To the Graduate Council:

I am submitting a thesis written by Jeffrey J. Borckardt entitled "What we don't know about memory error: differential effects of experimental memory distortion conditions." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Psychology.

Michael Nash, Major Professor

We have read this thesis
And recommend its acceptance:

Accepted for the Council:

Associate Vice Chancellor and
Dean of The Graduate School

WHAT DON'T WE KNOW ABOUT MEMORY ERROR: DIFFERENTIAL EFFECTS OF EXPERIMENTAL MEMORY DISTORTION CONDITIONS

A Thesis

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Abstract

The current study attempted to demonstrate the relationship between eyewitness memory and the quality of the target information. A target episode was presented to 40 undergraduates at the University of Tennessee via either videotape or a live enactment. Additionally, the target information itself was classified into 4 categories which were: 1) central actions of the agent involved in the incident, 2) peripheral actions of the agent, 3) central characteristics of the agent, and 4) peripheral characteristics of the agent. Participants' memory was tested for each of the 4 categories. Techniques for increasing memory error were applied to all memory categories and between both the videotaped and live conditions. Several significant main effects and interactions were found within each of the memory categories, between distortion conditions and between the 2 presentation conditions. Finally, an attempt was made to correlate individual differences in memory performance with measures modeled after Gudjonsson's (1984) scale of interrogative suggestibility.

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I. Introduction

Interest in memory error and distortion has increased with the recent controversy surrounding false memories of abuse. Because research in this area often finds its way into the legal system, much of the work done on the reliability of eye-witness testimony and memory accuracy of witnesses is cited as a framework for understanding the processes behind memory error and the factors influencing distortion.

Roediger and McDermott (1995) have demonstrated memory error for words from lists of semantically related items. Participants falsely recall and recognize critical lure words (i.e. bread) that are not presented in the original study lists composed from related items (i.e. butter, sandwich, toast, and jam). While a popular framework for understanding memory error of this nature is the source monitoring error framework (Johnson et al., 1993; Zaragoza, 1996), Pesta (in press) has found this same effect using phonemes and numeric equations. Since these items have little semantic attributes which could be confused with information from other internal or external sources, this suggests that the processes involved in this type of memory error may include more spreading activation and reconstruction errors. Still, Roediger and McDermott's

(1995) paradigm has been helpful in the understanding of cognitive processes involved in memory error but little is known about its application in terms of episodic memory which is more important in eye-witness testimony.

Loftus (1975) has extensively demonstrated error in episodic recall and recognition. Much of this work defines the experimental conditions under which memory distortion can take place. Loftus (1975) has shown how the wording of questions affects the answers given by participants. Reports of automobile speed were augmented by the use of the word "smashed" versus "bumped" or "contacted" in reference to an accident viewed by participants (Loftus and Palmer, 1974; Loftus, 1975). Loftus (1975) also reports the effects of false presuppositions on memory also known as the "misinformation effect." By including misleading information within questions about a video taped incident, subjects reported seeing a barn that was never presented, as well as a school bus, a truck, and a woman, all of which were not in the film. A similar effect was found with a video tape of a group of 8 demonstrators that disrupt a class. The researchers asked participants either "Was the leader of the *four* demonstrators who entered the classroom a male?" or "Was the leader of the *twelve* demonstrators who entered the classroom a male?" The participants in the "four" condition reported seeing significantly less people than participants in the "twelve" condition (Loftus, 1975).

Loftus (1997) has also documented the effects of imagination on memory performance. Participants who are asked to imagine an event that never happened are more likely over time to falsely report that the event actually did occur (imagination inflation). While this effect is primarily applicable to autobiographical memory it is reasonable to assume that it would also apply to episodic memory for a recently witnessed target incident. Imagination of a previously viewed event may result in "filling-in" of information that is not remembered or information that was not perceived.

These landmark experiments demonstrate the distortion of details in memory and peripheral ideas. But, a problem arises when generalizing to overall memory error. Craik and Lockhart (1972) introduced the idea of processing levels in memory research. According to this theory, the strength of a memory trace is a product of the perceptual analysis (Gardiner, 1974). "Deeper" semantic encoding or elaborative encoding of words and concepts in episodic memory leads to better memory than phonemic and poorly elaborated or poorly integrated items (Bradshaw and Anderson, 1982; Tulving, 1974; Gardiner, 1974). Loftus' (1975) misinformation experiments demonstrate memory error along the lines of the less elaborated and poorly integrated aspects of the target information. Memory for more broad, semantically central ideas in episodic memory

may be more resilient than peripheral ideas and details. In other words, memory for all aspects of a target incident, may not be equally vulnerable to the misinformation effect.

