MEMORY IN CONTEXT: THE INFLUENCE OF CONTEXT REINSTATEMENT ON THE RECOVERY OF EXPERIMENTALLY BLOCKED MEMORIES

A Senior Honors Thesis

by

JENNIFER S. WILLIAMS

Submitted to the Office of Honors Programs
& Academic Scholarships
Texas A&M University
In partial fulfillment of the requirements of the

UNIVERSITY UNDERGRADUATE
RESEARCH FELLOWS

April 2006

Major: Psychology

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ABSTRACT

Memory in Context: The Influence of Context Reinstatement on the Recovery of

Experimentally Blocked Memories (April 2006)

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The present study examined the effect of context reinstatement on the recovery of

experimentally blocked memories and the possible creation of memory errors. Context

refers to every aspect of the environment in which a to-be-remembered event has taken

place. Physically returning to a learning context, or creating a mental representation of it,

may allow one to use context information as a source of memory cues to enhance

memory performance. This is referred to as context reinstatement. Research shows that

memory performance is best if learning and testing conditions match, rather than if they

are mismatched (Smith, 1979; Thomson & Tulving, 1970). It is unclear if context

reinstatement can influence not only the enhancement of continuously accessible

memories, but whether it might also help with the recovery of blocked memories. Also,

because mentally reinstating context is a form of mental imagery, it is possible that this

process of reinstatement would lead to the creation of memories for imagined events or

memory errors. To examine these questions the present study manipulated mental and

physical reinstatement and examined both accurate and inaccurate memories. The

present study included three phases. First, participants performed an incidental learning

task with a series of word lists in one context. Next, participants performed either

memory interference tasks for three of the learned lists or distracter tasks in a different

context. Lastly, participants completed a series of memory tests in either the first or

second context, with or without context reinstatement. Results showed strong blocking

effects in the forget condition groups. Recovery effects were stronger in the physical

reinstatement group, as compared to the other groups. Interestingly, memory errors were

similar across experimental groups. Thus, physical, but not mental, context reinstatement

aided in the recovery of blocked memories, but the use of mental reinstatement did not

lead to memory errors. Results may edify other memory researchers, forensic

investigators and clinical psychologists who may use forms of context reinstatement and

mental imagery for memory enhancement or recovery purposes.

ACKNOWLEDGEMENTS

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INTRODUCTION[1]

The present study examined whether aspects of the environmental context

associated with a study episode can provide memory cues to help participants recall

blocked or inaccessible memories. Environmental context can include such information

as sights, sounds, and smells or subjective states like feelings and thoughts. The use of

environmental context to facilitate remembering is called context reinstatement. Forensic

investigators and clinical psychologists often use this technique to help victims and

patients recall blocked memories. Two context reinstatement techniques, the cognitive

interview and guided imagery, rely on mental reinstatement of the original episode.

Mental reinstatement is when people are essentially asked to imagine details of an event

that has taken place to aid recall of the event (Arbuthnott, Arbuthnott & Rossiter, 2001;

Scheflin, Brown, Frischholz & Caploe, 2002). As such, the cognitive interview has been

called an imagery-based memory recovery technique (Scheflin, Brown, Frischholz &

Capole, 2002). And the context reinstatement portion of the interview is seen as the

most integral component.

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[1] This thesis follows the style and format of *Memory & Cognition.*

However, researchers have questioned the accuracy of memories enhanced or recovered using mental imagery techniques like mental reinstatement (Garry, Manning, Loftus & Scherman, 1996). Yet, to date empirical studies have only examined the effectiveness of context reinstatement on the enhancement of continuously accessible memories and have neglected to examine the recovery value of context reinstatement or its possible influence on memory errors.

Because blocked memories may be of a traumatic nature and concern events like childhood sexual abuse, the recovery of such memories can have long-term, legal, interpersonal and mental health consequences for all parties involved. Considering the importance of the issues surrounding the recovery of blocked memories, the present study sought to empirically determine whether context reinstatement can aid in the recovery of blocked memories without leading to significant increases in the memory errors.

How the Debate Over the Accuracy of Recovered Memories has Shaped Memory Research

In past years psychologists and other professionals have been polarized over the question of whether recovered memories are veridical or false. This polarization is

known as the false memory debate. Over time laboratory, and some clinical, evidence

has accrued that affirms that both accurate and inaccurate memories may be produced

during attempts to recover inaccessible memories (Gleaves, Smith, Butler & Spiegel,

2004). The focus of the debate now centers on how each type of memory is engendered,

how frequently each type of memory occurs, and how to determine which memories are

inaccurate and which are accurate (Gleaves et al., 2004).

The issues surrounding recovered and false memories, which fuel the false memory

debate, stem from the idea that memories can be blocked. The term "blocked memory"

refers to the idea that information which is stored in memory can be temporarily

inaccessible to retrieval attempts. In everyday life this may be experienced as simple

forgetting, but in extreme cases this can be experienced as amnesia or other bouts of

memory failure. Freud was arguably the first to address the topic of repressed memories,

and pointed to such unconsciously held memories of sexual trauma as the underlying

cause of hysterical symptoms in his patients (Gleaves et al., 2004). Since Freud, memory

studies have followed interests associated with historical events. For instance, work has

been done concerning traumatic amnesia suffered by veterans following major wars, but

the spotlight has come full circle and is again focused on memories which survivors of childhood sexual abuse claim to have recovered (Gleaves et al., 2004).

For many years psychologists have continued to study blocked and inaccessible memories on many levels. For example, Jennifer Freyd (1994) has examined possible motivations for the repression of traumatic memories in her theory of betrayal trauma. This theory states that unwanted memories will be kept from a betrayed individual's consciousness so that they can maintain an attachment relationship with a betrayer on whom they depend for their survival.

In addition, some research has explored the neuro-anatomical mechanisms that may underlie the process of suppression, which is a kind of motivated forgetting (Anderson Ochner, Kuhl, Cooper, Robertson, Gabrieli, Glover & Gabrieli, 2004). This study found evidence that dorsolateral prefrontal cortex activity in the brain inhibits the hippocampal activity that is normally associated with memory storage. Thus, not only are the environmental factors leading to the creation of memory blocks being explored, but so are the neurological underpinnings of this process

Are False Memories Created During the Recovery of Blocked Memories?

