memory

DOCTOR OF PHILOSOPHY (1983)
(PSYCHOLOGY)

McMaster University
Hamilton, Ontario

TITLE: The Dissociation between Tacit and Reflective Measures of Memory

AUTHOR: Dawn E. Witherspoon

SUPERVISOR: Dr.L.L.Jacoby

NUMBER OF PAGES: xiii, 135

Abstract

RE-cognition - "to know again" - implies an element of awareness for remembering to occur. But is awareness a necessary condition for remembering? Research with amnesics shows that it is not. Amnesics, by definition, have a memory deficit in that they are unable to report recent prior experiences. None the less, they still display the effects of those prior encounters on their behaviour if tested in appropriate ways (e.g. Corkin, 1968; Warrington and Weiskrantz, 1970; Brooks and Baddeley, 1976). Although the amnesic does not recognize having participated in a particular task before (for example, reading inverted text - Cohen and Squire, 1980), he/she will show savings or improvement in the learning of that task on subsequent occasions when measures are employed that do not require a conscious report of the earlier event. In other words, amnesics do have memory, but are unaware of its influence.

Persons with normal memory abilities can also show evidence of memory in their actions or behaviour without coincident awareness of remembering. For example, imagine the execution of well-practiced skills, such as driving a car or typing a manuscript. These tasks require a great amount of prior knowledge in order to be performed properly, but do not seem to tax one's memory or rely on one's being aware of remembering the sequence of skills needed to be carried out.

The implication of these findings is that there can be a "dissociation" in memory between the awareness of remembering and having one's ongoing behaviour influenced by remembering. It may be that many effects of memory remain undetected, given that traditional memory research measures require the expression of deliberate interrogation and conscious retrieval of prior memory events; and consequently, ignore the investigation of tacit memory forms..

The main purpose of this dissertation is to experimentally identify, investigate and evaluate this dissociation as revealed by the memory measures. The generality of the effect and possible theoretical accounts of the effect will be explored. The first three experiments demonstrate that the dissociation can be obtained with a variety of populations and tasks. One class of measures will demonstrate with amnesics the existence of a memory influence, while another set simultaneously will deny its presence. With normal subjects, each of these measures may consistently demonstrate an effect of memory, but they will produce behavioural results which are stochastically and phenomenologically independent of one another. In Experiments Four and Five, further specification of this dissociation will be obtained by demonstrating that under certain conditions the dissociative result can be disguised or eliminated through manipulations of particular experimental variables. Finally, the results from Experiment Six provide converging evidence to suggest that the dissociation is related to the type of information that is available for processing. The relationship between the measures reflects the cognitive processes of remembering which, in fact, are dissociable.

Acknowledgments

The completion of this thesis would not have been possible without the knowledge and assistance of several people. I would like to thank my supervisor, Dr.L.Jacoby, and my committee members, Dr.L.Brooks and Dr.L.Allan for their much appreciated guidence, instruction and support. Their valuable comments and suggestions contributed greatly to both the manuscript and my education.

In addition, I would like to acknowledge the many faculty and graduate students, who made my stay at McMaster a rewarding experience, both academically and socially. I am particularly indebted to Dr.L.Siegel and Dr.B.A.Levy for the many stimulating conversations I shared with them during the past four years; and to Murray Goddard for his friendship and encouragement throughout the writing of this work, and for his useful comments on an earlier draft of the thesis.

Finally, I would like to express my warmest appreciation and gratitude to my parents, Al and Phyllis Witherspoon, and my brothers and sister for their help, patience and never-ending support over the years.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

- CHAPTER ONE -

INTRODUCTION

> "Probably no man, by voluntary effort, completely reactivates any portion of the <memory> record....It seems likely, however, that the original record continues to be available in some sort of way for the comparison and interpretation of <new information>....The stream of consciousness...leaves behind it a permanent record that seems to be complete for the waking moments of a man's life...."(Penfield, 1954, p.373).

Penfield (1954), basing his comments on electrode stimulation surgery with epileptic patients, argued that all events that are experienced, no matter how trivial, are recorded in memory and actively influence later encounters. Further, he suggested that these "records" are permanent and available, but that a problem of memory was in voluntarily accessing the information. This notion reflects, in part, the approach to be emphasized here. That is, memory can influence one's ongoing behaviour, and this effect is different from the voluntary retrieval or conscious access of the prior record. The dissociation of these two aspects of memory is the focus of the present thesis.

The two aspects of memory will be described in terms of tacit tasks of memory and reflective memory tasks. Tacit memory tasks measure influences of memory in ongoing behaviour without invoking deliberate access of the memory record. Tasks which assess on-line performance, such as reading or playing tennis, are measures of this sort. Although these memory measures rely on prior experience, they are tacit in the sense that the person need not be aware of accessing memory. In contrast, reflective memory tasks require a person to refer back to memory by recalling or recognizing a prior event. Measures of this sort are associated with deliberate and voluntary retrieval of a specific prior experience and necessarily require the person to be aware of remembering. In procedural terms, the dissociation between the two aspects of memory represents a lack of correlation in performance on the two types of task. That is, evidence of prior experience influencing performance on a tacit memory task can be observed independent of whether the person can make contact with the record of that prior event on a reflective memory task.

Evidence has been collected which clearly demonstrates this dissociation. While an amnesic patient (organic or functional) cannot explicitly remember or report a prior event, that prior experience can still have an impact on his/her ongoing behaviour (Hilgard, 1977; Whitty and Zangwill, 1977; Kihlstrom and Evans, 1979; Moscovitch, 1982; Cohen and Squire, 1980; Baddeley, 1982). Similar effects have been obtained with subjects displaying normal memory (Jacoby and Dallas, 1981; Jacoby and Witherspoon, 1982; Tulving, Schacter and Stark, 1982). The dissociation observed in patient populations is extreme, and implies that the amnesic is unable to deliberately use memory in any practical manner.

Due to the drastic difference between the amnesics' abilities on the two types of memory task, a variety of hypotheses have been promoted to account for the dissociation. A "multi-systems" account suggests that the dissociation reflects a qualitative difference in memory function and that two or more independent memory systems are responsible for this difference. In amnesia, one of these systems has been damaged. Within each system, there is correspondence between memory storage, the neurological structure associated with the memory record and the task which is capable of accessing that memory. As a result, the amnesic will demonstrate memory impairment under some conditions and not under others. A "differential processing" view also suggests that a qualitative difference is revealed in the amnesics' behaviour, but emphasizes the importance of the cognitive processes which mediate memory. This account argues that there are numerous relationships between encoding information in memory, retrieving information from memory and the tasks which measure memory performance. The dissociation observed between the memory measures could reflect the testing of different aspects of the same memory system, rather than the testing of different memory systems. Finally, a "differential sensitivity" view attributes the dissociation to a quantitative difference between the measures' ability to gain access to memory. In contrast to the processing view, this position suggests that the measures reflect the same aspects of a single memory. Reflective memory measures simply require more information than tacit memory measures in order to access, and report from, a memory record. As a result, for the amnesic, the tacit memory task is an easier task at which to succeed.

The following sections of the introduction will outline available evidence for the dissociation in the memory literature and discuss issues that arise as one attempts to understand the dissociation. Experimental work designed to address these issues will be reported in later chapters.

The first section is primarily a description of the characteristic dissociation phenomenon that is observed most directly - that of the amnesic syndrome. The effects in amnesia stimulated this thesis and serve as a prime example for identifying the dissociation.

The second section will review various sources of the memory literature for additional evidence of the dissociation. It will become clear from research with both human and animal brain-lesioned populations that, in order to obtain evidence of preserved memory in amnesics, the method of assessing memory must include tasks, such as motor skills, in which a conscious report of remembering is not required. In order to argue that the dissociation is a reliable manifestation of memory, however, one must address the issue of whether the preserved memory represents something more than just motor performance. The memory tasks should also include the application of skills which clearly involve a cognitive component (such as verbal knowledge). Further, in order to argue for the generality of the effect, one must address whether or not the dissociation represents a characteristic which is also true of normal memory. The dissociation should be observable with non-brain-damaged subjects and obtainable under a variety of conditions. Tasks which more directly implicate the use of cognitive knowledge will be discussed; and relevant research based on functional amnesia and normal memory will be presented. This issue of whether the effect is generalizable will be further pursued in the second chapter of the thesis.

The third section presents the three possible accounts of the dissociation. The differential sensitivity account suggests that independence reflects a quantitative difference between the memory measures. This argument is reminiscent of earlier descriptions regarding the relationship between recognition and recall. To address this position, methods of evaluation similar to those used to investigate the relationship between recognition and recall are employed. The next two views discussed argue for a distinction in terms of qualitative differences. The multi-systems account suggests that the dissociation between the measures reveals the existence of two or more memory systems, and the finding of independence would be a predictable and inevitable result (see Chapter Two). This conclusion of inevitability, however, is disputed by the third view, the differential processing account. Different processes are used for the interpretation of different types of information. One could argue, therefore, that perhaps there is only one memory system, but the different information employed by the memory tasks are responsible for observing a dissociation. Finding dependence between the measures when similar information is employed would lend support to this approach (see Chapter Three). This latter view is promoted by researchers interested in identifying the sources of information used as the basis of recognition decisions. The manner in which this approach accounts for the relationships between the measures will be addressed further in the fourth chapter.

The final section of the introduction will present a brief overview of the six experiments to be reported. These studies are directed at clarifying the above issues with the intention of providng a better understanding of the dissociation.

1.1 IDENTIFYING THE DISSOCIATION

The most conspicuous evidence for a dissociation in memory performance is observed in the behaviour of organic amnesia patients. The amnesic syndrome involves a severe impairment on reflective memory measures, such as recognition and recall. Even though amnesics are unable to acknowledge or report a previously learned experience, learning and practice effects can be observed in their performance on tasks which require perceptual-motor skills. This finding indicates that some form of memory ability is preserved in these patients. Further, it suggests that there are at least two varieties of memory performance - that which reflects their deficiency and that which allows for preserved capacities. The following section will review this evidence in order to establish the existence and significance of this dissociation.

1.1.1 THE ORGANIC AMNESIC SYNDROME

The amnesic syndrome is a psychological disturbance manifested primarily in a severe impairment of memory function (Talland, 1965). The condition is considered organic in that there is a specifiable physical trauma and/or anatomical damage which is responsible for the deficit. The prominent features of the syndrome are characterized by a severe anterograde amnesia - an apparent inability to acquire new memories, and partial retrograde amnesia - loss of recent memories previously available. Overlearned or well-established events that make up part of the individual's early history are essentially undisturbed (Seltzer and Benson, 1974). Other behavioural aspects, for example, intelligence and language capabilities, are also found to be normal and apparently unchanged from capacities prior to the onset of the disorder (Rozin, 1976; Moscovitch, 1982). This amnesia is not a unitary syndrome. It is derived from various aetiologies (e.g. cranial trauma, senility, vitamin deficiency, tumors) and loci of brain disorder (e.g. hippocampus, mammillary bodies, medial thalamic nuclei, mesial-temporal tissue - Victor, Adams and Collins, 1971; Lhermitte and Signoret, 1972; Brierley, 1977; Squire, 1981; Moscovitch, 1982). Even so, the behavioural features mentioned are relatively common across these varied populations.

There are two classic case studies of persons exhibiting the amnesic syndrome, who have sustained definable lesions. "H.M." was subjected to bilateral mesial-temporal lobe resection including extensive damage to the hippocampus in order to relieve epileptic seizures (Scoville and Milner, 1957). Post-operatively, H.M. did not differ appreciably from his previous status in terms of personality or general intelligence. The incidence and severity of the seizures were greatly reduced, particularly for the first year after treatment. The only radical and unexpected behavioural change was a resulting grave loss of recent memory. He could no longer recognize hospital staff or find his way about the hospital; he could not learn his family's new address, though he remembered the old one perfectly; he could not recall the location of frequently-used everyday objects, nor did he show any familiarity for the content of magazines that he would read over and over again. In 1960, another patient, "N.A.", sustained a unilateral stab wound to the diencephalon region involving the left dorsal thalamus (Teuber, Milner and Vaughan, 1968; Squire and Slater, 1978). Like H.M., N.A.'s memory for premorbid events is relatively intact, except for six to twelve months prior to the accident, and he displays normal reasoning and comprehension. However, he exhibits a profound impairment for the learning of recent events in tests of recognition (Squire and Moore, 1979) and has been unable to work since his accident. These patients display a disorder of memory with no other significant concomitant behavioural dysfunction.

Patients with a diagnosis of Korsakoff psychosis (Korsakoff, 1889) are the most extensively studied population of subjects displaying severe memory disorders. Typically, the disease originally manifests itself as the neurological symptoms of Wernicke's encephalopathy which develops after years of alcoholic consumption by patients who have suffered the more severe stages of alcoholism, including blackouts, delirium tremens and comas. The Wernicke symptoms include a variety of physical disorders, such as palsies, and a very prominent confusional and confabulatory state (Harrison, 1972; O'Brien and Chafetz, 1982). In addition, there is evidence of an amnesia, although it is difficult to detect due to the patients' insistence on confabulating. Following this, the patients may develop Korsakoff psychosis, in which the amnesic syndrome is the primary disorder, being unable to recall recent past episodes or to display learning of new information. The earlier symptoms essentially dissipate. Korsakoff patients demonstrate disorientation and lack of awareness of the deficit. The personality of the patient appears apathetic, passive and lacking in motivation (Talland, 1965; Tschersich, 1978). The disorder is differentiated from other cognitively-impaired populations, such as the senile dementias, due to the fact that the Korsakoffs' memory disability is the primary discernable feature observed in the psychoses. Comprehension and intellectual skills are generally considered to be intact. Korsakoff amnesics are frequently compared to those with surgically-induced, or otherwise lesion-acquired, amnesias which uniquely produce memory impairment as a deficit, even though the Korsakoff patient may display a more generalized dysfunction (e.g. perseverative tendencies on card-sorting tasks such as the Wisconsin; Oscar-Berman, 1973; Tschersich, 1978; Moscovitch, 1982). Experiment One will report results from a study conducted with the Korsakoff patient population.

1.1.2 THE CHARACTERISTIC DISSOCIATION:

Although a major component of the syndrome is anterograde amnesia, evidence has been accumulated indicating that under some conditions amnesics display some preserved ability to learn new material. The primary evidence for this new learning comes from investigations of perceptual-motor tasks. Patients show gains in performance when they are required to perform a motor task repeatedly: pursuit-rotor task (Corkin, 1968; Cermak, Lewis, Butters and Goodglass, 1973); mirror drawing (Starr and Phillips, 1970; Milner, Corkin and Teuber, 1968); tactile maze learning (Corkin, 1965); learning of new tunes on the piano (Gardner, 1974); identifying Gollin figures (Warrington and Weiskrantz, 1968); reassembling jigsaw puzzles (Brooks and Baddeley, 1976); and classical eyelid conditioning (Weiskrantz and Warrington, 1979). The amnesic acquires the skill at a rate comparable to the normal, and demonstrates normal levels of practice effects over time. That is, the amnesic can display influences of memory on consequent behaviour.

This finding of new learning may seem contradictory given the definition of the amnesic syndrome. In each of these studies, however, even after numerous exposures to the test situation, the patient will deny having had any previous interaction with the task and lacks any subjective sense of familiarity with it. For amnesics, the evidence of a memorial effect in behaviour seems divorced from any accompanying phenomenological and conscious experience of remembering. The amnesic may be able to produce correct responses by "guessing" or through the execution of some skill, yet will insist that he/she has never encountered the relevant event before. As a result, the memory deficit for new information continues to be an identifiable feature of the syndrome, if measured in terms of recognition.

It could be argued that the above examples represent simple motor-reflex learning and that "motor co-ordination" is a preserved skill in the amnesic. Consequently, the apparent memory discrepancy would arise solely due to the distinction between the anatomical substrates involved in cognitive versus motor abilities. There is some indication, however, that an influence of memory can also be found in tasks which involve verbal items – material which could be argued to necessitate the employment of higher cognitive abilities (e.g. Warrington and Weiskrantz, 1970). This issue will be addressed in the first experiment.

Regardless of the appropriate description for the discrepancy, an interesting dissociation between reflective tasks of memory and tacit memory performance has been identified. Amnesics do display effects of memory. This memory, however, is only evidenced in measures that do not require the subject to deliberately retrieve or report the previous event. If the amnesic's performance is measured with savings and relearning measures, some things can be learned very well and effects of memory will be observed.

1.2 FURTHER EVIDENCE FOR THE DISSOCIATION

In order to suggest that the dissociation represents a phenomenon that is a general characteristic of memory, parallel examples of the effect should be observable in other populations, with the use of various tasks and under a variety of conditions. Some supportive evidence for the dissociation can be found in the physiological and normal memory literature.

1.2.1 EVIDENCE FROM ANIMAL RESEARCH

A particularly perplexing controversy has developed in the neurophysiological literature on issues regarding the structural and physical basis of memory. Research with organic amnesic patients through the use of computerized transaxial tomography (CT-scan) and post-mortem histological reports, revealed that damage to anatomical substrates associated with various limbic structures of the circuit of Papez (Rozin, 1976) was sufficient to generate an amnesic syndrome. However, dating back to the studies of Lashley (1950) through to more recent research (e.g. Mishkin, 1954; Weiskrantz and Warrington,1975; O'Keefe and Nadel, 1978), the physiological correlates of memory have been questioned. Investigators have attempted to produce an amnesic disorder in animals by lesioning the limbic structures implicated in human amnesia. Although behavioural changes have been noted, they constitute perseverative tendencies and sequential confusions, rather than any consistent demonstration of a memory deficit _per se_. Failure to find the profound amnesia which is clinically observed in humans has been a serious obstacle to the understanding both of physiological functions and of the amnesic syndrome.

The noncorrespondence between the two research areas has prompted a number of explanations. One argument is that there is an evolutionary break between humans and other species. The absence of a global amnesia in other mammalian species could be an example of the differences in anatomy, apparent functions and conservatism of development in nervous-system evolution (e.g. Lockhart, 1968). Another possibility is that the neuropathology responsible for the amnesia in humans has been inaccurately localized and documented (e.g. Horel and Misantone, 1976; Mishkin, 1978; Squire and Zola-Morgan, 1983; Winocur, 1983). If so, then the animal-lesion analogues of the disorder have been inappropriately prepared, and a resultant amnesia not obtained.

A final possibility is that behavioural studies of non-human species have not concentrated on tests comparable to the ones used on people (Gaffan, 1974; Iverson, 1976). For example, visual discrimination tasks have repeatedly failed to demonstrate memory impairment in animals. Tests with animals invariably consist of on-line performance measures of the type that include re-learning and savings measures (e.g. time to travel through a maze). Note that these are measures in the perceptual-motor domain, measures with which amnesics fail to demonstrate memory impairment as well. There are few analogous tests [illegible] animals simulating a recognition paradigm - tasks in which a deficit in amnesia is undeniably observed with humans.

In an intriguing series of experiments, Gaffan (1977) attempted to devise behavioural measures for animals which were more similar to those used to study human amnesia. In one experiment, monkeys were trained on a picture-recognition task. The monkeys were shown a series of 25 pictures, each of which appeared twice per training session. The monkeys were to make a response to a picture on its second appearance in a session, but to make no response on its first appearance. They were successful on this task with up to 18 intervening items between repeated presentations. Following this, the monkeys underwent surgical transection of the fornix. After surgery, they displayed a severe memory impairment in this task when more than three items intervened between the first and second presentation. In this study, which closely resembles a recognition task, the animals demonstrated an amnesic-like response.

For studies in which reference to a specific prior event is essential for successful performance (e.g. delayed matching-to-sample tasks - Correll and Scoville, 1965), parallel results between human and animal amnesia data are frequently obtained (Squire and Zola-Morgan, 1983). The differential manner with which memory is assessed, therefore, may account for the apparent incompatibility of the human-animal research. Further, the animal data support the notion of a dissociation. Lesioned animals, like amnesics, demonstrate impaired memory on reflective memory tasks; whereas preserved memory is observed for tasks which simply measure motor-related skills.

The dissociation has been observed, in both human and animal populations, when contrasting tasks which involve perceptual-motor skills with reflective memory measures. In order to assess whether this dissociation simply identifies the separability of motor and cognitive skills, tasks which involve verbal knowledge should also be tested. Observing the dissociation with amnesic subjects by employing tacit measures of memory other than motor skills, as in the first experiment, leads one to assume that the dissociation is not restricted to motor tasks.

1.2.2 MEMORY DISSOCIATION IN NORMALS

The animal literature provided one source of converging evidence for the generality of the dissociation. It is not clear from the study of lesioned populations, however, whether the results reveal a dissociation also present in normal memory or represent only an abnormality in memory phenomena due to structural changes resulting from brain damage. Certain results in the literature regarding functional amnesia and normal memory can be cited (studies with persons who have not sustained physiological damage to the central nervous system and who usually do not display memory impairment), which would suggest that there is reason to suspect the occurrence of a dissociation with normals as well as amnesics.

Functional Posthypnotic Amnesia: The functional amnesias represent those cases in which an amnesic-like syndrome is displayed in the patient's symptomatology, but lack a concomitant physiological aetiology for the disorder. It can be initiated by psychological states, such as a hysterical reaction to a traumatic or emotional situation, or, as will be discussed in this section, by induced hypnosis. Since most hysterical or otherwise psychologically precipitated functional amnesias occur in isolation and endure for very short intervals (i.e. often only lasting from a few hours up to a couple of weeks), documentation of these patients is largely based on clinical interviews and single case studies (e.g. Schacter, Wang, Tulving and Freedman, 1982). Experimental research on functional amnesia consists primarily of studies performed with people who are susceptible to hypnosis. The research reported below is a brief review of relevant data suggestive of a dissociation in functional posthypnotic amnesia.

Research on posthypnotic amnesia has been reviewed and updated by Kihlstrom (1980). The amnesia represents a selective impairment for the recall of events and experiences that occurred while a subject was under hypnosis. The amnesia is induced by suggestion (Hilgard and Cooper, 1965) and can be entirely relieved by the subsequent administration of a prearranged reversibility cue (Kihlstrom and Evans, 1976). Since the amnesia can be relieved without the reinduction of hypnosis, the amnesia is not an example of state-dependent learning.

The selectivity of the impairment is demonstrated in the relearning experiments conducted by Hull's students (Hull, 1933). In those studies, hypnotized subjects were required to learn a particular skill, for example, to follow a specific path in a stylus maze or recite a list of paired-associate words. Upon recovery from the hypnosis, subjects were unable to remember the original learning experience. When required to relearn the material, however, they displayed considerable retention for the tasks with a savings measure of performance. Williamsen, Johnson and Eriksen (1965) obtained a similar effect with subjects that were amnesic for word lists that had been learned while under hypnosis. The subjects were able to identify degraded versions of previously learned words better than similarly degraded novel items.

More recently, Kihlstrom (1980) found that posthypnotic amnesic subjects, although unable to free recall previously learned items, produced these same words with a higher probability as "free associates" to semantically-related cues as compared to matched control test items. Even so, on a second free recall task, amnesic subjects continued to perform at significantly lower levels than non-amnesic subjects. When the amnesia was finally relieved by verbal cueing, a third free recall test was administered and subjects' memory for the items increased to 94 per cent.

These results clearly mimic the dissociation of interest. An induced amnesia produces behaviours which are characteristic of the disorder implied in organic amnesia. In this case it is not that the memory is unavailable (i.e. performance returns to normal when the amnesia is relieved) as has been a partial account for organic amnesia, rather the memory is not accessed by the processing which requires deliberate retrieval. It would seem that the physiological uniqueness of the lesion-induced populations is not necessarily the factor that allows for the dissociation between measures of memory to be observed.

Normal Memory Performance: "Induced" dissociative behaviour does not seem to be simply an unususal manifestation of the hypnotic condition. Evidence of a distinction between awareness-related and tacit memory performance can also be found in normals (i.e. subjects having normal memory capabilities) under ordinary conditions. As mentioned earlier, one can imagine well-practiced skills, such as playing tennis or riding a bike, that can be executed without one having to deliberately refer to the prior learning of that skill. In addition, there are some examples of normal behaviour which, like the functional amnesia results, can identify the dissociation in cognitive-related tasks as well as motor-related tasks. The following describes some of these examples.

One source of evidence includes perceptual identification studies (e.g. Murrell and Morton, 1974). When subjects are asked to identify briefly presented words, prior exposure to the words enhances the accuracy of report. This effect is produced by the subject "remembering", since the facilitation is specific to old items. However, the task represents a tacit measure of memory in that subjects are not instructed to refer to the previously studied items; and, in fact, reference to the prior learning is not a necessary condition in order to complete the requirements of the task. Jacoby and Dallas (1981) investigated the effects of the study phase on later perceptual identification performance. Their results are suggestive of a possible dissociation between memory behaviours similar in kind to the amnesic disorder.

Jacoby and Dallas (1981) found that a single presentation of a word during study is sufficient to produce the later facilitation in accuracy of report, in some cases doubling the probability. The benefit is observed even when 24 hours has intervened between study and test. Phenomenologically, however, the subjects often do not recognize that the perceptually identified items presented at test had been read in the earlier study phase. Further, subjects offer the description that some items can be easily detected because they seem to "jump out" from the screen. Enhanced perceptual identification of previously read items is apparently subjectively independent of the awareness that the items have been presented earlier. In addition, variables which significantly affect levels of recognition memory are found not to differentially influence identification accuracy. For example, with the levels-of-processing (Craik and Lockhart, 1972) manipulation, questions which encourage a semantic analysis of the target item result in better recognition memory than do questions that direct orthographic analysis. For the perceptual identification task, in contrast, no effect of varying levels of processing is found (Jacoby and Dallas, 1981). Finally, prior exposure to an item had an equivalent effect on identification report regardless of whether recognition memory levels were very poor or almost perfect.

Kolers' work (1974; 1975; 1976) also implicates a dissociation between tacit and reflective memory measures. In his task, subjects read several lines of text in which letters were rotated varying degrees. The measure of interest was reaction time. Subjects demonstrated a general practice effect in reading the translated text; their time to read a passage decreased with extended experience with the task. More interesting, however, was the finding that on later testing of the skill, subjects read previously presented text more quickly than novel inverted text. This facilitation of reduced reaction time for old items has been observed up to a year after study. Recognition for repeated items, however, was found not to be associated with these facilitated reading speeds, and was at chance levels a year later.

A similar relationship between recognition and lexical decision has been identified by Scarborough, Cortese and Scarborough (1977). In a lexical decision task, subjects are asked whether or not a string of letters constitutes a word. Subjects will show facilitation in accuracy and latency to respond on repeated presentations of target items (e.g. Hayman, note 1). This finding can be obtained with nonwords, as well as words. Since nonwords do not have pre-existing representations in memory, the repetition effect is attributable to a specific prior experience. Performance in lexical decision, however, is essentially unaffected by temporal delays, whereas recognition performance is significantly reduced (Scarborough et.al., 1977).

Tulving, Schacter and Stark (1982) have also provided evidence for the dissociation between the two types of tasks. Successful completion of graphemic word fragments is facilitated by prior presentation of the target items. As with the other tacit measures, however, performance on this task is unchanged after a one week retention interval, whereas recognition accuracy is greatly diminished. Further, with the use of different materials, they replicated the results of the first two experiments of this thesis (Tulving et.al., 1982, p.340) which became public (Psychonomics Society Conference, 1981) prior to formal publication in 1982 (Jacoby and Witherspoon, 1982). Tulving et.al. (1982) demonstrated that there is no predictive relationship between the two measures of memory. Successful performance on the word fragment task is statistically independent of whether or not an item can be recognized.

Finally, Zajonc and his colleagues (Moreland and Zajonc, 1977; Kunst-Wilson and Zajonc, 1980) found that subjects' ratings of their preference for certain pictorial stimuli is influenced by prior exposure to those stimuli (ratings are more favourable for old items). This effect of memory on preference judgments, however, is not correlated with the recognition of whether or not the items were previously encountered.

The generality of these effects may be typified by a result that has been identified by researchers investigating attributions of performance (e.g. Nisbett and Wilson, 1977). Nisbett and Wilson found that subjects' introspective reports of why they succeeded at a task which demonstrated memorial influences were uncorrelated with and/or inadequate to account for the accuracy levels they obtained. These subjects were unable to correctly report what they had based their decisions on; that is, like the amnesic, they could not reflect on what had influenced their behaviour.

The evidence for suggesting the general existence of the dissociation is compelling. Chapter Two will examine the relationship between tacit and reflective memory measures more thoroughly by addressing issues which could limit the conclusion that the dissociation represents a characteristic of normal memory performance.

1.2.3 SUMMARY OF THE EVIDENCE

The classic dissociation displayed by organic amnesic patients is not a restricted phenomenon. The generality of the effect is illustrated by animal studies, functional amnesias and persons with normal memory. The animal literature results showed that the distinction between traditional reflective memory measures and tacit memory tasks is an important one for identifying the dissociation. The functional amnesia results showed that the effect is not specific to brain dysfunction; and the normal subject data showed that the effect is not even specific to amnesic states.

Although most of the organic amnesia results give examples which contrast motor ability with a cognitive memory task, some evidence is reported with tasks that cannot as easily be classified in these terms (e.g. free association; perceptual identification). Finding parallels of the dissociation with various tasks and with various populations tends to lend support to the view that this dissociation represents a global characteristic of memory behaviour. The generality of the dissociation would suggest that, indeed, there are two varieties of memory.

1.3 THEORETICAL PERSPECTIVES

The conclusion that there exists at least two varieties of memory performance directs one to question the basis of the dissociation. The following section is a discussion of the three explanations outlined above: the differential sensitivity, multi-memory systems and the differential processing views.

There are certain theoretical assumptions attached to each of these positions. Those who argue that the effect reflects only the differential sensitivity of the memory measures would expect the dissociation to be unidirectional. That is, an effect of memory on tacit measures may not predict performance on the more traditional reflective memory tasks, but the converse would not be true. Those who promote the multi-memory systems view would expect the dissociation or independence to be universally obtained. No predictive relationship between the tasks should be observed. Finally, those who advocate the differential processing approach would want to suggest that the relationship observed is affected by the processing requirements of the task situation. By this view, although independence effects are primarily observed, it would be expected that conditions can be arranged under which dependence in the memory results is found. These predictions will be more thoroughly outlined below and will be investigated in the experimental section of the thesis.