A complimentary approach to understanding memory error focuses more on individual differences than on experimental conditions (Schooler and Loftus, 1986; Gudjonsson, 1986; Gudjonsson, 1989). Gudjonsson (1984) has developed a scale to measure individual differences in what he calls interrogative suggestibility. Gudjonsson's Scale of Interrogative Suggestibility uses the misinformation effect as well as social pressure to distort participants' responses to questions about an audio-taped incident. The degree to which a participant accepts the misinformation to be true (*yield score*) is added to the number of answers changed after the administrator tells the subject that he/she has done poorly and to try again (*shift score*)(response to social pressure). The total is thought to represent an individual's level of interrogative suggestibility. Gudjonsson (1989) found the suggestibility score to correlate significantly with individual levels of compliance, although this finding failed to replicate in another laboratory (Borckardt et al. in progress; Baker et al. in progress). However, a consistent, significant positive correlation between yield scores and shift scores has been reported as well as a significant negative

correlation between yield and shift scores and memory performance (Gudjonsson, 1984).

Much of the research in the area memory distortion effects relies on video-taped vignettes to provide target information (Loftus, 1975). While similar memory distortion effects have been found for live performances (Loftus, 1997), it would be helpful to directly compare distortion effects on memory between video taped presentations and live performances. Sanders and Chiu (1988) compared memory performance between presentation types but they didn't examine the specific impact of misinformation, imagination or social pressure on recognition memory performance.

The present study attempts to examine a number of variables (and their interactions) which have been shown to effect reported memory: the misinformation effect, social pressure, imagination, and time delay. But additionally, we seek to integrate the nature of the target information itself. We anticipate that these manipulations will indeed affect memory in general, but beyond this, we wanted to examine if these memory distortion effects impact processing levels differently.

First we are interested in differential distortion effects based on the centrality of the target information. Information central to the theme of the target information may be processed more deeply than peripheral information.

Several studies have demonstrated differences in performance between central versus peripheral information (Sheehan and Tildan, 1984; Hollin and Clifford, 1983) in addition to reporting children's perceived differences in memory ability between the two levels (O'Sullivan and Howe, 1996).

In addition to the centrality axis, we are interested in the role of the target content on memory distortion effects. We would like to distinguish the actions of the agent in a target situation from characteristics of the agent in the same situation (Sanders and Chiu, 1988).

It is hypothesized that memory for central information regarding actions and characteristics of the people involved in an incident will be more resistant to experimental distortion conditions than peripheral aspects. It is also hypothesized that accuracy of memory will be better for a video taped version of an incident than for a live performance of the same incident as participants may pay more attention to the video in anticipation of later tests on the material.

Finally, we would like to take a preliminary look at the relationship between individual difference measures (i.e. yield and shift) as per Gudjonsson (1984) and performance between different memory categories. In doing so, we hope to demonstrate a model that integrates Gudjonsson's model of individual differences with more

traditional experimental memory measures (Schooler, and Loftus, 1986; Gudjonsson, 1987).

Methods

Participants

Forty undergraduates at the University of Tennessee at Knoxville were given extra credit for participation in the experiment. There were 13 males and 27 females with a mean age of 22.93 (SD=6.64). The median and mode age was 22. The experiment was run in four groups of about 10 participants.

Materials

Incident Questionaire: Twenty-two upper-level psychology undergraduates and twelve graduate students in psychology were read a brief description of an incident ("A staff-person (man) interrupts a class to retrieve a box of slides from the room). They were then asked to categorize 80 questions as to whether the questions were inquiring about *actions central* (AC) to the theme of the incident, *actions peripheral* (AP) to the theme, *characteristics central* (CC) to identification of the person (or agent) in the incident, and *characteristics peripheral* (CP) to the identification of the person. The exact criteria the students were asked to use are in figure 1.

Figure 1. Criteria used for memory categorizations

Actions central (AC) - These are actions performed by the staff-person that you feel are directly relevant to the performance of the task described above.

