INFLUENCE OF TIME SPENT
IN AN ENVIRONMENT AND ENCODING STRATEGIES
ON THE ENVIRONMENTAL CONTEXT CHANGE EFFECT

By

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A THESIS PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE

UNIVERSITY OF FLORIDA

2006
ACKNOWLEDGMENTS

It has been a long journey and I would like to thank all those who have helped me along the way. I thank my advisor, Dr. Peter Delaney, for his guidance and providing me with the necessary motivation to see this to the end. I would also like to thank my committee members Dr. Ira Fischler and Dr. Scott Miller, for their valuable input, support, and patience throughout the duration of this thesis. I am deeply indebted to Lauren Saunders for her hard work and dedication in managing the lab and assisting me. I gratefully thank Jason Bendezu and Manuel Lopez for helping me collect a much needed portion of the data on very short notice. Michael Kung helped me with the study materials and I thank him for his assistance. I also thank the following people for helping me collect the pilot data and experimental data: Chris Cardani, Jaye Murray, Matt Smith, Stevie Fisher, and Alfredo Lloreda. I would like to thank Keith McGregor for being an unshakeable supporter. Dr. Carolyn Tucker has been a professional inspiration and I would like to thank her for her advice, understanding, and patience when I needed time away from work to collect data, write, and think.

Last but not least, I would like to thank the people in my personal life who may not have directly contributed to the completion of this thesis, but nonetheless are important to me. I would like to thank my parents who have supported my decisions and have been inspirational; I appreciate the sacrifices they have made in order to provide my brother and me a better future and education. I would like to thank my brother, who is my best
friend and staunchest supporter. I am grateful for my best friend, Azam Khalid, who has provided many needed laughs, warm encouragements, and valuable advice.
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The environmental context change effect is the finding that forgetting occurs when participants are tested in environments that do not match the encoding environment. Regardless of the high frequency of anecdotes that are reported, environmental context effects have been difficult to replicate or are modest. The following study includes one experiment that examined two variables that have not been extensively explored: time spent in the initial environment prior to studying and initial encoding strategies. Participants’ initial encoding strategy was fixed and some participants studied the words immediately or after a delay. They were then asked to recall the words in an environment that either matched the encoding environment or mismatched. Participants who were required to do a shallow encoding strategy were expected to have better recall when the environment matches, replicating the
environmental context change effect from past research, and to do better when studying the words after a delay than when words were studied immediately. After a delay, participants may be habituating to the environment and environmental cues will not be encoded with the target items. Participants who were required to engage in a deep encoding strategy were expected to not display any forgetting due to mismatch of environments regardless of duration of time spent in an environment. Deep encoding strategies allow for better retrieval cues in which there are inter-item associative processing where one item primes the retrieval of another item. Working memory was also measured as past studies have found that working memory is related to attentional control. A 2 Time of Encoding × 2 Encoding Strategy x 2 Environment between-subjects ANOVA with match and mismatch environments for the first factor, early and later encoding times as the second factor, and encoding strategy as the third factor revealed no significant main effects for time or significant interactions. The main effect of strategy was significant; participants in the deep encoding strategy have higher recall than those in the shallow encoding strategy regardless of time or if the environment matches or mismatches. There were no significant correlations in working memory with any of the variables of interest (time, strategy, environments). The results suggest that perhaps encoding strategy plays a much stronger role in environmental context change effect than was previously expected. However, problems with the population sample may have resulted in undetectable effects.
CHAPTER 1
ENVIRONMENTAL CONTEXT CHANGE EFFECT

In the coming-of-age movie *Cinema Paradiso*, a famous filmmaker returns to his small hometown after an absence of 30 years for his mentor’s funeral. After encountering his house and the dilapidated movie theater that was once the town’s soul, memories of his childhood with the man who inspired his dream to become a filmmaker and memories of his first love come drifting up. The film is dramatically poignant in that these memories are recalled with a haunting tinge of regret, nostalgia, and realization of the joy and complexity of life.

Our everyday life plays against a backdrop of environmental and sensory information. It is not surprising that our memories are intrinsically tied to contextually rich information. These contextual cues have the power to evoke vivid and intense memories. All of us have at one point or other experienced this—a song playing that triggers a memory of a time we heard the tune, catching a whiff of a scent that reminds us of a particular person, or returning to a previous place in the past and finding formerly unavailable memories are dredged up. Our memories are rich with these sensory, contextual cues.

The body of research on context is vast, examining such diverse contextual factors as mood (Eich, 1980; 1985), internal context (Eich, 1975; 1980; Weingartner, Adefis, & Eich, 1976), and environmental context (Smith, 1979; 1984; 1986; Smith, Glenberg, & Bjork, 1978). Experimental context change paradigms have been used extensively to study context reinstatement effects (Krafka & Penrod, 1985; Smith, 1979; 1984; 1985a),...
type of study material (Vela’s study as cited in Smith, 1988; Eich, 1985; Steuck & Levy’s study as cited in Smith, 1988), and type of environment (Godden & Baddeley, 1975; 1980; Saufley, Otaka, & Bavaresco, 1986; Smith, 1985a; 1985b). The environmental context change study paradigm can be divided into two categories: first-order and second-order experimental paradigms (Bjork & Richardson-Klavehn, 1988; Smith & Vela, 2001). First order experimental paradigms involve participants studying material in one environment and then being tested in the same environment (control condition) or a different environment (context change condition). Godden and Baddeley’s (1975) classic study is an example of a first order paradigm that examined context change where participants studied on land or under water and testing was either in the same environment or the other environment (e.g. study on land, recall under water). First order experimental paradigms provide a simple manipulation of context change and thus criticism has arisen that participants may be able to mentally reinstate their environment. Second order experimental paradigms involve participants studying at more than one environment and with more than one list; hence it is more difficult for participants to mentally reinstate their environment (Smith, 1984; Smith & Vela, 2001).

Environmental context examined in this experimental proposal can be specified in the following dimensions: external (vs. internal), incidental (vs. deliberate), not focal (vs. focal), and general (vs. specific) (Smith, 1988). Ostensibly, the distinction between external and internal context may seem straightforward. However upon further examination, external and internal context is more entwined than may be originally assumed. External context is represented internally while internal context may alter the perception of external context. However, for the sake of simplicity, researchers have
assumed that external context includes the physical aspect (i.e. environment) while internal context includes any factors that can be represented within a person (i.e. mood, thoughts, emotions). Environmental context is also incidental and not focal in that cues that are not meaningfully related to the study itself—that is, it is outside the attentional focus of the participant—are not actively utilized by the participant. Also, environmental context is general; not any one specific aspect of the environment is manipulated but all parts of the physical environment.

