EFFECTS OF CONTEXT ENCODING AND CUING: TESTS OF THE OUTSHINING AND OVERSHADOWING HYPOTHESES

A Thesis

by

ISABEL MANZANO

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

May 2008

Major Subject: Psychology

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Approved by:

Chair of Committee,	Steve Smith
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ABSTRACT

Effects of Context Encoding and Cuing: Tests of the Outshining and Overshadowing Hypotheses.

(May 2008)

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The following experiments looked at how encoding information and available cues at test can influence context effects. More specifically, the present experiments investigated the overshadowing and outshining hypotheses. Experiment 1 established a new method for attaining robust reinstatement effects by using movie scenes. Experiment 2 found support for the outshining hypothesis. So, if verbal and contextual cues were encoded and verbal cues were present at test, then context reinstatement through the reinstatement of the movie scenes would have little effect on memory. However, in the absence of verbal cues at test, significant context effects were found showing that the verbal cues were able to outshine the context (i.e., the movie scenes). Experiment 3 extended the outshining hypothesis by showing that strengthening the association between the verbal cues and the target items led to greater outshining of the movie scenes by the verbal cues. Experiment 4 looked at the overshadowing hypothesis and showed that if the context (i.e., the movie scenes) was not encoded well, but the verbal cues were then the context was overshadowed by the verbal cues. Further, if the association between the verbal cue and target items was encoded, then the

overshadowing effect was greater as compared to cases where the association between the two items was not encoded. Finally, Experiment 5 found that if context was well encoded but verbal cues were not well encoded then the verbal cues were overshadowed by the context. It was also found that encoding the association between the context and target led to a more robust overshadowing effect as compared to cases where the association was not encoded.

ACKNOWLEDGEMENTS

Many people have contributed to the completion of this work and it is only appropriate that I begin this thesis with thanks to my parents, especially my mom, Maria. Without her courage and support, I would never have had the opportunity to get this far in my education. I would also like to thank my sisters and brother for always supporting all of my endeavors. Additionally, I would like to give a big thanks to my committee chair, Dr. Steven Smith, for the time, patience, and advice that he invested through this entire process. The guidance of Dr. Lisa Geraci, Dr. Jyotsna Vaid, and Dr. Charles Shea was also much appreciated.

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1. INTRODUCTION: CONTEXT DEPENDENT MEMORY

Context can be generally defined as "anything that surrounds a target, spatially, temporally, or cognitively" (Balfour, 1998) and the effect of context on memory is important to study because many theories of memory storage and retrieval incorporate contextual cuing in their models. For example, current models of memory including the SAM model (Raaijmakers & Shiffrin, 1981), the ICE model (e.g., Murnane, Phelps, & Malmberg, 1999), other theories incorporate models of contextual drift (e.g., Mensink & Raaijmakers, 1988) use context as an important explanatory variable. Furthermore, contextual reinstatement is at the heart of applied procedures for improving memory, particularly for eyewitnesses to crimes (e.g., Geiselman, Fisher, MacKinnon, & Holland, 1985; Memon, Wark, Bull, & Koehnken, 1997). In the cognitive interview, for example, participants are explicitly asked to think back to the place and time where a crime has occurred in order to try to recall key information.

Context can be manipulated in a variety of ways. Some of the first studies involving context effects examined how context can reduce interference. In these studies, participants studied target and interfering lists presented in either the same or separate contexts. Results showed that learning the target lists in one environmental context and the interfering lists in another reduced interference (Bilodeau & Schlosberg, 1951; Dallett & Wilcox, 1968). Memory can also be improved with multiple learning contexts. Participants exposed to material in different environmental contexts or

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This thesis follows the style of *Memory & Cognition.*

rooms and then tested in an entirely different environmental context show improved memory for the study lists than when learning is confined to a single learning context (Smith, 1988). The improved recall is presumed to occur because providing multiple learning contexts provides participants with many more cues to aid the retrieval of items. A meta-analysis found that interference reduction and multiple learning context paradigms generally produced the most robust context effects (Smith & Vela, 2001).

Changing semantic contexts by exploiting the relationship between two words also improves memory. In one study that manipulated semantic context (Light & Carter-Sobell, 1970), participants were shown paired associates like *strawberry-JAM* that biased them to think of only that particular relationship (or context) between the words during study. At test, participants were then shown the same cue (same meaningful context) or a different cue (different meaningful context) that was also associated with the target (e.g., *traffic*). People found it more difficult to recognize the target, *JAM*, if the test cues given came from a different meaningful context as compared to cues that came from the same meaningful context (Light & Carter-Sobell, 1970).

Another type of context that aids memory is the incidental environmental context and the present paper will focus only on the manipulations of this type of context. An incidental environmental context differs from the contexts described above because it refers to the "spatial and temporal contexts that are not obviously related to the targets on a memory test" (Smith, 1994). Many dimensions of the incidental environment have been manipulated to examine context-dependent memory. Studies have looked at the effect of room manipulations (e.g., Smith, 1979; Smith, Glenberg & Bjork, 1978),

changes in the natural environment (e.g., Godden & Baddeley, 1975), and changes in the ambient odor (e.g., Herz, 1997; Smith, Standing, & de Man, 1992) and background music (e.g., Balch, Bowman, & Mohler, 1992; Smith, 1985) on participants' memory. When the incidental environmental context is the same at encoding and test memory is improved as compared to memory when the encoding environment is different from the test environment, an effect referred to as a reinstatement effect (Smith & Vela, 2001). Reinstatement effects can be understood based on the encoding specificity principle. This principle postulates that the environmental context can be encoded as part of a memory trace and that this can aid memory for information stored in the mind when a person is placed in the same context. Thus, because memory is cue-dependent, memory will always be best when the conditions at test match the conditions during encoding (Tulving, 1983). This cue-dependent effect occurs not only for incidental environmental cues, but for semantic contexts, as well (e.g., Light & Carter-Sobell, 1970).

The most common way to study reinstatement effects is through physical reinstatement manipulations where participants are physically placed in varying incidental environmental contexts. In these studies, participants encode targets in one environmental context, and are then tested either in the same environmental context or in a different environmental context (Smith, 1994). In a classic study, participants were asked to remember a list of words either underwater or on land. It was found that memory for the words was greatly improved when participants were tested in the same environment where the encoding occurred as compared to a different environment (Godden & Baddeley, 1975). A number of studies have also used room manipulations to

study the effects of reinstatement (Smith, Glenberg, & Bjork, 1978; Smith, 1979). In these studies, participants study lists of words in one laboratory room and recall the words in either another perceptually distinct room, or in the same room where encoding took place. Studies, such as the Godden and Baddeley (1975) study, have found that testing in the same environment where encoding occurred aids memory.

Other studies have looked at reinstatement effects by manipulating odors in the room and have found reliable context effects when odors during encoding are reinstated at retrieval (Herz, 1997; Smith, Standing, Anton de Man, 1992). For example in her second experiment, Herz (1997) had participants that were placed under some anxiety learn a list of nouns while an ambient odor was present in the background. Participants were then given a free recall test for the items and either had the same ambient odor present or no ambient odor. She found that memory was best when the same ambient odor was present at encoding and retrieval as compared to recall when no odor was present at retrieval.

Reinstatement effects have also been found by altering the ambient sound, such as background music or white noise (e.g., Balch et al., 1992; Smith, 1985). In the Balch et al., (1992) study, participants rated words for pleasantness while listening to a song in the background (either fast jazz, slow jazz, fast classical, slow classical). Then, some of the participants were given immediate free recall tests or 48-hour delayed free recall tests. At test, participants heard either the same music heard during encoding (i.e. same incidental context), different music from encoding (i.e. different incidental context), or no music. Participants who were exposed to same music during encoding and retrieval

recalled more items than those exposed to a different incidental context (background music) during immediate recall.

It is important to note that context effects have been found to affect not only memory for written material but also memory for motor tasks (Wright & Shea, 1991). In one study, participants completed a set of either difficult motor sequences or easy motor sequences, each with a different context (the backgrounds of their computer screens were manipulated). People who had the easy motor sequences were able to reproduce the sequence even if the context was changed, whereas people in the difficult motor sequence task needed context reinstatement to do well (Wright & Shea, 1991). Additionally, linguistic context at encoding may also affect memory (Marian & Kaushanskaya, 2007). Mandarin-English speakers' memories were tested by asking participants general questions that had more than one correct answer. It was seen that the language in which the questions were asked served as a retrieval cue. When participants were asked to name a statue with a raised arm in Mandarin they readily named the Statue of Mao. In contrast, when asked the same question in English, participants were more likely to name the Statue of Liberty, showing that the language in which the question was asked influenced the type of answers that participants provided.

There have been some notable exceptions to the findings presented above and researchers have postulated that the lack of a reinstatement effect with some incidental context manipulations may be due to mental reinstatement. Mental reinstatement refers to the idea that participants who are in a different context from where the encoding originally occurred can either spontaneously reinstate the learning context or be

instructed to mentally picture that context. Through mental reinstatement, participants who imagine the encoding context or who are shown pictures of the encoding context can sometimes recall as much as those participants who are physically placed in the encoding context, as long as the encoding context is not hard to recall (Smith, 1979; 1984). Mental imagery is also a technique employed in the cognitive interview (e.g., Smith & Vela, 1992). When questioning eyewitnesses, asking people to mentally picture the scene can help them remember key information (e.g., Fischer & McCauley, 1995).

Researchers sometimes fail to find effects of environmental context change due to participants performing more associative processing during encoding, meaning participants may be forming more connections among the study items on the lists. Fernandez & Glenberg (1985) conducted a series of experiments in which they varied the study and test environmental context. Some of the participants were tested in the same context while others were tested in a different context. The authors failed to find reinstatement effects in all of their experiments. A reason for Fernandez and Glenberg's (1985) lack of context effects might be due to the fact that in their study, participants were asked to generate sentences that incorporated the targets. This may have led to more associative processing of the targets during encoding and therefore less processing of the environment. In other words, incidental context-dependent memory effects may be dulled when participants perform associative processing at encoding because not only might they fail to encode the incidental context (i.e. the environment) during study,

participants will also have better cues to guide retrieval so that any changes in the environment will be unlikely to cause poor memory performance (Smith & Vela, 2001).

As a result of Fernandez and Glenberg's (1985) failures to find effects of context on memory, Bjork and Richardson-Klavehn (1988) posited that some environmental context cues might not have an effect on memory because only salient environmental cues affect memory. The authors then went on to speculate that only integral and influential environmental contexts could affect memory. The authors defined *integral* contexts as those associated with a person's knowledge bases or that are needed to present the stimuli, whereas *influential* contexts are those that relate to how stimuli are presented but that are not necessary for encoding it. The authors then explained that all other environmental contexts were incidental and would not produce reliable context effects.