Actions peripheral (AP) - These are actions performed by the staff-person that you feel are not directly related to the completion of any aspect of the task above.

Characteristics central (CC) - These are personal details about the physical identity of the staff-person that you feel are relevant to describing him in the situation above so that he might be identified later.

Characteristics peripheral (CP) - These are personal details about the physical identity of the staff-person that you feel are irrelevant to describing him in the situation above such that he could not be identified by the information.

Forty of the questions were eliminated from the list of 80 because there were low levels of agreement (less that 67%) between the raters. Cohen's Kappa for group agreement was calculated for the remaining 40 items ($K=.54$ $p<.000$).

These 40 items (all forced choice) were randomly arranged on a handout and there were 6 AC items, 12 CC items, 16 AP items and 6 CP items. Some AC items were "Did the person walk to the front of the room?" and "Did the person leave the slides in the room?" Some AP items were "Did the person knock 0,2,4, or 5 times before entering?" and "Did the person apologize for interrupting the class?" Some CC items were "Did the person who entered have on a blue white or brown shirt?", "Did the person have light or dark hair?" and "Did the person have any facial hair?" Some CP items were "How many buttons were open on the person's shirt?" and "Did the person have a pencil behind his ear."

Misinformation Questionaire: Half of the items in each of the four memory categories were used to create a separate misinformation questionnaire. Some of these items were "Was the person's brown shirt long or short sleeved?"(CC)(the shirt was really white), "In your opinion, did the person's blue bag clash with rest of his outfit?"(CP)(the bag was black), and "Which hand did the person use to wave to someone in the class?"(AP)(he did not wave to anyone). These items were intended to push

participants into responding incorrectly to the corresponding items on the incident questionaire.

Gudjonsson Yield and Shift Scores: From the misinformation questionnaire, participants were scored a 1 for each item on which they failed to catch that the presupposition was false. For example, if the participant said "long", "short", "yes", or "no" to any of the questions mentioned above in the misinformation questionnaire section without acknowledging that the shirt was not brown, or that the bag was not blue, or that the person did not wave, a 1 was scored for a total possible of 20. This score functioned as the **yield score** following from Gudjonsson's (1984) paradigm. Additionally, the number of answers to items on the misinformation questionnaire that participants changed between time 1 and time 2 was used as the **shift score.**

Telligan Absorption Scale: The Telligan Absorption Scale (TAS) is a 37-item true or false inventory designed to measure a person's degree of everyday mental involvement in activities and imaginational abilities. The TAS was used as filler material but it was hypothesized that it might correlate positively with memory performance as people with high TAS scores would possibly be more mentally absorbed in all aspects of the target incident.

Procedure

Participants were exposed to either a videotape or a live enactment of a staff person interrupting a class and picking up a box of slides from the front of the room. Twenty-two subjects (in the video group) viewed a video-tape of this well-rehearsed incident with the instructions to simply watch the video-tape and wait for further instructions. Without warning, eighteen subjects (in the "live" group) watched a live enactment of the same situation in their own class with the same actors, clothing and dialogue much like a real life incident that witnesses are asked to report.

All participants were then given 5 minutes to complete the Telligan Absorption Scale as a distracter.

Next, participants were given the 20-item misinformation questionnaire with the instructions to think back to either the video tape or the person that interrupted the experiment and answer the questions to the best of their abilities. They were told that the questions were designed to reveal their general impressions of certain aspects of the scenario that took place and which details stood-out most for them. They were instructed to write a much as necessary to completely answer each question.

Upon completion of the misinformation hand-out, participants completed the 40-item incident questionnaire

without knowing about the 4 memory categories of the questions.

Three memory distortion conditions (time delay, social pressure, and imagination) were collapsed into a single follow-up administration. Approximately 1 week later (*time delay*), participants were told that the 40-item memory measure was scored and that the scores were "extremely low; too low, in fact, for the experimenter to work with" thereby applying *social pressure* for participants to change some answers. They were asked to imagine the incident in as much detail as possible (*imagination*) and complete the 40-item questionnaire again while trying to be more accurate. The number of answers changed from time 1 to time 2 were totaled and functioned as the **shift score** following from Gudjonsson's (1984) paradigm.

All participants were thanked and thoroughly debriefed.