Of particular interest to this experimental paper is environmental context change. We can all relate particular episodes in which forgetting occurred due to a change in location: leaving a room to retrieve something only to forget it and suddenly remembering again when returning to the original room or returning to a childhood house and remembering certain incidents that were unlikely to be retrieved before. Regardless of the high frequency of anecdotes that are reported, environmental context effects have been difficult to replicate (Eich, 1985; Fernandez & Glenberg, 1985; Saufley, Otaka, & Bavaresco, 1985) or produce small effects. Smith and Vela (2001) performed a meta-analysis examining the reliability of context change and concluded that environmental context effects were modest but reliable. The effect seems to be influenced by several variables; of those identified by Smith and Vela were: degree of differences between environments examined, time interval between learning and recalling, presence or absence of the same experimenter, and type of material learned (i.e. associative or non-associative).

Not surprisingly, the more the encoding environment matches the retrieval environment, the smaller the magnitude of forgetting due to changing environments.
Smith and colleagues (1984, 1988, 2001) have suggested that the greater the resemblance between the encoding and testing environments, the more likely participants will mentally reinstate the original environment. Hence, the context change effect is reduced. In additional, increasing the time between learning and recall will bolster the context change effect. Accessibility of the memory traces may be weakened and hence more dependency on cue reinstatement, as in matching environments. This results in greater reliance on contextual cues and a larger context change effect is observed. The presence of the same experimenter during both encoding and testing phases of the experiment for the mismatch environment conditions would contaminate context cues for the new environment. The experimenter is viewed as part of the environment and in a sense, can serve as a retrieval cue. Therefore, when the same experimenter is present in the new environment, this environment has both new and old aspects (never exposed and previously exposed environments). Even more detrimental to experimental results would be if the same experimenter is also present during the testing phase. Participants spend a large amount of time during experiments interacting with the experimenter. Therefore, the presence of the same experimenter after an environment change is a poor experimental control. Consistent with this idea, Smith and Vela found that switching experimenters for mismatch environment conditions resulted in increased context change effects. Interestingly, the type of material studied can influence the magnitude of context change effects. Materials that elicit inter-item associative processing in which one item may potentially prime the other during retrieval were found to reduce the context change effect. Presumably, this was due to less reliance on environmental cues due to better retrieval cues.
Several hypotheses have been proposed to explain environmental context change effects. One of the first explanations posited that the context change effect is dependent on proactive interference. Context change that reduces proactive interference to benefit memory can be illustrated by naturalistic evidence. Smith (1988) points out vacations often facilitate creativity and productivity by aiding the vacationer in forgetting worries and trite ideas (i.e. “writer’s block,” “stuck-in-a-rut” conditions). We often refer to vacations as “escapes” and by going to an unfamiliar, novel environment, interest is renewed. In problem solving studies, it has been suggested that incubation or setting aside the problem when stuck and then later attempting to solve the problem may be dependent on context change (Smith, 1995). Smith suggests that a context change reduces fixation on and accessibility to wrong solutions. This idea could be observed by our tendency to “take a break” when a task becomes too frustrating or tedious. Although reduction of proactive interference may be a likely explanation for overall better performance due to a change in context, it does not adequately explain the forgetting that does occur when changing context. Early studies of environmental context suggested that a context change lead to a reduction in proactive interference, which resulted in better recall (Dallett & Wilcox, 1968). However, these studies included learning in multiple contexts, which is a different paradigm than the one used in this study. Studying lists of words in multiple contexts leads to better recall than studying in the same context because the environment acts as an organizational cue (Smith, 1982; 1984). This finding is supported by classroom studies in which no environmental context change effect was observed because students usually studied in many locations outside the classroom (Abernethy, 1940; Chen’s study as cited in Smith, 1988). Reduction of proactive
interference as a plausible explanation of context change effect has not been widely accepted. The context change effect refers to forgetting information due to context shifts whereas release from proactive interference generally leads to better recall or less forgetting (Wickens, 1970).

Physical disruption during the changing of contexts was also suggested as a possibility for the context change effect. Strand (1970) found that a disruption during encoding of words also display forgetting and posited physical disruption during changing environments as driving the context change effect. After the word presentation, participants were interrupted and asked to wait in the hallway. The time interval during the wait was equal to the amount of time walking participants to a new environment for the mismatch conditions. Participants waiting in the hallways (match conditions) were returned to their original environments for recall. This explanation has been discredited by studies that found reliable context change effects even after accounting for the physical disruption (Smith, 1979; Smith, Glenberg, & Bjork, 1978). Subsequent studies of context change effects included a physical disruption for all conditions to control for this potential confounding.

Tulving’s (1973) encoding specificity principle states that the match between encoding and retrieval episodes is most important for facilitating successful recall. The more similar the two episodes are in terms of intrinsic and extrinsic components, the more likely it is that the memory trace is recalled. This encoding specificity principle forms the underlying basis for the similarity principle, which provides a context change effect explanation. According to the similarity principle, the context change effect is due to the higher degree of difference between mismatched environments than when the
environments are the same. Ideally, environments with the most differences on the most
dimensions will result in a larger context change effect. However, this hypothesis is too
general: it does not specify what these intrinsic and extrinsic cues are. It is difficult to
make predictions, experimentally manipulate variables that will produce the most context
change, or control for variability because these cues are not defined.

The integration hypothesis (Baddeley, 1982) states that in order for the context to
influence memory the study material must be integrated with contextual cues during
encoding. Therefore, recall of the study material is highly dependent on these contextual
cues. This hypothesis has recently found support by studies examining context
integration (Earles, Smith, & Park, 1994; Eich, 1985; Park, Smith, Morrell, Puglisi, &
Dudley, 1990; Smith, Park, Earles, Shaw, & Whiting, 1998). These studies concluded
that environmental context cues were utilized only when participants were instructed to.
Not surprisingly, a context change effect was observed only when participants were
instructed to integrate the study materials with elements of the environment. However,
the integration process does not predict any context change effect for incidental
environmental context effects. Past studies have found reliable effects (Smith, 1979,
1985; 1986) and therefore this hypothesis has been viewed as not a strong explanation of
environmental context change effect.

Eich’s (1995) mood mediation hypothesis states that environmental context change
can be explained by mood-dependent memory. Participants’ moods vary across
environmental episodes and these moods become intrinsically tied to environmental cues.
Therefore, during retrieval, participants can access mood dependent cues as retrieval cues
to recall. Hence, when the learning and testing environments match, participants are able
to access their mood-dependent memory. A context change effect is observed when the environments do not match and participants cannot access their mood-dependent memory. However, mood mediation hypothesis has been unable to explain the effects of material type eliciting associative or non-associative processing, test type, etc. (Smith, 1995; Smith & Vela, 2001). Researchers have pointed out that mood-dependent memory may be a reflection of mental context (Smith, 1995). It is unlikely that changing locations could produce a large enough change in mood that would be robust; even strong effort to manipulate mood directly rarely result in effect sizes that reach or exceed the environmental context change effects.