The false memory camp is a group of individuals and psychologists who posit that

recovered memories, or those previously blocked memories which have been recalled,

may actually be confabulations. These researchers have developed a myriad of

experimental paradigms to test the conditions under which the formation of so-called

false memories may occur (e.g. Roediger & McDermott, 1995; Gleaves et al., 2004;

Loftus, 1997). Some have also cited high profile cases of false memory claims and

repudiators of recovered memories (de Rivera, 2000; Green, 1994; Henkel & Coffman,

2004).

One false-memory paradigm designed by Deese (1959) involves extra-list intrusions.

Extra-list intrusions occur when a word list is composed of items that are common

associates of one word that is intentionally omitted from that list. For example, a list

containing the words: *sock, shoe, toe, sole*, etc. would be given and the common

associate of this list would be the word *foot*. Participants will often recall later that the

word *foot* had been included in the list, and this is called an extra-list intrusion. In 1995

Roediger and McDermott used this paradigm to elicit memory errors in participants. The

participants studied these common-associate lists of words and then took free recall tests

in which they commonly recalled the omitted word. In a second free recall test error rates were higher than in the first test and participants made recognition errors for list items with high confidence. From these findings Roediger and McDermott (1995) made the statement that "we do show that the illusion of remembering events that never happened can occur quite readily" (p. 812).

In addition, entire fictitious childhood events can be implanted in participants' memories, as Loftus (1993) demonstrated in her 'lost in the mall' experiment. In this study a participant was convinced by his older brother that when he was a small child he was lost in a shopping mall and subsequently this participant began to form memories of the false event. Though the method and validity of this study were harshly criticized, the results of this experiment were still considered by some to be a successful memory implantation and various researchers have attempted to replicate this effect.

The imagination inflation effect has been used to explain this kind of false memory phenomenon (Garry, Manning, Loftus & Scherman, 1996; Goff & Roediger, 1998; Thomas & Loftus, 2002) Imagination inflation refers to the finding that imagining fictitious past events increases the confidence with which an individual reports that these events actually happened (Libby, 2003). For example, in Libby's 2003 study, the

contribution of imagery perspective to the imagination inflation effect was strongest

when the wording of questions at test encouraged participants to imagine real events in

the same perspective that they had used to imagine made-up events prior to testing.

One of the most widely accepted frameworks developed to explain the cognitive

mechanisms behind the production of such memory errors may be that proposed by

Johnson and Raye (1981), called reality monitoring. Reality monitoring is the process by

which one distinguishes between internally and externally generated information. In this

framework certain characteristics of memory traces can be used to distinguish between

memories of something actually perceived from something imagined. These

characteristics include: contextual information, semantic detail, sensory information and

cognitive operations. Johnson and Raye posited that memories from external sources are

richer in the first three characteristics and that memories from internal sources involve

more cognitive operations. While an individual is remembering something, judgment

processes are evaluating these criteria to decide to which source to attribute the memory.

Confusion about the source of a memory may occur for many reasons, including

situations in which similarities between the semantic and sensory information for

internal and external memories are too great.

From reality monitoring framework Johnson, Hashtroudi and Lindsay (1993)

developed the idea of source monitoring. They define source as a variety of

characteristics that specify the conditions under which a memory is acquired, and say

that this idea is related to, but more inclusive than, context. Source monitoring is an

expansion upon the idea of reality monitoring and adds to it ways to distinguish between

the source for a memory from either multiple possible internal and/or external sources.

For example, in a group discussion it may be important to recall who came up with an

idea. Did you or another group member create the idea? If it was another group member,

which one was it? Here distinguishing characteristics between internal and external

generations also include perceptual information, contextual information, semantic detail,

affective information and cognitive operations. Johnson et al. note that source

monitoring success and accuracy are not only dependent on immediate goals and social

pressures of the remembering party, but on the quality of the memory and richness of

contextualization when it is encoded into memory.

Before moving on, it must be noted that while memory errors may occur in empirical

and real world settings the implication that a recovered memory for an entire event could

be confabulated may not be a very accurate statement. Rather, the idea that, more often,

various *details* of an actual event, such as at what time or on what date some event

happened, are confused or mistaken may be more accurate. Therefore, the term "false

memory" has only been included in the present thesis as a reference to its use by other

researchers and the term "memory error" is used to refer to results in the present study.

Are Recovered Memories Accurate?

On the other side of the memory debate, proponents of memory recovery have

conducted experiments and cited case studies to demonstrate that accurate memories are

able to be recalled after a period of amnesia (Corwin & Olafson, 1997; see Gleaves,

Smith, Butler & Spiegel, 2004; Smith & Moynan, 2004). In one well documented case

study a 6 year-old Jane Doe was questioned in a videotaped interview by Dr. David

Corwin concerning allegations of sexual and physical abuse she had made against her

mother (Corwin & Olafson, 1997). When Dr. Corwin contacted Jane 11 years later, she

had no recollection of the abuse, all of which had been extensively documented and

corroborated years ago. During a meeting with Dr. Corwin, where Jane was questioned

about her abuse memories and was shown the videotape of her interview 11 years prior,

Jane reported that she suddenly had memories (including vivid details and sensory and

contextual information) of her mother abusing her. These reported recovered memories

were consistent with the documented allegations she had made as a young child, with the exception of one new memory she reported (the veridicality of which could not be undeniably confirmed).

On a different note, empirical studies (Smith & Moynan, 2004) demonstrated that affective word-lists could be blocked from participants' memories and that these blocked memories could subsequently be recovered when participants were shown the category names of the blocked lists. Participants studied emotionally charged affective lists (which contained explicit violent and sexual content) and non-emotional neutral lists and then performed memory interference tasks. Interestingly, during free recall testing participants were unable to recall both the neutral *and* the affective word lists. Yet when they were shown the category names of the blocked lists, participants were again able to recall these words.