1.3.1 DIFFERENTIAL SENSITIVITY

The dissociation has been demonstrated phenomenologically by the subjects' inaccurate report of an event, but simultaneous accurate memory performance as expressed in some other form. It could be argued that the tacit memory measures simply represent more sensitive measures of memory and, thus, are able to demonstrate a memory influence in situations when reflective memory tasks do not. The tasks measure the same aspects of memory, but differ quantitatively. In this vein, Meudell and Mayes (1981) suggest that the evidence of learning without coincident recognition is characteristic of "weak" memory. They found that when 17 months had intervened between study and test, normal subjects performed in a manner similar to amnesics. Nelson (1978) also argues along these lines by suggesting that recognition memory tests have a higher threshold than do the tacit memory tests.

The appeal to differential sensitivity is similar to earlier accounts of the relationship between recognition and recall. It was argued that in recognition, all of the item information is available and the subject need only decide whether the item has a match in memory. Recall was considered to be a more difficult task since the subject's task was first to generate possible responses and then to recognize the appropriate response (e.g. Bahrick, 1970; Kintsch, 1970). Due to the necessitiy of a generation stage, recall was assumed to be a less sensitive measure of memory for an event. It was argued that any dissociation of recognition and recall observed would be unidirectional. Items that are recognized may not be recalled; but if they are recalled, then they must also be recognized. Similarly, it would be argued that the tacit measures of memory may not guarantee success on any reflective memory measure, but success on the higher criterion reflective memory tasks would be reliably predictive of successful performance on the tacit measures.

The relationship between the two measures could be evaluated by observing functional changes due to the manipulation of relevant variables, as in Experiment Three; or, according to statistical measures of stochastic independence, as in Experiments One and Two. Evidence of the dissociation using either of these methods would argue against a position contrasting the sensitivity of measures (Tulving and Wiseman,1975; Wiseman and Tulving, 1976; Flexser and Tulving, 1978; Begg, 1979). These methods will be discussed below.

The first method consists of manipulating a relevant variable and observing the effect that manipulation produces in the overall means of the two measures. Independence would be inferred when the patterning of the marginal (mean) values of one task is different from, and, in particular, opposite to the patterning obtained by the marginals of the other task, a "cross-over" interaction. This form of evidence would not allow for a sensitivity argument, since it would demonstrate that both measures are "sensitive" to relevant memory variables; and they are "independent" since they would show the effects in opposite directions. Experiment Three presents a study in which an interaction can be found between the two tasks when subjected to the same encoding variables.

A second method involves the evaluation of the "stochastic independence" of the measures by use of the chi-square contingency. This analysis is informative (Castellan, 1965) because it can examine the relationship between the measures at an item by item level. Subjects may be able to perform at reasonable levels on either of the tasks being measured (i.e. the marginal information shows equivalent performance), but the retrieval events may still be independent of one another. For any particular retrieval attempt, there may not be a predictable relationship between the access of an item on one occasion and the access of that same item on some subsequent occasion. The contingency table allows one to assess this independence. Further, one can observe the conditional probabilities of the contingency table to reveal directional relationships between the measures by indicating the probability of responding one way, given that a certain response has already occurred. In contrast to a differential sensitivity argument, if stochastic independence is obtained, in which $X^2=0$ in the ideal case, the probability of successfully responding on a "high threshold" task of recognition is not predictive of also being successful on a "low threshold" tacit memory task. If there is a dependent relationship between the measures (i.e. a significant X^2 relationship is obtained, as is predicted by the sensitivity view), then showing memory for an event by one measure would predict the memory outcome of the other task. The notion, therefore, is that this statistic can evaluate the relationship between the memory measures in terms of predictive retrieval success; and the finding of stochastic independence would be incompatible with a sensitivity argument.

Both of these methods of examining the independence between the measures have been explored in the following experiments. Both can evaluate the adequacy of a sensitivity of measures argument; and each represents a completely independent evaluative method. (Note: to analyze the results using the chi-square contingency, consideration has been given to the "Simpson's Paradox" issue (Simpson, 1951; Hintzman, 1980; Flexser, 1981) – see Appendix A).

1.3.2 MORE THAN ONE MEMORY?

One current conceptual dichotomy in the normal memory literature contrasts memory for episodes or specific events and memory for general or semantic knowledge (Tulving, 1972). Episodic memory is characterized as storing information regarding personal experience and the temporal-spatial relations among events. Contextual information that distinguishes one event from another is critical for this type of memory. Episodic memory is considered to be important for recognition decisions, since being able to refer to a specific instance would allow one to decide whether or not there was a previous occurrence of the event. Semantic memory is considered to be free of any reference to personal experience, and is defined as representing the organized knowledge people possess about meaning, rules and symbolic relations and "does not register perceptible properties of inputs, but rather cognitive referents of input signals" (Tulving, 1972, p.386). Semantic memory would be important for skills such as problem-solving, reading and comprehension. Knowledge of precisely when and in what context a learning event occurred is irrelevant.

Although the episodic-semantic distinction was originally proposed as a convenient description, some investigators have treated episodic and semantic memory as representing two independent memory systems (e.g. Kintsch, 1975; Watkins and Tulving, 1975; Shoben, Westcourt and Smith, 1978; Tulving, 1983). Some have even tried to determine the physiological correlates of the two systems (Wood, Taylor, Penny and Stump, 1980; Warrington and Weiskrantz, 1982). The suggestion has been that the episodic memory system would be responsible for the reflective report of a specific event; whereas semantic memory would be influential in ongoing behaviour in a more general sense without specific temporal or contextual reference to any particular prior event. The possible existence of these two systems has been presented as an account of the dissociation observed in amnesia (e.g. Kinsbourne and Wood, 1975; Kihlstrom, 1980; Schacter and Tulving, 1982). It is argued that, in amnesics, the episodic memory system is impaired. Amnesics are unable to refer to autobiographical memories, however they can succeed at tasks which allow for the expression of general knowledge (e.g. normal I.Q. levels; preserved language skills).

A related, but somewhat different, perspective concerns the possible distinction between procedural and declarative knowledge as used in the artificial intelligence literature (Winograd, 1975). The distinction is reminiscent of the classical dichotomy between "knowing how" and "knowing that" and seems to represent other related distinctions such as habit versus pure memory (Bergson, 1910), and memory without record versus memory with record (Bruner, 1969). The procedural/declarative distinction has recently been promoted by Squire and his colleagues (Squire, 1982; Squire and Cohen, 1982; Squire and Zola-Morgan, 1983). Procedural knowledge is said to be "accessible only by engaging in or applying the procedures in which the knowledge is contained....There can develop in memory a <general> representation based on experience that changes the way an organism responds to the environment, but this representation...does not afford access to the specific instances that led to the change" (Squire and Zola-Morgan, 1983, p.14). Declarative knowledge represents the acquisition of specific facts and data structures that "reflect the outcomes of applying particular procedures or that reflect particular instances of their application" (Squire and Zola-Morgan, 1983, p.14). Procedural knowledge is responsible for memory displayed through action, whereas declarative knowledge is responsible for the ability to assert awareness of an event or report of a prior occurrence. The distinction may be more clearly represented by the following: knowing when and where a skill was learned may be critical for reflection, but may not be relevant to the execution of the skill itself. Procedural learning could account for the preserved motor skill ability that is observed in amnesia, while still permitting a substantial reflective impairment. That is, for amnesics, procedural learning is normal, but the ability to form a declarative record of the learning is impaired.

Tulving (1983) has promoted yet another multi-systems account of the dissociation, a view which was stimulated due to concerns regarding the structural and functional distinction between semantic and episodic memory (e.g. McKoon and Ratcliff, 1979; Anderson and Ross, 1980). Tacit memory tasks, which could be classified as semantic (e.g. lexical decision, word completion and perceptual identification), display episode specific effects (e.g. Carroll and Kirsner, 1982; Tulving et.al., 1982; Feustel, Shiffrin and Salasoo, 1983) and vice versa (Franks, Plybon and Auble, 1982). The evidence of prior event specificity in both reflective and tacit memory tasks, then, seems to reflect a phenomenon which is confined to only one of the memory systems described - episodic memory or declarative knowledge. Some investigators have argued that apparently abstract or general knowledge can be simply the application of episode-specific knowledge (Brooks, 1978; Medin and Schaffer, 1978; Jacoby, 1983). Semantic theorists, however, deal with episodic effects by arguing that there is a temporary activation of the semantic system which allows for the expression of repetition effects if tested over short durations. This suggestion is inadequate to account for the results, however, since facilitation can be observed over the long-term (e.g. up to a year after study). One solution to these criticisms has been to suggest that the disparate results indicate the existence of yet another memory system "as yet poorly understood" (Tulving et.al., 1982, p.341; Tulving, 1983).

Each of these views argues that the dissociation observed between the memory tasks is a consequence of separate memory systems mediating memory function. It is assumed that the differential results on the two classes of tasks occurs "because the tasks tapped different memory systems" (Tulving, 1983, p.97). Tacit memory tasks engage the system which is responsible for general knowledge (or some "other" memory system), whereas reflective tasks interrogate the system responsible for recording specific contextual details of an event. Since the memory tasks are identified with different underlying systems, the independence between the measures is an expected and unavoidable result. Independence would be observed between the two types of memory tasks because the memory systems they engage are independent. Obtaining consistent independence results, by use of the methods mentioned earlier, would support the multi-systems view of memory.

1.3.3 A DIFFERENTIAL PROCESSING VIEW

A differential processing account of the dissociation emphasizes the importance of differences in retrieval processes and the interaction between encoding and retrieval. These processes can be active within a single memory system and represent the utilization of different types of information. If the requirements of tacit and reflective memory tasks emphasize the use of different types of information, then one could argue that the dissociation in performance reflects a qualitative difference of memory function in terms of the differential processing of information, rather than the operation of different systems.

The nature of this processing account is most easily explicated by first describing the generally accepted account of the relationship between recall and recognition memory, an account which can be generalized to explain the relationship between tacit and reflective measures of memory. Under some conditions, performance on a recall test does predict recognition performance and a dependent relationship between the measures is observed. However, contradictory to the differential sensitivity account discussed earlier, it has also been found that words which cannot be recognized can sometimes be recalled (e.g. Tulving and Wiseman, 1975). That is, the relationship between the two types of test can approximate independence. A recognition test, therefore, cannot simply be an easier or more sensitive version of a recall test. The relationship between recognition and recall has been described in terms of differences in the retrieval information provided by the two types of test (e.g. Flexser and Tulving, 1978). The recognition test provides a "copy" cue to aid retrieval, whereas recall is reliant on the test context and other items recalled from a list as retrieval cues. Since the two types of test rely on different types of retrieval information, the relationship between performance on the tests can approximate independence. However, it is important to note that the relationship between the measures is a variable one.

The variable relationship between recall and recognition can be explained by suggesting that there are two forms of recognition memory, a suggestion that has been made by several investigators (e.g. Juola, Fischer, Wood and Atkinson, 1971; Humphreys, 1978; Rabinowitz, Mandler and Barsalou, 1977; Mandler, 1980). Although there are discernable differences between these numerous descriptions, there is an apparent consensus that recognition memory can be derived from two informational sources. Recognition can be determined by being able to respecify the original event, given available contextual cues. On the other hand, an event may be recognized as familiar, solely on the basis of available perceptual information.

Mandler and his colleagues (Mandler, Pearlstone and Koopmans, 1969; Mandler, 1972; Mandler, 1980; Mandler and Rabinowitz, 1981) have been the most vocal proponents of the view that there are two forms of recognition memory. According to Mandler (1980), if a test item seems sufficiently familiar, it will be accepted as being "old". If an item is not sufficiently familiar, a subject can employ a retrieval check, attempting to recall the test item or its study context and, thereby, justify a recognition decision. Feelings of familiarity reflect memory for the perceptual characteristics of an item along with its intra-item integration. Recognition of an item made on this basis would be expected to be independent of its recall, since the type of information being used to assess familiarity differs from that which would be used as cues for recall. In contrast, dependence between recognition and recall would be predicted for a recognition decision based on a retrieval check. In this case, the organization of items in a list or their inter-item integration is important, the same type of information that is important as a source of cues for recall.

Jacoby and his colleagues (Jacoby and Dallas, 1981; Jacoby and Witherspoon, 1982; Jacoby, 1983) have also argued that there are two bases for recognition memory decisions, and have related the "familiarity" basis for recognition decisions to effects on perceptual performance. Following Kolers (1974; 1975), Jacoby and Dallas (1981) note that the effect of prior experience with an item is to produce an increase in the "relative fluency" or ease with which a subject is able to process the repeated perceptual information as compared to novel information. Further, they suggest that differences in the fluency of processing perceptual information may be responsible for judged differences in familiarity and serve as a basis for recognition decisions. That is, processing information in a very fluent fashion can result in the inference that since something was interpreted or processed relatively quickly, it must have been seen previously. In this vein, subjects in recognition memory experiments often report that old items seem to "jump out" at them. By the view proposed above, this jumping out is due to an influence of recent prior experience on perception, and can be used as a heuristic for the recognition decision. Experiment Six is directed at evaluating evidence for the ability of subjects to judge changes in processing information. If the subjects are able to detect phenomenological differences in the stimulus presentations contingent on the items' memorial status, then this would support the view that subjects do have a basis on which to make an attributive judgment; and would suggest that in this way, recognition responses can be derived from perceptual information.

The perceptual fluency heuristic is nonanalytic and does not guarantee accuracy since factors that are definitionally irrelevant to the recognition decision can contribute to relative perceptual fluency. For example, a "new" word might be perceptually identified more readily due to its occurring frequently in the language. Use of the perceptual fluency heuristic would lead to more false recognitions of high frequency words as compared to low frequency words. The other basis for recognition decisions, retrieval of context, is seen as being more analytic and conservative. "The retrieval of the context associated with episodic events is <considered> the more important determinant of recognition <decisions>" (Feustal, Shiffrin and Salasoo, 1983, p.60) since it is restricted to information that is definitionally relevant to the recognition memory task. In this case, the subject reflects on the relevant prior experience and deliberately attempts to retrieve the prior study context of the tested item in order to decide whether a particular event had occurred previously.

By the above discussion, only one of the two types of processing, retrieval of context, truly involves reflection. The relative fluency basis for memory performance, in contrast, relies on perceptual information. The dissociation between reflective and tacit memory measures would occur because the tasks typically invoke these different types of processing. In a recognition test, the more reliable basis for a decision would be the retrieval of contextual information. In tacit memory tasks, no confirmation or test of retrievability is encouraged or required, so that the perceptual similarity between the test and a prior event is sufficient to allow one to respond. The independence between these measures reflects the individual access of a specific prior memory episode by making use of these differential sources of information.

However, if the relationship between the measures is best described in terms of processing differences that are guided by the types of information used in the task, then the manipulation of available information should produce dependent effects as well. A dependent relationship between the memory measures would be expected under conditions in which both tasks are reliant on the same type of information which would invoke the use of the same types of processing. For example, when the perceptual fluency basis for a recognition judgment is used, dependence between recognition and tacit memory measures would be expected. If perceptual information is effective in accessing the memory episode in one task, then it should continue to be effective on a similar subsequent attempt.

The predicted variability of the relationship between the reflective and tacit measures is reminiscent of the variable relationship found between recognition and recall tasks and is open to the same interpretation. One can assume a single memory representation; and potential dichotomies between the measures can be attributed to differences in the types of retrieval information made use of and/or the types of processing that the tasks require. Finding variable relationships between tasks can be easily accounted for in terms of differential processing, but is awkward for a multi-systems view which identifies the separability of the tasks with the separability of the memory stores. By the multi-systems view, it is expected that independence of the tasks would be the obtained result (Tulving, 1983). Experiments Four and Five are directed at the distinction between these two theoretical perspectives.

1.4 AN OVERVIEW OF THE EXPERIMENTS

The experiments presented in this thesis will investigate the dissociation, its limitations, and its potential contribution towards current theoretical accounts of memory phenomena. The experiments will be specifically concerned with the issues referred to earlier. Emphasis will be placed on substantiating the generality of the dissociation (independence - Chapter Two), the manipulation of this effect (dependence - Chapter Three), and possible sources of variance that can account for these apparently contradictory results (judgments of familiarity - Chapter Four).

1.4.1 THE TASKS

In amnesia, the dissociation becomes obvious only when one assesses memory in very different ways: the reflective memory measures of recognition and recall identify the amnesics' memory impairment; the tacit memory measures of motor tasks display the amnesics' memory ability. The type of measurement is clearly an important factor in allowing the phenomenon to emerge. This conclusion is substantiated by the animal preparation studies regarding the physiological basis of memory. The controversial and inconsistent findings from this research may be best understood as reflecting the importance of the memory measures.

What is at issue when investigating the importance of the memory measures employed, is whether or not the amnesics' preserved ability is restricted to and representative of motor skills alone. That is, does the dissociation observed between these measures simply reflect differences in cognitive and motor abilities? Or, can other tacit memory measures which more clearly implicate the cognitive system be found to produce a similar pattern of results. By globally defining tacit memory measures as those which assess the influence of memory in terms of changes in on-line performance, one can prepare experimental paradigms which would allow one to assess verbal knowledge (i.e. a skill which clearly involves cognitive ability) in order to address this question.

The tacit memory tasks employed in the following six experiments include a variety of measures selected on the basis of the global criterion. The measures include spelling behaviour (Experiments One and Five), perceptual identification (Experiments Two and Four), completion of word fragments (Experiment Three) and perceived time judgments (Experiment Six). Each of these tasks could be performed without the inclusion of a prior study phase, and as such do not require that the subject necessarily refer to a specific previous event. These will be compared to a reflective memory task of recognition.

1.4.2 THE EXPERIMENTS

Chapter Two will present three experiments aimed at examining the generality of the dissociation - across different populations and experimental paradigms. Experiment One will investigate the dissociation in Korsakoff patients and will use verbal materials, in order to demonstrate that the dissociative behaviour amnesics display is not restricted to a distinction between motor skills and cognitive abilities. Experiments Two and Three are directed at investigating the dissociation in normal memory subjects and employs different measurements and means of evaluation in order to establish the robustness of the phenomenon. Observing independence will suggest that the dissociation effect is not restricted to particular patient populations, nor to the type or sensitivity of the memory measures, but rather may represent a qualitative difference in memory function.

The third chapter investigates the variability of the relationship between the memory measures in order to more clearly describe the dissociation. By itself, the dissociation could either indicate the existence of two separate memory systems or the differential use and processing of information by a unitary memory.

Finding either independent and dependent relationships between the measures under different processing conditions could indicate that a single prior event or representation influences the behaviour, but that the access of that event will be similar or different, depending on the limitations imposed by the tasks. Such restraints are observed in Experiments Four and Five. Observing variable relationships between the measures which are contingent on manipulating the type of available information would be an awkward result for the view which identifies the different tasks with different memories.

The fourth chapter is concerned with possible sources of variance that contribute to observing a dependence between the two measures. In particular, this chapter considers the assumption that the recognition task can make use of different sources of information and it is this effect that produces the dependency. Recognition predominantly makes use of contextual respecification of the original learning event. Some authors have argued that another basis for a recognition decision is the judged fluency or efficiency of processing perceptual information. If this is the case, then one should be able to identify some conditions under which it is clear that a response can reflect this phenomenological judgment. Experiment Six is aimed at investigating this possibility.

Finally, Chapter Five will present a general discussion which summarizes the findings of the experiments and what can be inferred from their results. The results from the experiments are interpreted as suggesting that the dissociation represents the differential processing of available information rather than a quantitative difference between the two measures or the existence of two or more memory systems.

- CHAPTER TWO -

EVIDENCE FOR INDEPENDENCE

In this chapter, three experiments are presented which examine the dissociation between reflective and tacit measures of memory. The experiments will address two of the issues discussed in the introduction; the generality of the dissociation and the adequacy of a sensitivity explanation.

The first issue is concerned with establishing the generality of the effect. For dissociation to be considered a robust phenomenon, consistent evidence of independence between reflective and tacit memory measures should be obtained with various subject populations, tasks, and means of evaluation. Both amnesic and normal memory subjects will be tested and three experimental paradigms will be employed in the following studies. The dissociation would be viewed as a general memory phenomenon, if found under these diverse conditions.

The second issue is the adequacy of the sensitivity argument as an explanation for the dissociation. Given the methods of analysis used in these studies, one can determine whether the effect is descriptive of the quantitative differences between the measures, the differential sensitivity position, or rather, reflects a qualitative difference in memory. A differential sensitivity view would predict a dependent relationship between the measures. The tacit memory measures may or may not be able to access a particular learned event; however, if the memory is accessed by the less sensitive task of recognition, then the tacit memory task should also reveal evidence of memory. Finding stochastic independence between the two response measures and showing that relevant memory variables produce differential results in the measures, would eliminate this argument as a possible theoretical account of the dissociation.

Collectively, the major purpose of the following studies is to provide convincing evidence of independence in order to support the argument that the dissociation is a reliable manifestation of memory.

2.1 EXPERIMENT ONE – THE DISSOCIATION IN AMNESIA

The main finding of interest is that amnesic patients can exhibit memory influences in their behaviour, and this influence is apparently divorced from any recognition of the previous experience. The following experiment was an attempt to formally investigate this dissociation in Korsakoff psychosis patients. The study had three main objectives which will be outlined below.

One objective was to demonstrate that the preserved memory ability observed in amnesics is not restricted to perceptual-motor skills. Amnesics consistently show normal practice effects in tasks which involve repeated motor abilities (e.g. mirror drawing – Starr and Phillips, 1970). It is necessary to determine whether this memorial effect is constrained to these tasks, or can be observed in any task which allows for the expression of memory in a tacit way. Memory evidenced with the use of verbal material may be considered a convincing test of this notion.

There has been some suggestion in the literature that evidence for preserved memory can be found with verbal materials. Warrington and Weiskrantz (1970) have shown that, under certain conditions, cueing an amnesic with fragmented or partial versions of previously experienced words improved their ability to reproduce the target items. If the item had a restricted number of possible solutions, the amnesic was more likely to report solutions to target items than to novel ones. Unlike the motor skill tasks, however, this task did not display normal levels of performance in the amnesic.

As suggested earlier, the requirements of the task affect the behavioural responses observed. One might expect that normal performance levels would be observed if the amnesics were asked to simply free associate to the fragmented cues. Along this vein, it is interesting to note that when amnesics produce a response in a paired-associate recall task, they insist that they are "merely guessing"; they say they cannot remember the learning occasion, never mind the particular items in the list. Yet, their responses frequently show that they are guessing in a manner that demonstrates the effect of earlier learning. Amnesics might succeed at the task, verbal or non-verbal, if directed reference to the earlier experience is not required. In the following experiment, memory for verbal material is tested. Homophone items will be biased, through meaningful context in a question, towards their "low frequency" spelling pattern. Then memory will be assessed by two measures. One task will involve a recognition decision. The other task is designed to reduce any inclination on the part of the subject to intentionally refer to the study phase as a basis for responding. This measure is based on the subjects' spelling behaviour for homophones.

A second objective of this experiment was to produce evidence of preserved memory in the amnesic with a minimum of special instructions. Subjects are given a single prior exposure to the test material in the context of an incidental learning paradigm. Since there is no continued repeated experience with the material, the memory performance observed will not represent practice effects or artificially-produced good learning. The memorial influence will be based simply on having subjects answer questions that contain the target items in an inconspicuous manner. Showing memory influences in behaviour under these conditions would provide compelling evidence for suggesting that amnesics have preserved memory abilities for verbal material.

Finally, the study was designed to examine the dissociation phenomenon with controlled, comparable measures. As mentioned earlier, most of the evidence for the awareness-performance discrepancy arose from the casual observation that amnesics could show facilitation in relearning measures of a task, but would continue to deny any phenomenal familiarity with the repeated situation. In the following experiment, separate measures of the subjects' recognition and on-line performance are obtained in order to directly compare the responses. The recognition measure is a dependent variable in the same manner as is the tacit memory measure. The dissociation will be evaluated by a formal analysis of the independence between the measures, as well as by subjective phenomenological report.

2.1.1 METHOD

Subjects :

The five subjects in the amnesic group (mean age=57.8) were diagnosed Korsakoff psychosis patients having severe memory deficits as assessed by clinical methods. The patients, all having long histories of alcoholism before hospitalization, are presently residents of the Brockville Psychiatric Institute, Brockville, Ontario. Typically, they are unable to recall day to day events and have retrograde amnesia of varying lengths for events prior to their illness. Clinical interviews and assessments were conducted by Dr.S.Page (clinical psychologist), Dr.M.Siddiqui (psychiatrist), and staff - all of the Brockville Hospital, and Dr.G.Winocur (experimental psychologist) of Trent University. This was necessary in order to screen patients so that none participating in this study were incapable of completing the tasks or displayed signs of dementia and/or other cognitive complications that could render the data uninterpretable. All produced intelligence quotients within the normal range (mean I.Q.=93.4) as measured by the

Wechsler's Adult Intelligence Scale (W.A.I.S.), and were considered normal with respect to general comprehension abilities. None the less, these subjects obtained below normal scores, by at least one standard deviation, on the Wechsler Memory Scale (i.e. scores were below 85; mean=73.6).

The comparison subjects were first year McMaster University undergraduate students (n=5), who received course credit for participation. This population, although not selected as a control on the basis of sharing common characteristics with the amnesic patients, did serve as an interesting contrast group in this study. The students were much younger (mean age=20.4), and, clearly, did not have similar histories of alcoholism or institutionalization. Nor did they have any noticeable cognitive deficits, particularly with respect to memory abilities. However, as a contrast group they were able to provide two main comparisons: firstly, as a normal memory control in order to assess the effectiveness of the various memory measures. A substantial memory effect should be obtained with this group regardless of the way in which the memory is examined assuming the tasks adequately assess memory abilities. The amnesics, on the other hand, are not expected to consistently display evidence of memory. Secondly, this group can be examined as to whether the dissociation being investigated can be observed statistically and/or through subjective phenomenological report in young subjects who are cognitively alert and have no memory complications due to age, toxic disease or organic brain damage. That is, one can question whether the dissociation is specific to the amnesic population. This second factor is important for addressing issues which concern the transfer of knowledge between results obtained from abnormal and normal populations.

Due to the nature of the stimulus materials chosen for these studies, for this and all subsequent experiments, all subjects were required to be native English speakers or to have spoken English fluently for at least ten years.

Materials :

The materials employed in this study focus primarily on the use of homophones - words that have a single phonetic pronounciation, but have at least two different spellings and meanings (e.g. stairs and stares). In this study, homophones with only two spellings were used. Norms on spelling pattern preferences were obtained (e.g. Galbraith and Taschman, 1969) and are categorized into low and high frequency spellings (i.e. least versus most preferred).

Although these norms can be affected by many factors, such as frequency of occurrence in the language, the preferential spelling pattern data indicate that differential spellings do emerge given isolated presentation of a homophone. None the less, appropriate within-subject control items are also included. Appendix B1 presents the lists of homophone words along with all other material used in this study. Mode of presentation was auditory for all phases of this study so as to insure the homophones would remain ambiguous according to their phonemic characteristics and be disambiguated only through meaningful context.

Phase One - Study: Thirty unrelated questions were constructed. Half of these questions were designed to bias a homophone item, through meaning, towards its low frequency spelling pattern. In every case, the homophone is included as part of the question and is not required as an answer from the subject. The remaining 15 questions were included as distractor items and did not contain homophones. The level of difficulty of these questions was quite low and frequently autobiographical. Table 1.1 provides examples of the stimulus format. Two random sequences of presentation were employed.

Phase Two - Spelling Test: The test materials in this phase consisted of a list of 60 single words selected from four different item sets. The "critical" set consisted of the 15 homophones presented in the questions from phase one. Note that throughout all experiments the "critical" items will refer to items which are

Table 1.1

An Example of the Stimulus Format
For Experiment One

Phase One - Questions

Name the days of the week. (homophone)
What is your favourite sport? (nonhomophone)

Phase Two - Spelling

	homophone	nonhomophone
old	week (critical)	sport
new	waste (control)	fence

Phase Three - Recognition Test

	homophone	nonhomophone
old	week (critical)	sport
new	grate	train

presented in all phases of the experiment and are evaluated according to the contingency analysis where appropriate. The "control" set contained 15 new homophones not previously given. These two sets are the primary items of interest, as one can examine these to assess whether or not the subjects' spelling behaviour is influenced by the questions. Whereas control items should produce high frequency spelling patterns representative of the norms from which they were obtained; the spelling of critical items could demonstrate an influence of the earlier biasing procedure. In addition, two sets of nonhomophone distractor words were included. Fifteen were chosen from the distractor questions in phase one, equating for amount of previous exposure for a later test of recognition; another 15 were new items not heard in the earlier session.

Phase Three - Recognition Test: A second list of 50 words was constructed. Of these, 15 were the critical homophones and 15 were the nonhomophones chosen from the phase one questions. Another 20 items, ten homophones and ten nonhomophones, not previously presented in any phase, were included as distractors. Word presentations were randomly ordered.

Procedure :

All subjects were individually tested in a single session which lasted approximately one hour. A set of instructions was read to each subject indicating there were a number of phases in the experiment, and that each ~~would~~ be introduced individually. In this way, an incidental learning format was used such that there was no ~~directed~~ requirement to learn or study the material, nor was there prior knowlege of later task requirements - particularly with regard to subsequent memory evaluation.

Phase One - Study: Subjects were asked to listen to a number of questions and to respond orally to them immediately after each presentation with one word or short phrase answers. All questions were answered adequately by both groups of subjects, but will not be formally analyzed. The responses primarily served the function of assuring that each question was attended to and sufficiently understood, a necessary prerequisite for any disambiguation of the homophones to occur.

Phase Two - Spelling Test: A list of words was read to each subject. After each word, the subject was required to spell the item aloud and the response was recorded for later analyses. Occasionally, subjects were tempted to give two spellings for a particular homophone. In this case, both spellings were recorded, but only the first spelling produced was accepted as the official response (frequency of occurrence - for critical items=.033; for control items=.039).

Phase Three - Recognition Test: During this phase, another list of words was presented. After each word was read to them, subjects were asked to write down on a sheet of paper only those words they recognized as having heard during the question phase. Responses were scored for correct acceptance of "old" and false acceptance of "new" items. The spelling of homophone items was also evaluated.