As an alternative, Glenberg (1997) suggested that information from the world is continuously represented unless suppressed, which occurs in order to free up cognitive resources for more demanding tasks. In other words, environmental context cues are suppressed due to cognitive load. This idea informed two explanations of environmental context-dependent memory: the overshadowing hypothesis and the outshining hypothesis.

The overshadowing hypothesis (as described in Smith, 1988; Smith & Vela, 2001) states that context changes are due to a failure to encode environment contextual cues for a variety of reasons, such as control of attention or conceptual processing of study materials. Like the term implies, if environmental cues are overshadowed by other factors during encoding and are not stored, contextual change will not affect recall. Therefore, in the absence of factors that may overshadow environmental cues (e.g. material that allows for associative processing or that draws attention away from the environment), a context change should be observed.
Smith’s (1978; 1979; 1985; 1988) outshining hypothesis proposes that environmental cues are not used if other better cues are available. In other words, better non-contextual cues will outshine environmental cues much like the sun outshining all other celestial bodies in our sky. Unlike the overshadowing hypothesis, the outshining hypothesis states that environmental context cues are encoded, but are not utilized during retrieval because better cues are available. Better cues can be defined as deeper processing of the material, generation of better retrieval cues due to deeper encoding strategies, or those that encourage inter-item associations.

The overshadowing and the outshining hypotheses may seem similar in that they both specifies failures of the environmental context change effect, but they are actually different in their predictions of context change. One distinction is that the overshadowing hypothesis is concerned with failure to store contextual cues at encoding and therefore there are none to use at retrieval. The outshining hypothesis suggests that contextual cues may be encoded successfully but the cues are not used at retrieval because better retrieval cues are available. Both are dependent on associative processing and inter-item associations; however, overshadowing specifically explains context change effects as encoding effects while outshining specifically explains them as retrieval effects.

These theories have been largely unsuccessful at adequately predicting why and how context change effect occurs. Smith and Vela’s meta-analysis resulted in mixed findings for the overshadowing hypothesis and outshining hypothesis. It could be that these studies are not exploring variables that may influence encoding and retrieval—hence, affecting the magnitude of the context change effect. This may explain the mixed findings in the environmental context change literature. Therefore, I am proposing two
variables that may influence the context change effect and should be empirically investigated: habituation and strategy.

Habituation

How attention fluctuates over time is important in examining environmental context change. It has been shown that participants tend to mentally reinstate their environments by imagining the initial learning environment (Smith, 1979; 1984), resulting in a decrease in context change effect. In the absence of such a strategy, context change effects are observed. Glenberg, Schroeder, and Robertson (1998) found that when participants’ gazes were diverted from the environment during retrieval, recall was better due to less processing devoted to the present environment and more so to conceptual processing. Perhaps attentional control is related to effectively processing and retrieving environmental cues.

In Glenberg’s (1997) theory of environmental suppression, a shifting of cognitive resources must occur for conceptual processing. These cognitive resources seem to be attentional resources. Indeed, the overshadowing hypothesis and outshining hypothesis both imply that if attention is drawn away from the learning or testing environment, no environment contextual manipulations should be observed. It would seem intuitive to state that most people are aware of their environment, but that the attention fluctuates from the environment to the task, or focal information. The role of attention in context change studies seems to be under-explored and not examined thoroughly although most researchers agree that attention is important. Experimental manipulations to make the environmental cues more prevalent (Godden & Baddeley, 1975), novel or flashy (Dallet & Wilcox. 1968; Dulsky, 1935; Weiss & Margolius, 1954), or included explicit instructions to note the environment (Eich, 1985; Nixon & Kanak, 1981) have all been
aimed to capture or direct attention. The environmental contexts for Godden and Baddeley’s study were under water and on land. Participants in Dallet and Wilcox’s study were asked to wear a box of changing lights over their heads rather than change rooms. The box not only succeeded in producing a context change effect, but also caused nausea and disorientation for the participants. Most of us do not spend a large amount of our time in water, wearing scuba gear, or adorning our heads with a box full of lights. The box of changing lights and the equipment for going under water (scuba diving gear) as well as aspects of the environment (physical suspension in water, physiological changes) were distinct and novel enough that attention was more engaged to the environment than usual. These experimental manipulations contained unusual elements that drew attention.

Environments oftentimes are familiar and frequented: we work at a certain place, have a home at a certain location, or visit preferred stores. On the other hand when an individual first encounters or enters a new environment, the environment is unfamiliar and novel; thus the individual attends or orients to it. After a length of exposure to this environment, the orienting response is reduced and habituation occurs (Cowan, 1988; Groves & Thompson, 1970; Sokolov, 1975). Dehabituation or revival of the orienting response may appear if aspects of the environment capture attention or attention are directed to the environment. The longer the participant spends in an environment, the less novel and interesting the environment is. For example, waiting in the lobby at a new doctor's office, I swiftly surveyed the furniture arrangement and even find myself studying the prints hung against cheery wallpaper. As time went by (and it was obvious
my doctor was running late), I was no longer interested in the features of the room but instead perused the magazines available.

Habituation occurs over time and predicts that the longer the time spent in an environment, the less likely environmental cues will be utilized. Therefore, when participants are asked to study information, the environmental cues are less likely to be incidentally encoded with the study information. If the participant immediately studies information upon entering the environment, the participant’s attentional resources may still be allocated to perceiving the environment. Therefore it would seem that participants who study information immediately would also incidentally encode environmental cues. When the environment at recall does not match the one at studying, these participants are more likely to show the phenomenon of forgetting due to mismatch of environments. Using the example above, if I was asked to remember a list of questions I wanted to ask my doctor during the time that I was still actively interested in the room, I would be more apt to forget the questions once I entered the doctor's examination room. Upon entering the lobby again, I belatedly remembered the questions. If, however, I was asked to remember the questions after I was no longer actively interested in my physical environment, I would be more likely to remember them upon entering the doctor's examination room. Less forgetting due to changing environments occurs because attention is no longer focused on the environment.

Unfortunately, the literature on environmental context change has not extensively examined amount of time spent in an environment. Most real world events occur in a particular environment for more than the mere couple of minutes that are examined in laboratory studies. It would be more ecologically valid to examine the influence of time
in an environment. A recent study (Isarida, 2005) found that the longer time spent studying the words, the greater the magnitude of contextual information integrated with the study materials. Isarida proposed that environmental context effect is related to amount of time spent studying. This account is different from the habituation view in that Isarida predicts that time during encoding will increase the associative strength between the context and the item. The habituation view proposes that attention drawn to the environment before and during encoding results in sampling of the environment which will be incidentally encoded with the study materials.

