SUGGESTIBILITY EFFECTS FOR INFERRED TYPICAL AND ATYPICAL SCRIPT-BASED ACTIONS

by

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Abstract

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The following series of experiments investigated participants' memories for finished and unfinished script-based actions (typical and atypical) with a focus on the relationship between strength of recognition and vulnerability to misinformation. Atypical script-based actions (e.g., the theatre starting the wrong movie) were tested in the first experiment with adults. Three kinds of atypical actions were examined: Obstacles (actions that disrupt the goal of the story), Distractors (unanticipated mishaps), and Errors (undesired outcomes that are explicitly corrected in the scripts). The results show that the Error actions were less well recognized and more vulnerable to misinformation effects despite the fact that more information was given within the scripts about these actions. The next experiments examined recognition of stated actions and self-generated inferred actions in children and adults. Whereas previous studies required participant to make inferences about the cause of particular outcomes (i.e., backward inference effects), the scripts in the present experiments gave information about causal

actions and half of the time the results had to be inferred (i.e., forward inference effects). Results revealed the same pattern of recognition errors for the inferred unstated actions by both age groups, with children making more errors than adults. That is, adults and children alike have difficulties distinguishing inferred outcomes from those reported. In the last experiments, a forensically relevant script that required adults to make inferences about typical and atypical script-based activities was normed and tested. Two retrieval tasks, a yes/no recognition task typically used in memory tasks and a source monitoring task that reportedly requires participants to be more vigilant about whether they actually heard a report or inferred it, were used. The results revealed that atypical inferences produced more false identification errors that typical inferences regardless of task. These experiments add to and refine the widely accepted and researched Script pointed plus tag hypothesis originally proposed by Schank and Abelson (1977).

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Chapter 1: Introduction

It is a well established phenomenon that memory for an event, in terms of its accuracy, is vulnerable to how it is initially interpreted (the encoding process), what occurs afterwards, and how one is asked to recall it. Research on this topic has been particularly influential in allowing both scientists and legal advisors to explore the accuracy of eyewitness testimony in the courtroom. Memory can be distorted not only by post-event information but also inferences made during encoding or at retrieval. It is clear that inferences have both beneficial and negative consequences. The benefits include the ability to communicate efficiently by limiting the need to state implied information. However, inferences can also distort memory. It is clear that one is not always aware that certain details in memory were based on inferences (Johnson, Bransford & Solomon, 1973), nor is one always aware that inferred information was never actually presented (Misiurski & McDonough, in preparation). In eyewitness testimony, the ability to discriminate between inferences and perceived events becomes critical. The inability to correctly identify what was stated from what was inferred can have negative consequences.

One real life example of eyewitness memory distortions can be found in the case brought against Kelly Michaels. Although the standards of investigations are typically well structured, empirical findings are sometimes ignored as in State of New Jersey v. Margaret Kelly Michaels (1987). The Michaels' case relied heavily on eyewitness testimony of children. The controversial theme in this case was the use of suggestive techniques (Rosenthal, 1995). Margaret Kelly Michaels, a 23-year-old aspiring actress takes a job as a teacher's aid at the Wee Care Day Care center in 1984. While she worked

at the center for 7 months, the staff and parents described her as a likeable teacher. Shortly after she leaves, a child who had been under her care visits the doctor for a rash. During the visit, the child's temperature is taken rectally while a nurse rubs his back. The child said, "this is what my teacher does to me at nap time at school" and identified Michaels as that teacher.

An investigation was launched that included interviewing techniques that were very suggestive. After 82 child interviews and 19 parent interviews, charges were made against Michaels. The charges of sexual abuse were bizarre acts, including naked piano playing, peanut butter being licked off body parts, urination on children, knifes and light bulbs being inserted into the children's vaginas and forced feces eating. None of the children had any injuries consistent with these acts. The FBI was unable to find any human protein on the piano bench or any of the alleged tools used in the abuse. Michaels was convicted based on the testimony of the children alone.