2.1.2 RESULTS

As expected from the population norms, high frequency spelling patterns occur with a high probability for the control homophones presented in isolation (means: amnesics=.600, normals=.773. See Table 1.2 and Figure 1.1). However, the critical homophones that were subtly biased towards a least preferred spelling pattern produce a significant increase in the probability of low frequency spellings (amnesics=.627 and .217; normals=.506 and .200; p<.01. See Table 1.4). Note that even the amnesics display an effect of prior experience in behaviour when performance is assessed with this measure. With verbal materials, and a single prior exposure to the target item, the amnesics' behaviour can be influenced. As evidenced by the observed cross-over in spelling pattern (Figure 1.1), both amnesics and normals demonstrate a substantial memory influence, significantly

Table 1.2

Mean Proportion (and Standard Deviations)
of Homophone * Items
Spelled in a Particular Pattern

	Amnesics		Normals	
	Critical	Control	Critical	Control
Low Frequency	.627 (.076)	.217 (.056)	.506 (.160)	.200 (.115)
High Frequency	.230 (.076)	.600 (.047)	.494 (.160)	.773 (.112)
Incorrect	.143 (.082)	.187 (.099)	.000 (.000)	.027 (.037)

* - critical = homophones biased during question phase
  - control = new homophones

reducing the dominance of a high frequency spelling preference for biased items. The analysis of variance for this experiment is provided in Table 1.4. The 2 x 2 analysis for spelling patterns includes a between-subject factor (groups - Amnesics and Normals) and a within-subject factor (low spelling pattern versus other spelling). Note that low spelling is contrasted with the collapsed group of high and misspelled items, since the effect of interest is only whether or not the homophones display the memory bias from the study phase.

Despite the evidence of memory effects with the spelling measure for both groups, the recognition data replicate the typical findings. While subjects with normal memory capabilities tend to do very well on this measure (mean=.771), amnesics' recognition results are typically low (mean=.260; see Table 1.3 and Table 1.4). (Note that d' values should be calculated per individual based on a large number of trials. This was not possible in any of the studies reported due to the lack of data points. Instead the recognition results have been averaged across subjects in order to provide a general description of the discrimination level obtained in this and following experiments).

This dissociation between the amnesics' performance on the two measures was statistically evaluated in terms of the chi-square test for independence. Tables 1.5a and 1.5b present the contingency analysis results. The obtained chi-square test levels evidence no indication of dependence between the two response measures for amnesics (X^2=.765), or for Normals (X^2=1.497). Regardless of the extreme variation in the overall recognition obtained by the two groups, the comparisons invariably result in independence. Normal subjects' performance, although not obviously differential on the tasks, also display stochastic independence between the memory measures. As the conditional probabilities demonstrate (Table 1.6), there is no predictable relationship between the performances on the two tasks for either population. Successfully biased

Table 1.3
Mean Proportion (and Standard Deviations)
of Items[x] Called "old" in Recognition

	Old	New	d′
Amnesics	.260 (.149)	.073 (.059)	0.84
Normals	.773 (.171)	.060 (.015)	2.30

x - old items = homophone and nonhomophone from question phase
- new items = homophone and nonhomophone items not previously presented

- Note: The recognition differences are not attributable to a criterion shift since the false alarms are similar for both groups. In this way, Amnesics are demonstrating an ability to accurately discriminate between old and new items, even though they perform well below Normal levels of performance

Table 1.4

Analysis of Variance Tables for Experiment One

ANOVA for Spelling Patterns

Source	Sum of Squares	d.f.	Mean Square	F	Prob.
Group	6.05	1	6.05	2.52	N.S.
Error	19.2	8	2.4		
Spell	140.45	1	140.45	46.82	<.01
Sp x Gr	4.05	1	4.05	1.35	N.S.
Error	24.0	8	3.0		
Total	193.75				

ANOVA for Recognition

Source	Sum of Squares	d.f.	Mean Square	F	Prob.
Group	144.40	1	144.40	16.04	<.01
Error	72.00	8	9.0		
Total	216.40				

items, those obviously influenced by memory, were no more recognizable than recognition for any of the items in general, and vice versa.

The dissociation between the two tasks for amnesics was further supported by the spelling patterns observed in the written responses for recognition. For amnesics, even though there was a significant increase in low frequency spellings for the spelling test, in recognition there was no evidence of a biasing effect ($t=2.092$, 4 d.f., $p>.05$). For Normals, on the other hand, written recognition responses were invariably spelled in the low frequency pattern ($t=13.7$, 4 d.f., $p<.05$).

2.1.3 DISCUSSION

The data from the spelling phase clearly demonstrate an influence of memory on subsequent behaviour in both Korsakoff patients and Normals. Subjects tended to produce high frequency spelling patterns for the control items; whereas the critical items tended to be spelled in the low frequency form. Particularly interesting is the apparently preserved memory performance found with the patient population for materials that are not considered perceptual-motor in nature. By employing a very subtle question-answer procedure and measuring performance with spelling behaviour, unlike the findings in past studies concerning verbal memory tasks, substantial retention of the prior learning can be observed in amnesics. In addition, this effect is not one of practice or repetition. Providing a single auditory exposure to the critical homophones in their low frequency form significantly alters the Korsakoffs' (and Normals') spelling behaviour. This result coincides with much of the recent literature that has made use of comparable "cognitive" tacit memory measures. Amnesics show item-specific savings in reaction time for re-solving anagram problems (Baddeley, 1982) and the Tower of

Table 1.5

Chi-square Test for Independence
- Spelling Pattern Versus Recognition
of Critical Homophones

1.5a) **Amnesics**

		Recognition		
		Hit	Miss	
Spelling	Low	.180	.447	.627
	$\overline{\text{Low}}$	.073	.300	.373
		.253	.747	

X^2=.765

1.5b) **Normals**

		Recognition		
		Hit	Miss	
Spelling	Low	.415	.091	.506
	$\overline{\text{Low}}$	.345	.149	.494
		.760	.240	

X^2=1.497

* - neither of the X^2 values are significant

Table 1.6

Conditional Probabilities* for Critical Homophones
in the Spelling Experiment

	P(Rn/Sp)	P(Rn)
Amnesics	.287	.253
Normals	.821	.761

Rn=recognition
Sp=low frequency spelling

* - for independence: P(Rn/Sp)=P(Rn)
- X^2 values are not significant for either group (See Table 1.5)

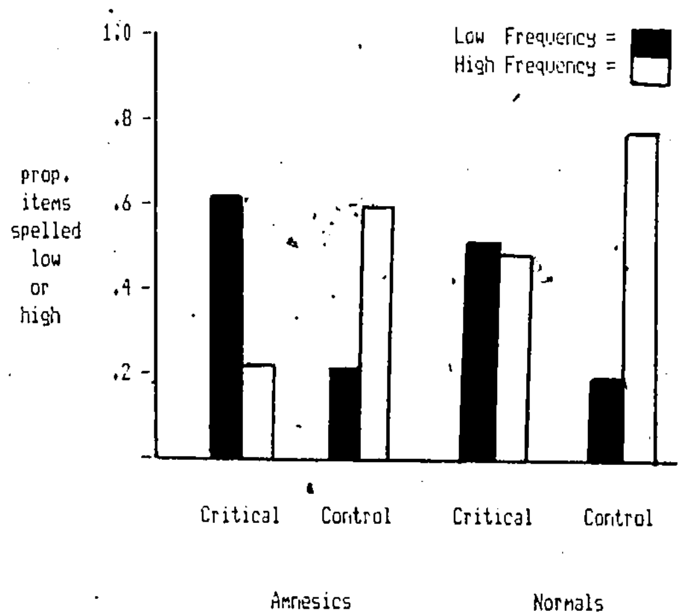

Figure 1.1 - Mean Proportion of Homophone Items (Critical or Control) Spelled in Either Low or High Frequency Pattern

Hanoi Puzzle (Cohen, 1983); re-reading inverted text script (Squire and Cohen, 1982; Moscovitch, 1982); and show facilitated accuracy for word completion tasks (Graf, Squire and Mandler, 1983) at levels which are equivalent to normal controls. In those studies that have tested the measure over a long term, the memorial effect has been shown to last for weeks and months, even without interim experience.

The recognition data, however, do not demonstrate these effects of retention in amnesics. As is typical of this memory measure (see for example, Warrington, 1974; Huppert and Piercy, 1976), normals perform considerably higher in a recognition task than do amnesics.

Consider what this implies for the amnesic population. They obviously can act in a manner which is consistent with memory for a highly specific event. They spelled items in a form which otherwise would not be produced had the words not been heard in that particular prior meaningful context. Yet, when amnesics are asked if they could identify those same items as ones which occurred in the question phase, they not only responded negatively, but also typically asked "what questions?". This dissociation found with Korsakoffs between their spelling performance and their recognition of the responsible event is typified in a clinical observation reported by the French psychologist Claparede (1911), cited in MacCurdy, 1928:

> "...I tried the following experiment...to see if she would better retain an intense impression that set affectivity into play. I pricked her hand forcibly with a pin hidden between my fingers. This little pain was quickly forgotton as indifferent perceptions and, shortly after the pricking, she remembered no more of it. However, when I moved my hand near hers again, she pulled her hand back in a reflex way and without knowing why. If, in fact, I demanded the reason for the withdrawal of her hand, she answered in a flurried way, 'Isn't it allowed to withdraw one's hand?'....or sometimes she would try to justify herself with 'Sometimes pins are hidden in hands'. But she never

recognized this idea of pricking as a memory" (p.115).

The independence analyses in this experiment reflect and extend this finding of dissociation using verbal materials. The contingency tables provide no statistical evidence for dependency between the two measures. The implications of a dissociation from the literature on functional and organic amnesia have been substantiated with the empirical and statistical evidence provided in this study. Whatever additional processing ability is required for the acknowledgement of a prior event, for Korsakoffs, this is nonfunctional, presumably due to their brain dysfunction. An account of the disorder may include a disconnection interpretation which suggests that ablation of the system creates the dissociation in the organic amnesic (e.g. Warrington and Weiskrantz, 1982).

However, the dissociation is not simply an artifact of abnormal memory behaviour, since a similar pattern of results with the independence analysis emerged for the normal subjects' data. The item by item analysis shows there is no predictable relationship between demonstrating a memory influence in the spelling of a homophone and recognizing that same item as having been presented earlier. For normals, the awareness of the prior occurrence of a particular item is independent of whether or not that same item demonstrates an effect of memory in spelling behaviour. For Korsakoff patients, the independence is more extreme in that they have essentially <u>no awareness</u> of the previous encounter. These results suggest that the spelling performance measure accesses memory in a manner which is different from and independent of recognition.

A differential sensitivity argument cannot account for these results. Without alternative evidence, one might attribute the Korsakoffs' performance as demonstrating that a recognition task is typically unable to exceed the patients' criterion for acknowledging a previous event. Once exceeded, however, recognition performance should be predictive of tacit memory performance. Thus, a sensitivity argument would have predicted a dependent relationship between the response measures. The stochastic independence of the measures, depicting no relationship whatsoever, tends to rule this out as a viable explanation.

The multi-memory system account, which attributes the independence to structural constraints in memory, however, would have predicted these results. They would argue that the findings support the view that there are at least two memory systems. In the amnesic, the system which is responsible for recognition is damaged, whereas the system which allows for memorial expression in some other form is intact. For normal subjects, both memory systems are functional, but they function in an independent manner.

The differential processing account would also be satisfied with these results. This position would suggest that the two measures are independent due to the different types of information being processed in the two tasks. The spelling performance reflects the fluent processing of available perceptual information, while recognition requires contextual information for the respecification of a particular event. For the patients, the perceptually-oriented process is intact, while the ability to retrieve context is not. Normal subjects are capable of processing either kind of information, so memory is evidenced by both measures, but in an independent fashion.

Although it is not always a beneficial strategy to attempt to devise or support normal theories of memory on the basis of anomalies in abnormal populations, the stochastic independence results for normals in this study implies the generality of the dissociation. The following two studies are designed to investigate the robustness of this result in normal memory populations using various measures of memory.

2.2 EXPERIMENT TWO -

PARALLEL DISSOCIATION IN NORMAL SUBJECTS

The dissociation between tacit memory performance and reflection is an obvious phenomenon in amnesics. From Experiment One, it is clear that they can show normal levels of memory influence in on-line performance, but are unable to report this influence or display its effect on traditional reflective tests of memory. In people with normal memory abilities, the dissociation is not as directly obvious. As observed in Experiment One, measures of memory evidence substantial effects with normals, regardless of the manner in which it is tested.

The analyses from the first experiment and results from the normal memory literature review suggest, however, that the dissociation is characteristic of normal memory. The following experiment was designed specifically to examine the dissociation in normal memory subjects' behaviour. Providing an example of independence similar to that obtained in Experiment One using a different experimental paradigm, a different sensory mode and different materials would implicate the robustness of the dissociation effect.

The paradigm chosen was a comparison of perceptual identification and recognition memory. Perceptual identification involves the identification of items which are tachistoscopically presented in some degraded form for a brief duration (e.g. using a mask to terminate visual processing of the item). This was judged to be a useful tacit measure of memory, as the subject's task is simply to read aloud the material that is presented. The recognition task requires the conventional two-choice (yes/no) recognition decision .

The perceptual identification and recognition measures would make contact with earlier research as they maintain some of the characteristics of measures already investigated. Warrington and Weiskrantz (1968; 1970) employed fragmented visually degraded versions of items in their cueing studies with amnesics and found a noticeable memory influence in behaviour. Williamsen et. al. (1965) used visually degraded words in their studies with the posthypnotic amnesic subjects and obtained similar findings. Both sets of results suggest that measures of visual identification are capable of displaying memorial effects, and can be interpreted in terms of the dissociation since recognition levels were at chance. Further, based on the results obtained by Jacoby and Dallas (1981), there is an implied dissociation between these two tasks in terms of the differential influence encoding variables have on the two measures. Whereas, the "levels of processing" technique (Craik and Lockhart, 1972) has repeatedly shown effects in recognition tasks; the perceptual identification of previously presented items produces equal facilitation regardless of the encoding manipulation.

<u>Procedural Considerations</u>: Any dependence or independence found will be interpreted as indicating the relationship between the tacit measure of memory and recognition. In order to avoid alternative accounts of the results, careful consideration must be given to possible methodological confounds which could artificially produce these relationships. These procedural concerns will be discussed below.

On re-analysis of some data collected by Jacoby and Dallas (1981), the order in which the tasks are given was considered a possible confound for producing dependency between the two measures (see Figure 2.4). Sequential ordering effects have been acknowledged as a possible source of dependency in the contingency analyses of memory retrieva[illegible]umphreys and Bowyer, 1980; Tulving et.al., 1982). Recognition can be substa[illegible]fluenced by two or more repetitions of an item (e.g. Donaldson, [illegible]). Perceptual identification, in contrast, has been shown to be minimally affected by two presentations, if at all (but see Feustal et.al., 1983 - using a clarification procedure). The re-analyzed data were based on results in which the recognition task followed perceptual identification. Recognition, therefore, had been exposed to repeated presentations of the items. The analyses for the different experiments produced significant dependent chi-square values ($p<.01$) and may be attributable to this repetition effect. As a result, order of task presentation has been reversed in this experiment.

Levels of performance are another important consideration. Ceiling effects can bias the independence analysis in a unidirectional manner, thereby producing a confound in the interpretation of the results. In order to allow for variable levels of responding, three relevant manipulations were included in this study. The first involves the length of delay between study and test. Although perceptual identification demonstrates enhanced performance over long periods of time (e.g. up to a week later - Jacoby, 1983), recognition accuracy decreases with longer intervals. The second manipulation served to vary the amount of similarity between the study presentation and recognition. The test material was presented either on the computer screen (as in study), on a typed sheet of paper (same sensory mode; different context), or auditorily by tape-recorder (different mode; different context). As the similarity between presentation format decreases, so does recognition accuracy (e.g. Tulving and Thomson, 1973). (Manipulation of this variable was not possible for perceptual identification. Due to the nature of this task, test presentation was the same as study presentation - on the screen.) The third variable involves the frequency status of the test material (Thorndike and Lorge, 1944). Both recognition and perceptual identification levels are affected by this manipulation. Low frequency items are better recognized than high frequency words; whereas, high frequency items are more readily identified than low frequency items in perceptual identification. These three variables should produce enough variation in responding between the two measures in order to assess any consequent variation in the independence relationships. Further, as pointed out in the introduction, demonstrating that variables differentially affect the two tasks is one source of converging evidence for independence.

Finally, given that the primary purpose of this study is to investigate whether or not the dissociation is a general finding in persons with normal memory, it is important to investigate the phenomenon under a number of different conditions. This allows one to establish how frequently and under what constraints the relationship can be found.

2.2.1 METHOD

Subjects :

Seventy-two first year McMaster University undergraduate students (mean age=20.8) participated in this study for Introductory Psychology course credit. Each subject was assigned randomly to one of six conditions. The conditions consisted of the twelve possible combinations of: presentation mode of recognition (three types; between-subjects), length of delay between study and test (immediate or delayed 20 minutes; between-subjects) and frequency status of test items (high or low; within-subjects). Subjects were tested individually, in a single session which lasted approximately one hour.

Materials :

One hundred and thirty words were selected on the basis of their frequency of occurrence in the language (65 high: A and AA, 65 low: <45; Thorndike and Lorge, 1944). All items were five letters in length. Ten of these items were used solely for practice in the perceptual identification procedure. The remaining words were included as test items and were counterbalanced for test item status (critical versus distractor); presentation positions were randomized (three orders). The materials for this experiment are provided in Appendix B2.

Phase One - Study: A list of 72 words was constructed. Forty-eight words (24 high and 24 low frequency) were designated as the critical items. These were to be presented in both the recognition and perceptual identification tests. The remaining 12 high and 12 low frequency words were to be tested again only during the third phase, thus serving as a control for repeated presentation effects from recognition on measures of perceptual identification. An example of the stimulus format for this experiment is provided in Table 2.1. All items were presented individually for a one second duration on a PDP-8 computer screen.

Optional Phase - Delay Task: For "delay" conditions only, a math quiz intervened between the study and test phases. The questions consisted of two pages of simple arithmetic problems which took approximately twenty minutes to complete. Arithmetic problems were used so as to avoid any stimulus interference with the word material, and yet provide a solving activity and time delay to encourage lower performance on tests of recognition.

Phase Two - Recognition Test: A second list of 72 words was prepared, consisting of the 48 critical items from phase one and 24 new items (12 high and 12 low frequency) that served as distractors. The materials were presented in one of three formats, depending on the condition assigned: either on the PDP-8 computer screen, as were the first phase items (SCR); typed in capital letters on a sheet of paper (TYP); or presented auditorily by taperecorder (AUD).

Phase Three - Perceptual Identification: The final list included the 48 critical items from both previous phases, the 24 distractor items from phase one, and an additional 24 new items (12 high and 12 low) not previously encountered in this experiment. The new items determine a baseline control for levels of identification.

Tachistoscopic presentation by PDP-8 computer was used. A black

Table 2.1

An Example of the Stimulus Format
For Experiment Two

Phase One - Study

	low freq.	high freq.
critical	chalk	grass
1-pres.	gourd	nurse

Phase Two - Recognition Test

	low freq.	high freq.
critical	chalk	grass
novel	truce	child

Phase Three - Perceptual Identification

	low freq.	high freq.
critical	chalk	grass
1-pres.	gourd	nurse
novel	prize	birch

cardboard sheet with a rectangle window display (8.5 cm. x 1 cm.) covered the screen. The stimuli were presented in this display area. Exposure duration of the items was set at 35 ms. for all subjects. This rate was chosen based on the results of pilot data and other experiments using a similar technique (e.g. Jacoby and Dallas, 1981) which indicated this as an average level for successful perception of novel items approximately 50 per cent of the time. Warning signals indicating the space in which the test item would appear (-   -) preceded, while a mask (&&&&&) immediately succeeded each item. The brief exposure of the stimulus, in addition to the masking procedure, make identification of the item a difficult task. Trial presentations were subject-paced.

Procedure:

The subjects were told that an objective of this experiment was to investigate speeded reading abilities and, as partial evaluation of this skill, they would be required to read aloud material presented at different exposure rates. Subjects were informed that there would be a number of phases in this experiment. As in the earlier experiment, and all subsequent experiments, each phase was introduced individually, thereby minimizing task requirement expectations. The subjects were given no indication of the memory test component to this experiment.

Phase One - Study: Each subject was seated in front of the computer at a distance of 70 to 75 cm. The subject was instructed to simply attend to and read aloud each word as it was presented on the computer screen. Incorrect responses were infrequent (mean=.025) and did not alter overall levels of performance on later tests.

Optional Phase - Delay Task: Subjects were asked to attempt to answer a number of simple arithmetic problems in a 20 minute period. This phase served only as an interference task and the results will not be analyzed.

Phase Two - Recognition Test: For this phase, a list of words was presented in one of three formats. In all cases, subjects were asked to indicate whether or not a particular word had been given during study. This response was obtained in various ways, depending on the presentation mode. For the SCR condition, subjects were asked to respond to individually presented items by pressing one of two buttons on a panel - either "yes" or "no". For the TYP condition, subjects indicated their decisions by circling the positively identified items. For the AUD condition, subjects were instructed to write down only those words they recognized as being previously read during study. Note that these conditions vary not only according to the mode of presentation of the test material, but also according to the manner in which the subject can respond. This factor also may contribute to the desired varying levels of performance on recognition. All responses were collected for later analyses.

Phase Three - Perceptual Identification: Subjects were told that this phase also involves reading skills, but that this time the presentations would be much faster. They were required to identify briefly presented items by reporting aloud the word that was to be flashed on the screen. Subjects were given ten practice trials before the test phase officially began in order to familiarize them with the procedure.

Prior to each trial presentation, a message was printed on the computer ("PRESS BUTTON WHEN READY"). When adequately attending to the screen, the subject was asked to press a panel button to initiate stimulus presentation. Warning signals appeared on the screen for a duration of 500 ms., followed immediately by the test stimulus. After 35 ms., the word was replaced by the mask, which remained on the screen for one second. Subjects were told that the mask indicated the termination of the trial. As soon as the item had been flashed, subjects were to report what they had read. Guessing was encouraged. Subjects were not informed of the potential memory component involved in this task.

2.2.2 RESULTS

Subjects are able to discriminate between old, previously read items and new distractors when making judgments of whether or not an item was presented in the earlier phase. Critical items were correctly recognized more often (mean old=.682, mean new (falsely recognized)=.071). Mean performance and averaged accuracy discriminations (d') for the twelve conditions are provided in Table 2.2.

Recognition performance varies dramatically as a function of the different conditions. As expected, recognition scores decrease over time, even with a delay of 20 minutes ($p < .01$ see Table 2.4, and Figure 2.1). In addition, recognition accuracy is affected by the frequency status of the item. Low frequency items are consistently recognized better than high frequency words (means: low=.811, high=.552; $p < .01$). Further, the level of retention, as measured by recognition, varies across the three modes of test presentation ($p < .01$). This result demonstrates the influence of repeated context. Being tested in the same format as the learning (reading) phase is most beneficial, apparently due to the very close match between study and test (SCR mean=.760). The encoding specificity principle (Tulving and Thomson, 1973) would predict this result, since it suggests that the more similar the test situation is to the learning phase, the more completely one can reinstate the original context, thereby making maximal use of available cues. (Note, however, that the false alarms also show this effect, and, therefore, the d' values do not demonstrate consistent differences). Being tested in the same modality as the study phase has some advantage in recognition, even if the formal presentation has been somewhat altered. As can be seen in Figure 2.1, recognition of the typed items (TYP mean=.682) was better than conditions in which items were read aloud to the subject (AUD mean=.604). While all main effects

Table 2.2

Results from the Recognition (Rn) Phase -
Mean Proportion of Items Judged as "Old"*
Including Averaged Discrimination Ability (d')

Mode	Delay	Freq.	Correct Rn	False Rn	d'
SCR	I	L	.903	.097	2.56
	I	H	.729	.132	1.74
	D	L	.830	.125	2.12
	D	H	.577	.118	1.38
TYP	I	L	.896	.063	2.83
	I	H	.618	.042	2.06
	D	L	.806	.098	2.22
	D	H	.406	.021	1.82
AUD	I	L	.743	.028	2.52
	I	H	.504	.028	1.88
	D	L	.688	.028	2.38
	D	H	.479	.083	1.35

I = immediate
D = delay
L = low frequency
H = high frequency

* - correct Rn refer to critical items which are correctly recognized
false Rn refers to novel items which are incorrectly called old
- for standard deviations refer to Table C.1 in Appendix C

SCR = presentation on computer screen
TYP = items presented on typed sheet
AUD = items presented by tape-recorder

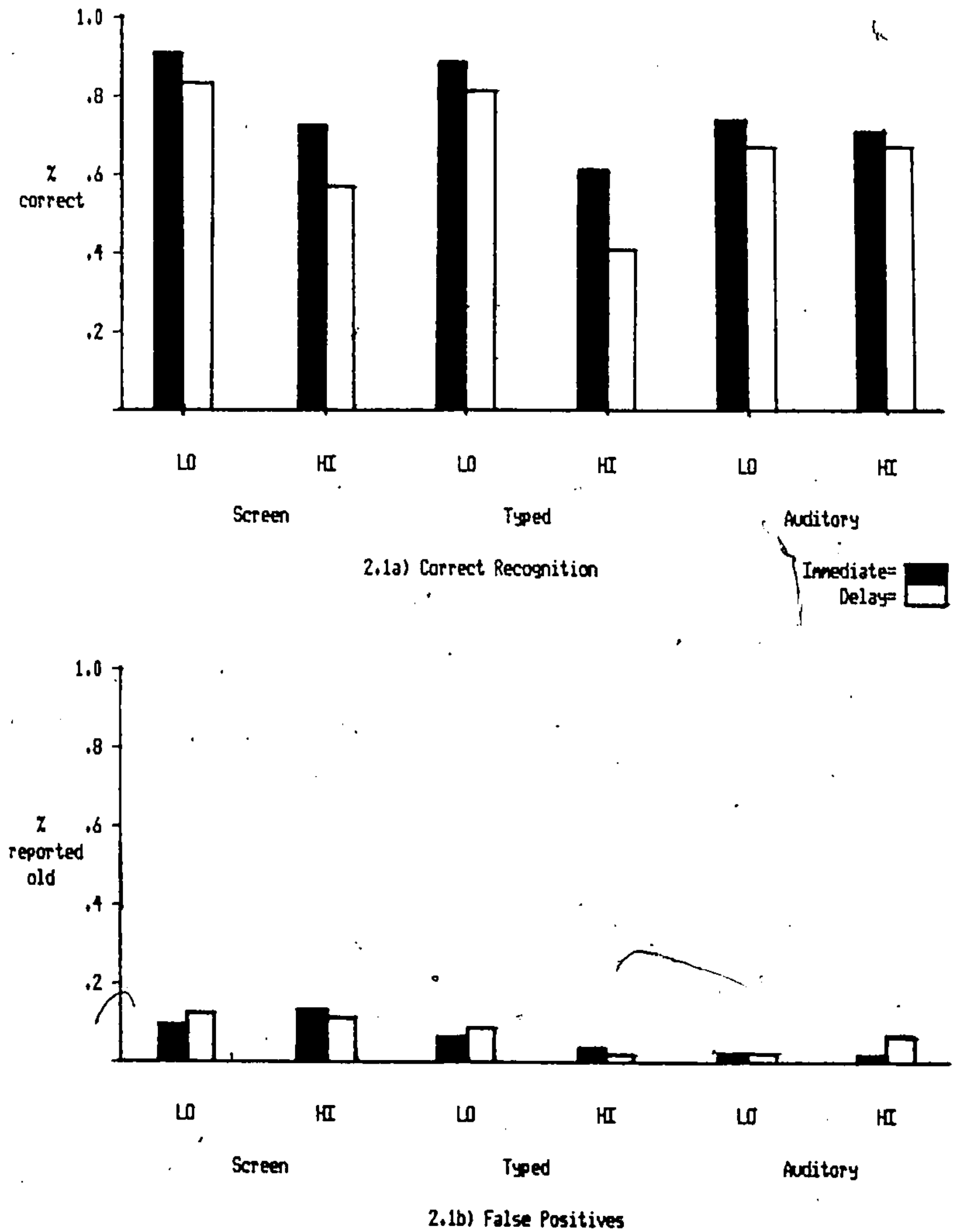

Figure 2.1 - Mean Proportion of Items Reported as "old" in Recognition; (a) = correct report; (b) = incorrectly reporting new items as old

produced the expected results, no significant interactions were obtained. The twelve conditions, however, adequately served their function of producing a wide range of accuracy levels for recognition. This, in turn, allows the independence analyses to be evaluated under a variety of performance levels.

Previously presented items are better identified than novel items in the identification task (mean critical=.789, mean novel=.516; $p<.01$. See Tables 2.3 and 2.4, and Figure 2.2). This result indicates that a significant and potent memory effect is obtained for items that are not extensively studied, and are not tested in a manner that relies on the conscious interrogation of the previous specific learning experience. Note that the analysis of variance evaluates only the critical and novel item comparisons, since there was no difference between once and twice presented items (means=.748 and .789, respectively, $t=0.872$, $p>.05$. See Table 2.3). The lack of a difference between these items suggests that no further repetition effect, beyond that of a single experience with the item, occurred in perceptual identification. A second exposure to the critical items due to the intervening recognition phase does not increase the probability of correctly identifying an item.

Frequency in the language produces differential results for overall perceptual identification (high > low, $p<.01$). The ordering of this effect is opposite to that obtained with the recognition measure. However, the degree of enhancement due to prior experience with an item is greater for the low frequency words ($p<.01$). There was no change in the potency of the old-new effect over delay interval ($p>.05$; interaction of old x delay: $p>.05$), or sensory mode of the intervening task ($p>.05$). This pattern is unlike that found in recognition, and indicates that these variables do not affect the two task measures in the same manner.