According to the overshadowing hypothesis, the longer the time spent in the learning environment, the higher the chances of the contextual cues incidentally encoded with the studied materials. Smith and Vela’s meta-analysis did not show amount of time spent in an encoding environment influencing recall performance. Effect sizes were calculated and compared for studies that had examined environmental dependent memory.

But these studies did not include amount of time spent in the environment prior to learning. Examined was time spent in the learning environment either during learning, such as completing a distractor task in between presentation of words or after learning, such as completing a distractor task while still in the learning environment. No studies have yet looked at time spent in an environment prior to studying.

**Strategy**

Another variable that has not been extensive examined and may affect the environmental context change effect is participant’s initial encoding strategy. In their meta-analysis, Smith and Vela found that study materials that do not induce associative processing showed a greater context change effect whereas associative processing
resulted in much smaller context dependency effects. These studies range from examining depth of processing (Murnane & Phelps, 1995; Smith, 1986; Smith, Vela, & Williamson, 1988) to varying the strength of retrieval cues of the study materials by associative processing. For example, in Smith’s (1986) study, the shallow processing task was actually an incidental short term memory task in which participants heard a short list of words and after several seconds, immediately recalled them or a “deeper” processing task in which participants were told to attempt to memorize the words. Afterwards, participants completed a variety of distractor tasks and then either recalled in the original or new environment. A context change effect was observed for the shallow processing but not for the deeper processing.

Studies that have looked at inter-item associations and associative processing of study materials found that these reduced or eliminated the context change effect. Smith and Vela (2001) suggested that participants do not utilize contextual cues even if they are available because associative processing provides better retrieval cues: Recalling one item would guide the retrieval of another. This outcome can be explained by both the overshadowing and outshining hypothesis, but both attribute it to different reasons. The overshadowing hypothesis predicts that associative processing draws attention away from the environment and therefore environmental cues are not encoded and therefore are not available for use. The outshining hypothesis predicts that environmental cues do get encoded but associative processing outshines the environmental cues as retrieval cues and are, thus, utilized.

Einstein and Hunt (1980) examined the levels of processing and organizational approach to encoding. They point out that levels of processing tasks often involve
processing individual items whereas organizational strategies involve processing between items. They conclude that there is a distinction between individual item based processing and relational processing and that this distinction is important in regards to defining elaborative processing. Craik and Lockhart's (1972) concept of elaborative processing involves individual item processing where items are made more meaningful and hence more accessible in memory. According to the levels of processing perspective, rote rehearsal is viewed as shallow processing because items are repeated in short term memory. Elaborate processing is rehearsing the items to store them into long term memory. The levels of processing view would argue that elaborative processing would result in better recall. However, Benjamin and Bjork (2000) found that in the presence of a time pressure, accessibility to items was more disrupted for elaborative rehearsal than rote rehearsal. They concluded that elaborative rehearsal may facilitate stronger retrieval cues but there is a time trade-off. Elaborate rehearsal is effortful and resource consuming; engaging in elaborate rehearsal during encoding and resurrecting the mental framework during retrieval is time consuming (Masson & McDaniel, 1981). However, there is evidence suggesting that the mere time and effort of elaborative processing of individual items is not enough to strengthen accessibility cues. Bradley and Glenberg (1983) found that time and attention spent during rehearsing items individually did not enhance recall. There was enhanced recall only when more than one item are rehearsed together, forming and strengthening inter-item associations.

Environmental context studies have only manipulated processing in the Lockhart and Craik sense. These studies utilizing associative processing have found that this greatly reduces or eliminates context dependency. However, no studies have looked at
encoding strategies that require relational item processing. In contrast to the Lockhart and Craik levels of processing view, depth of encoding strategies involve both forming inter-item associations as well as generating individual item distinctiveness. Therefore, shallow encoding would be viewed as maintenance rehearsal of individual items or rhyming the words. One form of deep encoding involves generating an interactive image or a story for all the items (Bower, Clark, Lesgold, & Winzenz, 1969). This categorization of encoding strategies has been utilized by researchers examining recollection (Perfect & Dasgupta, 1997), spacing effects (Delaney & Knowles, 2005), and directed forgetting (Sahakyan & Delaney, 2003; Sahakyan, Delaney, & Kelley, 2004).

Sahakyan and Delaney (2003) have found that changing internal contexts induces strategy changes in directed forgetting studies. In directed forgetting studies, participants are presented with two word lists and half are told to intentionally forget the first list. A typical outcome is the presence of both costs and benefits of directed forgetting, in which costs refer to the poorer recall that forget participants display for the first list relative to remember conditions and benefits refer to the increased recall that forget participants display for the second list relative to the remember conditions. In a series of studies, Sahakyan and Kelley (2002) and Sahakyan (2004) have argued that the costs in directed forgetting can be attributed to a mental context change. When instructed to forget the list, participants attempt to “think of something else”, which then changes their mental context. Therefore the context during encoding of the first list and the context during recall are mismatched, leading to poorer recall for the first list or costs. The benefits, however, are due to strategy changes that are induced by the mental context change.
Sahakyan and colleagues (Sahakyan & Delaney, 2003; Sahakyan, Delaney, & Kelley, 2004) have suggested that the mental context change that forget participants engage in are also evaluative in nature. Participants evaluate their encoding strategy for list one after being told to forget it and perhaps realize that their current method is ineffective, hence a strategy change occurs for the second list. Without prior knowledge or training, participants tend to engage in shallow encoding, such as rote rehearsal (Delaney & Knowles, 2005; Sahakyan & Delaney, 2003; Sahakyan, Delaney, & Kelley, 2004). Therefore switching to a deeper encoding strategy would explain the increase in recall for the second list for forget participants or the observed benefits. They concluded that utilization of a deep encoding strategy, especially those that initially engaged in shallow encoding, can improve recall due to better encoding of the information and better retrieval cues.