Finally, the failure to find effects of environmental context change on memory may be due to the type of test used. Most notably, the use of recognition tests can weaken and sometimes eradicate the effects of context change (Smith et al., 1978; Godden & Baddeley, 1980). For example, recognition tests using lists of words are not affected by room manipulations in the same way that recall tests are affected (Smith et al., 1978). Similarly, Godden and Baddeley (1980) in a replication of their 1975 study using a recognition test instead of a recall test failed to find any context reinstatement effects. Another factor that appears relevant is whether the study used lists of words as to-be-remembered material. A meta-analysis by Smith and Vela (2001) showed that reinstatement of environmental contexts aids both recall and recognition as long as the

studies discouraged inter-item associative processing. Because inter-item associations among list words are likely to be encoded and used to aid memory even on a recognition test, the presence of such associative cues could explain why weaker context cues did not have a significant effect. In cases in which the recognition test is not for a list of associated words, but rather for a single, to-be-remembered item, such as a single person seen in a staged event, environmental context cues do significantly affect recognition (e.g., Smith & Vela, 1992). Two hypotheses that have been posited to explain the difference in effect sizes found with environmental contexts, the outshining and the overshadowing hypotheses, are the focus of the present study.

OUTSHINING HYPOTHESIS

The outshining hypothesis (Smith, 1988; 1994; Smith & Vela, 1992) postulates that if participants engage in associative processing during the test, then it is unlikely that environmental context cues will be used to guide retrieval. Therefore, participants who receive more noncontextual cues at test, as in the case of paired associates or inter-associated word lists, will not have to rely on the environmental cues to aid memory because during the test, and will thus likely be focusing on the better cues (e.g., the words or associations) to guide retrieval and any change in the environment will likely have a negligible affect. The outshining hypothesis predicts that recall tests should demonstrate the most reliable environmental context effects because they do not provide noncontextual cues. With a recall test, participants are left with very little information to guide retrieval; therefore, participants are forced to rely on the cues from the environment to aid their memory. On the other hand, cued recall tests provide

noncontexual cues (i.e., a word) so people should show less dependence on the environmental context cues in cued recall tests. This hypothesis proposes that the discrepant results in the effects of changes in environmental context on recognition stem from the fact that recognition tests allow people to have powerful noncontextual cues at test, the actual to-be-remembered words, as well as other associated list words. The presence of the to-be-remembered stimulus decreases the need for contextual cues to aid memory (Smith & Vela, 2001).

An additional prediction of the outshining hypothesis is that if participants are asked to do associative processing of the items at encoding, then the environmental context will have little or no effect on memory at the time of recall. Associative processing is said to reduce reliance on environmental context because each item recalled or recognized serves as a good cue for other target items, such that the environmental context provides an ineffective and unnecessary cue (Smith & Vela, 2001).

There have been a handful of studies that have tested the outshining hypothesis. In a study involving context-dependent memory, participants had to study sentences and phrases and the encoding conditions were manipulated so that some participants would generate rich internal cues through imagery, organization/grouping, or self-referencing; while others encoded sentences superficially through typicality ratings. The researchers then looked at the effect of type of encoding and environmental context on recall of the phrases or sentences. They found more reliable context-dependent memory effects when participants did not generate rich contexts during encoding. The authors concluded that

their results could be explained by the outshining hypothesis since context-dependent effects only emerged when participants had not generated rich internal cues during encoding (McDaniel, Anderson, Einstein, & O'Halloran, 1989).

Another study attempted to directly test the predictions of the outshining hypothesis. In the first experiment participants were presented with pairs of words while the number of presentations of the words pairs was varied. There were four learning contexts that varied based on the foreground color, background color, screen location, and type style on computer screen. Recognition of the items was measured based on the number of repetitions and the environmental context manipulation (same or different). Results showed that the effect of context was greater as the item strength increased. The authors concluded that the outshining hypothesis cannot account for these findings because the outshining hypothesis would actually predict the opposite pattern: as item strength increases, context effects should decrease. A second experiment again measured recognition and manipulated study time and environmental context (the computer background) conditions. Results showed that recognition increased with the presentation time and the context effects did not change with item strength. Finally, a third experiment looked at recognition and manipulated cue strength with levels-of-processing. Participants studied a single list in a single context and they either rated the similarity of two members of a word pair (semantic task), or they counted vowels in word pairs (graphemic task). The authors once again did not find a decrease in context effects with increases in item strength, which they took as evidence that disconfirmed the outshining hypothesis (Murnane & Phelps, 1995).

There are a couple of issues with the Murnane and Phelps (1995) study. In their study, the number of targets were varied per context so in many cases their environmental contexts might have been overloaded. Additionally, their experiments showed that hits and false alarms both increased with the manipulations and so it can be argued that the background context manipulations might have been making everything seem more familiar; there was no indication that there was an effect of recollection. This is different from context memory effects where there is usually a change between hits and false alarms. Finally, a study conducted by Rutherford (2000) failed to replicate the findings from Murnane and Phelps' third experiment and found an effect of context manipulation with low but not high levels of processing (consistent with outshining hypothesis).

Another study that tested the outshining hypothesis (Cousins & Hanley, 1996) had participants study a list of words in one of two encoding conditions. Some of the participants encoded the list of words with relational processing while others encoded the list with individual item processing. The reinstatement effect on memory was then measured based on the type of processing done at encoding. Results showed no effect of room reinstatement on recall based on the study methods employed by participants. As a result, the authors posited that the outshining hypothesis could not explain their results (Cousins & Hanley, 1996). The problem with this study is that it is not necessarily a critical test of the outshining hypothesis because the authors failed to find any context effects at all with either relational processing which encouraged more associative processing during encoding or with individual item processing which involved less

associative processing of the items which the outshining hypothesis would argue would lead to more reliance on the environmental cues. Without finding any context-dependent memory effects it is impossible to weaken the context effects through outshining. In other words, the authors could not have investigated how more associative processing of the items may have discouraged the use of environmental context as compared to the effect of environmental context as a good retrieval cue when inter-item associations were discouraged.

OVERSHADOWING HYPOTHESIS

Whereas the outshining hypothesis focuses on what cues are used during the *test phase*, the overshadowing hypothesis focuses on the processes that take place during the *study phase*,. This theory is derived from the animal learning literature and is the idea that when trying to teach animals to respond to a compound stimulus, the animals may be naturally predisposed to learn more about one stimulus over the other. So, the presence of a good cue, a more salient cue, during training can impede the learning about a second, weaker cue, causing an animal to respond more strongly to the more salient cue (Domjan, 2003). Applied to the context-dependent literature, this hypothesis posits that if participants engage in conceptual processing at study, then the environmental context will be "suppressed" and therefore will not be encoded (Smith & Vela, 2001). Changes of suppressed and therefore unencoded environmental contexts should have no effect on memory for to-be-remembered events.

To date, there have been no studies in the context-dependent memory literature that have directly tested this hypothesis though a study conducted by Geiselman and

Bjork (1980) can be said to have tested the effects of overshadowing. In this study, participants were asked to use primary rehearsal to encode word trigrams. The background context, either a male or female voice, was manipulated during the encoding and test session. Results showed that recognition improved only when the context at test (the speaker's voice) matched the encoding context. In a second experiment, participants used secondary rehearsal to encode the trigrams while the encoding and retrieval context (the speaker's voice) were manipulated. In contrast to Experiment 1 findings, the second experiment did not find an effect of context reinstatement on recognition memory. The overshadowing hypothesis can explain their findings quite easily. In the first experiment participants were asked to use maintenance rehearsal, which is likely to lead to fewer associations being formed among the word trigrams. In contrast, the more elaborative rehearsal in Experiment 2 likely led to more associations being formed among all of the words. As the overshadowing hypothesis predicts, when more associative processing occurs during encoding, the background context is unlikely to be used as a cue to guide retrieval. On the other hand, because the first experiment led to fewer associations between the words during the encoding process, at test, participants had to rely on the background context (the speaker's voice) to guide their recognition for the trigrams.

Overall, the meta-analysis by Smith and Vela (2001) reported some support for the outshining hypothesis. The meta-analysis demonstrated that the kind of processing performed during encoding affects the size of environmental context effects. As predicted by the outshining hypothesis, the results showed that if participants are likely

to perform associative processing at encoding, then changes in environmental context will not affect memory performance. Of course, this finding is also in line with the overshadowing hypothesis as this theory posits that conceptual processing of the information during encoding will lead to a suppression of the environmental context.

The findings of Smith and Vela's meta-analysis (2001) did not completely support the overshadowing hypothesis' second prediction, though; the length of exposure to the environment at encoding did not affect the size of context effects. Although Smith and Vela's meta-analysis showed some support for both the outshining and the overshadowing hypotheses, the present paper experimentally tested these hypotheses. The present work tested two of these hypotheses, the outshining and overshadowing hypotheses, with respect to their effect on human memory.

PRESENT EXPERIMENTS

The purpose of the current experiments was to test the outshining and overshadowing hypotheses because the literature is lacking critical tests of these hypotheses. Experiment 1 tested a new method for manipulating incidental context whereas previous experiments had entire lists of words associated with one environmental context, leading to overloaded contexts, the method used in the present experiments allowed for a 1:1 target-to-context ratio thereby lessening the load on the context. Additionally, the background contexts in the present experiments were perceptually rich movie scenes that should serve as good retrieval context cues for participants. Finally, both contextual and noncontextual cues were manipulated at test which is critical for testing the outshining hypothesis.

Experiment 2 used the method from the first experiment to test the outshining hypothesis because the context cues and noncontextual cues could be manipulated at test. Many of the previous experiments that have tested the outshining hypothesis have manipulated the encoding conditions and at test have only manipulated the background context which makes it hard to critically test something like the outshining hypothesis. Experiment 3 further extended the predictions of the outshining hypothesis to see if there is a more pronounced outshining effect when the verbal cues are highly associated.

Experiments 4 and 5 tested the overshadowing hypothesis by manipulating the encoding instructions. In Experiment 4, participants were asked to form either an integrated mental picture, combining cue and target words, or two *separate* mental pictures of the cue and the target words. On the other hand, Experiment 5 tested a prediction of the overshadowing hypothesis by strengthening the relationship or association between the target words and the movie scenes, the environmental contexts.

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2. EXPERIMENT 1

RESEARCH OBJECTIVES

The goal of Experiment 1 was to test new stimuli, movie scenes, to see if these created an incidental rich environmental context that participants could use to aid their memory. A total of 30 background movie scenes and 30 words were used. The movie scenes included background sounds to make them more compelling contexts, and were not particularly distinctive; they were merely scenes of events that one may encounter on a daily basis (e.g. driving on a highway, walking on a sidewalk, people playing baseball on a field). To further clarify, these movie scenes were amateur videos of every day events that included no plot or dialogue. The words were not directly related to the movie scenes in any obvious way. It was predicted that if these incidental background movie scenes were able to create rich contexts for the targets, then participants should demonstrate better memory for the words that were associated with the reinstated scenes, as compared to their memory for words associated with the non-reinstated scenes.