This case was appealed on several grounds, including the questionable expert testimony, violations of closed circuit television procedures and suggestive questioning techniques used with child witnesses. In an Amicus brief, Bruck and Ceci (1995) outlined several issues, with supporting empirical evidence to show the techniques used in the Michaels case were misleading and suggestive. The topics included the bias of the interviewer, the effects of repeated questioning, the tone of the interviewer, peer pressure, the status of the interviewer, the use of anatomically correct dolls and source monitoring errors. Although it is highly probable that the interviewing techniques used in the Michaels' case elicited false eyewitness accounts, the verdict was not overturned based

on the interview techniques. The Appellate Division reversed the conviction based on the misuse of expert testimony and improper use of close-circuit television procedures.

The investigators in the Michaels case manipulated memory with more suggestive techniques than any laboratory would ethically desire to manipulate. This case offers us a real world understanding about the cost of memory distortion in the lives of both alleged victims and accused. It is clear that it is important for the scientific community to understand the factors that contribute to those errors. How can events so atypical such as 'naked piano playing' be identified as having occurred when in fact they did not? Are items that have only been inferred to have happened recognized as having actually occurred? What types of questions elicit suggestive vulnerability? Finally, is there a relationship between overall recognition and vulnerability to misinformation effects? These issues are of interest when one is interviewing children as well as adults.

To address these questions, several topics will be reviewed in the following chapters. First, the ways in which suggestions have been empirically tested will be reviewed. For example, in a classic misinformation study, Loftus and Palmer (1974) had participants answer questions after viewing a film of a vehicular collision. They found that speed estimates could be manipulated by post event questioning regarding the severity of the impact. Speed was chosen as the misinformed variable because it is not easily recognizable in that speed estimates yield varying results. Such variability allows one to question whether or not a relationship exists between the strength of recognition and vulnerability to suggestion. Although a few studies have looked at misinformation effects for script-based actions, (Greenberg, Westcott & Bailey, 1998; Lampinen, Faires, Neuschatz & Tolgia, 2000; Misiurski & McDonough, 2000; Smith & Studebaker, 1996)

the relationship between recognition strength and vulnerability to misinformation has not been investigated.

Second, one must understand how scripts (or previous knowledge) affect the organization and retrieval of actions, both typical and atypical, which will be discussed in Chapter 3. It must also be understood how scripts help one 'fill in the blanks' or make inferences for information that is not remembered. This will be discussed in Chapter 4. Also covered will be the costs and benefits of making such inferences and how these inferences can distort memory. Finally, Chapter 5 will investigate empirical evidence on how the different types of retrieval tasks (recognition vs. source monitoring) can influence what is recognized will be reviewed.

If inferences occur at encoding then the ability to recognize that one made an inference should be difficult even at short delays when the episodic trace is strong. Participants may be unable to distinguish inferences made from actions stated. What is of interest here is how typicality affects false recognition for inferences. Specifically, are participants able to distinguish between a typical inference from an atypical inference in a script-based story? Also, we need to understand how misinformation affects the memory trace of inferred typical and atypical script-based actions.

Whereas the research to be presented in Chapters 6-10 seeks to investigate the relationship between recognition strength and vulnerability to suggestion, it is not an attempt to uncover the underlying processes in suggestibility with children on issues from the Kelly Michael's case. This case example was presented to show that highly atypical actions that have been suggested can result in inferences that become integrated into the memory trace. Due to the complexity of the tasks used in the current research, adult

participants have been recruited for all but one study. In understanding the effects of misleading post event information on typical and atypical inferred actions, one can begin to make predictions as to how inferences are influenced by suggestion. This can aid our overall understanding of interviewing techniques and suggestibility. This could also lead to additional forensically relevant studies comparing finished and unfinished inferred actions based on typicality. Understanding the underlying functions of scripts can help researchers make predictions as to what will be accurately recognized and what actions are more likely to be erroneously recognized or inferred.