Deep encoding contains both relational and item-specific processing; generating an interactive image or story allows for each item to become linked or associated to another item. Retrieval of an item would therefore guide recall of another item. Based on the above research findings, the type of strategy during encoding may account for context dependency. Deep encoding may provide resistance to forgetting due to changing contexts. Because the majority of individuals without prior training engage in shallow encoding, the context change effect is observed. If instead deep encoding was used, the context change effect should be reduced or eliminated since associations between items serve as better retrieval cues than environmental cues. This predication would seem similar to the outshining hypothesis in that there are better retrieval cues available and hence environmental cues are outshone, however the outshining hypothesis
predicts that environmental cues are successfully encoded. Engaging in an elaborative processing task may potentially interfere with encoding of environmental cues as cognitive resources are allocated to the task, a suggestion of the overshadowing hypothesis. However, the overshadowing hypothesis attributed the context change effect to this. Use of a shallow strategy is not as effortful and will not detract from encoding of environmental cues and use of a deep strategy is more effortful and may detract from encoding of the cues. However, the lack of environmental cues is not necessary since the deep strategy provides better retrieval cues than environmental context cues. It would be interesting to examine further these ideas as no studies in the environmental context literature, thus far, have extensively examined relational encoding strategies.
CHAPTER 2
EXPERIMENT

The purpose of the first experiment was to examine the effect of time spent in the encoding environment and recall of words in matched or mismatched environments while controlling for participants’ encoding strategies. Participants that utilize deeper processing such as inter-item associations usually display resistance to contextual manipulations because recall of one item primes the recall of another item (Smith, 1988; Smith & Vela, 2001; Steuck & Levy’s study as cited in Smith, 1988). In this sense, deep encoding of the material may result in items becoming more associated with one another and more meaningful in memory. When information to be studied is more meaningful, environmental context effects have been observed to be lower than when the study materials are meaningful (Steuck & Levy’s study as cited in Smith, 1988; Vela’s study as cited in Smith, 1988). In light of this, experimentally controlling participants’ encoding strategies would allow closer examination of the separate influences of time and participants’ encoding strategies. I expect to find evidence supporting the following predictions of the influence of habituation and deep encoding strategies on the magnitude of the environmental context change effect.

**Time and Strategy Predictions**

Overall, participants in the match conditions are expected to do better than those in the mismatch conditions, replicating the environmental context change effect. This finding will replicate studies that found reliable context-change effect (see Smith & Vela, 2001) in that there is forgetting that occurs when changing to a physical environment
different from that for encoding. Participants who study the words immediately in the 
experiment should have poorer recall than participants who waited seven minutes and 
then studied the words. This may be because participants who immediately studied the 
words may attenuate to the environment. In other words, those that study the words after 
a delay have habituated to the environment. Hence, they have more attentional resources 
to allocate to the task than those that have not habituated to the environment and are still 
attenuating.

Participants trained through a deep encoding strategy are expected to have higher 
recall than those trained through a shallow encoding strategy regardless of influence of 
time or if the environment matches. Participants who were instructed through a shallow 
encoding strategy should be affected by time spent in an environment prior to studying 
the words. In particular, recall should be worst for those who studied the words 
immediately than those who studied the words after a delay when the environments 
mismatches, indicating a context change effect. For match conditions, there should be no 
influence of time since environmental cues are available for retrieval.

There should also be a significant recall environment by times of encoding 
interaction. Participants that study words immediately (early condition) in environments 
that match for encoding and recall should have the highest recall. The conditions that are 
expected to display the worst recall are the ones in which participants study the words 
immediately and then change environments (late and mismatch environment condition). 
For participants who study the words after waiting (the late condition), those that are in 
environments that match for encoding and recall should do better than those that are in 
environments that mismatch. This finding will support what was earlier predicted:
Habituation to the environment reduces the forgetting that occurs when environments mismatch. Participants who study words immediately incidentally encode environmental cues with the target words, resulting in a dependence on environmental context cues. Therefore when the recall environment is different from the initial environment in which the words were studied, recall should be reduced.

**Working Memory Predictions**

Working memory was also included as a measure due to its role in attentional control (Kane & Engle, 2000). Delaney and Sahakyan (2004) demonstrated that mental context change is related to working memory capacity. They instructed participants to continue to remember a list of words and then a mental context change task was administered. They found that high working memory participants were more affected by a mental context change, forgetting more information than low span participants. Based on these findings, I expect individual differences in working memory span to be related to recall in conditions where there is a change of environment but not in conditions where there is no environment change. In particular, high span working memory individuals’ recall may be reduced when there is a physical environmental change than low span individuals. If this finding was supported, consistent with Delaney and Sahakyan’s (2004) results, high span working memory individuals would, thus, be more context-dependent than low span individuals.

Working memory is expected to significantly correlate with recall from experimental conditions (i.e., strategy, time and environment manipulations). Those with higher working memory spans will be more likely to spontaneously use deep encoding strategies. Encoding strategies are effortful and maintaining these processes after an environment has changed may require the participant to inhibit attenuating to the new
environment and resurrect the mental scaffold of the effortful encoding strategy during recall. Individuals with high working memory span should have decreased performance when environments are changed. However, individuals with relatively low working memory span should remain unaffected by the environment changes. This may be because those with low working memory span may not need to inhibit the environment while engaged in effortful encoding strategies. Time is not expected to have a significant correlation with working memory. There is no indication from the research literature that suggests that habituation is influenced by working memory span. Therefore, the effects of the length of time spent in the encoding environment should probably be unaffected by working memory span.

Methods

In this experiment, the following variables were manipulated: initial encoding strategies, duration of time spent in an environment prior to learning, and whether the environment for learning and recall matched or mismatched. It has been argued that salient elements of the initial environment may still be present in the second environment, drastically reducing the environmental context change effect (Fernandez & Glenberg, 1985; Smith & Vela, 2001). For instance, the laboratory room for this environment is very similar to a lobby or office; both include similar office furniture and arrangements or similar presentation instruments. Therefore, to maximize contextual change, care is taken to ensure no part of the initial environment is salient when changing environments. In this experimental proposal, environmental context change is manipulated when the environment is changed from an outside to inside location and vice versa, different
experimenters for each phase of the change, and different methods of studying the words (on a multimedia player on the computer versus on a portable stereo).

Delaney and Knowles (2005) found that for participants engaged in shallow encoding, the most frequent strategy reported was verbal rehearsal and for deep encoding was a story generation mnemonic. In Delaney and Knowles’s Experiment 2, they experimentally controlled participants’ encoding strategies by training participants through a shallow or deep encoding strategy and requiring the usage of this strategy throughout the experiment. A similar method was used to fix participants’ initial encoding strategy in this experiment.

Participants

Participants were University of Florida undergraduates who received course credit or extra credit for completing the experiment. Participants were tested individually with 8 participants in each of the eight experimental conditions for a total of 64 participants.