Method

Participants

A total of 86 Texas A&M University undergraduate students participated in this experiment for course credit.

Design and Materials

The experiment used a 2 x 3 mixed factorial design. The word subset (A Words vs. B Words) was the within subjects variable and reinstatement (A scenes reinstated vs.

B scenes reinstated vs. no scenes reinstated) was the between subjects variable. These two variables served as the independent variables. Free recall performance served as the dependent variable.

Thirty words were derived from the MRC Psycholinguistic Database with written frequencies ranging from 50 – 100 (Kucera and Francis frequency norms). The 30 background movie scenes were randomly selected and were simply scenes of events that person may encounter on a daily basis (e.g., a park, a busy street, driving down the highway). Each participant studied all 30 words with their corresponding movie scenes.

Procedure

Participants were tested in groups of 10-20 people and were seated in front of a large video screen. They were told that they would study several lists of words superimposed on background movie scenes and that they should try to remember these words and movie scenes for a later memory test. The words and movie scenes were presented for 5 s each, and all participants saw all 30 background movie scenes and words.

After the study phase, participants were told that they would see some of the movie scenes that they viewed earlier. Participants were given a blank, lined sheet of paper and were asked to recall as many words as they could remember in any order. They were told to use the scenes, if they could, to aid their memory. During the free recall test participants in each condition saw 15 randomly chosen movie scenes (e.g., either set 1 or set 2). Participants in the control condition would simply see a blank screen. Each movie scene was played for 3 s. Participants were given approximately 3

min. for this recall test, the equivalent of four complete repetitions of the 15 reinstated movie scenes.

Results

An analysis of variance (ANOVA) tested the effect of reinstatement and word counterbalancing on free recall. A 2 (word counterbalancing: A vs. B) x 3 (reinstatement: A reinstated, B reinstated, no scenes) mixed ANOVA was computed, using proportion recalled as the dependent measure. Reinstatement was a between-subjects variable, and word counterbalancing was a within-subjects variable. The analysis showed a main effect of reinstatement, F (1,83) = 8.83, $p < .001$, $\eta^2 = .18$, indicating that people remembered more items when scenes were reinstated as compared to recall when scenes were not reinstated (Table 1). There was no main effect of word counterbalancing, F (1, 83) = 1.56, $p > .05$, $\eta^2 = .02$, showing that recall performance was similar for counterbalancing A and counterbalancing B words. There was a significant interaction of counterbalancing and reinstatement, F (1, 83) = 173.99, $p < .001$, $\eta^2 = .81$, showing that scene reinstatement improved the recall of counterbalancing A words and counterbalancing B words based on the scenes that were reinstated. That is, when A-scenes were reinstated, participants recalled more counterbalancing A words than counterbalancing B words, whereas when B-scenes were reinstated, participants recalled more counterbalancing B words than counterbalancing A words. When no scenes were reinstated, recall for counterbalancing A words and counterbalancing B words did not differ.

Table 1
Experiment 1: Mean Proportion of Recall Based on Scene Reinstatement

	Counterbalancing A	Counterbalancing B
A-Scenes Reinstated	.68 (.19)	.28 (.14)
B-Scenes Reinstated	.18 (.12)	.69 (.18)
No Scenes	.37 (.14)	.33 (.04)

Note—Standard deviations are in parentheses.

Pairwise *a priori* comparisons showed that in the A-scene reinstatement condition participants were more likely to recall counterbalancing A-words as compared to counterbalancing B-words, t (26) = 11.28, SE = .04, $p < .015$[1], indicating that participants recalled more words corresponding to the reinstated scenes as compared to words corresponding to nonreinstated scenes. In the B-scene reinstatement condition participants were more likely to recall counterbalancing B words as compared to counterbalancing A words, t (27) = 12.52, SE = .04, $p < .015$[2]. Finally, in the no scenes condition, there was no difference in the recall of counterbalancing A and counterbalancing B words, $p > .015$[3].

[1] Because three t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .015$.
[2] Because three t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .015$.
[3] Because three t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .015$.

A priori planned comparisons also indicated that there was a small effect of output interference with participants recalling more counterbalancing A-words when there were no scenes presented at test as compared to recall of counterbalancing A words when B-scenes were reinstated, t (58) = 5.68, SE = .03, $p < .025$[4]. There was no effect of output interference with counterbalancing B-words, t (57) = 1.30, SE = .04, $p > .025$[5], so participants recalled about the same number of counterbalancing B-words whether there were no scenes presented at test or if A-scenes were presented at test.

Discussion

The results from Experiment 1 demonstrated a robust context reinstatement effect; those items that were associated with reinstated scenes were recalled better than items that were not associated with the scenes presented at test. The effects seen in Experiment 1 were more robust than most of the previously reported effects. When the A-scenes were reinstated, participants were much more likely to recall the counterbalancing A-words as compared to the B-words with a mean difference of .40 between two word subsets. The mean difference between the two words subsets when B-scenes were reinstated was also large, .51, showing that participants recalled significantly more counterbalancing B-words as compared to the counterbalancing A-words. This shows that the contexts (i.e., the background movie scenes) were likely attended to by participants. The contexts were perceptually rich and engaging with a 1-to-1 context-to-target association which likely encouraged participants to focus on pay

[4] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[5] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.

attention to the contexts. At the moment, it is not clear which of these factors caused such large reinstatement effects.

Because these results showed such a powerful effect of the context on recall, it provided an excellent method to test if that effect can be weakened by outshining and overshadowing in the subsequent experiments. Experiments 2-5 tested the outshining hypothesis using this same method that was shown to produce robust context reinstatement effects, and could be easily adapted to critically test the outshining hypothesis. In these experiments participants studied a list of target words; each word appeared on top of a different background movie scene, and each target word was accompanied by a cue word. The present experiments tested the hypothesis that verbal cues provided during the test episode would "outshine" the background movie scenes as context cues.

3. EXPERIMENT 2

RESEARCH OJECTIVES

Experiment 2 tested the outshining hypothesis using the same method from Experiment 1 because it could be easily adapted to critically test the outshining hypothesis. In this experiment participants studied a list of 32 target words; each word appeared on top of a different background movie scene. This experiment tested the hypothesis that verbal cues provided during the test episode would "outshine" the background movie scenes as context cues.

Method

Participants

A total of 110 Texas A&M University undergraduate students participated in this experiment for course credit.

Design and Materials

The experiment used a 2 X 2 between-subjects design. Cue word (present vs. absent) and scene reinstatement (reinstated scenes vs. no scenes) served as the independent variables. Free recall performance served as the dependent variable of interest.

The materials included a list of 32 target words and 32 cue words from the MRC Psycholinguistic Database with written frequencies ranging from 200-300 (Thorndike-Lorge written frequency norms). The target words were 5-7 letters long while the cue words were exactly four letters long; the target and cue words were unrelated. The 32

movie scenes were scenes of everyday events unrelated to the target and cue words. The cue words were presented in all capital letters at the top of the screen while target words were presented at the bottom of the screen in lowercase letters. The words and movie scenes were presented on a video projector.

Procedure

Participants were tested in groups of 10-20 people and were seated in front of a large projection screen. They were told that they would study words written over background movie scenes. They were asked to try their best to remember the cue and target words and the movie scenes for a later memory test. Each of the movie scenes was presented for 5 s.

Immediately following presentation of the study words and background movie scenes, participants performed two distracter tasks for 5 min each in which they had to complete mazes and mental rotation problems. After the filled delay, participants were told that they would be given a memory test. They were given a blank sheet of paper, and, depending upon the condition, told that they would see either cue words, background movie scenes, or both and they were asked to write down as many targets as they could remember. Participants in the control condition were simply asked to write down as many words as they could remember, and were provided with a blank screen. Participants were told to recall the targets in any order, and they were given 45 s to write down as many targets as they could before the test stimuli (the movie scenes) began. It was emphasized that they were to write down *only* the target words and not the cue words (the words that we four letters long at the top of the screen). Each test stimulus

appeared for 4 s. The free recall test lasted a total of 6 min, the amount of time that it took for three repetitions of each of the stimulus.

Results

A 2 x 2 between-subjects ANOVA was used to examine the effect of cues (present vs. absent) and scene reinstatement (reinstated scenes vs. no scenes) on recall performance. Table 2 presents the proportion of words recalled when scenes and/or words were presented during the recall test. Results showed that there was a main effect of scene reinstatement F (1, 106) = 11.33, $p < .001$, $\eta^2 = .10$ indicating that people remembered more items when scenes were present ($M = .14$, $SD = .08$) as compared to when scenes were absent ($M = .10$, $SD = .05$). There was no main effect of cue words F (1, 106) < 1 and no interaction between the variables, F (1, 106) = 1.53, $p > .05$, $\eta^2 = .01$. The results demonstrated that recall improved when scenes were reinstated.

Table 2
Experiment 2: Mean Proportion of Recall Based on Type of Cues Present at Test

	Cue Words Present	Cue Words Absent
Reinstated Scenes	.14 (.08)	.14 (.07)
No Scenes	.11 (.06)	.09 (.04)

Note—Standard deviations are in parentheses.

A priori planned comparisons indicated that there was a scene reinstatement effect when cue words were absent. Participants recalled more items when scenes were reinstated than when there were no scenes present, t (41) = 3.13, SE = .02, $p < .025$[6], when cue words were absent at test. There was no scene reinstatement effect when cue words were present. The proportion of recall did not vary significantly based on whether scenes were present or absent, t (65) = 1.50, SE = .03, $p > .025$[7]. These results are consistent with the outshining hypothesis. When participants had the verbal cues present during the test episode, they relied more on these and less on the scenes to aid memory; the verbal cues outshone the environmental context cues. On the other hand, when participants only had environmental cues (i.e. the scenes) present during the test, they relied on these to aid memory and showed better memory for items whose scenes were reinstated.

A separate set of *a priori* planned comparisons examined the reverse outshining effect. When scenes were reinstated during the test, participants' recall was about the same whether cue words were present (M = .14, SD = .02) or absent (M = .14, SD = .07) showing no effect of cue reinstatement, t (45) = .36, SE = .23, $p > .025$[8]. On the other hand, there was a slight difference in recall rates when scenes were absent. Recall was higher when scenes were absent and cue words were present at test (M = .11, SD = .06) as compared to recall when scenes and cue words were absent (M = .09, SD = .04), t (61)

[6] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[7] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[8] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.