The differential patterns obtained on the two tasks implicate the

Table 2.3

Results from Perceptual Identification (PI) - Mean Proportion of Items[x] Correctly Identified

Mode	Delay	Freq.	Critical	1-Pres.	Novel
SCR	I	L	.791	.742	.313
	I	H	.892	.882	.708
	D	L	.812	.633	.333
	D	H	.865	.835	.650
TYP	I	L	.694	.661	.333
	I	H	.799	.815	.646
	D	L	.740	.693	.389
	D	H	.833	.848	.729
AUD	I	L	.694	.681	.354
	I	H	.837	.791	.750
	D	L	.691	.573	.313
	D	H	.815	.823	.674

I = immediate
D = delay
L = low frequency
H = high frequency

x - these items include critical items (presented during both Rn and PI), once presented items from study (1-pres.), and novel items not previously encountered in the experiment
- for standard deviations refer to Table C.2 in Appendix C

SCR = presentation on computer screen
TYP = items presented on typed sheet
AUD = items presented by tape-recorder

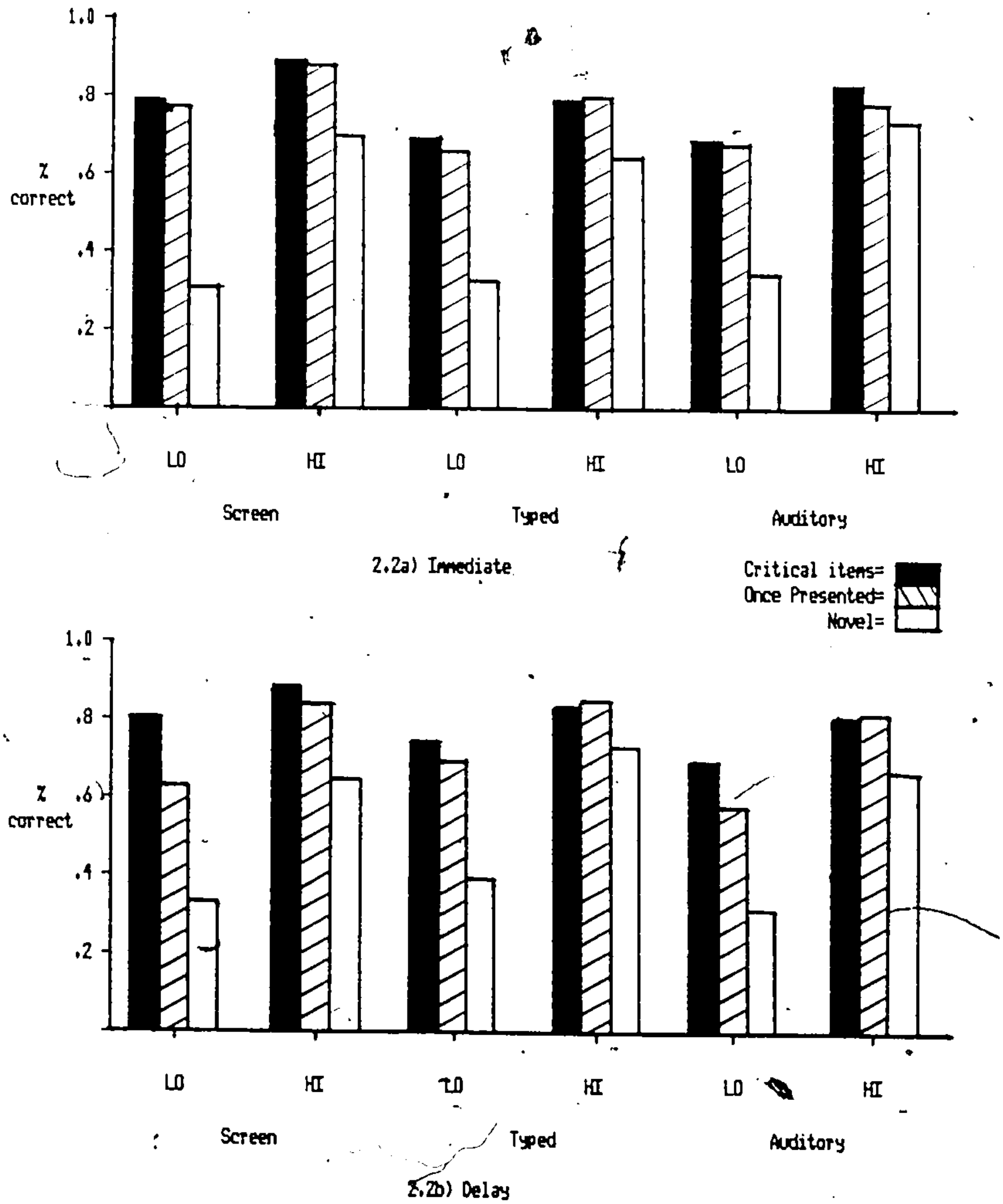

Figure 2.2 - Mean Proportion of Items Correctly Identified
in the Perceptual Identification Task;
(a) = no intervening task between study and test
(b) = testing is delayed by 20 minutes

Table 2.4

Analysis of Variance Tables
for Experiment Two

ANOVA for Perceptual Identification

Source	Sum of Squares	d.f.	Mean Square	F	Prob.
Mode	7.44	2	3.72	.26	N.S.
Delay	.09	1	.09	.01	N.S.
M x D	13.78	2	6.89	.48	N.S.
Error	941.85	66	14.27		
Freq.	552.78	1	552.78	190.19	<.01
F x M	4.00	2	2.00	.69	N.S.
F x D	1.84	1	1.84	.63	N.S.
F x M x D	2.11	2	1.05	.36	N.S.
Error	191.02	66	2.89		
Old	885.50	1	885.50	413.79	<.01
O x M	11.19	2	5.59	2.61	N.S.
O x D	.17	1	.17	.08	N.S.
O x M x D	3.69	2	1.85	.86	N.S.
Error	141.19	66	2.14		
F x O	160.50	1	160.50	94.01	<.01
F x O x M	2.19	2	1.09	.64	N.S.
F x O x D	.003	1	.003	.00	N.S.
FxOxMxD	.36	2	.18	.11	N.S.
Error	112.69	66	1.71		
Total	18224.59				

ANOVA for Recognition

Source	Sum of Squares	d.f.	Mean Square	F	Prob.
Mode	96.01	2	48.01	9.51	<.01
Delay	50.17	1	50.17	9.94	<.01
M x D	10.09	2	5.05	1.00	N.S.
Error	333.21	66	5.05		
Freq.	357.84	1	357.84	180.73	<.01
F x M	12.68	2	8.84	3.21	N.S.
F x D	5.06	1	5.06	2.56	N.S.
F x M x D	6.54	2	3.27	1.65	N.S.
Error	130.37	66	1.98		
Total	10387.01				

dissociation. The data can be further evaluated in terms of the stochastic independence analysis. Regardless of presentation mode, delay or frequency manipulations, the chi-square levels provide no indication of dependence (see Table 2.5; for the chi-square tables, see Tables 2.6, 2.7, 2.8). This independence relationship is clearly demonstrated by the conditional probabilities which provide no evidence of predictability between the two response measures (see Table 2.5). Perceptual identification of successfully recognized items is no greater than identification for unconditionalized items (i.e. P(PI/RM) essentially equals P(PI) in all cases). The relationship of these conditionals can be graphed to illustrate this independence (see Figure 2.3). For complete independence, the conditional probabilities should equal the marginal probabilities and, therefore, produce a diagonal line at 45 degrees. As is evident, the data reliably fall on or about the diagonal line - a visual indication of the independence obtained. For comparison purposes, one may refer to Figure 2.4, which displays highly dependent results - none of which fall on the diagonal axis.

The marginal probabilities in Tables 2.6, 2.7 and 2.8 demonstrate that a variety of manipulations affect the tasks differently (i.e. altering levels of recognition, but not of perceptual identification). The contingency values for each condition also show that the measures are unrelated in terms of their predictability for performance on either task. Given the consistent results across all twelve conditions, there is no reason to reject independence.

2.2.3 DISCUSSION

This experiment has been primarily a thorough demonstration of the independence between a tacit memory measure and a reflective memory measure. Although prior experience can facilitate later performance (for example, items could be more readily identified), it is not necessarily an effect of which one is

Table 2.5

Conditional Probabilities[x]
as Compared to the Marginals -
for all twelve conditions in Experiment Two

Mode	Delay	Freq.	P(PI/Rn)	P(PI)	X^2
SCR	I	L	.801	.791	1.391
	I	H	.883	.893	.619
	D	L	.807	.813	.206
	D	H	.853	.865	.463
TYP	I	L	.696	.694	.064
	I	H	.817	.799	1.048
	D	L	.738	.740	.024
	D	H	.847	.833	.276
AUD	I	L	.713	.694	1.444
	I	H	.861	.837	1.304
	D	L	.708	.691	.917
	D	H	.775	.813	2.460

I = immediate
D = delay
L = low frequency
H = high frequency

x - for independence: P(PI/Rn)=P(PI)
- all X^2 are non-significant ($p > .05$)

SCR = presentation on computer screen
TYP = items presented on typed sheet
AUD = items presented by tape-recorder

Table 2.6

Chi-square Test for Independence
- Perceptual Identification (PI) Versus Recognition
(Recognition is by Screen - SCR - Presentation)

Immediate

2.6a) Low Frequency

		Recognition		
		Hit	Miss	
PI	Cor	.723	.068	.791
	$\overline{\text{Cor}}$	.180	.029	.209
		.903	.097	

χ^2=1.391

2.6b) High Frequency

		Recognition		
		Hit	Miss	
PI	Cor	.644	.248	.892
	$\overline{\text{Cor}}$	.085	.023	.108
		.729	.271	

χ^2=.619

Delay

2.6c) Low Frequency

		Recognition		
		Hit	Miss	
PI	Cor	.670	.142	.812
	$\overline{\text{Cor}}$	.160	.028	.188
		.830	.170	

χ^2=.206

2.6d) High Frequency

		Recognition		
		Hit	Miss	
PI	Cor	.492	.373	.865
	$\overline{\text{Cor}}$	.085	.050	.135
		.577	.423	

χ^2=.463

Table 2.7

Chi-square Test for Independence
- Perceptual Identification (PI) Versus Recognition
(Recognition is by Typed sheet - TYP - Presentation)

Immediate

2.7a) Low Frequency

		Recognition		
		Hit	Miss	
PI	Cor	.624	.070	.694
	$\overline{\text{Cor}}$	.272	.034	.306
		.896	.104	

X^2=.064

2.7b) High Frequency

		Recognition		
		Hit	Miss	
PI	Cor	.505	.294	.799
	$\overline{\text{Cor}}$	.113	.088	.201
		.618	.382	

X^2=1.048

Delay

2.7c) Low Frequency

		Recognition		
		Hit	Miss	
PI	Cor	.595	.145	.740
	$\overline{\text{Cor}}$	.211	.049	.260
		.806	.194	

X^2=.024

2.7d) High Frequency

		Recognition		
		Hit	Miss	
PI	Cor	.344	.489	.833
	$\overline{\text{Cor}}$	.062	.105	.167
		.406	.594	

X^2=.276

Table 2.8

Chi-square Test for Independence
- Perceptual Identification (PI) Versus Recognition
(Recognition is Auditory - AUD - Presentation)

Immediate

2.8a) Low Frequency

		Recognition		
		Hit	Miss	
PI	Cor	.530	.164	.694
	$\overline{\text{Cor}}$	.213	.093	.306
		.743	.257	

X^2=1.444

2.8b) High Frequency

		Recognition		
		Hit	Miss	
PI	Cor	.434	.403	.837
	$\overline{\text{Cor}}$	.070	.093	.163
		.504	.496	

X^2=1.304

Delay

2.8c) Low Frequency

		Recognition		
		Hit	Miss	
PI	Cor	.487	.204	.691
	$\overline{\text{Cor}}$	.201	.108	.309
		.688	.312	

X^2=.917

2.8d) High Frequency

		Recognition		
		Hit	Miss	
PI	Cor	.371	.441	.815
	$\overline{\text{Cor}}$	.108	.080	.188
		.479	.521	

X^2=2.460

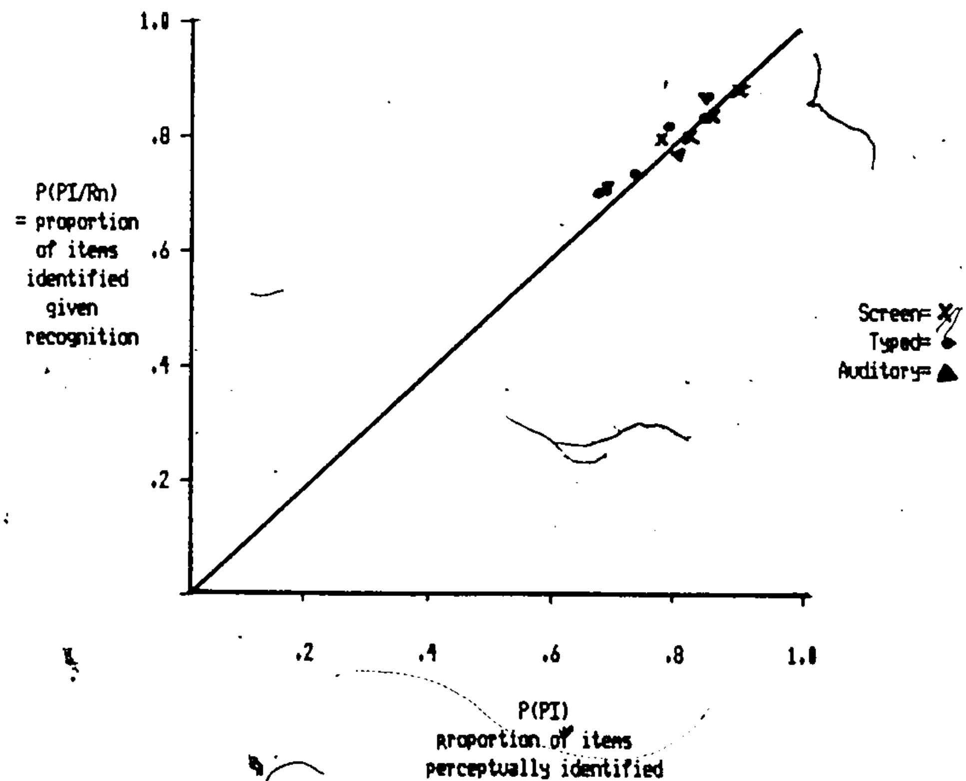

Figure 2.3 - Perceptual Identification (PI) and Recognition (Rn) plotted in terms of the Conditional Probabilities and Marginals.

x - complete stochastic independence is indicated by the diagonal (i.e. P(PI/Rn) = P(PI))
- all X^2 values indicate independence (range of X^2=.024 to 2.46)

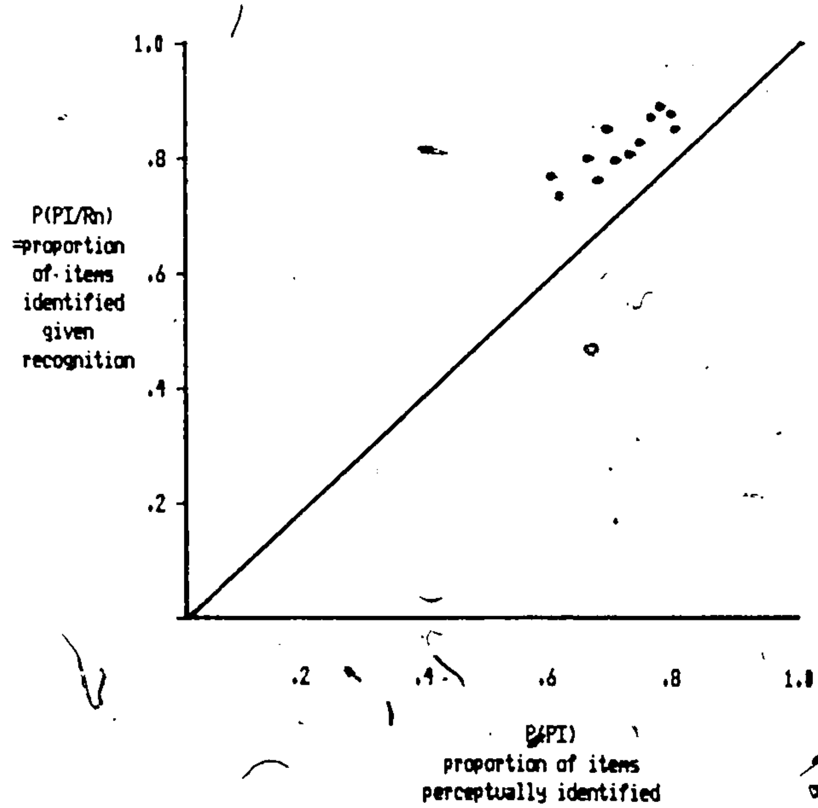

Figure 2.4 - Re-analyzed data plotted in terms of the Conditional Probabilities and Marginals comparing Perceptual Identification (PI) and Recognition (Rn) performance -obtained from re-analyzed data from studies in which the recognition phase followed perceptual identification

x - complete stochastic independence is indicatedby the diagonal (i.e. P(PI/Rn)=P(PI))
- the results display dependent relationships which may be attributable to a twice-presented effect on the recognition scores
- also see Tulving et.al. and Feustal et.al. for similar repetition effects on recognition performance

aware (that is, recognition of those same items is not guarenteed). The experiment was successful in providing evidence that the dissociation which is phenomenologically found in amnesic patients is readily obtainable in persons with normal memory. First, in all twelve conditions, there was no relationship between the recognition and identification of any particular item. Secondly, although the temporal variable produced significant changes in the marginal levels of recognition, the delay did not differentially affect the accuracy levels obtained in identification. Finally, subjective reports during the debriefing period indicated that most subjects were unaware of the correlation between items in the study phase and the later identification test - a phenomenological example of the dissociation. Even for those subjects who did notice some relationship between the items, they reportedly did so only after identification of the item was complete. This can be supported by analyzing trends in accuracy by serial position which demonstrate that identification accuracy did not differ between early and later presented items.

Consistent evidence for the dissociation was provided across a variety of situations, and as such does not denote any specific constraints in being able to produce these results. Instead, it appears that the finding of a dissociation, at least between the perceptual identification and recognition measures, is a robust one.

EXPERIMENT THREE -
2.3 A CROSS-OVER INTERACTION

In order to further evaluate the generality of the dissociation, the next experiment makes use of a different experimental paradigm. It was suggested in the first chapter that there are two separate methods with which to obtain converging evidence of a dissociation. The stochastic independence method used in

Experiments One and Two represents only one of these. Cross-over interactions of the marginals is a second method which could indicate the existence of a dissociation. The following study was designed to assess the effect a context manipulation has on the behavioural outcomes of recognition and yet another tacit memory measure.

As can be seen in Experiment Two, context manipulations clearly have an effect on recognition performance levels. Some context manipulations also have been shown to affect perceptual identification (e.g. Jacoby and Dallas, 1981; Jacoby, 1983a; 1983b). In one set of experiments, Jacoby (1983b) had subjects either read items in isolation, read items in the context of a word that predicts its occurrence, or generate the target items from a context word (its antonym). On a later test of recognition, subjects' memory performance was better for items learned in the context of another word. However, perceptual identification accuracy was poorer for items learned in the context of another item. For tests of recognition which are assisted by making use of contextual and associative information in order to respecify the original occurrence of an event, better performance was expected for the context conditions. However, it was argued that the reader uses expectations gained from context to reduce his or her reliance on the analysis of visual information. Thus, for tests which emphasize the use of visual information, as in the perceptual identification task, study which reduces the analysis of visual information is less useful.

Using word completion as the tacit memory measure, and a test of recognition, cueing context was varied in the following study. Evidence for the dissociation would be provided by observing different and opposite effects of the context manipulation on the two tasks. The tacit memory task in this case involves filling the missing letters of items in order to produce words. It does not as directly assess visual analysis as does a test of perceptual identification.

However, since the requirement of the tacit memory tasks is to simply respond to the presented situation, then the use of stimulus information may play a more important role in these tasks than it does in reflective tasks. Context, therefore, could affect performance on the two tasks in an opposite manner.

2.3.1 METHOD

Subjects :

This study consists of two related experiments. Sixty-four first year McMaster University undergraduate students (mean age=19.9) participated in this study for Introductory Psychology course credit. Eight group sessions were held, and subjects were assigned to a condition on the basis of which testing session they signed up for (N=8 per condition). The two experiments differed only with respect to the study format involved (read or solve). The four conditions of each experiment consisted of a context manipulation (cue or no cue provided during study), and two test formats (word completion or recognition). The experimental session lasted for approximately two hours.

Materials :

A word pool of 120 low frequency words (6 to 8 letters in length) was selected from an experiment by Tulving et.al. (1982). A semantically-related word was chosen for each of these items to act as the cue in the context conditions (e.g. cueing word - remedy; target word - antidote). The items were assigned randomly to three different subgroups and counterbalanced for test item status (critical items, new at study, and new at test). The materials are provided in Appendix B3 and an example of the stimulus format is provided in Table 3.1.

Phase One - Study: Subjects were presented with 80 items (or paired items) printed in capital letters on sheets of paper. Forty of these would be re-presented at test. For the "solving" groups, the target items were written as word fragments

Table 3.1

An Example of the Stimulus Format
For Experiment Three

Phase One - Study

	Read	Solve
Context	REMEDY - ANTIDOTE	REMEDY - AN_IDO_E
No Context	ANTIDOTE	AN_IDO_E

Phase Two - Test

Study	Recognition	Word Fragment
Read - Context	ANTIDOTE	A_IDO__
Read - No Context	ANTIDOTE	A_IDO__
Solve - Context	ANTIDOTE	A_IDO__
Solve - No Context	ANTIDOTE	A_IDO__

having two blanks per word and only one legitimate completion (e.g. AN_IDO_E or REMEDY - AN_IDO_E). In the "read" groups, the complete item was provided (e.g. ANTIDOTE or REMEDY - ANTIDOTE).

Intervening phase: During the next phase, subjects were given a number of assignments to do involving pictorial material and arithmetic problems. These tasks were used in order to avoid any stimulus interference with the word material, and yet provide a solving activity and time delay to encourage lower performance, particularly on tests of recognition.

Phase Two - Test: Eighty items (or paired items) printed in capital letters on sheets of paper were presented to the subject. Forty of the items were "critical" items repeated from phase one; the remaining 40 items had not been studied earlier. In the word completion test, the test items were presented as word fragments with only four letters revealed (e.g.A_IDO_ or REMEDY - A_IDO_) and included the blanks used in the first phase. Again, there was only one legitimate completion. For the recognition test, items were presented in their complete form.

Procedure :

The experiments employed a between-subject design across the four conditions: items were either "read" or "solved" in isolation or with a context word; and were tested by either completing word fragments or recognizing single items.

Phase One - Study: Subjects in the "solving" experiment were asked to complete the word fragments presented on the study sheets. They were given 20 minutes to perform this task. Since not all items were solved during this phase, the test results will be conditionalized on study performance. This analysis is more appropriate than the unconditionalized probabilities for these conditions. If the subject did not solve an item in the study phase, they had no experience with that item and, consequently, memory influences would not be effective.

Subjects in the "read" experiment were instructed to read aloud in unison the items printed on the study sheets. The test items for these conditions will be reported in terms of overall proportion correct.

Intervening Phase: Subjects were given tasks which involved similarity discriminations for pictorial stimuli and problem-solving of simple arithmetic questions. This session lasted approximately 60 minutes. The results from this phase will not be reported.

Phase Two - Test: Subjects either received a test of recognition or a word fragment completion task. For recognition, subjects were asked to indicate whether or not a word had been presented during the first phase by circling the positively identified items. For the word completion task, subjects were simply instructed to solve as many of the word fragments as they could. No reference was made to the study phase. The results were scored for accuracy.

Analysis : The design was between-subjects and, as a result, the relationship between recognition performance and word fragment completion cannot be analyzed in terms of stochastic independence. The within-subject design necessary for the independence analysis was not possible in this study because of a possible confound which could arise between study and test. Subjects who studied items in context, would be tested without context in recognition. Therefore, on a subsequent test of word completion, also tested in an isolated form, one would have seen the to-be-solved item in both a context and no context version. One could not assess which presentation, context or no context, would affect the subjects' solving performance.

The analysis of variance results are provided in Table 3.3. Note that the dependent measure includes the comparison of critical items, since performance on novel items does not vary with the encoding conditions.

2.3.2 RESULTS

Prior exposure to the word list results in a higher probability of completing word fragments of critical items than of novel items (see Table 3.2), regardless of the study format (read or solve). Word completion performance demonstrates an influence of specific prior experience with the target material, even though, like the spelling and perceptual identification measures, it does not require that the subject explicitly refer to the prior study event (that is, subjects are able to solve novel items to an extent). In addition, subjects are able to discriminate between critical and novel items when given a test of recognition (see Table 3.2)

The presence of a cueing item during study, however, differentially affects accuracy in performance on the two memory tasks. The results for the memory tasks display <u>opposite</u> effects in the amount of facilitation a semantically-related item contributes to later performance. Recognition accuracy is higher when learning involves a context item (means=.933 vs. .834 for solve conditions, and .571 vs. .481 for read). In contrast, solving items in isolation is impeded by having read a cueing item during learning (means=.569 vs. .658 for solve, and .335 vs. .395 for read). Due to conditionalizing the data on study performance, the "read" and "solve" experiments are not directly comparable. However, the cross-over pattern is observed with both study formats (see Figure 3.1). The context variable affects the two response measures in opposite ways indicating that both measures are sensitive to memory relevant variables. By examining the marginals, independence is evidenced by the cross-over interaction (task x context $F=11.76$, $p<.01$ for solve; and $F=7.5$, $p<.05$ for read. See Table 3.3).

Table 3.2

Summary Table Providing Mean Proportions (and Standard Deviations) for Items Responded To in Experiment Three

3.2a)

Study Format:			Test: WF*	Test: Rn*
Read	Context	Old	.335 (.058)	.571 (.071)
		New	.130 (.048)	.071 (.057)
	No Context	Old	.395 (.097)	.481 (.085)
		New	.171 (.064)	.046 (.043)

3.2b)

Study Format:			Test: WF	Test: Rn
Solve	Context	Old	.569 (.067)	.933 (.052)
		New	.139 (.075)	.055 (.048)
	No Context	Old	.658 (.097)	.834 (.097)
		New	.128 (.083)	.081 (.066)

WF = Word Fragment Completion Task
Rn = Recognition Task

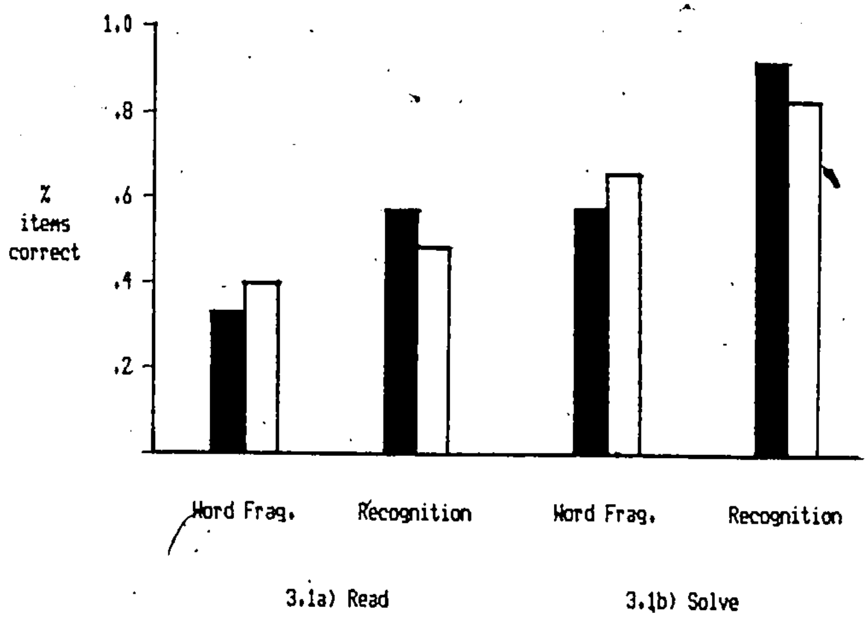

Figure 3.1 - Mean Proportion of Critical Items Correctly Reported in the Word Fragment Completion Task (Word Frag.) and the Recognition Task For Both the Read (3.1a) and Solve (3.1b) Study Conditions Depending on Whether or Not Study included a Semantically-related Context Word

x No Context Word at Study =
Context Word at Study =

Table 3.3

Analysis of Variance Tables
for Experiment Three

ANOVA for Read Condition

Source	Sum of Squares	d.f.	Mean Square	F	Prob.
Task	.207	1	.207	34.50	<.01
Context	.002	1	.002	.33	N.S.
T x C	.045	1	.045	7.50	<.05
Error	.175	28	.006		
Total	.429				

ANOVA for Solve Condition

Source	Sum of Squares	d.f.	Mean Square	F	Prob.
Task	.5833	1	.5833	97.22	<.01
Context	.0003	1	.0003	.05	N.S.
T x C	.0706	1	.0706	11.76	<.01
Error	.1819	28	.0060		
Total	.8361				

2.3.3 DISCUSSION

The dissociation of a tacit measure of memory and recognition is evidenced by the cross-over interaction produced by the context manipulation. Whereas recognition performance benefits from the study of a semantically-related cueing item; completing word fragments does not. Using a different experimental design, the word completion task has been shown to be stochastically independent of recognition (Tulving et.al., 1982). This study shows that the two tasks are also separable in the way that context affects later behavioural outcomes. Jacoby (1983a) demonstrates a similar influence of context when comparing perceptual identification with recognition.

These findings cannot be accounted for by a sensitivity argument. By a differential sensitivity view, one could not expect that the tasks would demonstrate opposite effects of the cueing manipulation. The result, however, is compatible with the positions that argue the observed independence reflects a qualitative difference in memory. A multi-systems approach would suggest that the results demonstrate the independent relevance context has for each of the different memories. The differential processing view would argue that the results demonstrate the importance of the compatibility between the type of information processed during study and the type of information made use of at test. For example, Jacoby (1983a) explains the cross-over interaction due to context in his study by contrasting data-driven and conceptually-driven processing. The conceptually-driven processing initiated during study, when study involved a cueing context, may have discouraged subjects from extensively evaluating the perceptual attributes of the stimuli. As a result, later testing of perceptual information reflects this poorer perceptual encoding. Recognition, in contrast, can make use of information relevant to either conceptual or data-driven processing. The benefit of contextual information and semantic interpretation (e.g. Craik and

Lockhart, 1972) reflects the use of conceptually-driven processes in recognition.

Both memory views could be satisfied with this type of account for the results. The two systems view would identify one memory system as perceptual for which data-driven processing in perceptually-oriented tasks is important and identify another separate episodic memory system on which recognition is based. The differential processing view would suggest that there is a unitary memory, and emphasize that the type of information employed by the task in combination with the task requirements, directs the type of processing that will be useful.