Experimental psychologists have noted that even in studies where the production of memory errors is the primary goal of experimenters, that most subjects do not create so-called false memories (Clancy, McNally, & Schacter, 1999; Loftus, 1997). For example, in Loftus' 1997 review of memory implantation studies she noted that "some false memories are easier to induce than others" such as those that are plausible and fit the

participant's established script for an event (p. S81). Loftus (1997) reminded her

audience that "the majority of subjects, be they adults or children, did not construct a

false memory despite the experimental demands [placed on them during these types of

studies]" (p. S80).

The Use of Mental Imagery in Guided Imagery and the Cognitive Interview

The present study examines, in part, the effects of mental reinstatement on memory

because it is a form of mental imagery. This is important because mental imagery

techniques are frequently used in real world settings and the outcomes of these uses may

have long-term negative consequences for numerous individuals. Among these

consequences are family discord due to allegations of childhood sexual abuse made

against relatives and criminal litigation based on eyewitness identification and

testimony. Thus, researchers have sought to find reliable ways to recover blocked

memories.

Such methods for enhancing and uncovering memories in real life settings include

guided imagery, which is used in therapy, and the cognitive interview, which is used in

forensic investigations. Both methods rely heavily on mental imagery and specifically on

mental reinstatement to context. Imagery techniques are very frequently used in

psychotherapeutic settings for a myriad of purposes, from overcoming phobias to

examining one's feelings about a past event (Arbuthnott, Arbuthnott & Rossiter, 2001).

Generally, mental imagery is used to help a patient gain new perspective and insight into

an issue which confronts them. Guided imagery can also be used for the enhancement

and scrutiny of memories, especially those with troubling or traumatic content.

Often the clinician will suggest a theme and starting point of the to-be-imagined

scenario, and then may direct the content and actions of the imagined actors however

they see fit. Guided imagery techniques attempt to elicit sensory information and

elaboration that would correspond with the imagined events, often to give the patient

insight about their feelings and reactions to certain issues (Arbuthnott et al., 2001).

While most psychologists recognize that imagery techniques are an invaluable part of

any psychotherapeutic process, memory errors may occur because of source monitoring

failures that result from an imagined memory being given additional sensory

characteristics during guided imagery (Kealy & Arbuthnott, 2003).

However, some research has shown that memories recalled with the use of mental

imagery may be quite accurate, and memory errors that do occur may be attributed either

to lax reality and source monitoring criteria or to certain types of social pressure (Clancy

et al., 1999; Kealy & Arbuthnott, 2003; Paddock & Terranova, 2001). That is, the techniques themselves may not be "risky", but the manner in which they are administered may contribute to the production of memory errors.

In a study that tested this possibility, participants rated the memory characteristics of perceived, natural and guided imagery immediately after either an event they perceived, one they imagined on their own or one through which they were guided by an experimenter (Kealy & Arbuthnott, 2003). The findings of this study indicate that the guided imagery-generated memories had sensory characteristics close to those of memories for perceived events, but that supporting memories generally used to make reality monitoring judgments were not as clear for imagery generated memories as for the perceived memories. This indicates that, despite imagery manipulations, there are distinguishing characteristics between the real and imagined memories which would allow an individual to determine which was true and which was false.

Research also shows that guided imagery may affect confidence (Paddock & Terranova, 2001). This study examined the influence of the authority and expertise of a guide on confidence using the Remember/Know paradigm (Tulving, 1985). In one variant of this paradigm, participants give a "know" judgment to an item because they

feel that it is familiar, and they give a "remember" judgment to an item if they explicitly

recall it from the study episode. Participants were either provided details of an event

from relatives, which they should have assigned a "know" response later, or they were

asked to generate their own details of an event, which they should have assigned a

"remember" response later. The results of this study demonstrated that using guided

imagery to recall details of this event lead participants to assign "know" events ratings

that were closer to "remember" ratings. Confusion as to which details they had been told

by relatives (which should have been assigned to the "know" category) versus which

details they had generated themselves (which should have been assigned to the

"remembered" category) was exacerbated for participants who thought that their

memory guide was an expert as compared to the participants who thought their guide

was a non-expert.

However, memory errors associated with guided imagery may be avoidable (Clancy

et al., 1999). These researchers tested the use of guided imagery in a sample of women

reporting recovered or continuous memories of childhood sexual abuse and found that

the recovered memory group demonstrated *less* confidence in imagined events than did

the control group. Clancy and colleagues noted that the recovered memory group at

times seemed more vigilant of the possibility that memory errors or confusion could

occur. So, performance differences between control and recovered memory groups may

have been due in part to stricter source monitoring criteria and wariness on the part of

the recovered memory participants. This suggests that guided imagery may not

contribute significantly to memory errors if those using it are informed about the

possibility that they may experience certain types of memory errors.

Overall, some reviews of imagery and context reinstatement research have deemed

the cognitive interview, and by extension guided imagery, to be reliable techniques for

memory enhancement that may produce relatively accurate memories (Malpass, 1996;

Scheflin, Brown, Frischholz & Caploe, 2002). One literature review examined whether

empirical studies could support claims from fellow researchers that guided imagery may

lead to false memories (Scheflin et al., 2002). Guided imagery is a crucial part of the

cognitive interview that is used in forensic settings to enhance eyewitness memory.

Since experimental examinations had been conducted primarily on the cognitive

interview as a type of imagery used for memory enhancement, Scheflin and colleagues

reviewed 42 such studies on the cognitive interview. The interview consists of 1) report

all instructions, in which all memories are reported regardless of their perceived

significance; 2) change perspectives, where an event is recalled from many different

perspectives; 3) change order, in which an event is recalled in different temporal orders;

and 4) mental reinstatement activities, in which mental imagery is used to recreate the

context of an event and use this memory to recall details of that event (Malpass, 1996).

One literature review reported that the findings of large increases in new information

retrieved without accompanying large increases in memory errors were very consistent

across the studies that were examined (Scheflin et al. 2002)**.** They concluded that

memory errors are found to increase when imagery procedures are used in conjunction

with coercive or suggestive questioning styles and that there is a dearth of evidence to

support the statement that guided imagery leads to the production of false memories**.**

Similarly, another review of the literature shows that increases in correct information

are elicited using the cognitive interview, but there is little concurrent increase in the

amount of false information elicited or in the confidence levels in errors (Malpass,

1996). So, Malpass' conclusions also support the Cognitive Interview, and by extension

the mental reinstatement technique, as effective memory tools.