= 1.90, *SE* = .01, *p* = .06[9]. These results show a trend in the right direction and supply some weak support for the reverse outshining hypothesis.

Discussion

The results of Experiment 2 supported the outshining hypothesis. This experiment showed that scene reinstatement effects were affected by the presence or absence of noncontextual cues (i.e., the cue words) during the test. As the outshining hypothesis predicted, when cue words were absent during the test episode, there was a strong scene reinstatement effect meaning participants recalled more targets when scenes were present at test as compared to recall when there were no scenes present at test. When cue words were provided at test however, no scene reinstatement effects were found because, just as the outshining hypothesis predicted, participants were solely relying on the noncontextual cues (i.e., the cue words) to guide recall.

Because the outshining hypothesis posits that outshining can occur with any types of cues and is not limited to context cues. Experiment 2 also looked at the reverse outshining effect or the cue word reinstatement effects as a function of the presence or absence of background movie scenes at test. These results also showed some support for the outshining hypothesis. When scenes were present at test, the effect of cue reinstatement was not significant.

[9] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.

On the other hand, when scenes were absent at test, the results while not significant, still hinted at a cue word reinstatement effect; that is, recall was numerically (but not significantly) better when cue words were provided at test. These results show that the outshining hypothesis can work with various types of cues. Thus, the movie scenes were able to "outshine" the cue words at test.

4. EXPERIMENT 3

RESEARCH OBJECTIVES

Experiment 3 tested whether outshining effects would be more robust when verbal cues were more strongly associated with target words. If the cue and target words were strongly associated, then the cue words would greatly outshine the background scene context because it would be extremely easy for these noncontextual cues to guide retrieval. On the other hand, if the association between the target and the cue word was weak then it would be harder for the cue words to guide retrieval and participants would be forced to rely more on the movie scenes. Thus, it would be expected that with a weak target cue association, the outshining effect should be eliminated or greatly diminished. To test this idea, the same method from Experiment 2 was used. Participants studied a list of target words along with cue words and background movie scenes. The strength of the cues was manipulated by selecting materials from the University of South Florida Free Association Norms. As in Experiment 2, recall was tested either with or without the movie scenes and either with or without cue words.

Method

Participants

A total of 216 Texas A&M University undergraduate students participated in this experiment for course credit.

Design and Materials

The experiment used a 2 X 2 X 2 between-subjects design. Cue word (present vs. absent), scene reinstatement (reinstated scenes vs. no scenes), and cue strength (strong vs. weak) served as the independent variables. Free recall performance served as the dependent variable of interest.

The materials included a list of 32 target words 3-10 letters long (none was four letters long) from the MRC Psycholinguistic database with written frequencies ranging from 100-300 (Thorndike-Lorge word frequency norms). There was a total of 64 cue words exactly four letters long from the MRC Psycholinguistic database with written frequencies ranging from 100-300 (Thorndike-Lorge word frequency norms). Of the cue words, 32 were strong associates (*mill-factory)* and 32 were weak associates (*smog-factory*). See Appendix B for a complete list of the associates. The 32 movie scenes were the same scenes used in Experiment 2. The words and movie scenes were presented on a video projector.

Procedure

Participants were tested in groups of 10-20 people and were seated in front of a large projection screen. They were told that they would study words written over background movie scenes. They were asked to try to remember the words and movie scenes for a later memory test. Each of the movie scenes was presented for 5 s.

Immediately following presentation of the study list participants performed two distracter tasks for 5 min each in which they had to complete mazes and mental rotation problems. After the filled delay, participants were told that they would be given a

memory test. They were given a blank sheet of paper, and, depending on the condition, saw either cue words, background movie scenes, or both, and they were asked to write down as many targets as they could remember. Participants in the control conditions were simply asked to write down as many words as they could remember and were provided with a blank screen. Participants were told to recall the targets in any order, and they were given 45 s to write down as many targets as they could before the test stimuli began. It was emphasized that they were to write down *only* the target words and not the cue words (the words that we four letters long). Each test stimulus appeared for 4 s. The free recall test lasted a total of 6 min, the amount of time that it took for three repetitions of each of the stimuli.

Results

A 2 X 2 X 2 between-subjects ANOVA was used to examine the effect of cues (present vs. absent), scene reinstatement (reinstated scenes vs. no scenes), and cue strength (strong vs. weak) on recall performance. Results showed a main effect of scene reinstatement F (1, 208) = 28.28, $p < .001$, $\eta^2 = .12$, showing that people's memories for target items improved when scenes were reinstated as compared to their memory for target items when there were no scenes present during the test. There was also a main effect of cue words F (1, 208) = 156.19, $p < .001$, $\eta^2 = .43$, showing that people remembered more target items when cue words were presented during the test as compared to memory for target items when there were no cues present during the test. Finally, there was a main effect of the strength of the association, F (1, 208) = 25.02, $p < .001$, $\eta^2 = .11$, showing that people's memory for target items was greater when the cue

and target items were strongly associated as compared to recall when the cue and target items were weakly associated. Means for strong associates will be presented on Table 3 and means for weak associates will be presented on Table 4. The interaction between cue word reinstatement and the strength of the association was significant, F (1, 208) = 6.81, $p < .05$, $\eta^2 = .03$. The interaction between scene reinstatement and the strength of the association was not significant, F (1, 208) = 1.50, $p > .05$. The interaction between cue word reinstatement and scene reinstatement was not significant F (1, 208) < 1. The interaction between the variables: cue word reinstatement, scene reinstatement, and strength of association was not significant F (1, 208) < 1.

Table 3
Experiment 3: Mean Proportion of Recall: Strong Associations

	Cue Words Present	Cue Words Absent
Reinstated Scenes	.57 (.13)	.25 (.13)
No Scenes	.51 (.15)	.17 (.07)

Note—Standard deviations are in parentheses.

Table 4
Experiment 3: Mean Proportion of Recall: Weak Associations

	Cue Words Present	Cue Words Absent
Reinstated Scenes	.43 (.14)	.24 (.14)
No Scenes	.28 (.12)	.08 (.06)

Note—Standard deviations are in parentheses.

Outshining Effects

A priori planned comparisons were used to examine the effect of scene reinstatement with strong associates. When cue words were absent during the test, there was a marginally significant effect of scene reinstatement, t (39) = 2.46, SE = .03, p = .017[10]. Thus, when there were no cue words presented at test, people recalled more words when scenes were reinstated as compared to when there were no scenes present at test. On the other hand, when strongly associated cue words were present during the

[10] Because four t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .0125$.

test, the effect of scene reinstatement was not significant, t (43) = 1.27, SE = .04, p > .0125[11]. These results replicate and extend the results of Experiment 1 and show support for the outshining hypothesis. In the absence of strongly associated cue words, participants make use of the scenes to aid their memory. However, the presence of strongly associated cue words during the test outshines the scenes and no effect of scene reinstatement is found.

A priori planned comparisons were also conducted to test the outshining hypothesis with weakly associated cue and target words. The first comparison showed a significant effect of scene reinstatement when cue words were absent during the test episode, t (43) = 5.00, SE = .03, p < .0125[12]. This means that in the absence of cue words during the test, participants remembered more items when scenes were present as compared to when scenes were absent. There was also a significant scene reinstatement effect when weakly associated cue words were present during the test, t (72) = 5.12, SE = .15, p < .0125[13]. This shows that even when weakly associated cue words were present, participants relied on the scenes and recalled more target words when scenes were present as compared to when scenes were absent. The results demonstrate that even with weakly associated words, relative to strongly associated cues, participants rely on context scenes more heavily to aid memory. These results are in line with the outshining hypothesis; the cue words will only outshine the scenes when they serve as

[11] Because four t-tests were computed for these planned comparisons a familywise correction required that the significance level was p < .0125.
[12] Because four t-tests were computed for these planned comparisons a familywise correction required that the significance level was p < .0125.
[13] Because four t-tests were computed for these planned comparisons a familywise correction required that the significance level was p < .0125.

compelling cues. When the cue and target words are weakly associated, participants are more likely to use the better cues, the scenes, to aid their memory, so a scene reinstatement effect is found when cue words are present and when they are absent. One inconsistency in these results is that the weakly associated cue words did not cause a significant outshining effect, yet the unrelated cue words in Experiment 2 did cause such an effect. The reason for this inconsistency is not readily apparent.

Reverse Outshining Effects

Another set of *a priori* planned comparisons tested the reverse outshining hypothesis: that the scenes might outshine the cue words with strongly associated cue and target items. There was a significant effect of cue word when scenes were absent t (38) = 9.38, SE = .04, $p < .0125$[14], participants recalled more items when cue words were present during the test (M = .51, SD = .15) when compared to when cue words were absent (M = .17, SD = .08). This demonstrates that the cue words served as compelling retrieval cues during the test. The effect of cue words was also significant when scenes were present t (44) = 8.07, SE = .04, $p < .0125$[15], proportion of recall was higher when participants had cue words available (M = .57, SD = .13) as compared to when there were no cue words present (M = .25, SD = .13). These results show that scenes did not outshine the strongly associated cue words. Because the cue words and targets were strongly associated, participants appear to have used the cue words almost exclusively to aid their memory.

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[14] Because four t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .0125$.

[15] Because four t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .0125$.

A priori planned comparisons also tested the reverse outshining effect with weakly associated cue and target items. There was a significant effect of cue word when scenes were absent, t (60) = 8.92, SE = .02, $p < .0125$[16]; participants recalled more items when weakly associated cue words were present at test (M = .28, SD = .12) as compared to recall when cue words were absent (M = .08, SD = .06). Thus, in the absence of scenes at test, people used the cue words to aid memory. There was also a significant effect of cue word when scenes were present, t (55) = 5.10, SE = .04, $p < .0125$[17]; participants recalled more items when weakly associated cue words were present at test (M = .43, SD = .14) as compared to recall when cue words were absent (M = .24, SD = .14). These reveal no support for a reverse outshining effect; the scenes did not outshine the weakly associated cue words.

Discussion

Scene Reinstatement Effect with Strong Associates

When the cue and target relation was (pre-experimentally) strong, then only a small effect of scene reinstatement was expected. In fact, the results showed that when strongly associated cue words were present at test, there was no effect of scene reinstatement. Thus, the strongly associated cue words were able to outshine the scenes because they were specifically chosen to be effective retrieval cues at test.

There was only a small scene reinstatement effect when there were no strongly associated cue words present at test. Participants probably encoded the association

[16] Because four t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .0125$.
[17] Because four t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .0125$.

between the cue and target, but were less likely to use that association when those words were not provided at test. Overall, the results demonstrated that with strong cue-target associations there was a strong outshining effect regardless of whether cue words were present or absent during the test.