Materials

Twenty unrelated, medium-frequency English nouns were selected. The words were recorded by a male voice at a rate of 1 word per 4 s and edited on Adobe Audition 1.5. The inside environment is a computer lab room inside the psychology building with a computer, two chairs, file cabinets and shelves, various computer equipment on the ground and shelves, books and stacks of paper on the shelves, and white walls. The outside environment is a relatively secluded and quiet picnic place outside the psychology building. This picnic place is surrounded by trees, has a roof over it and includes a stone table and stone benches on two sides of the table. The words were presented on a multimedia player on the computer for the inside condition. For the outside condition, the words were presented on a portable stereo with a compact disc
player. For the purposes of this experiment, different experimenters were considered different for only one variable: gender. Gender was considered a substantial enough difference for conditions where the environment was changed. Therefore, the gender of experimenters was counterbalanced to control for possible biases. Also, care was taken to ensure that the experimenters’ appearance were not similar (e.g. clothes, hairstyle).

**Procedure**

**Encoding**

Participants were tested individually. Before they began the experiment, informed consent was obtained from the participant in the hallway or neutral zone. Then they were led to the encoding environment and asked to sit facing away from the experimenter to discourage focusing solely on the experimenter. Half of the participants were told the experimenter was still setting up the experiment (the *late* condition). They were told to just sit quietly and wait until the experimenter finished preparing the experiment. The experimenter was actually surfing the internet on the computer for the inside condition or engaged in scoring data or a search-a-word game for the outside condition to appear occupied. The participant was discouraged from studying or from engaging in conversation with the experimenter to give the participant an opportunity to observe the environment. After seven minutes, the participant was told that the experiment was ready to begin and was then trained through a shallow or deep encoding strategy. The other half of the participants, upon entering the encoding environment, was immediately asked if they were ready to begin the experiment and trained through either a shallow or deep encoding strategy. Participants in the *shallow* condition were instructed in the verbal rehearsal encoding strategy prior to studying the words. They were instructed to rehearse the words out loud, adding each new word to the set already rehearsed. They were also
told not to be alarmed if they forgot any words and to continue rehearsing the words that they do remember. Participants in the deep encoding condition were instructed in the story generation encoding strategy where they were required to generate aloud a story utilizing each word. They were also told that they are required to use all the words in the story. After studying the words, participants engaged in a math distractor task for 90 s to reduce recency effects.

Recall

Participants in the match environment condition were led to the neutral zone and then were led back to the original environment by the same experimenter. For the mismatch environment condition, participants were led to the outside or the inside environment depending on their initial encoding environment and a different experimenter conducted the next portion of the experiment. Time between changing environments was controlled for both match and mismatch conditions so that the time for walking the participant to the new environment and the time for walking the participant to a neutral zone and back to the same environment is the same: 90 seconds. They were then asked to free recall the words on a blank sheet of paper for 90 seconds.

Post-recall measures

Retrospective verbal reports were collected to determine participants’ initial affective states and whether it changed and what they were thinking for those in the late condition. They were also asked if the strategy task was difficult (i.e. following instructions or engaging in the task) and if the words were spoken clearly and audibly. After this, all participants completed a working memory span task called the Triangle C Span Task. The Triangle C Span Task involves viewing slides on Microsoft PowerPoint that consist of light purple triangles, dark purple triangles, and light purple squares. Their
task is to count the light purple triangles out loud and remember this total. They will view 2 - 6 slides before being asked to recall the sequence of total number of light purple triangles on each slide. Triangle C Span scores range from 0 - 58. Figure 1-1 illustrates example slides.

![Figure 1-1](image_url)

Figure 1-1. Triangle C Span Task to Assess Working Memory Span Example Slides.

Participants should count and remember 4 purple triangles in the (a) first slide and 8 purple triangles in the (b) second slide. When the prompt to recall the total number of purple triangles from each slide appears (c), they should recall 4 and 8.

**Results**

**Time, Strategy, and Environment Variables**

In order to ensure proper counterbalancing, variables such as gender of experimenters and environment order were included in all main analyses; but since there are no significant interactions, were collapsed over. Mean proportions of words were calculated. A 2 Time of Encoding × 2 Encoding Strategy x 2 Environment between-subjects ANOVA with match and mismatch environments for the first factor, early and later encoding times as the second factor, and encoding strategy as the third factor revealed no significant main effects for time $F(1, 56) = .008, MSE = .0002, p = .929,$
environment $F(1, 56) = 2.031, MSE = .040, p = .160$, or significant interactions: for time and strategy, $F(1, 56) = .0006, MSE = .032, p = .859$; for time and environment, $F(1, 56) = 2.570, MSE = .0510, p = .115$; for strategy and environment, $F(1, 56) = 1.785, MSE = .0351, p = .187$; for time and strategy and environment, $F(1, 56) = .198, MSE = .0039, p = .658$. The main effect of strategy was significant, $F(1, 56) = 28.555, MSE = .563, p < .001$. Participants in the deep encoding strategy have higher recall than those in the shallow encoding strategy (see Table 1-1 for overall means and standard deviations) regardless of time or if the environment matches or mismatches.

Table 1-1. Recall Mean Proportions and Standard Deviations for Early, Late, Match, Mismatch, Shallow Encoding, and Deep Encoding Conditions

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Shallow</th>
<th>Deep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>Mean</td>
<td>S.D.</td>
</tr>
<tr>
<td>Early</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Match</td>
<td>.306</td>
<td>.073</td>
</tr>
<tr>
<td>Mismatch</td>
<td>.343</td>
<td>.018</td>
</tr>
<tr>
<td>Late</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Match</td>
<td>.344</td>
<td>.132</td>
</tr>
<tr>
<td>Mismatch</td>
<td>.300</td>
<td>.046</td>
</tr>
</tbody>
</table>

**Working Memory**

Nine participants did not have working memory span scores because their scores were excluded due to computer failures or failure to follow instructions. These nine participants were replaced. Participants’ Triangle C Span scores ranged from 9 to 45,
with a mean of 25.42 ($SD = 9.307$). There were no significant correlations between working memory and recall of the words, $r = .002, p = .988$, which was not what was predicted.