To conclude, the results from this study substantiate the argument that dissociation is a generalizable phenomenon in memory performance. As in Experiment Two, the independence is readily obtainable with normal subjects, even when a different method of evaluation (cross-over interaction) is employed, and yet another measure of on-line performance (word fragment completion) tested. Categorizing a task as a tacit measure of memory - not requiring a directed reference to previous experience - seems sufficient to generate the independence between reflective and on-line performance memory tasks. Finally, this independence is not accountable by a differential sensitivity argument.

2.4 SUMMARY OF THE INDEPENDENCE RESULTS

Empirical evidence has been provided for the phenomenological and theoretical dissociation of memorial influence on behaviour. The independence between tacit measures of memory and recognition is clearly demonstrated in the three experiments. In Experiment One, the independence between spelling behaviour and recognition performance is shown by the amnesics' differential memory abilities for the two tasks, and by the stochastic independence evidenced in both normal and amnesic populations. In Experiment Two, the stochastic independence between perceptual identification and recognition was consistently obtained over a wide range of conditions. In Experiment Three, the opposite benefits context provides for word fragment completion and recognition further indicates the independence of these types of task.

These results can address two possible limitations of the dissociation as originally observed in amnesics. First, the difference between measures which demonstrate preserved memory abilities in amnesics and those tasks which typically define the amnesics' memory impairment is not an isolated effect. This behavioural distinction can be obtained with a wide variety of tasks employing both motor and verbal skills, and with subjects who do not display any obvious differential memory abilities. The results support the suggestion that the dissociation is a robust and generalizable phenomenon of memory behaviour. Korsakoff patients are different from normals, not in their demonstration of the independence between on-line performance and awareness-related memory, but rather in the conspicuous manifestation of this dissociation in their behaviour.

Secondly, the dissociation between on-line and reflective memory tasks observed in the amnesics' behaviour is not attributable to the differential sensitivity of the measures. Demonstrating the stochastic independence between individual responses and the mutual sensitivity of the two measures to memory relevant variables in normal subjects is not compatible with this view. The results are more easily described as representing a qualitative difference in memory performance.

The dissociation can be interpreted as displaying the existence of two separate memory systems by suggesting that the two classes of task differentially measure the two types of memory. Consistently demonstrating the independence between the measures across numerous conditions supports this view. Differential processing of information by a single memory system can also be submitted as a possible account of the results. The dissociation reflects the independent access of memory by these processes. By this account, the task is not identified with a particular memory function or system. Instead, the important aspect is the type of information utilized for any particular retrieval attempt. The tasks may emphasize the use of different kinds of information and it is this factor that is responsible for the observed independence.

Although both memory accounts would predict the independence obtained, they differ in their predictions of the possibility of ever observing a dependent relationship between the measures. The multi-systems view identifies the tacit and reflective tasks with different memory systems and therefore invariably predicts independence of these measures with unconfounded variation of other variables. In contrast, the processing position would argue that variable relationships between the tasks should be possible, contingent on the type of information being processed. That is, the dissociation is not inherent to the tasks, but rather is reflective of the type of information employed in the task. A recent study by Graf, Mandler and Squire (1983) lends some support to this prediction. By manipulating an instructional variable and using a single task, they were able to show that amnesics could perform comparably to normals or much more poorly. In a word completion task, if the amnesic was asked to simply complete the word fragments, they displayed normal levels of performance. However, if they were instructed to complete the word fragments with items they had learned in the study phase, they performed significantly worse than normal memory subjects. In Chapter Three, the issue of dependence is examined. By manipulating the informational status of the tasks being investigated, one can observe whether the relationship between the tasks will vary accordingly.

- CHAPTER THREE -

AN INVESTIGATION OF THE LIMITING VARIABLES OF THE DISSOCIATION PHENOMENON

In Chapter Two, a dissociation between a reflective memory measure and various tacit memory measures was demonstrated for both normal and amnesic populations. It has been suggested by some investigators (e.g. Tulving et.al., 1982) that the tacit memory results may be mediated by an independent cognitive system other than episodic memory. This system respresents a structurally different mechanism in memory and may even be physiologically separable (e.g. Wood et.al., 1980; Warrington and Weiskrantz, 1982). This view explains the independence between the tasks as being a reflection of the fact that the tasks are differentially tapping the separate memory systems.

The description offered by Jacoby (e.g. Jacoby and Dallas, 1981; Jacoby, 1983b) contrasts with other views in that, although two separate memory phenomena may have been identified by the dissociation, this may be a reflection of the differential processing involved in the two tasks. Due to the reflective nature of the task, a recognition decision may primarily be based on the successfulness of retrieving the study context of an event. Since tacit memory tasks, by definition, do not encourage reference to the previous context, they may rely primarily on perceptual information. The independence could be due to the emphasis on the use of these different kinds of information. Alternatively, however, the relative ease with which perceptual information is processed may allow for the correct attribution of having prior experience with an event. The logic that the two types of information may converge on a similar operation (i.e. the recognition decision) suggests that dependence could also be demonstrated, if the tasks demanded similar processing of the items.

The following two studies represent an attempt to obtain evidence of a dependent relationship between the measures. If the two memory responses could in some way be forced to rely on a single source of information, for example, the perceptual characteristics of the stimuli, then, according to the processing account, a dependency between the measures should be produced. A result of dependency, however, would be awkward for a multi-systems account of the dissociation.

3.1 EXPERIMENT FOUR - RECOGNITION BASED ON LIMITED INFORMATION

No evidence of dependence was observed in the experiments reported in the second chapter. This could have been due to the fact that a recognition task primarily encourages the subject to respecify the study context and, as a result, does not encourage a decision to be based on a discrimination of the fluency of processing perceptual information.. If the recognition test items did not contain, or allow the use of, additional contextual information (e.g. meaning or organization), then reaffirmation of the original study context would be very difficult. Instead, the perceptual qualities of the stimuli would be prevalent and would constitute the primary source of available information. The recognition decision would be more reliant on the familiarity component of these perceptual characteristics. In this case, both the reflective memory measure and the tacit memory measure (e.g. perceptual identification) could be based on similar processing attributes (i.e. relative fluency). Under these conditions, the differential processing account would expect to observe a dependence between the measures.

The following experiment was an attempt to produce a situation in which the recognition decision could be made primarily on the basis of the familiarity of an item. In order to accomplish this, pronounceable pseudowords will be used as the test material. Pseudowords are items which, by definition, are not real words and, therefore, do not have any definitive meaningful referent associated with them. These items would provide less contextual information for recognition decisions, and would encourage subjects to attend more to the physical and perceptual characteristics of the stimuli. If this was accomplished, the comparison between the reflective and tacit measures of memory should reveal a dependence. This, in turn, would indicate the consequent dependence of memory processing for items judged on the basis on the same type of information.

3.1.1 METHOD

Subjects:

Twenty-four first year McMaster University undergraduate students (mean age=21.2) participated in this study for Introductory Psychology course credit. Subjects were tested individually in a single session which lasted approximately 45 minutes.

Materials :

A word pool of 102 items was constructed. These items were "pronounceable pseudowords", in so far as they were nonword items that followed the orthographic spelling patterns of regular English words. All were created by the transformation of one letter in regular high frequency words (selected from Thorndike-Lorge norms), either through the deletion, addition or alteration of a single letter, such that the pseudoword was five letters in length. Six of these were used as practice items in the perceptual identification procedure. The remaining pseudowords were used as test items, and were counterbalanced for position (two random orders) and test item status (four rotation orders, alternating critical and distractor items). An example of the stimulus format can be found in Table 4.1 and a list of all items used in this experiment is provided in Appendix B4.

Phase One - Study: Twenty-four items were selected as the critical items. These items would be tested in both the recognition and perceptual identification phases. Another 24 pseudowords were chosen as distractor items. The items were presented individually on a PDP-8 computer screen for a two second exposure duration.

Delay Interval: A ten minute delay interval intervened between the first and second phases, during which students were instructed to complete a single page of simple arithmetic problems. Subjects who finished the math sheet early were asked to check over their answers for the remaining period.

Phase Two - Recognition Test: Another list of 48 pseudowords was constructed. Half were the critical items from the first phase, and half were new distractor items. Presentation mode for this task was by computer screen as in the first phase. Individual item presentation was terminated when the subject made a response.

Phase Three - Perceptual Identification: A final list, comprised of the 24 critical items, and 24 distractor items not previously encountered, was prepared for tachistoscopic presentation by PDP-8 computer. Exposure duration for the test items was set at 50 ms. for all subjects according to the same criteria used in Experiment Two. Warning signals (- -) preceded, while a mask (&&&&&) immediately succeeded item exposure. Again, individual trial presentations were subject-paced and subject-initiated.

Procedure:

The procedure followed in this experiment was essentially identical

Table 4.1

An Example of the Stimulus Format
For Experiment Four

Phase One - Study

Critical	Novel
lonce	mirld
treap	yonch

Phase Two - Recognition Test

Critical	Novel
lonce	blesp
treap	flant

Phase Three - Perceptual Identification

Critical	Novel
lonce	glask
treap	clert

to that used in the second experiment, with some minor modifications. The differences consisted mainly of the subjects' treatment of the test responses. The subjects were again told that an objective of this study was to investigate abilities to read at speeded rates.

Phase One - Study: Subjects were informed that the stimuli to be read were not real words, but that all items were pronounceable. Subjects were told that nonwords were used because these items were potentially better indicators of the learning of basic speeded-reading skills, since, as students, they were already very skilled readers of the English language proper. They were instructed to treat the items according to regular orthographic rules of English, pronouncing each aloud as it appeared on the screen. In order to allow for the possible difficulty of this task, the stimuli remained on the screen for two seconds per item, instead of one. Although a record was kept of the missed items, the occurrence was so low (mean=.014) that there was no noticeable affect on later performance.

Delay Interval and Phase Two - Recognition Test: These phases were conducted in the same manner as the second experiment for the screen mode presentation condition. The recognition task consisted of asking the subject to decide whether or not a presented item had been seen in the reading phase of this experiment. Recognition results were collected by the computer for later data analyses.

Phase Three - Perceptual Identification: Presentation of the items was given in the same format as the earlier experiment. Instead of requiring the subject to read aloud the item, however, they were asked to identify it by writing down the presented letter string on an answer sheet. Guessing was encouraged to the point of asking the subject to write down as many letters as they could read, even if they could not reproduce all five possible letters. As before, subjects were not informed that some of these items had been encountered in earlier phases. Written responses were collected for later analyses, and were scored for accuracy in terms of letter by position. A response was considered correct only if all five letters were produced and were in the correct order for the full report measure. Partial report measures consisted of assigning a score out of five per item according to the correctness of letter identification and letter position.

3.1.2 RESULTS

Discrimination between previously presented and novel items is very good for recognition (mean critical (correctly recognized)=.765; mean novel (falsely identified)=.152; d′=1.75 - see Table 4.2 and Figure 4.1). Although the stimuli are unusual and were presented for a very brief exposure duration in the original reading phase, subjects were able to show evidence of learning.

In perceptual identification, the memorial effects to be reported were found with both whole-string correct report (i.e. all five letters were required for a single correct score) and partial letter string report. Analyses were conducted with both measures. Since ~~the pattern of~~ results was the same for both, only full report results will be discussed in subsequent sections. Previously presented pseudowords exhibit facilitation in perceptual identification over new distractors (mean critical=.640; mean novel=.315, t=10.356 - see Table 4.2 and Figure 4.1). Pseudowords are correctly identified with a higher probability if they had been read in the first phase. Thus, memory influences the perception of nonwords, even though they were not extensively studied.

Although both test measures display memorial influences on performance, when questioned at the end of the session, subjects again reported no awareness of the presence of old items in the perceptual identification task. Nonetheless, the dissociation analysis produced a significant level of dependence with the chi-square values, unlike the results of the second experiment (X^2=6.449 - see Table 4.3). This finding suggests that performance on one task influences or

Table 4.2

Mean Proportions (and Standard Deviations)
Summarizing the Results From the Pseudoword Experiment

	Critical[x]	Novel[x]	Statistic	
PI - FP	.640 (.143)	.312 (.128)	t=10.356 sig. 23 d.f.	PI=Perceptual Identification Rn=Recognition
PI - PP	.846 (.099)	.679 (.133)	t=4.13 sig. 23 d.f.	
Rn	.765 (.136)	.152 (.135)	d′=1.75	

x - Critical items represent previously studied items; Novel items represent new items
- means represent the proportion of items which were correctly reported for PI or reported as "old" for Rn
- FP = full report of pseudoword
- PP = partial report of pseudoword letters

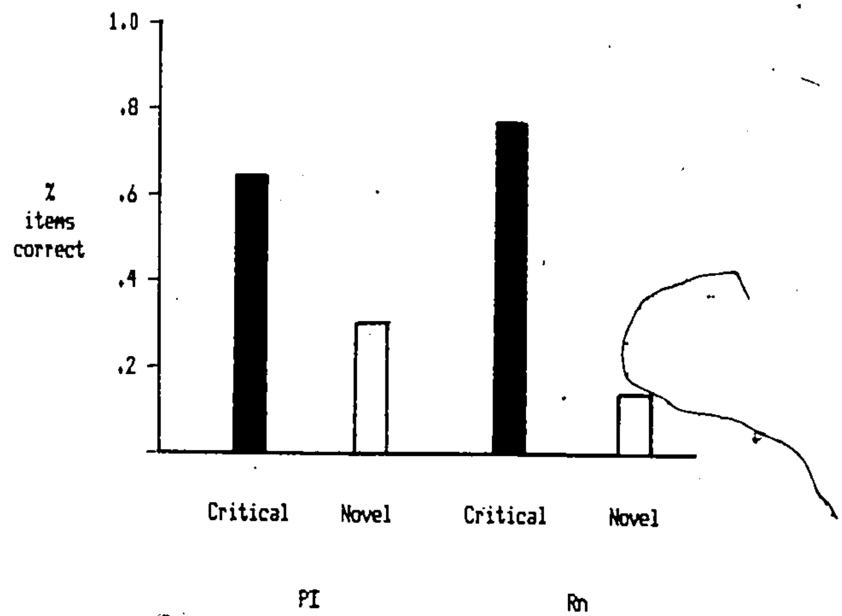

Figure 4.1 - Mean Proportion of Pseudowords (Critical or Novel) Correctly Identified in Perceptual Identification (PI) or Reported as "old" in Recognition (Rn)

predicts the subjects' performance on the other task. The conditional probabilities show that perceptual identification of successfully reported items is predicted from performance on recognition of those same items. Whether or not the item is recognized, predicts whether or not there is an advantage for the later identification of that item (see Table 4.3 which displays the conditional and marginal probabilities). Items that are not recognized show a considerable disadvantage (10%) in later perceptual identification ($P(PI/\overline{RM})$=.54; $P(PI)$=.64). To observe the contrast between these dependent results and the independence of the earlier experiments, refer to Figure 5.2. It is clear that these results do not conform to the results obtained in Chapter Two (they do not approach the diagonal representing the stochastic independence as do the cluster of other results). Overall, these results show that dependence was obtained between the two response measures.

3.1.3 DISCUSSION

The results from the perceptual identification phase clearly demonstrate the typical facilitation of report for previously encountered items over new items. However, this advantage of increased identification accuracy for old items was found to be dependent on whether or not the old item had been recognized. The results indicate that the performance on one task could be predicted from the results of the other. Such a result would not be expected if the memory measures were entirely based on different sources of information or different memory systems. Instead, it is plausible that both memory measures are accessing a single memory representation by making use of the same type of information. The measures reflect this result by displaying a dependent relationship. The rationale for this relationship can be described as follows: If there was successful access to the memory representation in one task (e.g.

Table 4.3

Chi-square Test for Independence and Conditional Probabilities - Evaluating the Relationship Between Perceptual Identification for Pseudowords and Recognition Performance

Chi-square Table:

		Recognition		
		Hit	Miss	
PI	Cor	.513	.127	.640
	$\overline{\text{Cor}}$	.252	.108	.360
		.765	.235	

$\chi^2 = 6.4494$

$p < .05$

Conditional Probabilities

	P(PI)	diff.
P(PI/Rn)=.671	.640	+.031
P(PI/$\overline{\text{Rn}}$)=.540	.640	-.100

recognition) by use of perceptual information, then a second retrieval attempt based on the same information should also be successful. If, however, the information is not adequate to access the memory on one occasion, then it should continue to be insufficient on later retrieval attempts. According to the differential processing account of the relationship between the measures, this finding would be expected.

Recognition memory decisions may be based on the reinstatement of the original context (e.g. Tulving, 1972; Rabinowitz, Mandler and Barsalou, 1977). In addition, however, the decision may be arrived at by way of a familiarity judgment based on the relative fluency or ease with which the perceptual attributes of an event are processed. If the processing is very fluent, then one can decide the event is a familiar one, and therefore, had likely been experienced previously.

In a perceptual identification task, subjects will identify items that have been read before more accurately, and with faster reaction times (Hayman, 1983) than new items. Additionally, subjects in this and the second experiment commented on their impression that some items remain on the screen longer or are visually clearer than other items. These findings suggest that the identification of the item is more fluent and phenomenologically distinct from new items. It is proposed that this fluency of processing observed in perceptual identification tasks is representative of the second type of information that contributes to a recognition decision.

It was suggested earlier that if a situation was devised which would minimize the amount of additional contextual information available, it would be possible to encourage a recognition decision to be made on the basis of perceptual information. This, in turn, would be reflected in a dependency between the recognition task and a measure of memory which is apparently completely determined by evaluating the perceptual information. By selecting pronounceable pseudowords, it was possible to insure that the encoding of the material would be based predominantly on perceptual characteristics. These items, which are not real words, have no definitive meaningful referent, and, therefore, reduced the amount of additional contextual information available. In so doing, any recognition decision made would rely more directly on the overall familiarity of the item, since confident verification of the original context would be difficult. The experimental results were successful in demonstrating a dependency between the memory response measures, and are interpreted as providing evidence that at times the recognition decision can be based on perceptual information.

3.2 EXPERIMENT FIVE - FURTHER EXAMINATION OF DEPENDENCE

The pseudoword experiment demonstrated that in some cases a dependency between recognition, a reflective memory task, and perceptual identification, a tacit memory task, could be obtained. It was argued that this result arose due to the fact that the recognition decision was encouraged to be made predominantly on the basis of perceptual information. In this manner, the memory response for both tasks relied on processing the same type of information and, consequently, displayed a dependent relationship. This provided evidence contrary to the dissociation experimental results found earlier in similar paradigms (Experiment Two), and lends support to the notion that recognition can result from different sources of information.

The following experiment provides another situation in which the two types of memory measures, when encouraged to rely on the same information, would reflect a dependent relationship. In this case, emphasis is placed on information which allows for confident reinstatement of the original context.

The tacit memory measure, which does not require one to retrieve context, normally would be expected to show independent effects of memory when compared to recognition. However, when the tacit memory task relies on information which allows for the intentional retrieval of previously learned items, then one might expect a dependence between this task and recognition. Unfortunately, if one explicitly requests the subject to refer to the prior experience, the task is no longer considered a "tacit" measure of memory. Therefore, in the following study, a manipulation was needed in which the tacit measure of memory could be obtained incidently, but still be reliant on information for the retrieval of the prior study context. It was decided that if the tacit and reflective memory measures could be obtained simultaneously, through a single response, they easily might be derived from the same type of information. Consequently, when a situation is designed in which this single response is encouraged to be predominantly based on the retrieval of the original event, the tacit memory results should mimic the recognition decisions.

It is suggested that due to stressing the reflective nature of the task (i.e. retrieval of context), the memorial influence of fluently processing perceptual information may be precluded in both recognition and tacit memory performance. Consider, for example, the finding that amnesics display poor performance on recognition tests. One would expect that if a recognition decision, in fact, can be derived from different sources of information (as in Experiment Four), then for amnesics, since deliberate retrieval of context is not an available memory strategy, the fluent processing of perceptual information should be relied on and produce preserved memory results in recognition. However, it is suggested that the amnesic will not or cannot respond on the basis of familiarity, once a decision has been arrived at based on an attempt to verify a previous event. That is, they may consider confirmatory contextual evidence to be a more reliable indicator of previous occurrence, which therefore, should override any suggestion of familiarity. Thus, if amnesics are asked to verify whether or not a particular event occurred before, and they fail to retrieve and/or access contextual evidence for the event, they will insist that that they had not witnessed the event. The more reliable indicator of prior occurrence (failure to retrieve the context) suggests a negative response; familiarity impressions are not treated as informative in this case and do not influence the response reported. When the amnesic is encouraged simply to "guess" which response is correct, they could perform above chance. They are permitted, under these conditions, to make use of the familiarity information; they need not be reliant on their failure to verify the original event.

Consider, also, the finding that complete stochastic independence was so consistently obtained in the first three experiments. If recognition can be based on either of the information sources, then, at least for cases in which the subject is not confident of the recognition decision to be made, one may expect that fluent processing of the perceptual information would assist the recognition decision. If so, some dependency between the two types of memory measures should have emerged, even if it were slight. None the less, there was no indication of any dependency obtained. This result would suggest that with normals, as with amnesics, once a decision is arrived at by engaging memory processes which respecify the original context, the other information is not attended to, or, at least, is non-influential.

Two situations were designed to vary the information from which both the tacit and reflective measures were derived. Using the homophone materials from Experiment One, subjects would be asked a number of questions, some of which would define a homophone item in terms of its low frequency spelling pattern. At test, subjects would be asked to make a recognition decision. They would indicate their response on a sheet of paper by writing down the items in either an "old" or "new" column, depending on their decision. Both memory measures would be assessed on the basis of this single response. The recognition response would be determined by the column in which they had entered their answer. The tacit memory measure of spelling pattern would be determined by scoring their written response.

In one condition, subjects were encouraged to base their recognition judgment exclusively on reinstatement of the original context. That is, an item was to be considered as "old" only when the subject could reproduce characteristic features of the original question. If it is the case that a decision arrived at on the basis of one's success at retrieving the context precludes the effects of fluent processing, then the responses would probably reflect a positive relationship between the recognition decision and the spelling performance (i.e. a dependency). That is, if the original question is retrieved, then the homophone item should be spelled in the low frequency pattern; and if the item is not recognized, that is, the original question is not retrieved, then the spelling performance should not display a fluency effect and would be spelled in the high frequency manner.

In a second condition, subjects were instructed to use a much less stringent criterion of recognizing the original event, in order to encourage judgments based on the fluency component of recognition. In this case, given that the measures are derived from a single response, if the item is recognized (i.e. displays the memory influence), then the dependency between the two measures should be evident. Both measures should display the memory effect; the item would be judged as old <u>and</u> would be spelled in a low frequency pattern. However, with a relaxed criterion for the recognition decision, if the item is judged as being not familiar, it still may be possible to find evidence of fluent processing affecting the spelling performance. Relaxing the stringent criterion for arriving at a decision may reduce the preclusive effect that confirming a prior occurrence by retrieving the original event has over influences of processing perceptual information. This, in turn, could allow for memorial influences on spelling behaviour even when the item is not recognized. For this reason, the error analysis will be particularly important.

3.2.1 METHOD

Subjects :

Twenty first year McMaster University undergraduate students (mean age=19.9) participated in this study for Introductory Psychology course credit. The subjects were assigned randomly to one of two conditions (N=10). All subjects were tested individually in a single session which lasted approximately 30 minutes.

Materials :

The stimuli used in this study were identical to those described in Phase One and Two of the first experiment, in which emphasis was placed on the usage and spelling patterns of homophone items. Refer to the materials section of Experiment One (Phase One and Two) and Appendix B1 for a full description of these stimuli. For an example of the stimulus format, refer to Table 5.1.

In addition, an answer sheet was prepared for the testing phase. This sheet was divided into two columns. One of the column headings was labelled "OLD", whereas the other had "NEW" written above it. These labels referred to the status of the to-be-tested item. If the item was previously heard in one of the questions, then it was to be considered as an old item. If the item was not given during the first phase, then it was to be designated as new.

Procedure :

Phase One - Study: The study phase was conducted in the same manner as the first

Table 5.1

An Example of the Stimulus Format
For Experiment Five

Phase One - Study: questions

Name the days of the week. (homophone)
What is your favourite sport? (nonhomophone)

Phase Two - Test

	homophone	nonhomophone
old	week (critical)	sport
new	waste (control)	fence

experiment. Subjects were asked to respond orally to 30 unrelated questions with one word or short phrase answers. These questions served to disambiguate the homophone items through meaningful context.

Phase Two – Test: The test phase was unlike the original study in a variety of ways. Firstly, there was one test session for the subject, rather than two separate tasks of recognition and spelling. Secondly, the measure of spelling behaviour was obtained from written, rather than oral, responses. Thirdly, there were two instructional conditions introduced at test, emphasizing different aspects and requirements of the subjects' responding.

The basic test procedure consisted of the following: All subjects were given a sheet of paper that was divided into two columns. They were asked to listen to a list of words presented on a tape-recorder. After each item was given, the subjects were required to write down the word on this answer sheet under one of the two labels. The task was described to the subjects as a test of recognition. The description, however, was varied according to which of the two conditions was being tested:

Group One – Subjects in the "stringent" condition were instructed to enter the presented item in the "old" column only if they could sufficiently reproduce the question in which the item originally occurred. If they could not remember the original question, then they were to place the item in the "new" column. A "sufficient" response required that the subject reproduce the gist of the original question.

Group Two – For subjects in the "non-stringent" condition, the description consisted of a simple interpretation of the to-be-presented item's status. Subjects were simply instructed to place an item in the "old" column, if it seemed familiar to them with respect to the study phase questions. If it did not seem familiar, they were to write the item in the "new" column. They were not required or encouraged to reproduce the original question in any way.

Notice that this testing format allows for the two measures of memory to be collected simultaneously and through a single written response. The recognition decision is ascertained by scoring which column the item is entered into ("old" versus "new"). At the same time, the spelling measure is determined by observing the spelling pattern used for this written response. These tasks will be scored in the same manner as used in the first experiment. This will include an analysis of the "critical" and "control" homophones for the spelling measure, and "old" previously presented items versus "new" distractors for recognition. In addition, the critical items, will be submitted to the chi-square test of independence.

3.2.2 RESULTS

The memorial influence on the spelling pattern of homophones was demonstrated again, as in the first experiment. The critical items which were disambiguated through meaning during the question phase were successfully biased towards low frequency spelling patterns for both groups (group 1: mean=.760, group 2: mean=.773. Refer to Table 5.2, p<.01). This influence on spelling was not obtained for control homophones not presented during the question phase (group 1: mean=.224, group 2: mean=.226).

In addition, the discrimination between old and new items for the recognition decision was highly accurate for both groups (group 1: d′=3.09, group 2: d′=2.23. Refer to Table 5.2 for mean values). The instructions at test, which attempted to distinguish between the two groups, were successful to the extent that group one obtained a higher level of discrimination. Subjects in group one were more accurate at discriminating between old and new items. In addition, there is a critierion difference since group two not only accepts more old items, but also

Table 5.2

Mean Proportions (and Standard Deviations)
Summarizing the Results For the Spelling and Recognition Tasks
in Experiment Five

Low Frequency
Spelling Performance

Group	Critical*	Control*	Statistic
1	.760 (.078)	.224 (.055)	t=16.805 sig. 9 d.f.
2	.773 (.114)	.226 (.100)	t=22.042 sig. 9 d.f.

Recognition

Group	Cor Rn*	False Rn*	Statistic
1	.777 (.077)	.013 (.013)	d'=3.09
2	.827 (.083)	.098 (.090)	d'=2.23

Group 1 = Stringent Condition
Group 2 = Non-stringent Condition

* - Critical items = homophones previously biased in the question phase
\- Control items = new homophones not previously presented
\- Cor Rn = old items correctly recognized and includes both homophone and non-homophone items
\- False Rn = false positives, i.e. new items incorrectly recognized as "old"

accepts more false alarms. This also indicates that the instructions were successful at encouraging group two subjects to be more lenient.

The critical items were submitted to the stochastic independence analysis. The chi-square values obtained a significant level of dependence between the recognition memory and the spelling response measures (group 1: χ^2=33.462, group 2: =15.110; p<.01. See Table 5.3 and Figures 5.1 and 5.2). This result suggests that performance on one task can reliably predict the subject's performance on the other task. The spelling pattern of the biased homophones was shown to be predictable from the recognition status of those items. An examination of the conditional probabilities reflects this relationship. Although, in general, the critical items displayed a significant memory effect, those that were recognized were the most likely to be spelled in the low frequency pattern (group 1: P(Sp/Rn)=.895, group 2: P(Sp/Rn)=.854. See Table 5.3). Items that were not recognized did not demonstrate the biasing effect to the same degree (.456 and .551). None of these values were equal to the expected marginal probabilities of the spelling bias, given assumptions of independece (P(Sp)=.760 and .773). In other words, the recognized items showed an increase in the probability of producing the spelling bias (13.5%, 8.1%); whereas the non-recognized items showed a considerable decrease in the frequency of this bias (30.4%, 22.2%. See Figure 5.2).

Further analyses were conducted in order to determine whether there were any differential effects between the two groups in terms of the dependency observed. The groups produced similar patterns of results in the above mentioned contingency analysis, however, the stringent group displayed a more potent correlation. The phi coefficient, representing a measure of correlation, was .472 for group 1 and .317 for group 2. This potentially informative result was investigated more thoroughly in terms of the spellings found in the error data.