Results

A 2x2x2x2x2 mixed design was used with Memory Content (actions vs. characteristics), Centrality (central vs. peripheral), Misinformation (items with misinformation vs. items without misinformation), and Additional Distortion (Time 1 (no delay, no pressure, no imagination) vs. (Time 2 (delay, social pressure, imagination)) as within subject

conditions and Presentation (video vs. real) as the between subject condition. Memory accuracy on the 40-item incident questionnaire was the dependent measure. All residuals were examined and were normally distributed. Levene's test for equality of variances showed that variances were equal. Chance levels were calculated for all possible conditions and all memory scores were significantly above chance performance ($p<.05$) except memory for actions peripheral to the scene.

The TAS was reliable with alpha equal to .88. The yield scale (leading questions answered incorrectly) and shift scale (changed answers between time 1 and time 2) were reliable with alpha levels of .84 and .39 respectively. The scale reliability for memory performance on the incident questionnaire at Time 1 was .70 and .49 at Time 2. Scale reliabilities were calculated for items in all possible memory categories: memory for actions (alpha=.64), memory for characteristics (alpha=.69), memory for central information (alpha=.62), memory for peripheral information (alpha=.56), memory for distorted items (alpha=.68), and memory for non-distorted items (alpha=.60).

Main effects were found for memory content ($F(1,38)=32.12$, $p<.000$), centrality ($F(1,38)=137.63$, $p<.000$), and misinformation ($F(1,38)=28.41$, $p<.000$). Actions ($M=.7398$) were remembered better than

characteristics (M=.6245) and central items (M=.7894) were remembered better than peripheral items (M=.5749). Items that were initially distorted with misinformation (M=.6266) were not remembered as well as items without misinformation (M=.7377).

Significant two-way interactions were found between memory content & presentation ($F(1,38)=11.11$ $p<.002$), misinformation & presentation ($F(1,38)=7.08$, $p<.011$), memory content & centrality ($F(1,38)=29.13$. $p<.000$), memory content & misinformation ($F(1,38)=17.69$, $p<.000$), and misinformation & additional distortion ($F(1,38)=4.18$, $p<.048$). Memory for agent characteristics was better in the live presentation condition (M=.6991) than the video presentation condition (M=.5786)($t(38)=3.32$, $p<.002$), but memory for actions was the same in both the live condition (M=.7338) and the video condition (M=.7457). Memory for misinformation items was the same in the video condition (M=.6264) and the live condition (M=.6267) but memory for normal items was better in the live condition (M=.7934) than the video condition (M=.6821)($t(38)=3.72$, $p<.001$). Memory for central information was better when the inquiry was about actions (M=.9104) than about characteristics (M=.6948)($t(39)=6.66$, $P<.000$) and memory for peripheral information was the same between actions (M=.5703) and characteristics (M=.5708). Memory for actions with misinformation (M=.7227) was better than memory for

characteristics with misinformation (M=.5304)(t(39)=7.14, p<.000) but when the items were not exposed to misinformation, memory for actions (M=.7581) was the same as memory for characteristics (M=.7063). Memory for items with misinformation was the same at time 1 (M=.6186) and time 2 (after social pressure) (M=.6344). Memory for items without misinformation was marginally better at time 1 (M=.7477) than at time 2 (additional distortion) (M=.7167)(t(39)=1.82, P<.077).

A significant three-way interaction was found between memory content, misinformation & presentation (F(1,38)=15.68, p<.000). The memory content effect was stronger in the video condition (t(38)=3.33, p<.002) but the misinformation effect was stronger in the live condition (t(38)=2.66, p<.01). Another three-way interaction was found between centrality, misinformation & presentation (F(1,38)=5.06, p<.03). Again, the misinformation effect was stronger in the live condition, but the centrality effect was marginally stronger in the video condition (t(38)=1.667, p<.10). Finally, a significant three-way interaction was found between memory content, centrality & misinformation (F(1,38)=14.28, p<.001).

A significant four-way interaction was found between memory content, centrality, misinformation, and

presentation ($F(1,38)=14.28$, $p<.001$). Table 1 shows the significant effects from the General Linear Model.

Additionally, a significant correlation was found between the yield and shift scores ($r=.467$, $p<.001$) which is consistent with Gudjonsson's (1984) findings. There were also several significant correlations between the yield and shift measures and memory performance in the different memory categories. Table 2 contains these correlations.