Context May Influence Memory by Providing a Source of Cues

The cognitive interview and guided imagery attempt to use important aspects of environmental context to influence memory processes. Similarly, the present study relied on how mental representations of an environmental context could be used to help participants recall certain memories. Mental reinstatement was tested, in which participants used mental representations of the learning context to help them remember experimental stimuli. Physical reinstatement was also tested, in which participants were physically returned to the learning context to help them remember experimental stimuli.

This idea that environmental context can provide memory cues has been an important part of memory research and previously memory cues were thought merely to be anything which had an association to the memory being recalled. However, in 1970 Thomson and Tulving showed that this memory-cue relationship could be tied directly to the context in which both occur. Previous experimental findings supported an encoding specificity hypothesis, which stated that retrieval cues are effective when they are encoded *along with* the to-be-remembered event, and that they are not merely pre-existing associates of that event. In a series of experiments using strong and weak associate cues Thomson and Tulving demonstrated that cues which were weakly

associated with the to-be-remembered stimuli were more effective in evoking retrieval of

the stimuli when these cues had been present at the time that the stimuli were encoded in

memory than were preexisting cues that were strongly associated with the to-be-

remembered stimuli. In short, the findings in favor of this encoding specificity principle

say that aspects of environmental context that are stored in memory at the same time as a

to-be-remembered event will be able to act as memory cues to facilitate the retrieval of

memories for the event later.

Working from this idea of context as a potential source of memory cues, Smith

(1979) sought to find out if participants could use their memory of a learning context,

through mental reinstatement, as a source of memory cues at test. Smith pointed out that

the environmental reinstatement effect refers to the finding that participants'

performance on tests will be better if the testing environment matches the learning

environment than if the testing and learning environments are different. In one of

Smith's experiments participants learned word-lists in one location and were then moved

to another location for memory testing. When participants were instructed to recall the

learning environment prior to their memory test they performed better than participants

who did not refer to their memory for the learning environment as a mnemonic

technique. From the results of this and related experiments, Smith (1979) concluded that

context effects can be "brought under cognitive control" using mental reinstatement (p.

460).

<u>The Present Study</u>

So, in order to test the effectiveness of mental and physical reinstatement on the

recovery of blocked memories, and not as an enhancement techniques for degraded,

continuously accessible memories, the present study merged aspects of two prior

studies: one Smith (1979) and one Smith and Moynan (2004).

The Smith and Moynan (2004) study used the retrieval bias method, which yielded

large forgetting (blocking) and recovery effects and allowed the researchers to monitor

the occurrence of memory errors. The retrieval bias method (see Figure 1) is based on

the output interference paradigm (see Figure 2). In their study of the blocking and

recovery of affective word lists, an incidental learning task presented participants with

categorized lists of words, some of which were emotionally-charged affective lists and

some of which were neutral lists. Participants then performed either distracter tasks to

keep them from rehearsing the lists or were re-exposed to a subset of the learned lists.

Later, they took a free recall test which was used to observe blocking effects for the lists

to which the forget group had not been re-exposed. Participants then saw the category

names of the blocked lists in a cued recall test which helped them remember the blocked

lists. Interestingly, Smith and Moynan (2004) found that the distinctive lists (which

included violent and sexual content), as well as neutral lists, were subject to strong

forgetting effects.

The output interference paradigm, on which this retrieval bias method is based, states

that the stimuli to which a participant is re-exposed will be more accessible in memory

than stimuli from which one has been distracted. Shifting the accessibility of sets of

stimuli this way results in memory interference for the reduced accessibility stimuli, and

the effect of this is observed as a memory block.
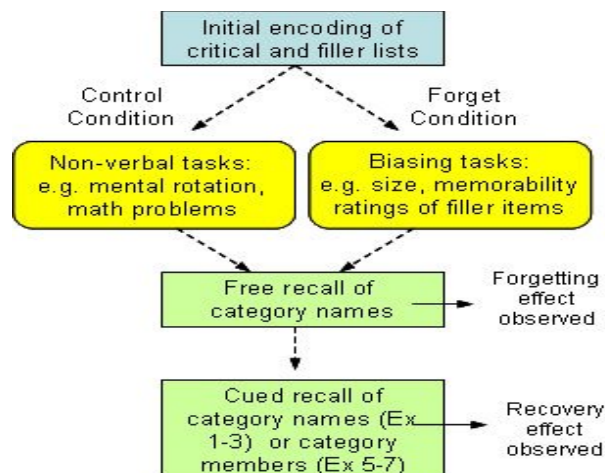
Figure 1. Retrieval Bias Method (from Smith et al., 2003)
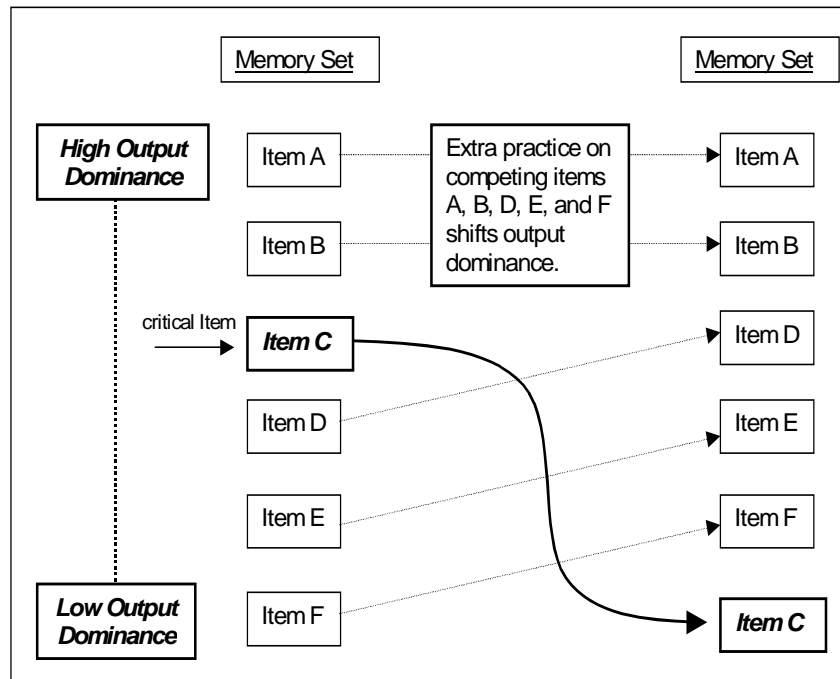
(from Smith et al., 2002)