Table 5.3

Chi-square Test for Independence and Conditional Probabilities
- Spelling Pattern Versus Recognition of Critical Homophones

Chi-square Table

Group 1

		Recognition: Hit	Recognition: Miss	
Spelling	Low	.620	.140	.760
	$\overline{\text{Low}}$	.073	.167	.240
		.693	.307	

χ^2=33.462
p<.01

Group 2

		Recognition: Hit	Recognition: Miss	
Spelling	Low	.626	.147	.773
	$\overline{\text{Low}}$	.107	.120	.227
		.733	.267	

χ^2=15.110
p<.01

Conditional Probabilities

Group:	Conditional	P(Sp)	Diff.
1	P(Sp/Rn)=.895	.760	+.135
	P(Sp/$\overline{\text{Rn}}$)=.456	.760	-.304
2	P(Sp/Rn)=.854	.773	+.081
	P(Sp/$\overline{\text{Rn}}$)=.551	.773	-.222

Group 1 = Stringent Condition
Group 2 = Non-stringent Condition
Sp = low frequency spelling
Rn = correct recognition

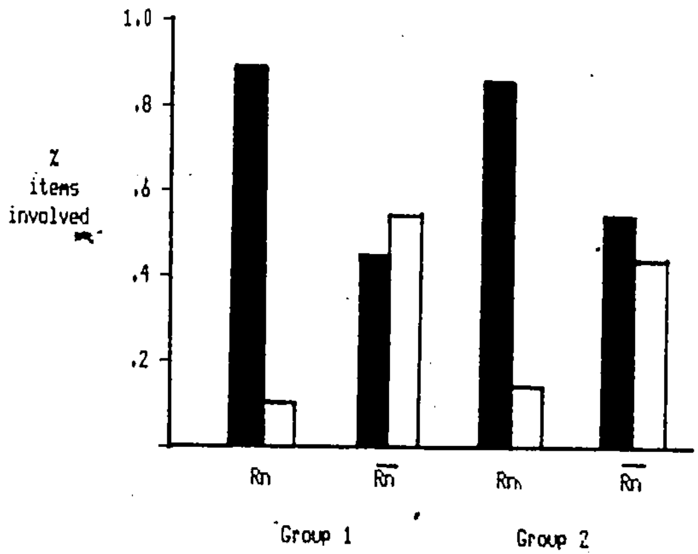

Figure 5.1 - Spelling Patterns for Homophone Items Conditionalized on Recognition Accuracy (Rn=correctly recognized; $\overline{Rn}$=incorrectly reported as "old")

x - Low frequency = ■
High frequency = □

The mean values for critical items that were not recognized (i.e. false negatives) were compared for the two groups. Although the difference is not significant (See Table 5.4, $p<.10$), the direction of the trend is interesting. If a critical item is not recognized, it tends to have a greater probability of being spelled in the high frequency pattern, when the subject has been given a more stringent criterion for recognition acceptance.

Finally, Table 5.5 displays the results of this study and the spelling performance for normal subjects from Experiment One. The dependent relationship between the spelling bias and recognition is clearly emphasized for the groups in this study. When the measures are obtained simultaneously, the low frequency spelling pattern is more pronounced for recognized items (.895, .854). When spelling performance is obtained without requesting reference to the earlier occasion as in Experiment One, the data do not show this result (.546).

3.2.3 DISCUSSION

Similar to the results of the first experiment, homophones that were biased during the question phase produced a higher probability of low frequency spelling for both groups. The non-biased homophones, however, tended to be spelled in the high frequency pattern, as would be expected according to the norms from which they were selected. In contrast to the first experiment, however, the biasing effect obtained in this study was shown to be dependent on the recognition decision made. The contingency results for both groups provided statistical evidence for dependency between the two memory measures.

The dependence can be interpreted as demonstrating the extent to which the two measures relied on a common source of information. Further, it is suggested that the use of contextual information as the basis for a recognition decision minimizes the influence judgments of fluent processing of perceptual

Table 5.4

Proportion of High Frequency Spellings
for the False Negative Recognition Report of Critical Homophones

group	mean	Statistic	
1	.544	t^{*}=1.871 18 d.f.	$p<.10$
2	.449		

Group 1 = Stringent Condition
Group 2 = Non-stringent Condition

t * -test = a comparison of Groups 1 and 2
in terms of the high frequency spelling patterns obtained
for false rejected "old" items

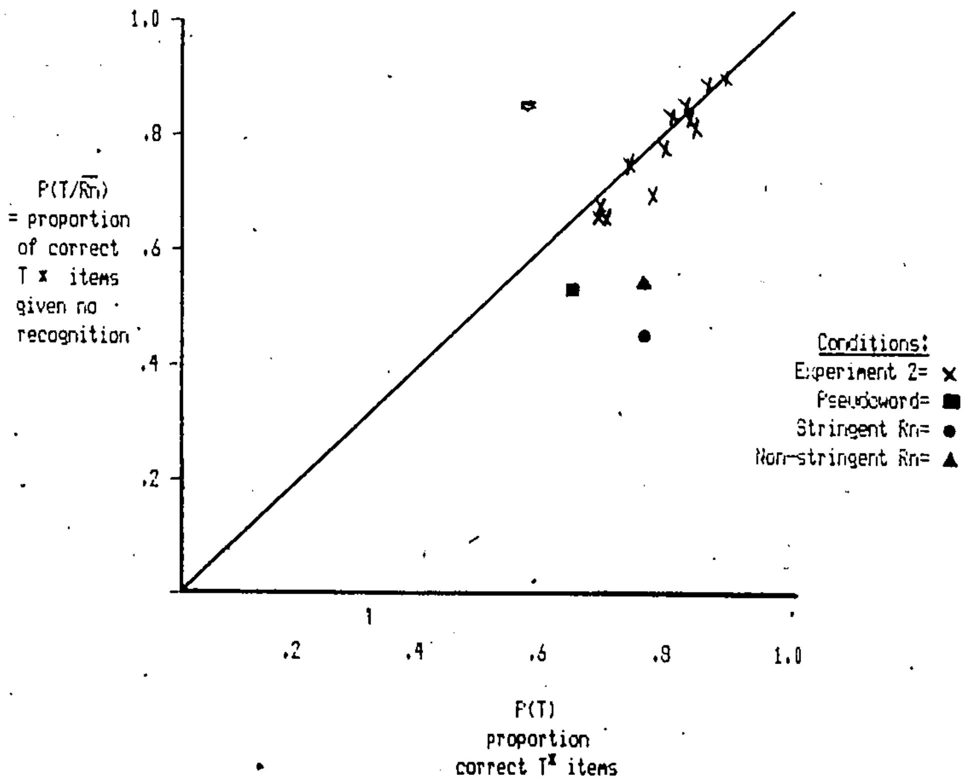

Figure 5.2 - Tacit Measures of Memory (T) and Recognition (Rn) plotted in terms of the Conditional Probabilities and Marginals comparing Experiments 2 (showing independence), 3 and 4 (showing dependence)

x - "T" represents either of the tacit measures involved, i.e. perceptual identification (Experiments 2 and 3)or spelling (Experiment 4)

- complete stochastic independence is indicated by the diagonal (P(T/$\overline{Rn}$)=P(T)

Table 5.5

Comparison of Low Frequency Spelling Performance
for Critical Homophones in Experiments 1 and 5

- Presented in Mean Proportions
and Conditionalized on Recognition

	Low Frequency Spelling Performance		
Spelling:	Group 1	Group 2	Normals
P(Sp)	.760	.773	.506
P(Sp/Rn)	.895	.854	.546

Group 1 = Stringent Condition
Group 2 = Non-stringent Condition
Normals = Subjects in Experiment 1

P(Sp) = Overall mean probability
P(Sp/Rn) = Conditionalized Probability

information could have on behaviour. For the stringent condition, subjects were required to reproduce the original question and thereby emphasizes the reflective nature of the task and the use of reinstatement of context as a source for the recognition decision. With successful recognition, the original meaning of the item must be retrieved (in addition to other contextual information), thereby producing the biasing effect. With false negatives, the item has been judged as not previously encountered based on the inability to reinstate the original context, and no significant fluency effect on spelling behaviour is observed.

In the "non-stringent" condition, again, it is argued that the correlation between the two measures was found due to the use of the same information. Even though the criterion for acceptance was relaxed for these subjects, the significant dependence indicates that the reflective nature of a recognition decision tends to preclude the influence of fluency on spelling behaviour. Two interesting results, however, were observed which suggest evidence for a subtle fluency effect. This condition displayed a tendancy towards a lower overall level of dependency between the measures, and displayed a tendancy to produce a higher percentage of biased spelling patterns with falsely rejected old items.

Intentional retrieval of contextual information influences the amount of dependency observed between the measures. The stringent condition showed stronger dependency effects than the non-stringent condition; and, in turn, both of these groups showed greater dependence than the subjects in Experiment One, in which the tacit spelling measure was obtained without reference to the prior study.

The dependence found between the measures in this study demonstrates that for recognition decisions which emphasize the reflective nature of the task (i.e. stringent condition), the reinstatement of context significantly reduces fluency effects in performance. Further, this is typically the basis on which a recognition decision is made, since the same results obtained for the non-stringent condition. Although recognition may be derived from either of two sources of information, the contextually-based mode is preferred for decisions of prior occurrence.

3.3 SUMMARY OF THE EVIDENCE FOR DEPENDENCY

The two experiments in this chapter were aimed at investigating the amount of dependence that could be obtained under specialized circumstances. Experiment Four demonstrated that the recognition decision can be made successfully and accurately on the basis of information which is highly impoverished in terms of content and meaning. The recognition decision relied predominantly on the perceptual characteristics of the stimulus. Since perceptual identification necessarily relies on available perceptual information , this arrangement allowed for a dependence to be obtained between memory measures. Both tasks were required to access the same source of information. In addition, it was shown that this dependency could be obtained with different tacit memory measures and in either a visual or auditory modality. The dependency is a reliable finding since whenever a situation is contrived to encourage a particular information source to be accessed and utilized in either task, evidence of a dependency between the memory measures can be found. Finally, evidence was obtained demonstrating that if a recognition decision was encouraged to be made exclusively on the basis of the reinstatement of context, the alternate source of information would be non-influential or would not be used (Experiment Five).

This last result is particularly interesting, since for the dissociation experiments, it was argued that the independence between the two memory tasks arose due to the recognition decision being typically and predominantly reliant on the retrieval of context, therefore precluding the effects of fluency. No clear evidence had shown that this, in fact, was the reason for the dissociation. Experiment Five was able to disentangle influences of the two sources by encouraging subjects to make a decision on the basis of reinstatement of context, and by insisting on a single response measure. Had both sources of information been accessed, then false negative responses would have been expected to display the effects of fluency independent of the access to the contextual information. These results, however, were not found - even with the less stringent group, although some suggestive results were noticed in this condition. This provides empirical support, then, for the arguments made in terms of the dissociation obtained and observed in amnesics and normals.

The variable relationship between the measures of memory is an awkward result for the multi-systems account to explain, since they argue that the tasks engage different memory systems. Tacit memory tasks which require either general knowledge (Kinsbourne and Wood, 1975), procedural knowledge (Squire and Zola-Morgan, 1983) or perceptual knowledge (Tulving, 1983) - depending on one's theoretical bias - will engage one memory system. Recognition tasks which require episodic information regarding the specific details of a prior event's occurrence, will engage a different and independent system. Thus, an independence relationship between the tasks is predicted and should be observed.

The differential processing account which suggests that the relationship observed between the measures should reflect the type of information used for processing in the task, however, can explain these results. For situations in which similar types of information are employed in the two memory tasks, a dependent relationship would be expected. The tasks will typically display independent relationships, however, since in most cases the information emphasized in the tasks is very different. Recognition predominantly will make use of contextual, temporal and associative information in order to retrieve a prior occurrence. When recognition relies on this information, tacit memory measures will be independent of this measure, since such information is not requested or required, or perhaps even realized, in these task situations. However, dependencies between the tasks can arise whenever the tasks must depend on the same type of information. Therefore, when recognition is made to rely on the perceptual information, then dependency between the two measures is likely to be evidenced. Similarly, if the tacit memory measure is made to rely on the recognition of a prior event, then again, dependencies would be expected.

The suggestion that the variable relationships depend on the types of information predominantly used in the task, is derived from the notion that recognition decisions can be based on two information sources. Recognition will primarily rely on one's ability to access contextual information relevant to the events' prior occurrence. However, perceptual attributes of the stimulus can sometimes initiate feelings of familiarity. Jacoby and Dallas (1981) account for this result in terms of using the fluent processing of an event as a heuristic. Experiment Four shows that recognition is forced to rely primarily on perceptual information of the stimuli, since the material is devoid of any meaningful referents (barring idiosyncratic individual differences). When the material is re-presented at test, the subject processes repeated information more efficiently and rapidly. If the subject is able to detect this difference, given that there is nothing else to go on, then he/she may decide that the item has been encountered before. Since the perceptual identification also is reliant on the amount of perceptual information analyzed, then a dependency is obtained. In Experiment Five, an opposite effect is observed. In this case recognition is encouraged to rely on one's ability to reinstate the original event. Using this type of information precludes the influence of perceptual information and the fluent processing of "old" information goes undetected or unnoticed. Since the two measures of memory are obtained in a single response, and the spelling behaviour is assessed after the decision has already been made, then relatively no effects of fluency are observed.

The assumption is that the relative fluency of processing perceptual information typically accounts for the performance on tacit memory measures, and it is this aspect of memory processing which allows for a dependent relationship between recognition and tacit memory tasks to be obtained. The next chapter is concerned with providing evidence for this notion, in order to substantiate this argument as an appropriate description for the results obtained in the thesis thus far.

- CHAPTER FOUR -

THE JUDGMENT OF FLUENCY

The results of the first three experiments established the basic memory dissociation phenomenon in markedly different circumstances. In the previous chapter this dissociation was interpreted as happening because the different tasks often are accomplished by different types of memory processing. To review, reflective memory measures definitionally require the subject to refer to a specific prior episode to recall or make a recognition judgment; tacit, on-line performance measures only instruct the subject to perform some skill, making no demands that processing be based on any particular prior episode. This definitional difference often results in the reflective tasks being based on a process of respecification of the referent event and the tacit tasks being based primarily on the processing of perceptual information. At an extreme, this difference in underlying process allows complete statistical independence between different memory measures of what ostensibly is the same single prior episode. However, under some circumstances, it is suggested that adequate performance on reflective tasks also can be achieved by perceptually-based judgments of relative fluency, as was argued in Experiment Four. Since this judgment is based on the same type of processing used to accomplish the tacit memory tasks, we expect and find a strong correlation between the two types of tasks under these circumstances. In this chapter, the suggestion that judgments of relative fluency are based on the processing of perceptual information will be explored experimentally.

Memory on the basis of perceptual characteristics could be arrived at by the relatively faster and more efficient processing of repeated events. A second encounter with an event is more easily processed since the prior memory episode actively assists the deciphering of the repeated event. Jacoby and Dallas (1981) suggest that this could be achieved if a subject was able to evaluate the occurrence of this relatively more efficient processing of the stimulus. If an item was relatively fluently identified, and the subject could detect this fluent processing, then he/she may judge that the event was a familiar one, and likely encountered previously.

The ability for subjects to be sensitive to this fluent processing has been hinted at by their phenomenological comments that items "jump out" at them during a perceptual identification test (Jacoby and Dallas, 1981). In the perceptual identification experiments reported in this thesis (Experiments Two and Four), subjects would accuse the experimenter of altering the length of the exposure duration for items during test. They were convinced that some items "stayed on the screen longer than others". These perceived duration reports led to the design of the next experiment. It was hypothesized that the phenomenological reports may be correlated with the memorial status of the test items (i.e. repeated or novel). If this correlation was found to exist, and the subject was able to consistently detect the correlation, then this could lend support to the notion that subjects can be sensitive to the relative changes or fluency in the processing of particular items. This, in turn, could result in a judgment of familiarity and subsequent recognition for the event. The next experiment examines this correlation of phenomenological report and memorial status of test items by evaluating perceived time judgments for briefly presented stimuli.

The following will review some of the relevant research from the time perception literature. The experiment will attempt to provide empirical evidence for the subject's ability to judge fluency on some subjective basis. This would lend support to the argument that perceptual information, at times, can result in phenomenological impressions of familiarity, and account for the fact that dependence can be found in constrained conditions between measures that typically rely on independent sources of information.

4.1 EXPERIMENT SIX - MEMORIAL EFFECTS ON PERCEIVED DURATION JUDGMENTS

In recent years, a major focus in the time perception literature for brief displays has been the influence of nontemporal factors on perceived duration (see Allan, 1979 for a review). Several investigators have concentrated on this aspect due to its potential contribution in providing insight as to the mechanism and variables important for the processing of information (e.g. Warm and McCray, 1969; Avant, Lyman and Antes, 1975; Erwin, 1976; Thomas and Cantor, 1978). The influence of cognitive variables was assumed since many studies had shown that stimuli presented for physically identical exposure durations did not necessarily produce identical "perceived" time judgments (Goldstone and Goldfarb, 1963; Schiffman and Bobko, 1974; Avant and Lyman, 1975; Adams, 1977). The tendancy has been to interpret this finding in terms of stimulus attributes affecting the amount of time spent processing the stimulus and the amount of time devoted to temporal aspects of the presentation.

Although some stimulus attributes, such as spatial frequency and target luminance (see Long and Beaton, 1980a; Long and Beaton, 1980b) seem to affect visual persistance alone and, therefore, do not require an information processing explanation, other factors such as familiarity and target size "would seem to reflect processes beyond sensory persistence" (Long and Beaton, 1980a, p. 429). Avant and his colleagues (Avant et.al., 1975) argue that differences in these subjective judgments may in fact index the "operations" of perceptual processing. Differences in brightness or contrast have been shown to account for some of these results. When these factors are controlled, cognitive variables (such as stimulus repetition) are found to be effective in altering exposure duration reports (Avant et.al., 1975). Warm, Greenburg and Dube (1964), Warm and McCray (1969), Devane (1974) and Avant and Lyman (1975) have also found effects of stimulus familiarity affecting subjective duration. As Avant et.al. (1975) have suggested, it seems clear that judged relative duration as a measure of early processing should provide "a relatively sensitive index of a familiarity effect on the ease of automatically initiating a contact between some dimensions of verbal materials and their memorial representations" (p. 262).

The fact that familiarity is one of the nontemporal variables reputed to affect perceptions of the stimulus is an interesting finding in light of the current research endeavour. Subjective reports from the perceptual identification studies and the suggestion from the perceived time judgment literature implies that a relationship between familiarity and time judgments can emerge.

A Procedural Consideration: The contour mask used in the perceptual identification task disrupts or terminates processing of the letter constituents. It is suggested that repeated items are processed more efficiently and, thereby, are less disrupted by the masking effect. Unfamiliar items require longer processing times to initiate item identification. As a result, if item information is not quickly accessed, given a 30 ms. exposure duration, processing of the novel stimuli may never begin. One would expect the familiar items to be judged as longer in duration, since processing had been initiated. Unfamiliar material may be interfered with due to slower processing and appear to "flash" on the screen. As a result, repeated items have a higher probability of being correctly identified (processed) than novel items. Any differential time judgments observed may be a function of correctness of report, rather than the additional ability to judge the difference between repeated and novel items. For this reason, the results will be conditionalized on accuracy. Correctly reported items should be judged as remaining longer on the screen (i.e. processing is initiated) than incorrect items. Particularly interesting, however, will be the relationship observed between the repeated and novel items that are both correctly reported. A difference in duration estimates for these conditionalized results would suggest that subjects are capable of detecting relative changes in the processing of these two types of items on the basis of their memorial status.

4.1.1 METHOD

Subjects:

Twenty-one volunteers were paid $3.00 for participation in this experiment. Subjects were either high school (N=10) or university level (N=11) students. The experimental session lasted approximately 45 minutes. Each subject was tested individually.

Materials:

A word pool of 134 low frequency five-letter items was chosen from the Thorndike-Lorge (1944) word frequency counts. Fourteen of these items were used solely for practice in the perceptual identification task. The remaining words were used as test items and were counterbalanced for item status (critical set versus two distractor sets) and presentation positions were randomized (seven orders). Critical items refer to those that were presented in both phase one and three; distractors acted as control and filler items. All stimuli were presented on a PDP-8 computer screen in the same fashion as used in Experiments Two and Four. An example of the stimulus format is provided in Table 6.1 and all stimulus materials are provided in Appendix B5.

Phase One - Study: A list of 80 words was constructed, 40 of which were repeated

Table 6.1

An Example of the Stimulus Format
For Experiment Six

Phase One - Study

critical	novel
jaunt	knoll
verse	crock

Phase Two - Pretraining

stimulus duration (ms.)

20	33	46	59
ZZZZZ	ZZZZZ	ZZZZZ	ZZZZZ

Phase Three - Test

critical	novel
jaunt	noose
verse	guile

during the third phase (critical items). Each item was presented for a one second exposure duration.

Phase Two - Pretraining: This phase was a pretraining phase for learning time discriminations. The mode of presentation of the stimuli was identical to that used in the perceptual identification studies. The material is presented tachistoscopically on computer screen. A letter string of five "Z's" (ZZZZZ) was presented repeatedly for four different brief exposure durations (durations= 20, 33, 46, 59 ms.). These rates were chosen as a means of balancing the durations around the later test rates of 30 and 50 ms., while allowing for a large enough difference to be noticed and discriminated by the subjects (i.e. 13 ms.). Each display was introduced by a warning signal (- -), and immediately followed by a mask (&&&&&). Exposure rates were presented in a random order for 100 trials - 25 trials per rate.

Phase Three - Test: A second list of 80 words was prepared. Forty items were the critical words from phase one, and another forty were new items not previously encountered in this study. The stimuli were presented tachistoscopically by computer for two exposure durations of 30 and 50 ms., having 20 critical and 20 novel distractor items presented per duration. These rates were chosen to avoid ceiling and floor effects in accuracy of identification, yet maintain a 20 ms. difference between exposure durations. As in the second phase, warning signals preceded, while a mask immediately succeeded each item exposure. Item presentations were initiated by the subject.

Procedure :

Subjects were told that there were two themes of interest in this study. They were told that of primary concern was the investigation of speed reading skills, and that the study would concentrate on tasks related to this topic. They were also told that a second area of interest involved their ability to make fine discriminations between very brief exposure durations, since this ability of detection may interact with, or be a possible relevant component of, the speeded reading skill. The fact that there was a memorial aspect to this experiment was not mentioned.

Phase One - Study: Subjects were instructed to attend to the computer screen and read aloud each item that was presented. Misread items were noted, but were found to occur with a very low probability (mean=.021) and did not affect later identification performance.

Phase Two - Pretraining: Subjects were given repeated examples of the four stimulus duration rates that were to be judged. Each of these rates was assigned a categorical response of 1, 2, 3, or 4, which was to be associated with the length of time the stimulus was on the screen. The categorical judgments were paired with the stimuli in descending order: 1 indicated the shortest stimulus duration, whereas 4 indicated the longest stimulus duration. Following the example presentations, the pretraining phase began, and the subjects were asked to produce the appropriate time judgments themselves. After the letter string was flashed on the screen, the subjects would indicate their time response by pressing the appropriate number on the computer keyboard. It was stressed that the response to be made was to be a judgment regarding how long the letter string remained on the screen. Each trial was subject-initiated. This phase served only as pretraining for making time discriminations. The results were assessed to insure that all subjects could perform this task above chance levels, in order to continue in the experiment. No further analyses were performed on these results.

Phase Three - Test: Subjects were initially given 14 practice trials, in order to familiarize them with the perceptual identification procedure, which was then followed by the main test list. A word would be flashed on the screen, and the subjects' task was to read aloud the presented item. Subjects were then given another 14 practice trials using the same stimuli. This time, however, they were required to provide two responses: first, they were to identify the presented word by reading it aloud; and secondly, they were to assign a time response to the presentation in the same manner as had been used in Phase Two. They were not informed that only two duration lengths would be presented, and were reminded that there were four possible categorical judgments that could be made. This latter point was included so as to encourage variability in responding. No feedback regarding item identification or judgment accuracy was given to the subject during the experimental session. Verbal responses and time judgments were recorded for later analyses.

4.1.2 RESULTS

The memorial effect typically observed in other perceptual identification studies was replicated. Previously presented items exhibit facilitation in identification accuracy over new items for both 30 and 50 ms. exposure durations (critical means=.493 and .801; novel means=.364 and .631. See Table 6.2).

Memorial events also influence perceived time judgments. Even though, overall, items presented for 50 ms. are judged as being longer in duration than items presented for 30 ms. (weighted means=2.554 versus 1.876), for each of these rates, differential effects due to prior exposure is found for old and new items (2.288 versus 2.167). This result is related to accuracy of identification. Judged durations of previously read items are longer than those of new items when conditionalized on correct identification (30 ms.: 2.159 versus 1.958; 50 ms.: 2.852 versus 2.697). For both 30 and 50 ms. presentation rates, when items are correctly identified, there is an increase in perceived length of stimulus duration for previously encountered items (see Table 6.3). Incorrectly reported words,

Table 6.2

Mean Proportions (and Standard Deviations)
Summarizing the Results for Accuracy of Identification
in Experiment Six

Duration	Critical*	Novel*	T	n
30 ms.	.493 (.219)	.364 (.257)	25	21
50 ms.	.801 (.108)	.631 (.219)	1	15

* - Critical items represent previously studied items
- Novel items represent new items
- Duration refers to time duration of stimulus presentation
- "T"=Wilcoxon T; p<.01
- Note: n's vary because ties are eliminated

Table 6.3

Mean Time Judgment Responses
for Items in the Perceptual Identification Task

Accuracy:		Duration: 30 ms.[x]	T	n	50 ms.[x]	T	n
Correct	Critical	2.159	48	19	2.852	46.5	20
	Novel	1.958			2.697		
Incorrect	Critical	1.627	148 (N.S.)	20	2.513	34.5 (.05)	17
	Novel	1.752			2.194		

Summary Means:

Critical	vs. Novel	Correct	vs. Incorrect	30 ms.	vs. 50 ms.
2.288	2.162	2.442	2.004	1.876	2.554
T=44 n=20		T=4 n=21		T=0 n=21	

x - Duration refers to the time duration of stimulus presentation
- the summary means are weighted values from the raw data
- "T"= Wilcoxon T; $p<.01$, unless indicated otherwise
- Note: n's vary because a) ties are eliminated; and b) conditionalizations produce some zero cells

Correct = correctly identified
Incorrect = incorrect response
Critical = items that were presented during study
Novel = items not previously presented

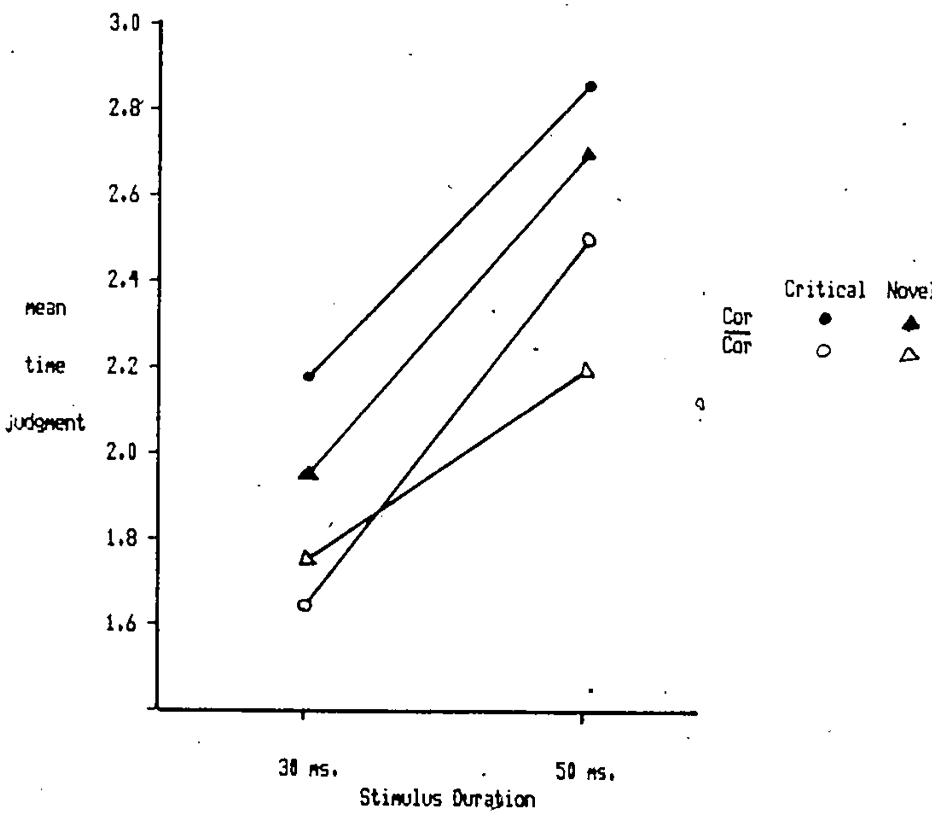

Figure 6.1 - Mean Time Judgment Responses Given for the Two Stimulus Durations

* - Critical = items previously presented
- Novel = new items
- Cor = correctly identified
- $\overline{\text{Cor}}$ = incorrecly identified

which are judged as being shorter in duration than correct items, showed this pattern of results only at the longer 50 ms. stimulus duration (Figure 6.1).

Nontemporal variables have an effect on temporal judgments. This is not due to any inconsistency or inability on behalf of the subject to make accurate real-time discriminations. Subjects were able to correctly categorize physically longer durations as being longer. For a more direct analysis of this effect, d' and ROC (receiver operating characteristic) plots in Z coordinates (Green and Swets, 1966) are provided (Table 6.4 and Figure 6.2. Note that the d' analyses have been performed on all data, collapsed across subjects, due to having an insufficient number of data points for individual subjects).

Subjects were capable of making a discrimination of 20 ms. between stimulus durations. In addition, they demonstrated constant sensitivity in three of the four comparisons investigated (d' values all approximately equal to 1.0; r^2 for the 9-point ROC line is .987). Critical-correct, novel-correct and critical-incorrect stimulus groups are essentially identical in discriminability. Not only could subjects accurately discriminate between 30 and 50 ms. presentations, but this ability also remained constant across stimulus categories. The consistency in discriminability for real-time estimates, regardless of influences due to nontemporal variables, is predicted from models of time perception (see Allan, 1979).