Discussion

Consistent with Loftus' (1975) findings, the present study demonstrated the negative effects of misinformation, imagination, social pressure and time delay on memory performance. Furthur, the results suggest that actions were remembered better and are were more resistant to distortion than characteristics of the agent. Additionally, the central aspects of both actions and agent characteristics were remembered better and were more resistant to distortion than peripheral aspects. These findings are consistent with Craik and Lockhart's (1972) ideas and our hypotheses. While these results may seem simple and intuitive, they introduce an important qualification of much of the previous research in the area of eye-witness memory distortion. In terms of laboratory

Table 1. Significant effects from the General Linear Model using memory accuracy as the dependent measure.

Source	F	Sig.
Memory Content	32.12	.000
Centrality	137.64	.000
Misinformation	28.41	.000
Memory content * Presentation	11.11	.002
Misinformation * Presentation	7.08	.011
Memory Content * Centrality	29.13	.000
Memory Content * Misinformation	17.69	.000
Misinformation * Additional Distort	4.18	.048
Memory Content * Misinformation * Presentation	15.68	.000
Centrality * Misinformation * Presentation	5.06	.030
Memory Content * Centrality * Misinformation	14.28	.001
Memory Content * Centrality * Misinformation * Presentation	14.28	.001

Table 2. Significant correlations between yield and shift scores and memory accuracy for memory categories.

	Yield	Shift
AC w/ Misinfo @ Time1	...	...
AC w/ Misinfo @ Time2	...	-.362*
AP w/ Misinfo @ Time1	-.540**	-.386*
AP w/ Misinfo @ Time2	-.383*	...
CC w/ Misinfo @ Time1	-.573**	...
CC w/ Misinfo @ Time2	-.522**	-.434**
CP w/ Misinfo @ Time1	-.326*	...
CP w/ Misinfo @ Time2	...	.348*

* p<.05

** p<.01

research, some aspects of memory, more than others, were prone to distortion. However, it must be clearly understood that these findings do not directly apply to the controversy surrounding false memories of abuse. Researchers have demonstrated that memory for all aspects of an event can, in fact, be created and distorted over time using intensive techniques and under the right social circumstances (Loftus, 1997; Loftus, 1997; Loftus and Ketcham, 1991; Loftus, 1993). The present study examined memory for a situation that resembles the events and pressures one might experience as an eye-witness to an incident.

Overall, we have shown that some experimental conditions designed to cause memory distortion, have variable effects on different aspects of memory for an event. More research needs to be done in this area to clarify the effects of different distortion conditions on memory. Also, some care needs to be taken in presenting claims about the malleability of memory.

A useful feature of this study is the integration of individual difference measures with the experimental manipulations (i.e. creation of yield and shift scores and correlating them with memory accuracy) (Schooler and Loftus, 1986; Gudjonsson, 1987). The present study presents several significant relationships between yield and shift scores and memory performance for misinformation

items within the different memory categories. This study demonstrates a means of predicting individual effects of distortion on memory using variables created from Gudjonsson's (1984) framework. While Schooler and Loftus (1986) argue that using the same target information for both the memory meaures and the yield and shift measures is confounded, Gudjonsson (1987) has shown the same predictive relationships with unrelated measures of memory and yield and shift performance.

Future research in this area and replication studies need to correct some of the problems with the present study's design. First, the content of the vignette in the present study was very innocuous in nature. A real event that witnesses would be asked to testify to would most likely contain more emotionally charged material. Also, eye-witnesses in experimental settings may not be as cautious about identification decisions because there are no significant consequences for mistakes (Wells, 1993). Future studies should consider these points for the sake of applicability. Additionally, the misinformation items in the present study should have been counterbalanced between groups with the items that are not exposed to misinformation. It also would have been useful to separate the time delay, social pressure, and imagination conditions for a more thorough understanding of each one's unique effect on memory. Finally, a more thorough analysis of the

memory categories would be helpful in determining the characteristics of the items unrelated to the categorization that may be influencing memory performance.

There appear to be several qualifications to be made regarding previous findings in the area of eye-witness memory distortion as the present study found varying effects of misinformation, imagination, time and pressure on accuracy between memory categories. Research of this nature may give us more clues as to the mechanisms involved in memory error and distortion.

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