Scene Reinstatement Effect with Weak Associates

The weak association between the target and cue words led to a lack of an outshining effect. When the weak cue words were present at test they failed to outshine the background movie scenes because the words were weakly associated, and therefore furnished little information to aid their memory.

When cue words were absent, the scene reinstatement effect was significant demonstrating that the weakly associated cue words were unable to outshine the background movie scenes. This probably occurred not only because the association between the cue and target words was weak leading participants to rely on other cues to aid their memory (i.e., the movie scenes), but also because the cue words were absent during the test, leading participants to focus solely on the movie scenes to aid memory.

Cue Reinstatement Effect with Strong Associates

Experiment 3 also examined whether the presence or the absence of scenes during the test would have an outshining effect on the effectiveness of the cue words, a reverse outshining effect. When there was a strong association between the cue and target word, there was a strong cue reinstatement effect regardless of whether the background movie scenes were provided during the test, showing that the background movie scenes were unable to outshine the strongly associated cue words. This probably

occurred because the association between the cue and target was so strong that participants simply relied on this association to aid their memory.

Cue Reinstatement Effect with Weak Associates

The results showed no support for the reverse outshining effect with weakly associated target and cue words. The scenes did not outshine the cue words because it was probably easier for participants to form an association between the target and cue word as compared to forming an association between the target words and the context (i.e., the background movie scenes).

5. EXPERIMENT 4

RESEARCH OBJECTIVES

The purpose of experiment 4 was to study the overshadowing hypothesis to see if the effect of scene reinstatement varied as a function of whether the cue words were intentionally encoded or not. This was manipulated through the introduction of an encoding instruction condition where participants were explicitly told to encode the cue words and associate them with the target words. Recall was compared to a group of non-instructed participants. It was expected that if the encoding instructions focused participants' attention on the verbal cues and targets, then the context (the movies scenes) would not be well encoded and would therefore be overshadowed by the instructions.

The second purpose of this experiment was to examine whether the scene reinstatement effect depended on not only the encoding of the cue words, but also on whether the association between the target and cue words was encoded. This was manipulated through the type of encoding instructions provided for participants; some participants formed a strong association between the target and cue words through the formation of an integrated image of the two items which should lead to less reliance on the scenes; whereas others formed a weaker association through the formation of two separate images of the items which should lead to more reliance on the scenes. It was expected that if participants formed a stronger association between the target and verbal cues through the formation of an integrated image, then the overshadowing effects

would be stronger as compared to the overshadowing effect when participants formed two separate images of the target and the verbal cue. So, when participants formed an integrated image, there should be more reliance on the cue words.

Finally, this experiment was conducted to see whether the outshining hypothesis predictions would hold true based on the cues provided at test.

Method

Participants

A total of 348 Texas A&M University undergraduate students participated in this experiment for course credit.

Design and Materials

The experiment used a 2 X 2 X 3 between-subjects design. Cue word (present vs. absent), scene reinstatement (reinstated scenes vs. no scenes), and encoding instructions (separate instructions vs. integrated instructions vs. no instructions) served as the independent variables. Free recall performance served as the dependent variable of interest.

The materials included a list of 32 target words and 32 cue words from the MRC Psycholinguistic database with written frequencies ranging from 200-300 (Thorndike-Lorge written frequency norms). The target words were 5-7 letters long while the cue words were exactly four letters long; the target and cue words were unrelated. The 32 movie scenes were scenes of everyday events that were not obviously related to the target and cue words. The words and movie scenes were presented on a video projector.

Procedure

Participants were tested in groups of 10-20 people and were seated in front of a large projection screen. They were told that they would study words written over background movie scenes. They were asked to try to remember the words and movie scenes for a later memory test. The participants in the instructed condition were placed in one of two groups: integrated image or separate images. In the integrated image condition, participants were asked to form a single mental image that incorporated the cue word and the target word. In the separate images condition, participants were asked to form two separate mental images, one image for the cue word and one image for the target word. There was a final group that served as a control and received no deliberate instructions. The participants in the no instructions group were simply told to memorize the scenes and the words (the targets and cues). Each of the movie scenes was presented for 5 s.

Immediately following presentation of the study list, participants performed two distracter tasks for 5 min each in which they had to complete mazes and mental rotation problems. After the filled delay, participants were told that they would be given a memory test. They were given a blank sheet of paper and depending on the condition, participants were told that they would see cue words, background movie scenes, or both, and they were asked to write down as many targets as they could remember. Participants in the control condition were just asked to write down as many words as they could remember and were provided with a blank screen. Participants were told to recall the list items in any order and they were given 45 s to write down as many targets

as they could remember before the test stimuli begin. It was emphasized that they were *only* to write down the target words and not the cue words (the words that we four letters long). Each test stimulus appeared for 4 s. The free recall test lasted a total of 6 min, the amount of time that it took for three repetitions of each of the stimulus.

Results

A 2 X 2 X 2 between-subjects ANOVA was used to examine the effect of instructions (instructed vs. non-instructed), cues (present vs. absent) and scene reinstatement (reinstated scenes vs. no scenes) on recall performance. The instructed condition included both conditions in which participants were asked to image target and cue words separately, and instructions to form integrated images that included both, target words and their accompanying cue words. The proportion of items recalled based on these variables is presented in Table 5. Results showed a significant main effect of instruction, F (1, 340) = 7.28, $p < .05$, $\eta^2 = .02$, showing that instructing the participants during the encoding session improved memory for target items as compared to their memory when there were no specific instructions; the overshadowing effect. There was also a main effect scene reinstatement, F (1, 340) = 6.26, $p < .05$, $\eta^2 = .02$, showing that the presence of scenes aided participants' memories for target items. The main effect of cue word was marginally significant, F (1, 340) = 3.59, $p = .06$, $\eta^2 = .01$, showing that presence of cues improved memory as compared to the absence of cues. The interaction between scene reinstatement and instructions was not significant, F (1, 340) = 1.83, $p >$ .05. The interaction between scene reinstatement and cue words was also not significant, F (1, 340) < 1. There was a significant interaction between instructions and

cue words, F (1, 340) = 9.24, $p < .05$, $\eta^2 = .03$, showing that when there were no instructions given during the encoding session, memory was the same when cue words were present or absent. However, when participants were given instructions during the encoding episode, memory was better when cue words were present as compared to memory when cue words were absent. Finally, the interaction between instructions, cue word, and scenes was not significant, F (1, 340) = 1.24, $p > .05$, $\eta^2 = .00$.

Table 5
Experiment 4: Mean Proportion of Recall: Instructed vs. Non-instructed

		Cue Words Present	Cue Words Absent
No Instructions	Reinstated Scenes	.15 (.07)	.19 (.06)
	No Scenes	.09 (.06)	.10 (.05)
Instructions	Reinstated Scenes	.25 (.20)	.14 (.07)
	No Scenes	.21 (.18)	.14 (.05)

Note—Standard deviations are in parentheses.

No Instructions

A priori planned comparisons were conducted to test the effect of scene reinstatement when no special instructions were given to participants during the study encoding. Results showed a significant scene reinstatement effect when cue words were

absent from the test, t (27) = 4.42, SE = .02, $p < .025$[18], showing that in the absence of cue words, memory was better when scenes were present at test as compared to memory when scenes were absent. When there were cue words were present at test and no special instructions were given to participants during the encoding session, there was no significant effect of scene reinstatement, t (28) = 2.28, SE = .02, $p > .025$[19].

Another set of *a priori* planned comparisons was conducted to test the reverse outshining effect. It was found that when scenes were absent during the test there was no significant effect of cue words, t (27) = .12, SE = .02, $p > .025$[20]. There was also no significant effect of cue words when scenes were present during the test, t (28) = 1.66, SE = .03, $p > .025$[21]. These results show no evidence of the scenes outshining the cue words (i.e., the reverse outshining effect).

Instructions

A priori planned comparisons were also conducted to analyze the scene reinstatement effect in the presence of special instructions given during the encoding session. In the absence of cue words at test, the effect of scene reinstatement was not significant, t (134) = .09, SE = .01, $p > .025$[22], meaning that recall did not differ based on the presence or absence of cue words at test. When cue words were present at test, there

[18] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[19] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[20] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[21] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[22] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.

was once again no scene reinstatement effect, t (151) = 1.46, SE = .03, p >.025[23]. The results demonstrate that the instructions during the encoding session worked out as planned. That is, participants seemed encode primarily the relationship between the target and the cue word, and they used the relationships that they had formed between the words to guide retrieval of the targets. As a result, the scenes went essentially unused by participants to aid memory.

The second family of *a priori* planned comparisons looked at the reverse outshining effect. When scenes were absent, the effect of cue words was significant, t (142) = 3.21, SE = .02, p < .025[24]; recall improved when cue words were present at test (M = .21, SD = .18) as compared to recall when cue words were absent (M = .14, SD = .05). Thus, participants appeared to rely on the cue words in the absence of any other cues to remember the target items. When scenes were present at test, the cue effect was also significant, t (143) = 5.05, SE = .02, p < .025[25] with participants again recalling more items when cue words were present (M = .25, SD = .20) as compared to their memory performance when cue words were absent (M = .14, SD = .07). Thus, the results did not demonstrate evidence for the reverse outshining hypothesis.

Altogether, these results show that the effect of the encoding instructions was a powerful one that did not allow participants to encode the context (i.e., the movie scenes) well; the context was overshadowed by the encoding instructions. Thus,

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[23] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was p < .025.
[24] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was p < .025.
[25] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was p < .025.

participants depended on the cue words to remember the targets, and scenes had very little effect on recall.

Another 2 X 2 X 2 between-subjects ANOVA was conducted to examine the effect of the type of instruction (separate pictures vs. integrated picture), cues (present vs. absent) and scene reinstatement (reinstated scenes vs. no scenes) on recall performance using only the instructed conditions. The means for this analysis will be displayed on Table 6. Results showed a significant main effect of type of instruction, F (1, 281) = 121.94, $p < .05$, $\eta^2 = .30$, showing that having the participants form a single integrated picture at encoding improved memory for target items as compared to memory when participants were instructed to form two separate pictures of the cue and the target items. The main effect of scene reinstatement was not significant, F (1, 281) < 1. There was a main effect of cue word, F (1, 281) = 89.31, $p < .05$, $\eta^2 = .24$, showing that having cue words present at test improved memory for target items. The interaction between the type of instruction (integrated picture vs. separate pictures) and scene reinstatement was not significant, F (1, 281) < 1.

Table 6
Experiment 4: Mean Proportion of Recall: Integrated Image vs. Separate Images

		Cue Words Present	Cue Words Absent
Integrated Image	Reinstated Scenes	.40 (.18)	.14 (.06)
	No Scenes	.39 (.22)	.15 (.05)
Separate Images	Reinstated Scenes	.11 (.06)	.13 (.07)
	No Scenes	.13 (.07)	.12 (.04)

Note—Standard deviations are in parentheses.