The novel-incorrect stimulus group showed a lowered sensitivity to detect differences between 30 and 50 ms. rates. Evaluation of the errors in identification reflect this tendency. The error data were re-categorized in terms of the amount of similarity between the given response and the tested item (number of letter x position correct. See Table 6.5). Although, there is a tendency to label novel-incorrect words as short, sensitivity in discrimination increases as the amount of similarity increases. This pattern was not obtained with the

Table 6.4

Discrimination Analyses (d′) –

Cummulative Proportions of Time Judgment Categories
for 30 and 50 ms. Stimulus Durations

		Category Time Judgments			
		2	3	4	
Correct Critical Items	30 ms.	.79	.29	.04	
	50 ms.	.95	.68	.25	
	d′	.84	1.02	1.08	d′=.98
Correct Novel Items	30 ms.	.77	.19	.02	
	50 ms.	.92	.59	.20	
	d′	.66	1.11	1.21	d′=.99
Incorrect Critical Items	30 ms.	.56	.11	.00	
	50 ms.	.85	.46	.09	
	d′	.89	1.13	.98	d′=1.0
Incorrect Novel Items	30 ms.	.62	.14	.02	
	50 ms.	.78	.31	.06	
	d′	.46	.58	.50	d′=.51

Note: the proportions refer to the cummulative proportion of items that were assigned a category time judgment response of 4, 3 or 2 (i.e. from longest time to shortest)

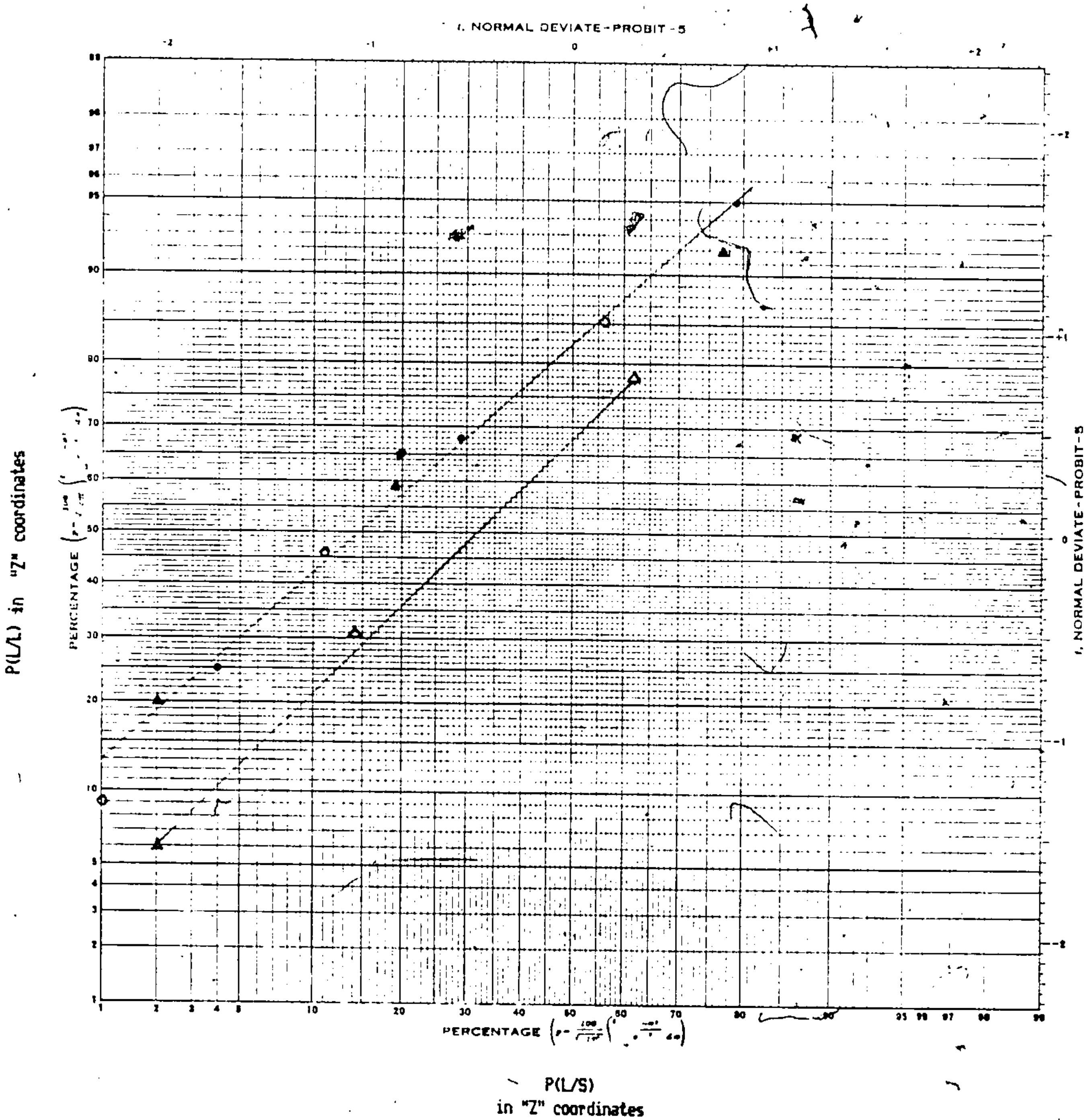

Figure 6.2 - Receiver-Operating Characteristic Curve (ROC) plotted in terms of the discrimination analyses (d')

* - P(L/L) = probability of responding "long" given a "long" (50 ms.) duration was presented
- P(L/S) = probability of responding "long" given a "short" (30 ms.) duration was presented
- all probabilities are given in terms of "Z"-scores; according to a normal distribution

<u>Table 6.5</u>

Discrimination Analyses (d′)
for Incorrectly Identified New Items

		Category Time Judgments			
		2	3	4	
0 to 3 letters x	30 ms.	.59	.12	.02	
	50 ms.	.69	.19	.03	
	d′	.28	.30	.17	d′=.25
4 or 5 letters x Items	30 ms.	.70	.18	.03	
	50 ms.	.80	.45	.11	
	d′	.65	.75	.65	d′=.69

x - letters = number of letters in common with the test item

Note: discrimination ability increase~~s as the~~ incorrect
response increases in similarity to the test item

critical-incorrect items. If no response is provided, d′ values for both critical and novel items show poor discrimination (d′=.34 and .38). A number of effects could contribute to an omitted response in this test format (which may include blinking, looking away from the stimulus, partial detection, or actual non-detection). The resulting increased proportion of guesses for time categorizations would be expected. Once some accurate information is obtained from the stimulus such that any response can be made, at 50 ms., old items show the facilitation in discriminability.

The pattern of the ROC plots illustrates the pattern of performance revealed by the mean values. The results are plotted in terms of the probability a long response was given to either a 30 or 50 ms. presentation. Correctly identified items are judged more liberally than are incorrect items, and critical items are judged more liberally than are novel items. This can be interpreted as indicating that correct items, in general, are perceived as remaining longer on the screen than incorrect items; and, similarly, previously encountered items are perceived as being longer in duration than new items. The ROC analysis shows that although time judgments vary with the different conditions, temporal discriminations between 30 and 50 ms. does not, for three of the four conditions.

Thus, subjects indeed can detect real-time differences, but in addition to maintaining this discrimination, can still be influenced by nontemporally related variables. In this study, memorial events are shown to affect perceived time durations.

4.1.3 DISCUSSION

As has been shown in the other experiments, a single prior presentation of a word during study enhances the perceptual identification of that word relative to novel items. The results also indicate that stimulus familiarity alters perceived duration judgments. The time judgment data support the phenomenological reports of subjects that some words appear to remain longer on the screen than others. Words presented during study were judged as being longer in duration than novel words. This result was found to be contingent on accuracy of identification. Correctly identified critical items were judged longer than new items. Incorrectly identified items were only differentiated between critical and novel items for the longer duration.

Further, the discrimination data provide general support for the suggestion that the ability to distinguish between real duration differences was unchanged across the nontemporal variable. The exception was the novel-incorrect stimuli for which discrimination ability was noticeably decreased. The finding, that nontemporal variables influence duration judgments but not duration discrimination, is consistent with other reports in the time perception literature (see Allan, 1979).

When the subject processes an item, to the extent that an accurate identification can be produced, there is a tendency to judge the duration as relatively long. More interesting is the finding that correctly identified repeated items are more likely to be judged long than are correct novel items. Subjects can differentiate between the two sets of words. For incorrectly identified words, the difference between repeated and novel items is found at the longer stimulus duration. The error analysis shows that novel-incorrect items tend to be labelled short. Thus, even when words are not correctly identified, temporal judgments indicate that repeated words are differentiated from novel words. There appears to be information available about whether a word is repeated or novel, even if it was not correctly identified.

The familiarity of an item is shown to increase duration estimates. The results display a pattern similar to that of Warm and McCray's (1969) results.

As with longer presentation durations (e.g. 1 second), temporal judgments for briefly presented stimuli were longer for repeated or familiar items.

In experiments investigating perceptual identification, subjects identify repeated items with a higher probability and with faster reaction times than items not previously encountered in the study session. Jacoby and Dallas (1981) have described this benefit in performance as demonstrating perceptual fluency. As with several "automatic" behaviours (e.g. driving a car), actions that at one time were very slow and deliberate, become smoother, more coordinate, and "fluent" through repeated experience. On each subsequent occasion, this fluency can be judged in terms of the performance or processing "relative to" the prior occurrence of that action, or to a novel experience of some other action. Judged relative fluency could, therefore, indicate whether or not an action is a familiar or novel experience; and has been purported to be one of the components contributing to a recognition decision.

Recognition can be derived from processing different kinds of information. It could rely on contextual information necessary for reinstatement of the original event. Alternatively, it could be based on a fluency "heuristic" which results from efficient processing of perceptual information. The fact that recognition can at times be encouraged to rely on these various sources of information may provide an explanation for the differential relationships between reflective and tacit memory tasks observed in Chapters Two and Three. Much of this proposal rests on the suggestion that subjects are able to judge the relative fluency of processing information. The only indication of this was the voluntary subjective reports of the phenomenal presentation of the stimuli in a tachistoscopic task. Subjects often stated that some items "remained on the screen longer" allowing them more time to read/identify the word. The results of differentially judging the temporal aspects of the stimuli found in this experiment coincide with their subjective impression. The pattern of results is consistent with the view that fluency is facilitated by one's prior experience and that the relative fluency with which an item is processed can be judged by the individual. In this case, fluent processing results in the phenomenological impression that items are available on the screen for a longer period of time. That is, correctly-identified items are judged as being presented for temporally longer intervals than items not identified (or processed) accurately; and perceived duration of repeated items is longer than items that have not been previously encountered, even when novel items are fully processed.

4.2 SUMMARY OF FLUENCY JUDGMENTS

The results of this experiment suggest that subjects can detect changes in the processing of information. This ability is correlated with the memorial status of the item; old items are consistently differentiated from novel items. This finding lends support to claims made regarding judged relative fluency as a basis for recognition. Repeated material is more readily and rapidly identified (e.g. Jacoby and Dallas, 1981). If the subject could assess the ease with which an item is processed, then he/she could accurately attribute this facilitation to the prior occurrence of the event. Evidence that subjects can detect changes in stimuli which are directly correlated with repeated presentations is provided by this study. The notions regarding the judgment of fluency advocated by Jacoby and Dallas (1981), therefore, have some empirical basis. Further, obtaining support for these views is beneficial, since it allows one to examine this account as an an appropriate description of the differential relationships observed between measures of memory.

- CHAPTER FIVE -

GENERAL DISCUSSION

The experimental results can briefly be summarized as follows. A dissociation is clearly evidenced by the independence found in Experiments One, Two and Three. The results support the suggestion that the dissociation is, in fact, a robust and typical memory phenomenon. It may be inferred that these results implicate the existence of two or more memory systems - and some theoretical positions would support such a claim. However, a differential processing argument can also be submitted as a possible account of the effect. Adopting this view led to designing of the last three experiments. By manipulating the informational status of the tasks being investigated, dependent results were observed in Experiments Four and Five; and a potential description of the means by which different sources of information could be used to allow for the correlation to emerge was identified in Experiment Six.

In this chapter, the possible theoretical interpretations of the results will be reviewed. Generally, as pointed out in the introduction, there are three positions which could account for the dissociation phenomenon as classically observed in amnesic behaviour. These have globally been referred to as the differential sensitivity argument, multi-memory systems view and the differential processing position. These accounts will be discussed in light of the experimental results reported in this thesis. Both the differential sensitivity and multi-systems view have difficulty reconciling the different relationships observed. The processing position, however, is compatible with the empirical findings. Although, indeed, this latter account may not be a definitive and conclusive answer to the understanding of memory phenomena, it is considered to be a useful framework within which to continue interesting explorations which may not otherwise be pursued.

5.1.1 THE CLASSIC DISSOCIATION

Organic amnesics display a perplexing dichotomy in memory abilities. Amnesics, by definition are not able to acknowledge the occurrence of a prior event. However, they can display the influence of memory on later behaviour, if memory is measured in appropriate ways. This dissociation in performance is not simply a reflection of the difference between motor and cognitive skills. Suggestive results of a similar dissociation in other populations (e.g. functional amnesics) involving behaviours which are not readily distinguished on these grounds, tend to disavow this explanation. Further, the first experiment provided evidence that amnesics could display this classic dissociation between preserved and impaired memory skills using verbal materials.

The primary factor in obtaining evidence for preserved memory in amnesics seems to rely on the manner in which the memory is assessed. If amnesics are required to deliberately retrieve a specific prior event in order to be successful in the memory task, they are unable to display evidence of memory. If they are simply asked to perform some skill, they can display memorial influences in their behaviour (e.g. spelling). Clear evidence can be provided that demonstrates that the amnesic is "remembering" in this latter case, since the skilled performance can often be attributed to a specific prior experience. For example, in the first experiment, amnesics were simply asked to spell some items - a task they could readily perform at whether or not the "study" phase had been included. However, the specificity of a memory influence was evidenced by the spelling bias produced for homophones that were previously disambiguated.

The dissociation seems to be between the reflective and tacit nature of the task. "Recognition", a traditional measure of memory, typically stresses the reflective component. For amnesics, this is an inappropriate method for evaluating their memory abilities.

5.1.2 EXPLAINING AMNESIC BEHAVIOUR

One account for the amnesics contrasting performance in memory is that the reflective memory tasks are less sensitive measures than are tasks which assess on-line performance (tacit memory measures). The amnesic is unwilling or unable to intentionally retrieve previously learned material (perhaps due to motivational differences or strategical differences as a result of brain damage). Tacit memory measures, however, are able to bypass this constraint. A differential sensitivity explanation is particularly convincing, if one considers the amnesic patient's passive attitude and insistence of naivity and denial whenever a memory question is proposed.

A second account for this dissociation in memory ability presumes the existence of two or more memory systems. This position explains the amnesic's behaviour by suggesting that the system responsible for reflective memory has essentially been destroyed due to physiological brain damage. Some "other" memory system, however, has remained intact. Since recognition tasks assess this reflective system, amnesics cannot display memory abilities. Tacit memory measures, however, assess skill performance, and, as such, amnesics display preserved memory.

A third view suggests that one need not postulate the existence of more than one memory. There may be a unitary memory system, but it may be accessed in different ways depending on the processing engaged by information used in the task. In this vein, reflecting on an event may typically involve processing a different type of information than that used to allow for memory influences in on-line performance. For example, investigators have identified two sources of information which can contribute to a recognition decision - either reinstatement of context for the original event or use of perceptual information. The former is the preferred method for acknowledging a prior occurrence. However, if this information is unavailable, perceptual information can be sufficient to allow for recognition. The tacit memory measures are viewed as typically reliant on interpreting perceptual information, since the task simply requests one to react to the situation - engaging processing in order to retrieve the context of the prior event is not a requirement. The dissociation displayed by the amnesic reflects the inadequacy or inability of the patient to deliberately retrieve this type of information. They are, however, able to demonstrate preserved memory through processing perceptual information.

The appropriate description for the dissociation cannot be evaluated with amnesic populations, since the patients will always perform poorly on reflective memory tasks. However, if these arguments are applicable to memory performance in general, then implications derived from each of the positions can be examined with subjects having normal memory capabilities.

5.1.3 PREDICTIONS FOR INDEPENDENCE

The alternative accounts of the dissociation have different predictions for the relationships which would be observed between reflective and tacit memory tasks tested with normal subjects. A sensitivity argument would suggest that a dependent relationship between the memory measures is expected. Performance on a tacit memory task may not predict recognition performance, however success on the recognition task should guarentee successful performance on tacit memory measures. In addition, a memory relevant variable which affects performance on one of these tasks should not differentially affect performance on the other.

The multi-memory systems view argues that since the two memory tasks access two different memory systems, complete independence between the measures should invariably be observed. There would be no predictive relationship between the measures, and variables that affect one measure would not be expected to affect the other measure in a similar fashion (Tulving, 1983).

Finally, the differential processing account would suggest that variable relationships should be obtained between the tasks dependent on the type of information processed. Since the tasks typically make use of different kinds of information, independence between the measures should be typically observed. However, since recognition can also make use of perceptual information, dependent relationships should be obtainable.

5.2 NORMAL MEMORY AND DISSOCIATION

The experiments reported in this thesis concentrated on examining the behaviour of normal memory subjects. It is assumed that the dissociation in memory performance is not simply attributable to brain damage or some other artifact in amnesic behaviour. Normal memory performance, then, is a useful medium through which to disentangle the differential predictions of the three possible accounts for dissociation. Persons with normal memory capabilities are not as restricted as amnesics to behaving in only one possible fashion.

5.2.1 INDEPENDENCE BETWEEN MEMORY MEASURES

The results from Chapter Two provided ample evidence that complete independence between the measures is obtained. Performance on the tacit memory measures of spelling behaviour in Experiment One and perceptual identification in Experiment Two was not predictive of or predicted by performance on recognition.

Instead, clear stochastic independence between the response measures was observed in both tasks and with amnesic and normal subjects. The relationship did not vary with changing levels of performance obtained on the tasks (Experiment Two). Further, independence was observed by a cross-over interaction in Experiment Three. Performance on recognition was differentially affected by studying an item with a semantically-related context as compared to performance in the word completion task. Whereas, context was useful for later recognition accuracy, it was not useful for the ability to solve word fragments.

The clear independence between the two tasks is incompatible with a differential sensitivity argument. It is not the case that the tacit memory measure is more capable of assessing memory performance than tests of recognition, rather it simply assesses memory in a different way.

5.2.2 DEPENDENCE BETWEEN MEASURES OF MEMORY

The multi-systems account would not predict a dependent relationship between the memory measures. The differential processing account would suggest that such results can be contrived, if indeed, the type of information used in the task is the important factor to consider and not the task itself. In Chapter Three, dependent relationships between the measures were observed. These findings were obtained when comparing the same tasks that were used in the second chapter which demonstrated independence (i.e. recognition versus spelling or perceptual identification). Clearly, the task itself is not the only, or even primary, source of the independence results - as is suggested by those promoting a multi-systems account.

These results are compatible with a processing account of the dissociation. A single memory system is assumed, and the differential processing of information predicts the changes in performance. In Experiment Four, test material was chosen that would necessarily reduce the type of information that was available. Pronounceable pseudowords which had no definitive meaningful referents were used. Recognition of these items would rely much more on the visual familiarity of these items. Perceptual identification of these items would also rely on the amount of visual analysis performed. If it is the information used in the task situation, and not the task per se that is important, then if the perceptual information was sufficient to access the memory episode in one case, it should continue to be adequate in the other situation. Thus, a dependency between the measures would be predicted and was found. In Experiment Five, the two memory measures were again made to rely on the same type of information. In this case, information which is used to reinstate the original event was emphasized (e.g. contextual, organizational and associative information). Again, a dependency was observed between the measures.

The multi-memory systems view would never have predicted these results which show that manipulations in the instructions and the available information produce dependent relationships. These changes in relationships are predicted by the processing view.

5.3 DIFFERENTIAL PROCESSING

In order for the processing view to be an appropriate description for the variable relationships observed, it has been argued that recognition can make use of various kinds of information. "Recognizing" can occur through the respecification of the original occurrence; recognizing can also be achieved through use of perceptual information. The manner in which this memory result is measured, will emphasize the different types of information to be relied upon. Evidence for these different kinds of information has been theorized by several investigators (e.g. Juola and Atkinson, 1973; Mandler, 1980; Jacoby and Dallas, 1981). In order to apply this to the dissociation, however, one first must address assumptions of this position. The first assumption is that perceptual information, like respecification information, relies on memory for single prior episodic representations, and therefore can be described within a unitary memory system. The second assumption is that the "dissociation" in memory performance arises due to the difference between respecification of an event - a deliberate retrieval attempt and the memory influence of rapidly processing perceptual information. Finally, it is assumed that the reflective memory task of recognition typically encourages the use of respecification for a response to be provided; whereas, the tacit memory measures typically rely on the fluent processing of perceptual information - but that either type of information could influence the behavioural outcome on the two tasks.

7.3.1 THE ASSUMPTIONS

Perceptual information, like respecification information, relies on memory for single prior episodes. Evidence in support of this assumption can be provided by studies which describe effects of specific facilitation as measured by perceptual identification for words (e.g. Experiments Two; Jacoby and Dallas, 1981, Jacoby, 1983a; Jacoby, 1983b) and pseudowords (e.g. Experiment Four; Feustal et.al., 1983), and reading latentcies for inverted text (e.g. Kolers, 1974). Each of these tasks clearly involve the analysis of visual information, and all demonstrate enhanced performance (higher probability of accuracy) for items that were specifically viewed in a preliminary study phase over experimentally novel items. In a recognition task, the subject is specifically asked about prior episodic information and to (re)specify the occurrence of some event. In both cases, memory for specific instances influences the performance outcomes. It would seem most parsimonious to describe the common use of a prior episodic event within the confines of a unitary memory system.

Some investigators, however, prefer to categorize memory in light of these results (Tulving and Schacter, 1982). They argue that although the results demonstrate that both types of tasks display an influence of memory for prior episodes, because the tasks show independence, they still must involve different memory systems. In fact, at last count, there were "four" separate memory systems to contend with (Tulving, 1983, p.105). This multiplication of systems is a means of dealing with specificity and independence at the same time and, therefore, remains a viable explanation for the results. However, there is at least one philosophical tradition which reasons that in the event of two explanations of a phenomenon, the more parsimonious description would be preferred. "We are to admit no more causes of natural things than such as are both true and sufficient to explain their appearances" (Issac Newton, 1846 - from Smith and Grene, 1940). In addition, the fact that the position would not have predicted the dependent relationships that were also obtained tends to question its usefulness.

The view that a single memory system processes different types of information accounts for the dissociation phenomenon by suggesting that in the two tasks, different types of information are predominantly being used. It is this which produces the independent access of a memory event between the memory measures. Deliberate retrieval of a prior memory is independent of access to that memory by a perceptual means. Whereas respecification of an event encourages the subject to assess and confirm the evidence of contextual and organizational information in order to assert an event's prior occurrence; perceptual information is processed in a "run off" fashion. Prior experience with a similar event will aid in the more fluent processing of a later event. Memory essentially assists processing of similar perceptual events, and does so in a fashion which does not require deliberate retrieval of that memory.

However, at times, the fluent processing of this information may be an event that the subject can detect. One may be able to assert a recognition decision based on this phenomenological impression. If the subject can judge that an event was relatively easily processed, he/she may infer that the event must be a familiar situation and has been encountered before. This suggestion could account for the results in Experiment Four. Recognition decisions were arrived at with test material which essentially required the visual processing of the letter constituents. A decision can be based on a evaluation of processing the perceptual information. This notion receives support from the results of Experiment Six. Subjects phenomenologically perceive differences between stimuli, and this performance is contingent on their prior experience with that event.

5.3.2 ALTERNATIVES.

The processing account of memory is compatible with the results obtained in this thesis. The other theoretical views were not found to predict the variable relationships obtained between the two measures of memory. Nonetheless, one would want to consider whether these other accounts could be modified in some way which would incorporate the findings reported.

Consider the differential sensitivity argument which cannot account for the stochastic independence between the measures. One might argue that no relationship between the measures was obtained in the first three studies with normals because the differential sensitivity notion is only applicable to patients with unique memory deficits. However, the stochastic independence relationship obtained [illegible] the amnesic results would suggest that this view is still not viable. On the [illegible]ions that amnesics did report an "old" item in response to the recogniti[illegible]task, it remained unpredictive of performance on the supposed more sensitive spelling measure of memory. Even though normals may not be an appropriate comparison for understanding abnormal behaviour, the sensitivity argument is not able to deal with the amnesic results.

The multi-systems view predicted the independence results, but would have never predicted the finding of dependence. This is primarily due to the assertion that the tasks are identified as measures which access each of the memory systems. Since the memories they access are separate, then the measures would reflect this independence. One might assume, however, that under conditions in which the type of information has been constrained, the two systems may show similar patterns in behaviour, since they are both reliant on limited information. Similar patterns in behaviour (i.e. mean performance levels), however, do not imply the dependent or predictive relationship of the access of one memory representation of an item and a subsequent access to another memory representation of the same event. One would have to predict that information sufficient to access a particular event from one system will access the identical memory knowledge from another system which contains a different representation of that event. This would seem to be a questionable possibility. Further, by this prediction, it is clear that the information employed by memory becomes the primary factor to consider, rather than the tasks themselves. By stressing the importance that information provides in determining the variable relationships, this argument now appears very similar to the differential processing account.

5.3.3 REMAINING QUESTIONS

The processing account seems to have identified an important factor for consideration in understanding the relationships between memory measures. Questions still remain. For example, how many memory representations of an event exist. It is certain that the memory measures in the studies ~~reported each~~ are attributable to the influence of a single prior experience. Perhaps there is only one representation of this memory experience (unitary memory) or there are different memories representing this event. Given that the multi-systems account is willing to assert the role information plays, then either one or more systems can be presented as a plausible account for the results. It would seem that "in the final analysis, whether one prefers an explanation couched in terms of a <unitary or multi memory system view>...is a matter of intellectual taste and scientific style. As long as we are limited to psychological methods, the issue <at this time> cannot be decided on empirical grounds" (Tulving, 1983, p.83).

Further, unfortunately the predictive strength of this position is unclear. Although an account which stresses the importance of information does predict that variable relationships can be observed between measures of memory, it is not clear whether one can always predict the relationships a priori, given a novel situation. For example, Begg and his colleagues (Bacon, 1979; Harris, Begg and Mitterer, 1980) have obtained dependent relationships between tacit memory measures of frequency estimation or validity ratings and recognition performance. The fact that this relationship could occur is clearly in line with a differential processing approach. The problem is whether one could have predicted that these tasks would employ the same (dependence) or different information (independence), given only a description of the tasks to be performed. For frequency estimation, one might have expected the dependent relationship, since the task was for the subject to judge how often an item occurred previously - clearly, reference to the earlier study was important. For truth ratings, however, the task was simply to rate how "true" a statement was. In this case, without a good understanding of what this task entails, one may have predicted independence. A better understanding of the particular task requirements involved, clearly, is needed.

5.3.4 CONCLUDING REMARKS

The dissociation phenomenon has implications for current memory research. One implication is that alternative measurements of memory are important for consideration. Traditional reflective memory tasks, such as recognition and recall, are inadequate for appropriately assessing the amnesic's memory abilities. For a more complete understanding of the amnesic disorder, and normal memory processing, measures that allow analyses of both abilities and deficits are necessary. Further, a differential processing approach to the empirical findings could have implications for memory disordered populations. Although with these patients, the aware-related abilities are disrupted, given that at times subjects can be sensitive to fluent processing of perceptual events, perhaps therapeutic techniques based on conditioning could be devised. The patient perhaps could be conditioned to react "as if they know" something has occurred before, when they detect some reliable change in stimulus processing. Finally, the results of these studies have contributed to an understanding of memory functioning. Task analyses of memory measures seem to be very important for interpreting controversies in memory research (e.g. the comparative work between animal and human research). The use of tasks, other than those traditionally employed, have shaped the way in which researchers must think about memory. Clearly, informational constraints are reflected by the different applications of these measures, which may have not otherwise been as obvious with the traditional reflective memory paradigms. Whether the answer is directed at postulating more memory systems or not, one must incorporate the obtained results into his/her framework of memory function: the dissociable properties observed between different measures of memory implicate the differential processing of cognitive behaviour.

Reference Note

1. Hayman, G. A task analysis of lexical decision. Ph.D. dissertation, McMaster University, 1983.

References

Adams, R.D. Intervening stimulus effects on category judgments of duration. Perception and Psychophysics, 1977, 21, 527-534.

Allan, L.G. The perception of time. Perception and Psychophysics, 1979, 26, 340-354.

Anderson, J.R., and Ross, B.H. Evidence against a semantic-episodic distinction. Journal of Experimental Psychology: Human Learning and Memory, 1980, 6, 441-466.

Atkinson, R.C., and Juola, J.F. Factors influencing speed and accuracy of word recognition. In S. Kornblum (Ed.), Attention and performance IV. New York: Academic Press, 1973.

Avant, L.L., and Lyman, P.J. Stimulus familiarity modifies perceived duration in prerecognition visual processing. Journal of Experimental Psychology: Human Perception and Performance, 1975, 1, 205-213.

Avant, L.L., Lyman, P.J., and Antes, J.R. Effects of stimulus familiarity upon judged visual duration. Perception and Psychophysics, 1975, 17, 253-262.

Bacon, F.T. Credibility of repeated statements: Memory for trivia. Journal of Experimental Psychology: Human Learning and Memory, 1979, 5, 241-252.

Baddeley, A. Amnesia: A minimal model and an interpretation. In L.S. Cermak (Ed.), Human memory and amnesia. Hillsdale: Erlbaum, 1982.

Bahrick, H.P. Two-phase model for prompted recall. Psychological Review, 1970, 77, 215-222.

Begg, I. Trace loss and the recognition failure of unrecalled words. Memory and Cognition, 1979, 7, 113-123.

Bergson, H.L. Matter and memory. translation by N.M. Paul and W.C. Palmer. London: George Allen, 1910.

Bishop, Y.M., Feinberg, S.E., and Holland, P.W. Discrete multivariate analysis: Theory and practice. Cambridge: MIT Press, 1975.

Brierley, J.B. Neuropathology of amnesic states. In C. Whitty and O. Zangwill, (Eds.), Amnesia: Clinical, psychological and medicolegal aspects. London: Butterworths, 1977.

Brooks, D.N., and Baddeley, A.D. What can amnesic patients learn? Neuropsychologia, 1976, 14, 111-122.

Brooks, L.R. Non-analytic concept formation and memory for instances. In E. Rosch and B. Lloyd, (Eds.), Cognition and categorization. Hillsdale: Erlbaum, 1978.

Bruner, J.S. Modalities of memory. In G.A. Talland and N.C. Waugh (Eds.), The pathology of memory. New York: Academic Press, 1969.

Carroll, M., and Kirsner, K. Context and repetition effects in lexical decision and recognition memory. Journal of Verbal Learning and Verbal Behavior, 1982, 21, 55-69.

Castellan, J. On the partitioning of contingency tables. Psychological Bulletin, 1965, 64, 330-338.