To investigate the possibility that recall in the experimental conditions was dependent on individual differences in working memory, linear regression analyses were employed (Jaccard and Turrisi, 2003). Linear regression has been utilized by Delaney and Sahakyan (2004) to examine individual differences in working memory for mental context change effect. Linear regression analyses were conducted to examine proportion of words recalled as a function of working memory, experimental conditions (time, environments), and their interaction. Experimental condition was entered as orthogonal contrast-coded variables and the analyses were conducted separately for each strategy group (shallow and deep). The main effects were entered simultaneously and the interaction terms were entered to determine if any of the interactions explain any additional variance. The total model was significant for shallow encoding, $F(6, 25) = 2.940, p < .05$ but not for deep encoding, $F(6, 25) = .794, p = .583$. For shallow encoding, there was a significant main effect of environment, $F(1, 25) = 2.805, p < .01$ and revealed a significant working memory and time interaction, $F(1, 25) = 2.340, p < .05$. Thus, the effect of experimental conditions was modulated by working memory span when participants were required to engage in a shallow encoding strategy. For shallow encoders, the higher the working memory, the higher the proportion of words recalled for matching; whereas for mismatch environments, differences in working memory span does not influence recall environments (see Figure 1-2).
For deep encoders, working memory is not influenced by physical environmental manipulations (see Figure 1-3).
Figure 1-3. Best-fitting Regression Lines for Working Memory and Proportion of Words Recalled in Each Environment for Deep Encoding Condition

Retrospective Reports

For the retrospective reports, participants were asked about their affective states before the experiment, after the delay (for those in the late condition), and what they were thinking about during the delay. These are experimental checks that ensure that participants’ recall is not better or poorer due to high arousal. Past research on emotion and arousal has shown that higher arousal tends to result in better memory performance (Anderson, 1988; Duffy, 1962; Mandler, 1975; Yerkes & Dodson, 1908). In this
experiment, participants’ responses were categorized as either high arousal (e.g. excited, impatient, tense, nervous, anxious), neutral (e.g. “feels fine”, good, curious, relaxed, calm, “normal”), or low arousal (e.g. sad, tired, sleepy, bored). When the experiment started, 35.9% participants experienced high arousal, 48.4% experienced neutral arousal, and 12.5% experienced low arousal. The affective states did not significantly affect recall; in other words, despite the past findings on arousal and better memory performance, participants’ performed at a comparable rate whether they were highly aroused, neutral, or had reduced arousal. Of those that were in the late condition, 53.1% had different affective states before and after the delay (52.94% changed to a high arousal state, 23.53% changed to a neutral arousal state, and 23.53% changed to a low arousal state). However, this switching did not significantly affect recall. Although participants found engaging in the strategy task was slightly difficult, this was more due to the length of the word list when adding the words to the cycle of repetitions rather than any difficulties with following the instructions. No participants reported having any difficulties hearing the words clearly.

**Post Hoc Analyses**

Of the 64 participants that participated in the experiment, 48.4% \( (n = 31) \) were from introductory psychology courses. The others, 51.6% \( (n = 33) \), were from upper division psychology courses. This may have biased the results; to test this post hoc, descriptive statistics for the data was analyzed separately and the mean proportions of recall were compared for those in the introductory psychology courses and those in upper division psychology courses. There were 2-6 of each type of student in each condition cell; therefore, because the cells do not contain equal sample numbers, the data should be interpreted with caution. However, the upper division psychology students had overall
slightly higher recall for both shallow and deep encoding than introductory psychology students. This is especially true for deep encoding for some of the conditions, such as *early* and *match*, $M = .388$ ($SD = .085$) for introductory students versus $M = .650$ ($SD = .173$) for upper division students (see Table 1-2 and Table 1-3).

### Table 1-2. Recall Mean Proportions and Standard Deviations for Introductory Psychology Course Students

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Shallow Time</th>
<th>Deep Time</th>
<th>Mean</th>
<th>S.D.</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early</td>
<td></td>
<td></td>
<td>.250</td>
<td>.050</td>
<td>.388</td>
<td>.085</td>
</tr>
<tr>
<td>Match</td>
<td></td>
<td></td>
<td>.342</td>
<td>.020</td>
<td>.450</td>
<td>.354</td>
</tr>
<tr>
<td>Mismatch</td>
<td></td>
<td></td>
<td>.276</td>
<td>.035</td>
<td>.608</td>
<td>.139</td>
</tr>
<tr>
<td>Late</td>
<td></td>
<td></td>
<td>.300</td>
<td>.000</td>
<td>.438</td>
<td>.144</td>
</tr>
<tr>
<td>Match</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>Shallow Mean</td>
<td>Shallow S.D.</td>
<td>Deep Mean</td>
<td>Deep S.D.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>--------------</td>
<td>--------------</td>
<td>-----------</td>
<td>-----------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early</td>
<td>.340</td>
<td>.065</td>
<td>.650</td>
<td>.173</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.350</td>
<td>.000</td>
<td>.508</td>
<td>.174</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late</td>
<td>.367</td>
<td>.147</td>
<td>.625</td>
<td>.160</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.300</td>
<td>.071</td>
<td>.475</td>
<td>.203</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER 3
GENERAL DISCUSSION

Environment

Past research has shown that context change effect is a modest, although reliable effect (Smith & Vela, 2001). However, no significant effect of environment was observed; participants did equally well if the encoding and retrieval environments matched or mismatched. Fernandez and Glenberg (1985) did not find any reliable context change effects and actually observed a different context advantage as frequently as not finding any advantage. They suggested that differences in environments and type of disruption tasks in the literature may result in discrepancies in the magnitude of context change effect. Perhaps the context change effect does occur but is undetectable by current experimental manipulations.

This explanation, however, seems unlikely. Other researchers have been able to find context change effects (Smith, 1979; 1984; 1986; Smith, Glenberg, & Bjork, 1978). The environmental context change effect is also vulnerable to a number of different manipulations, as was discussed in Smith and Vela’s meta-analysis. In this study, participants in the match condition were asked to walk to a neutral zone and then back to the initial environment. In several of Smith’s studies (1979, 1984, 1986), the participants in the match condition were asked to wait in a neutral zone. This difference in disruption task may account for no significant context change effects in the present study: Smith’s participants, while waiting in the neutral zone, may view this as an opportunity to rehearse the studied words. Whereas participants in this study were continuously
walking for the duration of the disruption task and may view this task as beginning another unrelated task. Therefore these participants are less likely to engage in rehearsal.

A criticism of past studies that did not find environmental context change effects was that the environments were not different enough. Care was taken in this study to maximize the differences between the two environments by choosing an indoor office setting and an outdoor picnic table setting and the experimenters conducting the environments. However, participants could be viewing the environments as part of the same task (studying words) and therefore, their expectations did not alter. Manipulating participants’ expectations is a difficult experimental control. Isarida (2005) found that type of task can contribute to context change effect, yet environmental context change effect has been demonstrated for same-task studies (see introduction).

**Encoding Strategy**

There was a significant effect of strategy on recall. Participants that were instructed to engage in a deep encoding strategy had higher recall than those that were instructed through a shallow encoding strategy. Past environmental context research found that deep processing resulted in better recall (Murnane & Phelps, 1995; Smith, 1986; Smith, Vela, & Williamson, 1988) possibly due to relational inter-item processing. Therefore, an associative inter-item processing that converts the target items into more meaningful information will result in better recall, as was observed in this study. This replicates past research findings where deep encoding strategies result in better recall than shallow encoding strategies (Delaney & Knowles, 2005; Sahakyan & Delaney, 2003; Sahakyan, Delaney, & Kelley, 2004). It may be that initial encoding strategy may be powerful enough to eliminate any environmental or time influences. If this was the
case, then it would be interesting to examine shallow encoding strategy for future research as the majority of participants engage in shallow coding.