However, the interaction between type of instruction and cue word was significant, F (1, 281) = 96.96, $p < .05$, $\eta^2 = .26$, showing that forming a single, integrated picture of the target and cue word led to a big cuing effect, but forming separate pictures of the items led to no effect of word cues. The interaction between scene reinstatement and cues was not significant F (1, 281) < 1. Finally, the interaction between type of instruction, scene reinstatement, and cues was not significant, F (1, 281) = 1.03, $p > .05$, $\eta^2 = .00$.

Integrated Picture

A priori planned comparisons were conducted to test the effect of scene reinstatement based on the presence or absence of cues when participants formed integrated pictures of the target and the cue words. When cue words were absent at test, there was no significant scene reinstatement effect, t (86) = .54, SE = .01, $p > .025$[26]. When cue words were present at test, the effect of scenes was again not significant, t (60) = .30, SE = .05, $p > .025$[27]. The results both demonstrate that when participants formed integrated pictures, they relied on this association to aid memory and the presence or absence of scenes had very little effect on item recall.

A second family of *a priori* planned comparisons was conducted to test the reverse outshining effect. The cue reinstatement effect was significant when scenes were absent, t (69) = 4.98, SE = .05, $p < .025$[28]; participants showed superior memory for items when cues were present as compared to their memory for items when cues words were absent. Thus, having cue words at test improved memory of target items when compared to memory when cue words were absent.

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[26] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[27] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[28] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.

The second t-test showed that when scenes were present, the cue reinstatement effect was again significant, t (77) = 8.72, SE = .03, $p < .025$[29]. Recall was better when cue words were present as compared to memory when cue words were absent. Together, these results demonstrate that having participants form an integrated picture during study strengthened the association between the target and cue word to the point where scenes were not necessary and therefore did not affect recall (i.e., no reverse outshining effect).

Separate Pictures

A family of *a priori* planned comparisons was conducted to test the effect of scene reinstatement in the presence or absence of cue words when participants were instructed during the study episode to form two separate mental pictures of the target and cue words. When participants formed two separate pictures of the target and cue word, there was no significant effect of scene reinstatement when cue words were absent, t (46) = .67, SE = .02, $p > .025$[30]. This demonstrates that participants were relying on cue words and not scenes to recall the target items. When cues were present, the effect of scene reinstatement was not significant, t (89) = 1.37, SE = .01, $p > .025$[31], again lending support to the idea that people used the encoding instructions to encode the cue and target words, so the presence or absence of scenes did not affect recall.

The second set of *a priori* planned comparisons looked at the reverse outshining effect. The cue reinstatement effect in the presence or absence of scenes was not

[29] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[30] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[31] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.

significant t (71) = .77, SE = .01, $p > .025$[32] and t (64) = 1.22, SE = .02, $p > .025$[33], respectively.

Discussion

Encoding of the Information

This experiment examined the overshadowing hypothesis by manipulating the instructions provided during the encoding episode. Some of the participants were intentionally instructed to encode the cue and target words, whereas others received no explicit instructions. It was expected that the participants in the encoding instruction conditions would be more likely to encode the cue words, leading to a lack of a scene reinstatement effect at recall, whereas those in the non- instructed condition would be less likely to encode the cue words, thereby leading to a scene reinstatement effect in the absence of other cues.

As predicted, participants in the instructed condition failed to show a scene reinstatement effect regardless of the presence or absence of cue words at test. Thus, the instructions to encode the cue words and target items overshadowed the encoding of the context. In other words, it seems that the scenes were not well encoded. The results yielded no support for the encoding of the scenes because there was no improvement in target items recalled when the scenes were reinstated. However, when no instructions were given during the encoding session to intentionally encode the cue and target words in memory, there was a robust scene reinstatement effect when cues were absent, but no

[32] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[33] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.

effect when cues were present. These results are in line with those of Experiments 2 and 3, when participants were not instructed in any special way, an outshining effect can be found with cue words outshining the context.

Encoding of the Association

This experiment also sought to examine the importance of encoding the association between the cue and target word and this was tested through the manipulation of the instructions at encoding. As predicted, when participants encoded the association between the cue word and the target word through the creation of an integrated image there was no scene reinstatement effect regardless of whether the cue words were present at test. Weakening the association through the creation of separate images also led to a lack of scene reinstatement effects on recall though the effects were clearly weaker with the formation of separate pictures. This shows that weakening the association between the target and cue words led to a slight weakening of the overshadowing effect.

Reverse Outshining Effect

Finally, there was no evidence for the reverse outshining effect. Results showed no indication that cue word reinstatement had any effect on recall performance regardless of the presence or absence of scenes in the non-instructed condition; these results replicate the findings from Experiment 2. Additionally, when participants were intentionally instructed to encode the cue words, the cue reinstatement effect was significant regardless of the presence or absence of the scenes at test, so the scenes did not outshine the cue words. This was probably caused by the fact that participants in the

encoding instructions condition were explicitly told to focus on the cue words, so they relied on these cues to guide recall of the target items.

Regardless of the strength of the association between the target and cue word, there was no evidence of a reverse outshining effect. This was expected because the encoding instructions forced participants' attention away from the context (i.e., the movie scenes) thus it would have been hard for these to outshine the cue words.

6. EXPERIMENT 5

RESEARCH OBJECTIVES

The purpose of Experiment 5 was to study the overshadowing hypothesis to see if the effect of scene reinstatement was a function of whether the scenes were intentionally encoded or not. This was manipulated through the introduction of an encoding instruction condition where participants were explicitly told to encode the context (movie scenes) and target items and was compared to a group of non-instructed participants. It was expected that participants would fail to encode the verbal cues and these would therefore be overshadowed by the instructions.

The second purpose of this experiment was to see if the scene reinstatement effect depended on not only the encoding of the context, but also on whether the association between the target and context (i.e., the movie scene) was encoded. This was manipulated through the type of instructions provided for participants; some participants formed a strong association between the target and context through the formation of an integrated image of the two whereas others had a weaker association through the formation of two separate pictures of the items. It was expected that there would be a stronger overshadowing effect of the verbal words through the formation of a stronger association between the movie scenes and the targets.

Finally, this experiment was conducted to see whether the outshining hypothesis predictions would hold true based on the cues provided at test. A replication of the Experiment 2 results was predicted.

Method

Participants

A total of 279 Texas A&M University undergraduate students participated in this experiment for course credit.

Design and Materials

The experiment used a 2 X 2 X 3 between-subjects design. Cue word (present vs. absent), scene reinstatement (reinstated scenes vs. no scenes), and encoding instructions (integrated image vs. separate images vs. no instructions) served as the independent variables. Free recall performance served as the dependent variable of interest.

The materials included a list of 32 target words and 32 cue words from the MRC Psycholinguistic database with written frequencies ranging from 200-300 (Thorndike-Lorge written frequency norms). The target words were 5-7 letters long while the cue words were exactly four letters long. The target and cue words were unrelated. The 32 movie scenes were scenes of everyday events unrelated to the target and cue words. The words and movie scenes were presented on a video projector.

Procedure

Participants were tested in groups of 10-20 people and were seated in front of a large projection screen. They were told that they would study words written over background movie scenes. They were asked to try to remember the words and movie scenes for a later memory test. Some participants received explicit instructions during the encoding session to form either a single image (integrated image) or two separate

images with the movie scenes and target word. In the integrated image condition, participants were asked to form a single mental image that incorporated the incidental background movie scene and the target word. In the separate images condition, participants were asked to form two separate mental images, one image for the incidental background movie scene and one image for the target word. There was also a no instructions condition where participants were simply told to memorize the background movie scenes and words (target and cue) as best as they could with no mention of the use of imagery. Each of the movie scenes was presented for 5 s.

Immediately following presentation of the study list, participants performed two distracter tasks for 5 min each in which they had to complete mazes and mental rotation problems. After the filled delay, participants were told that they would be given a memory test. They were given a blank sheet of paper and depending on the condition, participants were told that they would see cue words, background movie scenes, or both and they would asked to write down as many targets as they could remember. Participants in the control condition were just asked to write down as many words as they could remember and were provided with a blank screen. Participants were told to recall the list items in any order and they were given 45 s to write down as many targets as they could remember before the test stimuli begin. It was emphasized that they were *only* to write down the target words and not the cue words (the words that we four letters long). Each test stimulus appeared for 4 s. The free recall test lasted a total of 6 min, the amount of time that it took for three repetitions of each of the stimulus.

Results

A 2 X 2 X 2 between-subjects ANOVA was used to examine the effect of instructions (instructed vs. non-instructed), cues (present vs. absent) and scene reinstatement (reinstated scenes vs. no scenes) on recall performance. The instructed condition included both conditions in which participants were asked to image target words and movie scenes separately, and instructions to form integrated images that included both target words and their accompanying movie scenes. The proportion of items recalled based on these variables is presented in Table 7. Results showed a significant main effect of encoding instruction, F (1, 271) = 36.15, $p < .05$, $\eta^2 = .12$, showing that instructing the participants to form images of the background scene and target item during the encoding session improved memory for target items as compared to participants' memory when there were no special instructions. There was also a main effect scene reinstatement, F (1, 271) = 25.85, $p < .05$, $\eta^2 = .09$, showing that the presence of scenes at test aided participants' memories for target items. The main effect of cue word was not significant, F (1, 271) < 1, showing that presence or absence of cues did not affect memory differentially.

The interaction between scene reinstatement and instructions was significant, F (1, 271) = 9.03, $p < .05$, $\eta^2 = .03$ and this was probably the result of having participants focus their attention on the scenes in the instructed condition and having no particular focus of attention in the non-instructed condition. The interaction between scene reinstatement and cue words was not significant, F (1, 271) < 1. There was a lack of an

interaction between instructions and cue words, F (1, 271) < 1. Finally, the interaction between instructions, cue word, and scenes was not significant, F (1, 271) < 1.

Table 7
Experiment 5: Mean Proportion of Recall: Instructed vs. Non-instructed

		Cue Words Present	Cue Words Absent
No Instructions	Reinstated Scenes	.15 (.06)	.15 (.09)
	No Scenes	.12 (.05)	.10 (.05)
Instructions	Reinstated Scenes	.35 (.22)	.33 (.21)
	No Scenes	.16 (.08)	.18 (.09)

Note—Standard deviations are in parentheses.