Figure 2. Output Interference Blocking Paradigm (from Smith et al., 2003)

The methodology of the present study integrated context manipulations into the

retrieval bias method. An incidental learning task was performed in Context (room) A,

memory interference tasks or distracter tasks were performed in Context (room) B, and a

series of memory tests were taken in either Context A or B depending on the

participants' group assignments. The test series included: 1) free recall test 1, in which

the blocking effects from the interference tasks could be observed; 2) free recall test 2

that, for context reinstatement groups, was preceded by physical or mental context

reinstatement and that measured the memory recovery incited by this reinstatement; and

3) cued recall test which allowed all groups with blocked memories of the experimental

stimuli to recall this stimuli.

The context reinstatement manipulations were hypothesized to increase memory

recovery in the second free recall test because, as is indicated by the encoding specificity

principle and implied by previous research, the conditions in which participants had the

opportunity or were encouraged to use the environmental context as a source of memory

cues would demonstrate better performance on memory tests than those who were not

(Smith, 1979; Thomson & Tulving, 1970). Also, no increase in memory errors was

hypothesized to accompany the use of context reinstatement techniques, particularly

mental reinstatement. This was partly because previous literature reviews did not find

evidence that the cognitive interview or guided imagery, which both use mental

reinstatement, caused more memory errors than other techniques (see Malpass, 1996;

Scheflin, Brown, Frischholz & Caploe, 2002). The findings of another researcher also

indicated that memory errors may occur under the influence of authority figures, and the

present study's experimenter had limited interactions with participants that were restricted to presenting them with stimuli and instructions (Paddock & Terranova, 2001).

The findings of the present study demonstrated that context reinstatement, in either form, did not negatively impact memory accuracy. Also, findings demonstrated that while physical reinstatement was modestly effective as a memory recovery technique, mental reinstatement was not. Future studies may seek to determine whether the ineffectiveness of mental reinstatement as found here is replicable or is peculiar to the present study. Also, future researchers may seek to replicate or augment the recovery and low error rate effects of physical reinstatement in experiments that combine mental and physical reinstatement and that use more generalizable stimuli (i.e. affective word lists, laboratory enactments, etc.), samples from various populations (i.e. individuals with Post Traumatic Stress Disorder, children, adults, etc.), and different experimental methods or designs.

In summary, memories can be blocked and recovered, and those that are recalled can be both accurate and error laden. Empirical research shows that human memory may be subject to suggestion and confusion under certain circumstances. There is also, however, evidence that shows that memory can be rather resistant to the production of

memory errors in many instances. So, questions in this debate now ask how accurate and

inaccurate memories are formed, how frequently each occurs and how to distinguish

between them.

Imagery has been incorporated into methods of memory recovery and

enhancement which address the issues just discussed. However, disagreement as to the

risks associated with using mental imagery in such capacities has called for more

research into this topic. The present study contributes to a growing body of research that

seeks to respond to this call. The present study examined an imagery technique that has

been used in real life settings and in numerous empirical studies. However, previous

work has looked at the memory enhancement value of mental reinstatement, while the

present study looked at the recovery capabilities of mental and physical reinstatement

and has found modest, but positive, results for physical but not mental reinstatement.

METHOD

<u>Participants</u>

The participants were 149 undergraduate students enrolled in an

introductory psychology course. Individuals who elected to participate received

partial fulfillment of a course requirement, and had the option of writing a short

paper in lieu of participating in this study. Participants signed up using the

Department of Psychology online sign-up database. Each session included 15-20

participants, and lasted approximately one hour.

<u>Design</u>

Two environmental contexts, room A and B, were used in the present

study. Twenty participants were randomly assigned to each of the eight groups,

which differed in the pattern of rooms or instructions used in each group. All

participants learned in room A and performed intervening tasks in room B. All

context manipulations were made at test. Also, all participants were given cued

recall in the same room in which they received the second free recall task.

A 2 x 4 between-subjects design was used. Forgetting, a between-

subjects variable, consisted of a control group and a forget group. The forget

group was given two extra exposures to the 18 filler lists after original learning,

whereas the control group was given two non-verbal tasks after original learning.

Test context was also a between-subjects variable (see Tables 1 & 2), consisting

of groups AA (both free recall tests given in the original learning room), BB

(both free recall tests in the interference room), PR first free recall in the

interference room, retest in original learning room), and MR (both free recall

tests given in the interference room, mental reinstatement of the original learning

context for the retest).

Table 1. Context (room) Changes and Experimental Design; Control Condition

Experimental Groups	AA	BB	MR	PR
Incidental List Learning	A	A	A	A
Interference - distracter tasks	B	B	B	B
Free Recall 1	A	B	B	B
Administer mental reinstatement instruction to MR group				
Free Recall 2	A	B	B	A
Cued Recall	A	B	B	A

Table 2. Context (room) Changes and Experimental Design; Forget Condition

Experimental Groups	AA	BB	MR	PR
Incidental List Learning	A	A	A	A
Interference - re-exposure to lists	B	B	B	B
Free Recall 1 →observe forgetting fx	A	B	B	B
Administer mental reinstatement instruction to MR group				
Free Recall 2 → observe reinstatement fx on recovery	A	B	B	A
Cued Recall → observe recovery fx	A	B	B	A

<u>Material and Apparatus</u>

Twenty-one categorized word lists were used in the present study (see Appendix A). Each list consisted of a category name (e.g., *FLOWERS*) followed by ten list members (e.g., *tulip*, *rose*, *orchid*, etc.). Three of these lists were critical lists, or to-be-blocked lists. The remaining 18 filler lists were used to achieve retrieval bias.