Cermak, L.S., Lewis, R., Butters, N., and Goodglass, H. Role of verbal mediation in performance of motor tasks by Korsakoff patients. Perceptual and Motor Skills, 1973, 37, 259-262.

Claparede, E. Recognition et moitie. Archives of Psychology Geneve, 1911, 11, 79-90.

Cohen, N. Amnesia and the distinction between procedural and declarative knowledge. In N. Butters and L.R. Squire (Eds.), The neuropsychology of memory. New York: Guilford Press, 1983.

Cohen, N.J., and Squire, L.R. Preserved learning and retention of pattern-analyzing skill in amnesia: Dissociation of knowing how and knowing that. Science, 1980, 210, 207-210.

Corkin, S. Tactually guided maze-learning in man: Effects of unilateral cortical excisions and bilateral hippocampal lesions. Neuropsychologia, 1965, 3, 339-351.

Corkin, S. Acquisition of motor skill after bilateral medial temporal-lobe excision. Neuropsychologia, 1968, 3, 255-265.

Correll, R.E., and Scoville, W.B. Performance on delayed match following lesions of medial temporal lobe structures. Journal of Comparative and Physiological Psychology, 1965, 60, 360-367.

Craik, F.I.M., and Lockhart, R.S. Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 671-684.

Devane, J.R. Word characteristics and judged duration for two response sequences. Perception and Psychophysics, 1974, 38, 525-526.

Donaldson, W. Context and repetition effects in recognition memory. Memory and Cognition, 1981, 9, 308-316.

Erwin, D.E. Further evidence for two components in visual persistence. Journal of Experimental Psychology: Human Perception and Performance, 1976, 2, 191-209.

Feustel, T.C., Shiffrin, R.M., and Salasoo, A. Episodic and lexical contributions to the repetition effect in word identification. 1983, in press.

Flexser, A.J. Homogenizing the 2 x 2 contingency table: A method for removing dependencies due to subject and item differences. Psychological Review, 1981, 88, 327-339.

Flexser, A.J., and Tulving, E. Retrieval independence in recognition and recall. Psychological Review, 1978, 85, 153-171.

Franks, J.J., Plybon, C.J., and Auble, P.M. Units of episodic memory in perceptual recognition. Memory and Cognition, 1982, 10, 62-68.

Gaffan, D. Recognition impaired and association intact in the memory of monkeys after transection of the fornix. Journal of Comparative and Physiological Psychology, 1974, 86, 1100-1109.

Gaffan, D. Monkeys' recognition memory for complex pictures and the effect of fornix transection. Quarterly Journal of Experimental Psychology, 1977, 29, 505-514.

Galbraith, G.G., and Taschman, C.S. Homophone units: A normative and methodological investigation of the strength of component elements. Journal of Verbal Learning and Verbal Behavior, 1969, 8, 737-744.

Gardner, H. The shattered mind. New York: Random House, 1974.

Goldstone, S., and Goldfarb, J.L. Judgment of filled and unfilled durations: Intersensory factors. Perception and Psychophysics, 1963, 17, 763-774.

Graf, P., Squire, L.R., and Mandler, G. Amnesic patients perform normally on one kind of memory test for previously presented words. 1983, in press.

Green, D.M., and Swets, J.A. Signal detection theory and psychophysics. New York: Wiley, 1966.

Harris, G., Begg, I., and Mitterer, J. On the relation between frequency estimates and recognition memory. Memory and Cognition, 1980, 8, 99-104.

Harrison, R. Principles of internal medicine. New York: Grune and Stratton, 1972.

Hilgard, E.R. Divided conciousness: Multiple controls in human thought and action. New York: Wiley, 1977.

Hilgard, E.R., and Cooper, L.M. Spontaneous and suggested posthypnotic amnesia. International Journal of Clinical and Experimental Hypnosis, 1965, 13, 261-273.

Hintzman, D.L. Simpson's Paradox and the analysis of memory retrieval. Psychological Review, 1980, 87, 398-410.

Horel, J.A., and Misantone, L.G. Visual discrimination impaired by cutting temporal lobe connections. Science, 1976, 193, 336-338.

Hull, C.L. Hypnosis and suggestibility: An experimental approach. New York: Appleton-Century-Crofts, 1933.

Humphreys, M.S. Item and relational information: A case for context independent retrieval. Journal of Verbal Learning and Verbal Behavior, 1978, 17, 175-187.

Humphreys, M.S., and Bowyer, P.A. Sequential testing effects and the relationship between recognition and recognition failure. Memory and Cognition, 1980, 8, 271-277.

Huppert, F.A., and Piercy, M. Recognition memory in amnesic patients: Effects of temporal context and familiarity of material. Cortex, 1976, 12, 3-30.

Iverson, S.D. Do hippocampal lesions produce amnesia in animals? International Review of Neurobiology, 1976, 19, 1-49.

Jacoby, L.L. Perceptual enhancement: Persistent effects of an experience. Journal of Experimental Psychology: Learning, Memory, and Cognition, 1983, 9, 21-38.

Jacoby, L.L. Remembering the data: Analyzing interactive processes in reading. Journal of Verbal Learning and Verbal Behavior, 1983, 22, in press.

Jacoby, L.L., and Dallas, M. On the relationship between autobiographical memory and perceptual learning. Journal of Experimental Psychology: General, 1981, 3, 306-340.

Jacoby, L.L., and Witherspoon, D. Remembering without awareness. Canadian Journal of Psychology, 1982, 36, 300-324.

Juola, J.F., Fischer, I., Wood, C.T., and Atkinson, R.C. Recognition time for information stored in long-term memory. Perception and Psychophysics, 1971, 10, 8-14.

Kihlstrom, J.E. Posthypnotic amnesia for recently learned material: Interactions with "episodic" and "semantic" memory. Cognitive Psychology, 1980, 12, 227-251.

Kihlstrom, J.E., and Evans, F.J. Recovery of memory after posthypnotic amnesia. Journal of Abnormal Psychology, 1976, 85, 564-569.

Kihlstrom, J.F., and Evans, F.J. (Eds.), Functional disorders of memory. Hillsdale: Erlbaum, 1979.

Kinsbourne, M., and Wood, F. Short-term memory processes and the amnesic syndrome. In D. Deutsch and A.J. Deutsch (Eds.), Short-term memory. New York: Academic Press, 1975.

Kintsch, W. Models for free recall and recognition. In D.A. Norman (Ed.), Models of human memory. New York: Academic Press, 1970.

Kintsch, W. Memory representations of text. In R.L. Solso (Ed.), Information processing and cognition. Hillsdale: Erlbaum, 1975.

Kolers, P.A. Two kinds of recognition. Canadian Journal of Psychology, 1974, 28, 51-61.

Kolers, P.A. Specificity of operations in sentence recognition. Cognitive Psychology, 1975, 7, 289-306.

Kolers, P.A. Reading a year later. Journal of Experimental Psychology: Human Learning and Memory, 1976, 3, 554-565.

Korsakoff, S.S. Etude medico psychologique sur une forme des maladies de la memoire. Revue Philosophique, 1889, 28, 501-530.

Kunst-Wilson, W.R., and Zajonc, R.B. Affective discrimination of stimuli that cannot be recognized. Science, 1980, 207, 557-558.

Lashley, K.S. In search of the engram. Society of Experimental Biology Symposium No. 4: Physiological mechanisms in animal Behaviour. Cambridge: Cambridge University Press, 1950.

Lhermitte, F., and Signoret, J. Analyse neuropsychologique et differenciation des syndromes amnesques. Revue Neurologique Paris, 1972, 126, 161-178.

Lockhart, R.B. The albino rat: A defensible choice or bad habit. American Psychologist, 1968, 23, 734-742.

Long, G.M., and Beaton, R.J. The effects of spatial frequency and target type on perceived duration. Perception and Psychophysics, 1980a, 28, 413-421.

Long, G.M., and Beaton, R.J. The contribution of visual persistence to the perceived duration of brief targets. Perception and Psychophysics, 1980b, 28, 422-430.

MacCurdy, J.T. Common principles in psychology and physiology. Cambridge: Cambridge University Press, 1928.

Mandler, G. Organization and recognition. In E. Tulving and W. Donaldson, (Eds.), Organization of memory. New York: Academic Press, 1972.

Mandler, G. Recognizing: The judgment of previous occurrence. Psychological Review, 1980, 87, 252-271.

Mandler, G., Pearlstone, Z., and Koopmans, H.S. Effects of organization and semantic similarity on recall and recognition. Journal of Verbal Learning and Verbal Behavior, 1969, 8, 410-423.

Mandler, G., and Rabinowitz, J. Appearance and reality: Does a recognition test really improve subsequent recall and recognition? Journal of Experimental Psychology: Human Learning and Memory, 1981, 7, 79-90.

McKoon, G., and Ratcliff, R. Priming in episodic and semantic memory. Journal of Verbal Learning and Verbal Behavior, 1979, 18, 463-480.

Medin, D.L., and Schaffer, M.M. Context theory of classification learning. Psychological Review, 1978, 85, 207-238.

Meudell, P., and Mayes, A. The Claparede phenomenon: A further example in amnesics, a demonstration of a similar effect in normal people with attenuated memory, and a reinterpretation. Current Psychological Research, 1981, 1, 75-88.

Milner, B., Corkin, S., and Teuber, H. Further analysis of the hippocampal amnesic syndrome. Neuropsycologia, 1968, 6, 215-234.

Mishkin, M. Visual discrimination performance following partial ablations of the temporal lobe: II. Ventral surface vs. hippocampus. Journal of Comparative and Physiological Psychology, 1954, 47, 187-193.

Mishkin, M. Memory in monkeys severely impaired by combined but not by separate removal of amygdala and hippocampus. Nature, 1978, 273, 297-298.

Mooreland, R.L., and Zajonc, R.B. Is stimulus recognition a necessary condition for the occurrence of exposure effects? Journal of Personality and Social Psychology, 1977, 35, 191-199.

Moscovitch, M. Multiple dissociations of function in the amnesic syndrome. In L.S. Cermak (Ed.), Human memory and amnesia. Hillsdale: Erlbaum, 1982.

Moscovitch, M. A neuropsychological approach to perception and memory in normal and pathological aging. In F.I.M. Craik and S. Trehub (Eds.), Aging and cognitive processes. New York: Plenum Press, 1982.

Murrell, G.A., and Morton, J. Word recognition and morphemic structure. Journal of Experimental Psychology, 1974, 102, 963-968.

Nelson, T.O. Detecting small amounts of information in memory: Savings for nonrecognized items. Journal of Experimental Psychology: Human Learning and Memory, 1978, 4, 453-468.

Newton, I. Newton's Principia: The mathematical principles of natural philosophy. translation by A. Motte. New york, 1846.

Nisbett, R.E. and Wilson, T.D. Telling more than we can know: Verbal reports on mental processes. Psychological Review, 1977, 84, 231-259.

O'Brien, R., and Chafetz, M. The Encyclopedia of alcoholism. New York: Green Spring Inc., 1982.

O'Keefe, J., and Nadel, L. The hippocampus as a cognitive map. London: Oxford University Press, 1978.

Oscar-Berman, M. Hypothesis testing and focusing behaviour during concept formation by amnesic Korsakoff patients. Neuropsychologia, 1973, 11, 191-198.

Penfield, W. The permanent record of the stream of consciousness. Proceedings of the 14th International Congress of Psychologists. North-Holland Publishing Co., 1954.

Rabinowitz, J., Mandler, G., and Barsalou, L.W. Recognition failure: Another case of retrieval failure. Journal of Verbal Learning and Verbal Behavior, 1977, 16, 639-663.

Rozin, P. The psychobiological approach to human memory. In M.R. Rosenzweig and E.L. Bennett, (Eds.), Neural mechanisms of learning and memory. Cambridge: M.I.T. Press, 1976.

Scarborough, D., Cortese, C., and Scarborough, H. Frequency and repetition effects in lexical memory. Journal of Experimental Psychology: Human Perception and Performance, 1977, 3, 1-17.

Schacter, D., and Tulving, E. Memory, amnesia, and the episodic/semantic distinction. In R.L. Isaacson and N.E. Spear (Eds.), The expression of knowledge. New York: Plenum Press, 1982.

Schacter, D., Wang, P., Tulving, E., and Freedman, M. Functional retrograde amnesia: A quantitative case study. Neuropsychologia, 1982, 20, 523-532.

Schiffman, H.R., and Bobko, D.J. The role of number and familiarity of stimui in the perception of brief temporal intervals. American Journal of Psychology, 1977, 90, 85-93.

Scoville, W.B., and Milner, B. Loss of recent memory after bilateral hippocampal lesions. Journal of Neurology, Neurosurgery and Psychiatry, 1957, 20, 11-21.

Seltzer, B., and Benson, D.F. The temporal pattern of retrograde amnesia in Korsakoff's disease. Neurology, 1974, 24, 527-530.

Shoben, E.J., Wescourt, K.T., and Smith, E.E. Sentence verification, sentence recognition, and the semantic-episodic distinction. Journal of Experimental Psychology: Human Learning and Memory, 1978, 4, 304-317.

Simpson, E.H. The interpretation of interaction in contingency tables. Journal of the Royal Statistical Society, 1951, 13, 238-241.

Smith, T.V., and Grene, M. From Descartes to Locke. Chicago: University of Chicago Press, 1940.

Squire, L.R. Two forms of human amnesia: An analysis of forgetting. Journal of Neuroscience, 1981, 1, 635-640.

Squire, L.R. Human memory: Neuropsychological and anatomical aspects. Annual Review of Neuroscience, 1982, 5, 241-273.

Squire, L.R., and Cohen, N.J. Remote memory, retrograde amnesia, and the neurophysiology of memory. In L. Cermak, (Ed.), Human memory and amnesia. Hillsdale: Erlbaum, 1982.

Squire, L.R., and Moore, R.V. Dorsal thalamic lesion in a noted case of chronic memory dysfunction. Annals of Neurology, 1979, 6, 503-506.

Squire, L.R., and Slater, P.C. Anterograde and retrograde memory impairment in chronic amnesia. Neuropsychologia, 1978, 16, 313-322.

Squire, L.R., and Zola-Morgan, S. The neurology of memory: The case for correspondence between the findings for man and non-human primate. In J.A. Deutsch (Ed.), The physiological basis of memory. 1983, in press.

Starr, A., and Phillips, L. Verbal and motor memory in the amnesic syndrome. Neuropsychologia, 1970, 8, 75-88.

Talland, G. Deranged memory. New York: Academic Press, 1965.

Teuber, H., Milner, B., and Vaughan, H.G. Persistent anterograde amnesia after stab wound of the basal brain. Neuropsychologia, 1968, 6, 267-282.

Thomas, E.A.C., and Cantor, N.E. Interdependence between the processing of temporal and non-temporal information. In J. Requin, (Ed.), Attention and performance VII. New Jersey: Erlbaum, 1978.

Thorndike, E.L., and Lorge, I. The teacher's word book of 30,000 words. New york: Columbia University, 1944.

Tschersich, A. Clinical course and prognosis of the Korsakoff syndrome in alcoholics: 55 self observations. Fortschritte Neurologie, Psychiatrie und ihrer Grenzgebiete, 1978, 46, 519-563.

Tulving, E. Episodic and semantic memory. In E. Tulving and W. Donaldson, (Eds.), Organization of memory. New York: Academic Press, 1972.

Tulving, E. Elements of episodic memory. New York: Oxford University Press, 1983.

Tulving, E., Schacter, D.L., and Stark, H.A. Priming effects in word-fragment completion are independent of recognition memory. Journal of Experimental Psychology: Learning, Memory and Cognition, 1982, 8, 336-342.

Tulving, E., and Thompson, D.M. Encoding specificity and retrieval processes in episodic memory. Psychological Review, 1973, 80, 352-373.

Tulving, E., and Wiseman, S. Relation between recognition and recognition failure of recallable words. Bulletin of the Psychonomic Society, 1975, 6, 79-82.

Victor, M., Adams, R.D., and Collins, G.H. In F. Plum and F.H. McDowell, (Eds.), The Wernicke-Korsakoff syndrome. Philadelphia: F.A. Davis Co., 1971.

Warm, J.S., Greenburg, L.F., and Dube, C.S. Stimulus and motivational determinants in temporal perception. Acta Psychologica, 1976, 40, 489-493.

Warm, J.S., and McCray, R.E. Influence of word frequency and length on the apparent duration of tachistoscopic presentations. Journal of Experimental Psychology, 1969, 79, 56-58.

Warrington, E.K. Deficient recognition memory in organic amnesia. Cortex, 1974, 10, 289-291.

Warrington, E.K., and Weiskrantz, L. A study of learning and retention in amnesic patients. Neuropsychologia, 1968, 6, 282-291.

Warrington, E.K., and Weiskrantz, L. Amnesic syndrome: Consolidation or retrieval? Nature, 1970, 228, 628-630.

Warrington, E.K., and Weiskrantz, L. Amnesia: A disconnection syndrome? Neuropsychologia, 1982, 20, 233-248.

Watkins, M.J., and Tulving, E. Episodic memory: When recognition fails. Journal of Experimental Psychology: General, 1975, 104, 5-29.

Weiskrantz, L., and Warrington, E.K. The problem of the amnesic syndrome in man and animals. In R.L. Isaacson and K.H. Pribram, (Eds.), The hippocampus. New York: Plenum Press, 1975.

Weiskrantz, L., and Warrington, E.K. Conditioning in amnesic patients. Neuropsychologia, 1979, 17, 187-194.

Whitty, C., and Zangwill, O. (Eds.), Amnesia: Clinical, psychological and medicolegal aspects. London: Butterworths, 1977.

Williamsen, J.A., Johnson, H.J., and Eriksen, C.W. Some characteristics of posthypnotic amnesia. Journal of Abnormal Psychology, 1965, 70, 123-131.

Winocur, G. Memory localization in the brain. prepared to appear in L. Squire and N. Butters (Eds.), The neuropsychology of memory, 1983.

Winograd, T. Frame representations and the declarative-procedural controversy. In D.G. Bobrow and A.M. Collins, (Eds.), Representation and understanding: Studies in cognitive science. New York: Academic Press, 1975.

Wiseman, S., and Tulving, E. Encoding specificity: Relation between recall superiority and cognition failure. Journal of Experimental Psychology: Human Learning and Memory, 1976, 2, 349-361.

Wood, F., Taylor, B., Penny, R., and Stump, D. Regional cerebral blood flow response to recognition memory versus semantic classification tasks. Brain and Language, 1980, 9, 113-122.

APPENDIX A

Dealing With Simpson's Paradox

To analyze the results for evidence of dissociation in terms of stochasitic independence, consideration must be given to a problem that chi-square 2 x 2 contingency tables are potentially subject to - referred to as "Simpson's Paradox". Simpson's Paradox states that if two or more 2x2 contingency tables are collapsed into one, the summary table may show a relationship which is different from those shown by any of the original tables (Simpson, 1951). It consists of the possible existence of multiple covariates as confounds in the data, and can affect, therefore, the interpretation of the chi-square result. The source of the confound(s) would be due to extraneous correlated variable(s) interacting with either or both of the two main variables being compared. By collapsing the tables, the result could be the emergence of some spurious relationship which does not represent the true one that exists between the variables of interest.

Memory research, due to practical concerns, does not collect its data based on a single subject with a single item over a large number of trials. Instead, the data usually consist of summary results collapsed across various subjects having been tested with a number of items. As warned by Hintzman (1980), therefore, memory retrieval analyses are particularly subject to this potential third-variable problem. In this case, one can conceive of at least three classes of possible extraneous effects; namely: a) subject differences (some subjects may be better at remembering than others; b) item differences (some items may be more difficult to remember than others); and c) subject-by-item interactions (e.g. individual differences in vocabulary or special personal significance of items). In reaction to these potential sources of dubious interpretation, Flexser (1982; also see Bishop, Feinberg and Holland, 1975 for occassions when collapsing the tables is permissible) prepared an analysis which contains a "homogenizing" technique for extracting out the subject and item covariates, thus eliminating these two possible sources as additional effects. The remaining variable of subject-by-item interaction includes any other possible correlative influence. This variable, however, represents the effects of possible theoretical significance, since it includes those cases in which there is a potential differential effect of "this" subject accessing "this" particular item on "this" particular test as compared to the "other" particular test. All of the data reported in this thesis have been subjected to Flexser's adjustment correction.

Further, at times stochastic independence is observed (experiments 1, 2 and 3), while at other times dependence is obtained (experiments 4 and 5). The fact that the relationships can be varied suggests that even if the "absolute" value of the chi-square table does not depict the precise amount of dependence in the relationship, the "relative" amount of dependency obtained across situations remains of interest.

APPENDIX B

Verbal Materials
Used for the Experiments

Appendix B1:

Experiment Ones and Five -
Materials Used for Spelling Experiments

	Questions Containing Homophones:	most common answer:
1.	Name the days of the week	S,M,T,W,T,F,S
2.	Who won the last federal election?	Trudeau
3.	What is the answer to eight multiplied by five?	40
4.	Name something you can bake made of flour and eggs.	bread
5.	Do you have an aunt or uncle who lives in Toronto?	my aunt/uncle
6.	A beet or a potatoe grows in the ground. Name another root vegetable.	carrot
7.	Name a horse's gait, other than gallop.	canter
8.	Name a large body of water, other than sea or ocean.	lake
9.	Who is heir to the throne of England?	Prince Charles
10.	What kind of fish is easily caught from the end of a pier? sunfish	
11.	Who is the author of the tale about the Ugly Duckling?	H.C.Anderson
12.	Name a musical reed instrument.	clarinet
13.	Name a bird of prey.	hawk
14.	What kinds of things can you carry in a pail?	water/soil
15.	At what time is the mail usually delivered where you live?	at (9):00 a.m.

	Questions Containing Non-Homophones:	most common answer:
1.	What is the opposite of the word cold?	hot
2.	What is the name of your family doctor	Dr. X
3.	How many pints are there in two gallons?	16
4.	What city has the largest population in Ontario?	Toronto
5.	Can you play the game of chess?	yes
6.	What is your favourite sport?	hockey
7.	What class of tree loses its leaves in the fall?	deciduous
8.	On what date is Christmas celebrated?	Dec. 25
9.	Name the famous tower in Paris.	Eiffel
10.	How often do you exercise in a month?	12 hours
11.	Name a unique type of animal that lives in Australia:	koala bear
12.	Have you ever travelled anywhere in a train?	yes, to X
13.	What is your favourite type of fruit pie?	apple
14.	What did you have for dinner yesterday?	meat, potatoes...
15.	Can you speak a language, other than English?	no

Homophone Test Items:

Critical	Control (Sp)	Control (Rn)
(low/high)	(high/low)	(high/low)
aunt/ant	bail/bale	ball/bawl
beet/beat	break/brake	board/bored
eight/ate	close/clothes	bow/beau
flour/flower	deer/dear	course/coarse
gait/gate	earn/urn	peak/peek
heir/air	feet/feat	poor/pour
mail/male	great/grate	sail/sale
pail/pale	grown/groan	seen/seam
pier/peer	night/knight	vain/vein
prey/pray	stare/stair	wave/waive
reed/read	steal/steel	
sea/see	sum/some	
tale/tail	team/teem	
week/weak	waste/waist	
won/one	weight/wait	

Non-homophone Test Items:

From Study	Novel (Sp)	Novel (Rn)
chess	card	book
city	chair	cabin
cold	fence	calendar
date	fudge	money
dinner	glass	province
doctor	key	queen
exercise	match	salad
fruit	mirror	table
language	movie	window
pints	music	yellow
sport	paint	
tower	picture	
train	season	
tree	triple	
unique	wall	

Appendix B2:

Experiment Two -
Words Used in Perceptual Identification
and Recognition

Word List:

Low Frequency Items
abuse album anvil banjo baton beret bison boxer burro cadet chalk cider
clamp comma cream crock decoy diner easel ether evade fancy flask fudge
gnome gourd grape gully holly icing juice ladle lapel latch magic major
mixer mucus mural noose optic otter paste patio pecan plaza prize rayon
resin roach robin salve sedan slush tongs tonic torso truce yacht zebra

High Frequency Items
apple bacon birch blood board brain cabin chair child climb clock coral
crime devil drain earth fence flesh given grass grave habit horse hotel
human issue knife light match metal money motor nurse ocean paint paper
pause peace plant point pride pupil queen quite river rough sheep stamp
stone style sugar table teeth tower train unite wagon water wheat wheel

Practice Items
actor draft ledge march month phone scarf scold sleep virus

Appendix B3:

Experiment Three -
Test Words and Semantically-related Paired Items

Target Item	Context Word	Target Item	Context Word
aardvark	mammal	inertia	inaction
agnostic	skeptic	inferno	furnace
almanac	publication	insomnia	sleepless
analogue	parallel	isthmus	peninsula
anatomy	structure	jamboree	celebration
antenna	aerial	kerosene	fuel
antidote	remedy	knapsack	satchel
antique	old	kumquat	fruit
anybody	someone	lacrosse	game
approval	consent	ladybug	beetle
apricot	marmalade	lanolin	soap
asbestos	magnesium	lettuce	salad
assassin	murder	lexicon	dictionary
atrocity	outrage	lineage	ancestry
avocado	green	lithium	metal
bachelor	misogamist	lozenge	throat
bandanna	scarf	marjoram	seasoning
basilica	church	mascara	cosmetic
bayonet	weapon	membrane	tissue
beeswax	honey	migraine	pain
behavior	conduct	monogram	initials
borough	suburb	mystery	secret
bureau	chest	neonate	infant
cabaret	tavern	nirvana	oblivion
cashmere	wool	nocturne	song
cavalry	troop	octopus	mollusk
chassis	frame	operetta	musical
chimney	vent	oration	speech
cholera	disease	outsider	stranger
cinnamon	spice	paraffin	wax
clarinet	instrument	paranoia	fear
climate	weather	pendulum	swing
cobbler	mender	peroxide	dye
corvette	vehicle	pharaoh	autocrat
crevice	chasm	phoenix	bird
cutlery	spoons	pigment	melanin
cyanide	poison	plankton	algae
delirium	mania	polliwog	frog

Target Item	Context Word	Target Item	Context Word
democrat	politician	rainbow	spectrum
dinosaur	reptile	rhetoric	declamation
duodenum	intestine	ruffian	scoundrel
electron	atom	sanskrit	writing
ellipse	oval	sapphire	gem
emissary	messenger	sheriff	officer
epitaph	inscription	spatula	utensil
estuary	fiord	sprocket	wheel
exponent	power	surgeon	doctor
fascism	dictatorship	tequila	drink
filtrate	residue	theorum	axiom
flamingo	stork	thyroid	gland
flannel	cloth	toboggan	sled
gazette	journal	tricycle	transportation
gondola	boat	twilight	dusk
granary	bin	universe	world
hayloft	barn	vendetta	revenge
hexagon	shape	verandah	porch
horizon	limit	warranty	contract
hyacinth	flower	yoghurt	custard
hydrant	water	zeppelin	dirigible
ideology	belief		
incision	cut		

Appendix B4:

Experiment Four -
Pronounceable Pseudo-words Used in Perceptual Identification and Recognition

Pseudo-words:

Test Items
achor admet alarp anvit ardid asket avest baver blean blesp brast bucre
bunly caden chome clefe clert cobur crach cralk crusp daten delap dralt
drilk eable elber enler filpy fimti firse flact flamt frese frent garil
ginet glask gloka grast greel harst hetch hilin horet hunce inate jegli
knate laped liber lonce lupel mager manel menor mirld narew natre norbe
obben obrut pafen parel prent prind raber rense ronic rudle rurck siber
sloen smalt snact sneep stanb stren stune tampe taver teart thaid trene
trife trilo troke troud truct trumb ujelt upint urden vegeg yikam yonch

Practice Items
alvot canch lameb mudel treap vinge

Appendix B5:

Experiment Six -
Low Frequency Items Used in Perceived
Time Duration Study

Word List:

Test Items

abhor abuse actor adult album alike anvil banjo basal baton
bayou beret bison brine broom burro cadet canoe chafe chalk
chard chore cider clamp comma crock dealt decoy diner dread
easel ether evade expel fable facet fauna flake flask fudge
ghost girth giver gnome gourd guile hazel holly horde icing
imply islet jaunt jetty knoll lance lapse lathe lease ledge
lynch magic mango manor mixer moist mound mural naval neigh
nerve noose nudge oasis onion optic otter palsy parch patio
pecan peril pivot plaid plaza quart rayon razor realm relax
resin rogue salad salve scald scent sedan sever shunt slush
stoop talon tease tempo toast tonic tongs torso tripe truce
ultra usher vault verse virus vocal waist waxen yacht zebra

Practice Items

barge blaze dairy exact frown genus jewel knave ladle pearl
revel roach spore twist

APPENDIX C

Standard Deviation Tables
For Experiment Two

Table C.1

Results from the Recognition (Rn) Phase -
Standard Deviations for Items Judged as "Old"[x]

Mode	Delay	Freq.	Correct Rn	False Rn
SCR	I	L	.086	.111
	I	H	.157	.083
	D	L	.183	.091
	D	H	.161	.130
TYP	I	L	.079	.052
	I	H	.171	.044
	D	L	.083	.115
	D	H	.190	.038
AUD	I	L	.147	.054
	I	H	.249	.054
	D	L	.120	.054
	D	H	.216	.112

I = immediate
D = delay
L = low frequency
H = high frequency

x - correct Rn refer to critical items which are correctly recognized
false Rn refers to novel items which are incorrectly called old

SCR = presentation on computer screen
TYP = items presented on typed sheet
AUD = items presented by tape-recorder

Table C.2

Results from Perceptual Identification (PI) -
Standard Deviations for Items[x] Correctly Identified

Mode	Delay	Freq.	Critical	1-Pres.	Novel
SCR	I	L	.181	.180	.287
	I	H	.093	.114	.209
	D	L	.166	.171	.191
	D	H	.075	.111	.232
TYP	I	L	.209	.215	.219
	I	H	.149	.153	.252
	D	L	.161	.164	.257
	D	H	.130	.116	.147
AUD	I	L	.218	.206	.201
	I	H	.124	.127	.238
	D	L	.161	.183	.201
	D	H	.109	.112	.153

I = immediate
D = delay
L = low frequency
H = high frequency

x - these items include critical items (presented during both Rn and PI), once presented items from study (1-pres.), and novel items not previously encountered in the experiment

SCR = presentation on computer screen
TYP = items presented on typed sheet
AUD = items presented by tape-recorder