**Time**

It would seem from real-life observations that the more time spent in an environment, the easier and better developed the representation of the environment will be. Smith’s overshadowing hypothesis (as described in Smith, 1994; Smith and Vela, 2001) actually predicts that the longer the time spent in an environment, the higher the chance that environmental retrieval cues will be utilized. Therefore, changing environments will result in poorer recall because of the utilization and greater dependency of environmental cues. Regardless, time spent in an environment, whether enhancing or reducing opportunities to utilize environmental context cues, seems intuitively to significantly influence the magnitude of context change effect.

Surprisingly, there were no significant time manipulation effects; there were no support for the habituation hypothesis as an adequate explanation of the context change effect.

One possible explanation may be that the time interval in this study (seven minutes) was not enough for participants to habituate to the environment. Perhaps participants did not attenuate to the environments as was hoped and had “zoned out” during the delay. It does not seem to be that the environments must be radical to catch participants’ attention; however, it would seem that participants are more focused on completing the experiment and therefore their attention becomes tunnel-vision.

**Working Memory**

There was mix support for the working memory predictions. There were no significant correlations for working memory span and word recall, suggesting that perhaps the environmental context change effect is not related to working memory. This
does not provide direct support for the prediction that individual differences in working memory should also reflect and predict the magnitude of environmental context change effect, specifically, that high span working memory individuals should be more affected by changing environments. Delaney and Sahakyan (in press) found that when participants were asked to forget information, high span individuals had poorer recall compared to low span individuals. They attributed this to the mental context change that occurs with a “forget” cue; high span individuals were more affected by the mental context change than low span individuals. Surprisingly, this was not observed with regular correlations as was predicted.

However, multiple linear regression analyses revealed interesting trends. Based on the results of the linear regression analyses to assess individual differences in working memory affecting recall of experimental conditions, it would seem that there was some support for the hypotheses. For those engaged in a shallow encoding strategy, those with high working memory span were more affected by the manipulations of environment and time, resulting in lower recall when environments matched than mismatched, replicating Delaney and Sahakyan’s (2004) findings. For those engaged in a deep encoding strategy, their individual differences in working memory did not influence experimental manipulations, and hence did not affect recall. These findings provide some support for the prediction that environmental and time manipulations should affect those in the shallow encoding condition but not for those in the deep encoding condition.

Engle and Turner (1986, 1989) argued that working memory is independent of task-related processing. However, it would seem more likely that deep encoding provides such powerful retrieval cues that there is no influence of individual differences
in working memory span. Kane, et al. (2000, 2001) argued that working memory capacity was attentional based. Due to the mixed working memory results, this also suggests that perhaps environmental context change effect is less dependent on attentional processing and is driven much more by strategy than was previously thought. However, the trends are in the predicted direction.

**Population Sample Problems**

The retrospective reports showed that participants tend to become increasingly more aroused after a delay (e.g. impatient, tense, nervous, excited). However, most participants initially begin the experiment as either aroused or neutral (e.g. “normal”, good, fine, curious). Interestingly, participants’ affective states did not affect recall, which does not support Eich’s (1995) mood hypothesis theory.

The non-significance of the results may be due to a number of these reasons. However, it would seem that there were problems with the sample population. Upper division psychology students may have more expert knowledge and hence, may have guessed the purpose of the study. This may actually affect the results of the late condition in which participants were told to wait quietly while the experimenter is setting up; students from upper division psychology courses may see through the ruse. These students from upper division courses may also be better at engaging in the encoding strategies since they may have already developed better study strategies. The post hoc comparisons suggest that there were differences in the performance of introductory students versus upper division students. There were differential performances for the participants depending on whether they were introductory psychology or upper division students as is evidenced by very different means. However, due to the low and unequal
number of participants in each cell, caution should be taken when interpreting these results.

It could also be possible that there were outliers in the data set, as is evidenced by high standard deviations in some conditions such as the early, mismatch, and deep experimental conditions for introductory to psychology students (SD = 7.071). These outliers may have biased the data. In future follow-up studies, these outliers should be replaced.

Another potential explanation for the non-significant results is not having enough statistical power to detect the effects. There were eight participants in each of the experimental cells which may not be enough participants to detect context change effects. In spite of this, there were no ceiling effects or flooring effects. Follow-up studies should include more participants and be cautious of participant recruitment.

**General Conclusion**

Despite all these possibilities, it could be that initial encoding strategy greatly influences context change effect. It would make sense to think that information that is more meaningful is less forgotten. In the real-life evidence, we often find that we forget what we initially set out to do when moving to a new environment, such is the case when going to obtaining a drink while watching television or retrieving an office supply in the midst of typing. However, perhaps more often, we do not forget that we are going to work or class as soon as we leave our homes or that we are going to return an important phone call in the midst of the day. Perhaps this is because this information is meaningful; we usually have a routine where we go to work or class at the same time every day or that a phone call is very important. This information would be deeply encoded because it is organized, important, and meaningful. The items or task that is usually forgotten due to
an environmental context change effect may be not as important as other activities that are occurring; getting more paper for the printer or getting a drink in a midst of a broadcast game may be not as important or of one’s interest as working on the paper that is due soon or the game that is playing on the television. We unconsciously prioritize our tasks and information and hence, the items that are not as important are not processed as much to prevent exhausting cognitive resources.

It is interesting to note that encoding strategies play a bigger role in incidental memory, such as environmental context change, than was originally expected. In this study, participants’ encoding strategies were controlled; participants were required to utilize a deep or shallow encoding strategy to study the words. It is important to remember that without instruction, participants tend to overwhelmingly choose an initial shallow encoding strategy (Delaney & Knowles, 2005; Sahakyan & Delaney, 2003; Sahakyan, Delaney, & Kelley, 2004). This may not be adequate to explain the discrepancies in the environmental context change literature, but future research should examine the role of encoding strategies and the magnitude of environmental context change effect.
LIST OF REFERENCES


BIOGRAPHICAL SKETCH

I was born in Thailand in 1982; at that time, my parents and brother were on their way to America. They were the “boat people” of Vietnam, refugees of the Vietnam War in search of a better home and a hopeful future. Three months later, we eventually ended up in Oklahoma City, Oklahoma, which I would come to regard as my home city and would graduate from Northwest Classen High School in 2000. In 2003, I graduated from Oklahoma State University with a Bachelor of Science degree in psychology and a minor in biology. I entered the cognitive psychology program at the University of Florida in 2003.