A PowerPoint slideshow was used to present task instructions, word lists, and category cues. Participants were not told in advance that there would be memory tests following any tasks. For the list presentations each category name and list member was shown on an individual slide for three seconds, and was

followed by a blank slide for three seconds. Typicality ranking forms used in the

learning task presented the participants with space to write out and rank each

category name and list member. Another typicality ranking form was used in the

interference condition which consisted of the 18 filler lists and space for

participants to rank each list member for its typicality. A recall rating form was

used in the interference condition which consisted of the 18 filler lists, and

provided participants with space to rate how likely it was that they would recall a

list item later in the experiment. A series of mazes and mental rotation tasks were

used in the control condition. The PowerPoint slides were shown on a computer

screen in one context and on a projector screen in the other context.

Procedure

In the first stage of the experiment, which was the learning stage,

participants studied 21 categorized word lists (e.g., *FLOWERS*: *tulip*, *rose*,

orchid, etc.) in environmental context A, which was a room in the Psychology

Building at Texas A&M University. Participants were not told in advance that

there would be memory tests following any tasks. Participants were instructed to

write the category names (e.g., *FLOWERS*) and list members (e.g., *tulip*, *rose*,

orchid, etc.), and to rank each list member by how typical it was in its category. This was a deep level of processing task which ensured that each category name and list member was seen and processed by the participants.

In the second stage of the experiment, which was the interference stage, all participants were moved to environmental context B, a different room in the Psychology Building that looked very different from room A, to perform two intervening tasks. Intervening tasks consisted of interference tasks for the forget condition or filler tasks for the control condition, with tasks lasting six minutes each.

To create interference participants were re-exposed to the 18 filler lists using typicality ranking and recall rating tasks. In the typicality ranking tasks participants were asked to rank each list member for how typical it was in its category. In the recall rating tasks participants were asked to rate how likely it was that they would later recall each list member. These tasks assured that the participants processed the filler lists on a deep level, and the re-exposure to these lists created a retrieval bias whereby critical lists would become less accessible or blocked from memory.

The control tasks consisted of a series of mazes and mental rotation tasks. Mental rotation sheets presented participants with figures and asked them to determine which out of series of rotated figures matched the first figure shown. These non-verbal cognitive tasks were used to prevent participants from rehearsing the lists from the original learning task.

In the testing stage each participant completed three tests. The first two tests consisted of consecutive free recall tasks, each lasting one minute and thirty seconds. For free recall tests participants were asked to write down as many category names (e.g., *FLOWERS*) as they could remember from the original presentation of the lists. The MR groups were given mental reinstatement instructions prior to the second free recall test, in which they were asked to think back to the room where they saw all of the word lists, to think about how they felt as the experiment was beginning, to think about what they may have heard or seen or smelled, and to use their memory for this room to help them recall the word lists. The purpose of the first free recall test was to observe blocking effects for the critical lists. If the critical list category names were not recalled during the first free recall test, blocking effects could be positively determined. The

second free recall test was used to determine the effects of MR instructions on

recovery of the critical lists. If the MR groups recalled any of the critical

category names in this test it would indicate that the MR instructions affected

memory recovery.

A cued recall task lasting 4.5 minutes followed the free recall tasks. For

this test, participants were presented with each category name of the three

dropped out/critical lists, and these category names were shown individually on a

PowerPoint slide for 1.5 minutes apiece. Participants were asked to write down

all the list members corresponding to each category name presented to them. The

cued recall test was used to observe recovery effects. By providing participants

with the category names of the critical lists, the list members were made more

accessible to memory, diminishing the retrieval bias that had blocked them

initially.

Environmental Contexts

Room A was on the fourth floor of the cognitive psychology labs in the

Psychology Building. This room had several windows. The lists were presented on a

large projector screen using a laptop computer and a projector machine. Participants sat

in rolling chairs around a large circular conference table. In this context coffee was

always brewed to create a distinct odor which added to the disparity between contexts.

Room B was also on the fourth floor of the cognitive psychology labs in the Psychology

Building. This room had no windows, contained many computers, and participants sat

close together in rigid chairs to which desk tops were attached. The PowerPoint slides

were presented on a computer monitor placed on a rolling desk, and there were no

distinct odors in this room. These rooms were in different locations and were very

distinct from one another.

RESULTS

A $p < .05$ significance level was used for data analysis unless otherwise noted.

Free Recall, Blocking and Re-test Recovery

Word list categories were considered to be recovered if they were written on the response form by participants.

A 2 (test number) X 2 (condition) X 4 (context group) mixed Analysis of Variance was used to calculate the proportion of critical category names recalled on free recall 1 and free recall 2 tests. Condition (control vs. forget) and Group (AA, BB, MR, PR) both served as between subjects variables. Test number (free recall 1 vs. free recall 2) served as a within subjects variable.

The results of the mixed ANOVA revealed no main effect of context group on the proportion of critical category names recalled [F (3, 140) = 0.37, MSE = 0.13]. The participants in all groups recalled a similar number of critical category names during free recall.

There was a main effect of condition on the proportion of critical category names recalled [F (1, 140) = 36.07, MSE = 0.13], with participants in the control conditions

recalling more critical category names than did participants in the forget condition

(Table 3).

There was also a main effect of test number on the proportion of critical category names recalled [$F(1, 140) = 4.16$, $MSE = 0.3$], with participants recalling more critical category names in free recall 2 than in free recall 1 (see Table 3 & 4). There were no significant interactions between the variables of the mixed ANOVA.

The physical context reinstatement group showed a recovery effect that was modest in strength; an increase of 11% in the number of critical category names recalled in free recall 2 vs. free recall 1 in the physical reinstatement group as compared to an increase of 5.6% in the mental reinstatement group and a 0-2% increase in the groups with no reinstatement. While the mental reinstatement groups did have a slight advantage over the no-reinstatement groups, planned comparisons show that this was not a statistically supported recovery effect.   .