No Instructions

A priori planned comparisons were conducted to test the effect of scene reinstatement when no special instructions were given to participants during encoding. Results showed a marginally significant scene reinstatement effect when cue words were absent from the test, t (29) = 2.24, SE = .03, p = .04[34], showing that in the absence of cue words, memory was better for the targets when scenes were reinstated at test as compared to memory when scenes were absent. When cue words were present at test

[34] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was p < .025.

and no special instructions were given to participants during encoding, there was no significant effect of scene reinstatement, t (31) = 1.59, SE = .02, $p > .025$[35].

Another set of *a priori* planned comparisons was conducted to test the reverse outshining effect. When scenes were absent during the test, there was no significant cue reinstatement effect, t (30) = 1.09, SE = .02, $p > .025$[36]. There was also no significant effect of cue words when scenes were present at test, t (30) = .19, SE = .03, $p > .025$[37]. These results showed no evidence for a reverse outshining effect for participants in the non-instructed condition.

Instructions

A priori planned comparisons were also conducted to analyze the scene reinstatement effect in the presence of special encoding instructions. In the absence of cues at test, the effect of scene reinstatement was significant, t (108) = 4.93, SE = .03, $p < .025$[38] showing that participants remembered more target items when scenes were present at test as compared to memory when scenes were absent. When cues were present during the test, there was a significant scene reinstatement effect with participants having superior memory for targets when scenes were present at test as

[35] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[36] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[37] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[38] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.

compared to their memory when scenes were absent, t (103) = 6.12, SE = .03, $p < .025$[39]. The results demonstrate that the encoding instructions worked as planned; participants seemed focused on the relationship between the target and the scenes and relied on the scenes, not the cue words to help memory. As a result, there was a significant scene reinstatement effect regardless of whether cue words were present at test.

The second family of *a priori* planned comparisons looked at the cue effect in the presence or absence of scenes when instructions were provided during study, the reverse outshining effect. When scenes were absent, the effect of cue words was not significant, t (101) = 1.36, SE = .02, $p > .025$[40], showing that participants did not use cue words to remember the target items. When scenes were present, the cue effect was again not significant, t (110) = .54, SE = .04, $p > .025$[41]. Because the encoding instructions focused participants' attention on the scenes and target words and not the cue words, there was no reverse outshining effect.

These results show that encoding instructions were successful at focusing participants' attention on the context (i.e., movie scenes) and target items. Unlike in Experiment 4, this experiment had participants focus on the context (i.e., the movie scenes) so the noncontextual cues were not well encoded and were therefore overshadowed by the movie scenes. As a result, participants depended on the scenes to remember the targets, and the cue words had little effect on recall.

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[39] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[40] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[41] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.

Another 2 X 2 X 2 between-subjects ANOVA was conducted to examine the effect of the type of encoding instruction (separate pictures vs. integrated picture), cues (present vs. absent) and scene reinstatement (reinstated scenes vs. no scenes) on recall performance. The means from this analysis are shown on Table 8. Results showed a significant main effect of type of instruction, F (1, 207) = 28.88, $p < .05$, $\eta^2 = .12$, showing that having the participants form a single integrated picture during encoding improved memory for target items as compared to memory when participants were instructed to form two separate pictures of the movie scene and the target item. The main effect of scene reinstatement was significant, F (1, 207) = 1.58, $p < .05$, $\eta^2 = .25$ showing better memory when scenes were present at test as compared to memory when scenes were absent. The main effect of cue word was not significant, F (1, 207) < 1.

The interaction between the type of instruction (integrated picture vs. separate pictures) and scene reinstatement was significant, F (1, 207) = 13.47, $p < .05$, $\eta^2 = .06$. However, the interaction between type of instruction and cue word was not significant, F (1, 207) < 1. The interaction between scene reinstatement and cue word was not significant F (1, 207) = 1.89, $p > .05$, $\eta^2 = .01$. Finally, the interaction between type of instruction, scene reinstatement, and cues was not significant, F (1, 207) < 1.

Table 8
Experiment 5: Mean Proportion of Recall: Integrated Image vs. Separate Images

		Cue Words Present	Cue Words Absent
Integrated Image	Reinstated Scenes	.47 (.23)	.41 (.22)
	No Scenes	.18 (.08)	.20 (.09)
Separate Images	Reinstated Scenes	.25 (.16)	.25 (.15)
	No Scenes	.14 (.08)	.17 (.10)

Note— Standard deviations are in parentheses.

Integrated Picture

A priori planned comparisons were conducted to test the effect of scene reinstatement based on the presence based on the presence or absence of cue words when participants formed integrated pictures of the target and the movie scenes during the study session. When cue words were absent at test, there was a significant scene reinstatement effect, t (45) = 4.42, SE = .05, $p < .025$[42] with participants recalling more target items when scenes were present as compared to their memory when scenes were absent. When cue words were present at test, the effect of scene reinstatement was again significant, t (46) = 6.05, SE = .05, $p < .025$[43] showing that the presence of scenes was

[42] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[43] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.

beneficial as compared to memory for targets in the absence of scenes. The results demonstrate that when participants formed integrated pictures of the targets and scenes, they relied on this association to aid memory and the presence or absence of cue words had very little effect on memory.

A second family of *a priori* planned comparisons was conducted to test the reverse outshining effect. The cue reinstatement effect was not significant when scenes were absent, t (40) = 1.03, SE = .03, $p > .025$[44] showing that cue words did not affect memory in the absence of scenes. The second t-test showed that when scenes were present at test, the cue reinstatement effect was not significant, t (51) = .98, SE = .06, $p > .025$[45]. Results showed no evidence for a reverse outshining effect probably because the encoding instructions strengthened the association between the target and movie scene so the presence of cue words did not affect participants' memories.

Separate Pictures

A family of *a priori* planned comparisons was conducted to test the effect of scene reinstatement in the presence or absence of cue words when the encoding instructions asked participants to form two separate mental pictures of the target and movie scenes. With the formation of two separate images, participants recalled more target items when scenes were present at test as compared to their memory when scenes were absent, t (61) = 2.54, SE = .03, $p < .025$[46]. This demonstrates that participants were

[44] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[45] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[46] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.

relying on scenes to recall the target items. When cues were present, memory was once again better when scenes were present at test as compared to memory when scenes were absent, t (55) = 3.45, SE = .03, $p < .025$[47]. These results show that the cue words were not well encoded due to the encoding instructions.

The second set of *a priori* planned comparisons looked at the cue reinstatement effect based on the absence or presence of scenes, or the reverse outshining effect. The effect of cues when scenes were absent and present were not significant t (59) = 1.19, SE = .02, $p > .025$[48] and t (57) = .00, SE = .04, $p > .025$[49], respectively. This was expected as participants were not explicitly asked to pay attention to the cue words and were therefore mostly focused on the movie scenes and target words.

Discussion

Encoding of the Information

This experiment tested the overshadowing hypothesis by manipulating the instructions provided during the encoding episode. Because the overshadowing hypothesis' main tenet lies in whether the context information is intentionally encoded it was expected that the participants in the non-instructed condition would be less likely to intentionally encode the context in memory leading to a weak scene reinstatement effect whereas those people in the instructed condition would be more likely to encode the context thereby leading to a robust scene reinstatement effect.

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[47] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[48] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.
[49] Because two t-tests were computed for these planned comparisons a familywise correction required that the significance level was $p < .025$.

It was found that in the non-instructed condition there was a borderline effect of scene reinstatement when cue words were absent at test and absolutely no effect of scenes when there are cues given at the test; in other words, an outshining effect. However, when instructions were given during encoding to intentionally encode the context in memory, there was a robust scene reinstatement effect regardless of the presence or absence of cues. This was expected because participants were explicitly instructed during the encoding session to pay attention to scenes in one way or another. These findings support the overshadowing hypothesis showing that the context must be encoded in order to find robust scene reinstatement effects.

Encoding of the Association

Additionally, this experiment sought to extend the overshadowing hypothesis. So, not only would the context have to get encoded in order to have a robust effect on recall, it may have an even bigger effect if the association between the context and target is intentionally encoded; this was tested through the manipulation of the instructions during the encoding session.

As expected, when participants encoded the association between the context and the target words through the creation of an integrated image there was a robust scene reinstatement effect regardless of whether the cue words were present at test. Weakening the association through the creation of separate images marginally reduced the effects of scene reinstatement on recall. This shows that encoding a stronger association between the target and context led to a slightly stronger overshadowing effect.

Reverse Outshining Effect

Finally, there was no indication that the cue word reinstatement had any effect on recall because none of these results showed significant effects. This was expected as participants were explicitly instructed to focus on the target words and movie scenes and so the cue words were not likely to be used to guide retrieval.

7. SUMMARY AND CONCLUSIONS

The existence and size of context-dependent memory effects was contested until just a few years ago. Cohen's *d* was calculated robust context effects were found in all experiments with only one exception, the Experiment 4 instructed conditions (Tables 9 & 10) because in this experiment, participants were asked to encode the verbal cues and target items only and so context reinstatement did not affect participants' memories for targets. In all of the other experiments (including Experiment 4, the non-instructed participants), the effect sizes when verbal cues were present at test were about half as big as when no cues were present at test. This shows that context affected memory, but mainly in the absence of noncontextual cues. One reason that large context effects were found could be due to the fact that the present experiments tested recollection of material rather than familiarity. Previous research has shown that context reinstatement effects are more robust when testing involved free recall tests, which engage primarily recollection, as compared to recognition tests, which depend more heavily on familiarity (Smith & Vela, 2001). Another feature that distinguishes these experiments is that the movie scene method used a 1:1 context-to-target ratio. In previous studies of environmental context-dependent memory (e.g., Godden & Baddeley, 1975; Smith, 1979; Smith et al., 1978), context cues were typically overloaded with entire lists of words. The present experiments, however, used non-overloaded context cues, which might have contributed to robustness of the present context effects. The contexts in these experiments were also perceptually rich; the movie scenes were constantly

changing and had corresponding background sounds. Murnane et al. (1999) found that perceptually rich contexts, in the form of background line drawings, were associated with context-dependent recognition memory, even though perceptually simpler contexts (e.g., screen colors) did not improve recognition. This perceptual richness of context movie scenes might have encouraged participants to pay attention to the contexts and might have provided powerful cues to aid retrieval of target items when the scenes were reinstated. Finally, the manner of presentation of the stimuli might have led to the robust context effects found in the present experiments. Previous experiments manipulated the incidental context through changes in rooms (e.g., Smith, 1979, Smith et al., 1978) or odors (e.g., Herz, 1997), which did not draw special attention to the context and might therefore have gone unnoticed by some of the participants in those experiments. On the other hand, more attention might have been drawn to the context in the present experiments because the to-be-learned material was overlaid on the movie scenes. Increased attention to the scenes might have led to the strong context effects that were observed.