Planned comparisons were computed to determine the effects of context reinstatement on memory recovery using t-tests which compared the mean proportions of critical category names recalled in free recall 1 versus the mean proportions of critical category names recalled in free recall 2. All tests were considered significant at $p < .05$.

There was a significant memory benefit for physical reinstatement that occurred in the

PR group in the forget condition, [t (17) = 2.92, p = .01]. Despite trends in the means

that would indicate a similar memory benefit for mental reinstatement in the MR group

of the forget condition, no significant memory benefit was demonstrated for this group,

[t (17) = 1.00, p = .33].

Table 3. Free Recall 1; Mean Proportions of Critical List Names Recalled as a Function
of Context Group and Condition

	Context Group			
Condition	AA	BB	MR	PR
Control Condition	.590 (.251)	.592 (.293)	.647 (.249)	.666 (.322)
Forget Condition	.476 (.326)	.389 (.348)	.296 (.253)	.259 (.244)

Note: Standard deviations appear in parentheses.

Table 4. Free Recall 2; Mean Proportions of Critical Names Recalled as a Function of Context Group and Condition

	Context Group			
Condition	AA	BB	MR	PR
Control Condition	.621 (.278)	.648 (.242)	.627 (.286)	.708 (.269)
Forget Condition	.476 (.290)	.427 (.298)	.352 (.312)	.370 (.253)

Note: Standard deviations appear in parentheses.

Cued Recall, Memory Errors and Recovery

A 2 (condition) X 4 (group) one way ANOVA was calculated using the

proportion of critical lists that included intrusions in cued recall (see Table 5). The

results of the one-way ANOVA found no significant main effects for group [F (3, 140) =

0.64, *MSE* = 0.02], condition [F (1, 104) =0.03, *MSE* =0.02], or interactions. Participants

in any one experimental group did not experience significantly more memory errors than

the participants in the other groups. Also, participants in either condition did not

experience significantly more memory errors than participants in the other condition.

However the mean proportions of category intrusions shown in Table 5 indicate that

memory errors occurred more frequently for the context reinstatement groups in the

control condition than they did for the no-reinstatement groups in the control condition.

And that in the forget condition memory errors occurred less frequently for the context

reinstatement groups than they did for the no-reinstatement groups. It should also be

noted that the MR group maintained a consistently low intrusion rate in both control and

forget conditions.

A 2 (condition) X 4 (group) one way ANOVA was calculated using the

proportion of critical list items recalled in cued recall. The results of the one-way

ANOVA found no significant main effects for group [F (3, 140) = 0.18, MSE = 0.07],

condition [F (1, 140) = 0.03, MSE = 0.07], or interactions, with participants in all groups

and conditions recalling similar numbers of critical list items.

Table 5. Cued Recall; Mean Proportions of Category Intrusions as a Function of Context Group and Condition

| | Context Group | | | |
Condition	AA	BB	MR	PR
Control Condition	.363 (.250)	.370 (.225)	.372 (.200)	.416 (.355)
Forget Condition	.444 (.285)	.444 (.225)	.370 (.253)	.407 (.244)

Note: Standard deviations appear in parentheses.

DISCUSSION & CONCLUSIONS

The present study showed strong forgetting effects in the first free recall test for

the groups in the forget condition as compared to the groups in the control condition.

The forgetting effects found here are consistent with previous experiments using the

retrieval bias method (Smith & Moynan, 2004). Such effects demonstrate a retrieval

advantage for the filler lists over the three critical lists to which participants were not re-

exposed. This means that participants were more likely to access filler lists than the lists

to which they were not re-exposed, causing a memory block.

Also, a stronger forgetting effect occurred in the groups that received the first

free recall test in Context B (a different room than the study context), indicating a strong

context interference effect. This offset was demonstrated by the fact that groups tested in

the intervening context (Context B) recalled fewer critical lists during the first free recall

test than did the group tested in the learning context (Context A). The context

interference effect is consistent with the encoding specificity principle (Tulving &

Thomson, 1970), which states that performance on memory tests will be better if

learning and testing conditions match than if they are mismatched.

The second free recall test yielded modest recovery effects in the physical

reinstatement group, but not in the mental reinstatement group, for the initially blocked

stimuli. While it could be argued that participants would recall more in the second free recall test due to the additional time it afforded them to try to recall the word lists, this argument would not account for the fact that the strongest recovery effects were demonstrated by a context reinstatement group. Indeed, free recall performance for the physical reinstatement group showed the strongest recovery effect from the first free recall test to the second. This implies that this context reinstatement technique granted participants in the physical reinstatement group some advantages during the recall process which the other groups did not receive. This physical reinstatement recovery effect was modest in strength, and while the mental reinstatement groups did have a slight advantage over the no-reinstatement groups this was not a statistically supported recovery effect.

This is the fist study to show that physical context reinstatement can influence the recovery of experimentally blocked stimuli. Previous research has only focused on the usefulness of these techniques for enhancing memories which were continuous and in which there may have been a decrement for the target memories (Malpass, 1996; Scheflin, Brown, Frischholz & Caploe, 2002; Smith, 1979).

Despite the fact that the cognitive interview has been called a memory recovery

technique (Scheflin et al., 2002) the findings of the present study do not support the

implication that mental reinstatement is useful for recovery. It is not clear, however,

why physical reinstatement had an influence on recovery while mental reinstatement did

not. Future research should explore the differences in these two similar procedures to

better establish their usefulness in memory recovery, and determine whether some

peculiar aspect of the present study may have influenced the results for mental

reinstatement.

The use of more detailed and elaborate mental reinstatement instructions than

were used in the present experiment may show that this sort of context reinstatement can

influence the recovery of more forgotten memories. Also, the administration of source

monitoring instructions along with context reinstatement techniques may improve the

accuracy of memories that are reported by individuals using them.

Equally important is the finding that the rates of memory errors, as observed

during cued recall testing, were not higher in the context reinstatement groups than in the

other groups. To the contrary, although this was not statistically significant, the means

for the context reinstatement groups *decreased* in the forget condition as compared to the

control condition, while in the no-context reinstatement groups the converse was true.