Table 9
Experiment 1: Movie Scene Reinstatement Effect Sizes

	Cohen's *d*
Experiment 1 A-Scenes Reinstated (Counterbalancing A Words)	**3.32**
Experiment 1 B-Scenes Reinstated (Counterbalancing B Words)	**4.80**
Experiment 1 No Scenes Reinstated	**0.41**

Table 10
Experiments 2-5: Cue Word Reinstatement Effect Sizes

	No Cues Given at Test Cohen's *d*	Cues Given at Test Cohen's *d*
Experiment 2	**1.40**	**0.54**
Experiment 3 Strong Cues	**1.10**	**0.54**
Experiment 3 Weak Cues	**2.13**	**1.68**
Experiment 4 No Instructions	**2.33**	**1.18**
Experiment 4 Instructions	**0.02**	**0.34**
Experiment 4 Integrated Image	**0.16**	**0.11**
Experiment 4 Separate Images	**0.28**	**0.41**
Experiment 5 No Instructions	**1.15**	**0.79**
Experiment 5 Instructions	**1.31**	**1.66**
Experiment 5 Integrated Image	**1.72**	**2.43**
Experiment 5 Separate Images	**0.92**	**1.28**

OUTSHINING EFFECTS

The outshining hypothesis states that if participants engage in conceptual processing during the test, then it is unlikely that environmental context cues will be used to guide retrieval. Previous experiments have failed to critically test this theory because they have only manipulated the environmental context during the test episode (e.g., Cousins & Hanley, 1996). Thus, the effect of scene reinstatement in the presence and or absence of better, noncontextual cues was never experimentally tested. In

contrast, the method employed in the present experiments allowed for the manipulation of the varying cues (i.e., noncontextual and context) provided at test. During encoding in Experiments 2-5, target words were overlaid on a background movie scene, and each target and movie context was accompanied by a cue word. At test, the scenes were reinstated (or not reinstated) either in the presence of the appropriate cue words, or without the cue words. If cue words are provided at test, then presumably, it should encourage the use of conceptual processing; that is, encoded associations between cue and target words are likely to be used to guide recollection. The outshining hypothesis predicted that if cue words were presented at test, then scene reinstatement would have little, if any effect on recall of target words.

Experiments 2-5 found repeated support for the outshining hypothesis. In Experiment 2 when participants were presented with noncontextual cues (i.e., the cue words) at test, no scene reinstatement effects were found. However, when noncontextual cues were not provided at test, a significant scene reinstatement effect was found. Thus, the presence of verbal cues at test outshone the environmental context cues; participants used the verbal cues to guide retrieval as a first recourse, and in the absence of verbal cues, used the scenes to help them recall items. Experiment 3 manipulated the strength of the association between the cue word and the target item to see if the outshining effect would be more robust when the verbal cues were more closely associated with the target words. As the outshining hypothesis predicted, there was a clear outshining effect when the association between cue and target words was strong, showing that participants relied heavily on the verbal associative cues to guide retrieval. On the other hand, when the

association between the cue and target was weak, the verbal context was unable to outshine the background movie scenes. Because the relation between the two words was tenuous, participants were unable to rely on the noncontextual cues to guide retrieval and so scene reinstatement effects were found.

Experiments 4 and 5 demonstrated further evidence in support of the outshining hypothesis, particularly in the control conditions in which no special encoding instructions were given. In the control conditions of Experiments 4 and 5, as in Experiment 2, it was seen that scene reinstatement benefited recall only when cue words were not provided at test. When cue words were given at test, scene reinstatement had no significant effect on recall.

REVERSE OUTSHINING EFFECTS

If "outshining" in the present paper refers to the dampening effect that noncontextual cues can exert on contextual cuing, then a "reverse outshining" effect refers to the effect that movie scenes have on the cue word reinstatement effect. Overall, Experiments 2 and 3 found only weak support for reverse outshining effects,. In Experiment 2 in the presence of scenes at test there was no cue reinstatement effect; however, in the absence of scenes, memory was better when cues were present as compared to when cues were absent. Thus, the presence of movie scenes outshone the cue words as retrieval cues. Experiment 3 only found a hint of a reverse outshining effect; whereas cue words did not aid recall when scenes were reinstated at test, the cue word reinstatement effect failed to reach significance in the absence of scenes at test.

OVERSHADOWING EFFECTS

Whereas the outshining hypothesis focuses on what occurs at test, the overshadowing hypothesis focuses on encoding. Overshadowing posits that the encoding instructions can influence what cues will be well encoded in memory and which will be weakly encoded in memory. In Experiment 4, the encoding instructions focused attention on the verbal cues, which made it unlikely that the context (i.e., the movie scenes) would be encoded. Results demonstrated that because the cue words were encoded well, participants used these cues to aid memory. Results also showed no scene reinstatement effect; participants failed to encode the context cues well and they therefore had less contextual cues available to aid memory. Thus, Experiment 4 showed that the context cues were weakly encoded and were therefore overshadowed by the well-encoded verbal cues. The uninstructed participants, on the other hand, demonstrated an effect of scene reinstatement when cues were absent, and a lack of scene reinstatement effect when cues were present (replicating the results from Experiments 2-3). Strengthening the association between the cue and target words through the encoding instructions made the overshadowing effect slightly stronger, with participants relying on the cue words more heavily when they formed an integrated picture as compared to their use of cue words when they formed separate pictures of the cue word and target word.

Experiment 5 examined the overshadowing hypothesis by instructing participants to encode context cues and the target item well, presumably overshadowing the verbal cues. Because participants failed to encode the verbal cues well, they neglected to use

these cues to guide retrieval. Instead, participants almost exclusively used the context cues to guide retrieval. Thus, in Experiment 5, the verbal cues were not encoded well and they were therefore overshadowed by the instructions to encode the context cues and target items. As in Experiment 4, the uninstructed participants showed a marginal scene reinstatement effect when cues were absent, and a lack of scene reinstatement effect when cues were present (replicating the results from Experiments 2-4). Strengthening the association between the movie scenes and target words through the encoding instructions increased the overshadowing effects, with people recalling more when they formed an integrated picture of the movie scenes and target words as compared to when they formed two separate images of the scene and target words.

Context reinstatement benefits recollection, as measured by recall, when contexts are well-encoded, when context-target associations are encoded, and when context cues at test are not outshone by other cues. When contexts are not well-encoded (Experiment 4), when context-target associations are not encoded (the separate imagery condition of Experiment 4), or when noncontextual cues are provided at test (Experiments 2-5), no context reinstatement effects were found. Thus, the present experimental findings provide clear support for the conclusions of Smith & Vela's (2001) meta-analysis.

LIMITATIONS

There are some limitations to the present experiments. At the forefront of these is the fact that the incidental context may not have been as incidental a context as an odor, background music, or a room manipulation. Because the movie scenes were presented on a screen, attention was drawn to these scenes more so than when

participants are placed in a room that differs from the encoding room. However, it is not currently clear how much attention people are devoting to the scenes and whether this attention differs from that given to physical contexts. Additionally, the manner of presentation might have led to the formation of stronger associations between the words and the context during encoding. The present experiments had a 1:1 target-to-context ratio and these conditions may have resembled a paired associates task. The incidental nature of environmental context effects needs further study to see what factors may be moderating the scene reinstatement effects found in the present experiments.

FUTURE DIRECTIONS

The present experiments are the first critical tests of the outshining and overshadowing hypotheses in recollection, and future experiments should examine the different features of the context cues and the extent to which these dimensions affect the retrieval of items. For example, future experiments should manipulate whether having sounds attached to the movie scenes is crucial in order to have the scenes aid memory. This would help to narrow down the factors that are truly critical in aiding people's memories. It would be interesting to see if the sounds are actually able to provide more/less information as compared to the movie scenes or if these must work in concert to provide the best results.

Also, it would be interesting to see if a person requires exactly the same scene reinstated in order for it to aid memory. Would a similar reinstated scene yield the same memorial benefits? What about the same scene during a different time of the day? In other words, what is it exactly that jogs participants' memories? Maybe it is not necessary to provide people with the same context, maybe only critical aspects of the context are necessary.

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APPENDIX A

LIST OF TARGET ITEMS WITH THEIR CORRESPONDING CUE WORDS

Target Items	Verbal Cues
Drawer	Boss
Engine	Vine
Grass	Cane
Celery	Lock
Picnic	Sofa
Bench	Taxi
Shell	Doll
Basket	Horn
Cellar	Bell
Circus	Brow
Parade	Lamp
Angel	Rope
Jacket	Clay
Beard	Tour
Candle	Pool
Collar	Duck
Garage	Bowl
Cushion	Flag
Skirt	Band
Bride	Soap
Actress	Moon
Jewel	Corn
Female	Tool
Camera	Gown
Clock	Fork
Button	Palm
Banker	Seed
Waist	Leaf
Forest	Bulb
Alarm	Dirt
Adult	Sink
Prison	Menu

APPENDIX B

LIST OF TARGET ITEMS WITH THEIR CORRESPONDING STRONG AND WEAK CUES

Target Items	Strong Cues	Weak Cues
Chain	Link	Rope
Honey	Milk	Bear
Package	Wrap	Send
Shame	Pity	Shun
Twist	Bend	Spin
Ribbon	Sash	Gift
Medicine	Pill	Heal
Scratch	Itch	Flea
Wrinkle	Iron	Skin
Novel	Book	Poem
Branch	Twig	Vine
Carpet	Shag	Tile
Bacon	Eggs	Pork
Factory	Mill	Smog
Score	Goal	Bowl
Instrument	Tuba	Drum
Apple	Core	Peel
Prince	Frog	King
Switch	Swap	Dial
Tobacco	Pipe	Spit
Bee	Hive	Busy
Jacket	Vest	Stud
Fog	Mist	Clog
Wealth	Rich	Slum
Tractor	Plow	Farm
Oyster	Clam	Fish
Grass	Weed	Path
Fur	Mink	Shed
Threat	Bomb	Warn
Rubber	Foam	Hose
Payment	Bill	Toll
Key	Lock	Door

APPENDIX C

LIST OF MOVIE SCENES USED IN EXPERIMENT

Movie Scenes
Crosswalk
Fox Building
Sidewalk 1
Windmills
Weight Room
Skyline
Walking Upstairs
Sidewalk 2
Parking Lot
Stream
Park
Street
Crosswalk 2
Retail Store
Library
Indoor Basketball
Yellow Cart
Walking Downstairs
Restaurant
White Car
Highway Drive
Busy Street
Carwash
Hallway
Storefront
Brick Sidewalk
Fountain
Racquetball
Skyscrapers
Kitchen
Homeless Person
Pamphleteer

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PRESENTATIONS

Geraci, L. & Manzano, I. (2006). Delayed JOLs predict the isolation effect. Poster presented at the Armadillo Conference, Lubbock, TX.