Also, the mean of memory errors in the mental reinstatement group for the forget

condition was numerically (although not statistically significant) the lowest of all of the

groups in the forget condition. Overall, the memory error rates found in this study

support the assertion that imagery techniques like mental reinstatement to context, as

administered without undue influence or coercion (though it was not found to be an

effective recovery technique) do not seem to be "risky" in the sense of increasing false

memories in this paradigm.

Findings from cued recall also demonstrated that the forget groups all

experienced similar recovery effects during this test. This was expected and is consistent

with Smith's outshining hypothesis (Smith & Vela, 2001) which states that the memory

cues provided in cued recall, in this case the category names of the critical lists, make

the use of contextual cues to aid recall unnecessary. Thus, even the context reinstatement

groups would not need to rely heavily, or at all, on the learning context as a source of

cues to help them remember the blocked stimuli. Their performance on the cued recall

test would be expected to be comparable to the no- context reinstatement groups, as it was actually found to be.

The implications of the results indicate, first, that the use of mental imagery techniques like mental reinstatement to context may not be as detrimental to memory accuracy as some researchers might suggest (Garry et al., 1996; Goff & Roediger, 1998; Libby, 2003; Thomas & Loftus, 2002). Second, the present findings, in conjunction with those of other researchers (Clancy et al., 1999; Kealy & Arbuthnott, 2003; Paddock & Terranova, 2001), imply that memory accuracy may be affected more by how imagery techniques are administered rather than by the techniques themselves. Third, it may be that in real world settings the use of physical reinstatement for memory recovery purposes along with mental reinstatement for memory enhancement purposes may be a complementary pairing of these techniques. In this case, details of a memory that is recovered via physical reinstatement can then be enhanced via mental reinstatement.

However, the assertions and conclusions that can be made in the present study may be limited because of some aspects of the experimental methodology. For example, using word lists as experimental stimuli may not generalize to real-world settings. Although, list learning paradigms are used frequently throughout cognitive memory

studies, their similarity to real-life events and to the forms in which information may

normally be encoded in memory is modest. Also, the word-list stimuli do not have the

highly affective or traumatic content that many blocked memories may have, and so the

present study does not attempt to make assertions regarding how traumatic or strongly

emotional memories may be affected by the use of context reinstatement techniques. It

should be noted, however, that the methods used in the present study have also proven

effective for materials with more affective content that contain explicitly violent and

sexual material (Smith & Moynan, 2004). In addition, the context rooms would ideally

have been counterbalanced and there would have been different experimenters working

in each room. The room counterbalancing would have ensured that neither context was

influencing participants' memories in some unforeseen way. And having different

experimenters for each context would have possibly provided a salient change between

contexts and also have paralleled situations in which an eyewitness, for example, would

have to deal with multiple investigators in various environments. Also, it may have been

interesting to monitor the memory errors that participants experienced in the second free

recall test when the context reinstatement manipulations were applied, rather than only

monitoring them in cued recall. This would allow for a more detailed account of the

immediate effects of context reinstatement on memory accuracy in the second free recall

test as well as an account of the after effects of context reinstatement in cued recall.

Future research should address these limitations directly, perhaps in replication studies.

For instance, another study similar to the present one could use affective vs. neutral

paragraph stimuli that describe real-life scenarios to determine the effectiveness of

context reinstatement and mental imagery on memory for more generalizable stimuli.

In summary, the present study finds that physical reinstatement to context can

influence the recovery of blocked memories, and that the imagery component of mental

reinstatement did not negatively affect memory accuracy later. The former finding is

novel, and may lead to future studies concerning the ability of context reinstatement to

recover inaccessible memories. The second finding does not support the proposal that

mental imagery techniques used to influence memory lead to "false memories" or to

recall which is any more error prone than that yielded by other recovery methods.

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APPENDIX A

| Reading Materials | *Death (critical list) | Structural Parts |

magazine	Croak	beams
short story	Rot	door
novel	Vulture	floor
journal	Coffin	steps
letter	Morgue	lobby
article	Corpse	ceiling
essay	Cemetery	roof
poem	Die	basement
Bible	Road-kill	elevator
newspaper	Murder	wall

*Tools (critical list)	Kitchen Utensils	*Birds (critical list)
saw	fork	eagle
sander	pan	crow
nails	can opener	cardinal
pliers	bowl	blue jay
wrench	beater	dove
file	saucer	hawk
crowbar	stove	parrot
vise	skillet	canary
wedge	toaster	pigeon
screwdriver	blender	sparrow

Weapons	Fish	Elective Offices
sword	sardine	governor
rifle	marlin	mayor
bomb	perch	secretary
mace	carp	sheriff
gun	cod	president
switchblade	pike	senator
missile	tuna	chairman

pistol	shark	judge
dagger	salmon	alderman
bazooka	herring	congressman

Flowers	Vehicles	Human dwellings
rose	truck	mansion
tulip	bus	apartment
daisy	airplane	tent
poppy	trolley	cave
magnolia	bike	hotel
lilac	ambulance	trailer
lily	carriage	cottage
gardenia	tractor	igloo
buttercup	jeep	building
pansy	train	shack

Vegetables	Countries	Fruits
corn	France	apple
peas	Russia	banana
green beans	Brazil	strawberry
beets	Norway	apricot
celery	Austria	cherry
spinach	Peru	plum
asparagus	Japan	raspberry
broccoli	India	grape
squash	Australia	watermelon
lettuce	Italy	lime

Insects	Earth Formations	Clothing
mantis	hill	shoes
mosquito	lake	bra

roach	cliff	underwear
scorpion	mountain	shorts
spider	river	skirt
tick	rock	shirt
wasp	plain	jeans
locus	desert	dress
flea	island	hat
cricket	valley	jacket

Musical instruments	Cities	Furniture
viola	Los Angeles	bed
drum	London	bookcase
accordion	New York	dresser
harmonica	Baltimore	lamp
cello	Denver	shelves
flute	Houston	sofa
clarinet	Rome	cabinet
organ	Washington	table
xylophone	Miami	stool
guitar	Paris	mirror

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