The purpose of this research is to investigate the relationship between recognition strength and vulnerability to suggestion for stated and inferred actions. It is proposed that more recognizable actions are less vulnerable to post event information that can often become part of the original memory trace. Numerous studies have found a distinct pattern of recognition for typical and atypical script-based actions (Bellezza & Bower, 1981; Davidson, 1994; Davidson & Hoe, 1993; Smith & Graesser, 1981). The recognition rates shown in these studies have been consistent with the hierarchical order predicted by the Script-Pointer plus tag hypothesis (Schank & Abelson, 1977). It is within this framework that the current predictions are made as to which actions will be more recognizable and therefore be less likely to produce memory distortions, which can occur when the suggested information obtained after an event has been experienced becomes integrated into the original memory trace. This type of memory distortion is often referred as misinformation effect. In the research to be presented misinformation effects are investigated for stated and inferred typical and atypical actions. Predictions

will be made and the results discussed within the framework of the Script Pointer plus tag hypothesis (Schank & Abelson, 1977).

Chapter 2: Eyewitness Research and the Judicial System

The courts offer guidelines in evaluating memory accuracy in eyewitness testimony. These guidelines are within the general framework of an information processing theory that scientists use to discuss eyewitness memory. The information processing approach makes the analogy that the human mind operates like a computer. The acquisition stage would correspond to the receiver or input buffer device. This information would then be encoded and stored temporarily in what would be considered the central processor. Finally the memory would be retrieved from the hard drive. Yet it is important to point out that unlike a computer, the stimuli that enter the mind are not infallible to misinterpretation. Inferences, post event misinformation and other factors that can in turn affect retrieval.

The Supreme Court proposes several factors to be considered in eyewitness testimony (Neil v. Biggers, 1972). Some of the factors to be considered can be directly related to a stage of information processing: 1) the opportunity of the witness to view the criminal at the time of the crime (acquisition); 2) the witness' degree of attention (coding); 3) the accuracy of the witness' prior description of the criminal; 4) the level of certainty demonstrated by the witness at the confrontation; and 5) the length of time between the crime and the confrontation (retrieval). These five factors constituted a critical milestone in dealing with the potential of eyewitness misidentification. Information processing provides scientists a framework in which empirical investigations could then be focused. The results of such investigations offer a foundation on which researchers can further investigate memory distortions and recognition errors. In the past 30 years there have been numerous cases involving eyewitness identification issues,

including instructions to jurors, the use of empirical findings and the allowance of expert testimony. The following is a review of some of these cases as discussed by Monahan and Walker (1998). One important case concerning the accuracy of eyewitness testimony that built on the proposal from Neil v. Biggers was offered in United State v. Telfaire (1972). The Telfaire case provided additional juror instructions, which are used to aid in the understanding of the accuracy of eyewitness testimony. The Telfaire instructions also fit into an information-processing framework. Specifically, jurors are instructed to consider the external context at the time of acquisition (e.g., distance, luminance, noise level), the internal influence on coding (e.g., stress, personal biases, fatigue, drugs, attention) and the factors that influence retrieval (interval between observation and retrieval, state of mind, misleading information) in evaluating the accuracy of eyewitness testimony.

Specific guidelines for the admissibility and reliability of scientific evidence were set by the Supreme Court in Daubert v Merrell Dow Pharmaceuticals (1993). Issues to consider in allowing scientific evidence include: the testability of the evidence; peer review of the methodology; the reliability of the results; the standards of the methodology; and the acceptability of the evidence in the general scientific community. Expert witnesses often discuss the problem of post event information. Researchers agree that memory accuracy is vulnerable to event encoding (i.e. initial interpretation), storage, and the way in which people recall the events. Research on this topic has been particularly influential in allowing both scientists and the courts to explore the accuracy of eyewitness testimony. In the late 1800s, Ebbinghaus (1885/1964) designed a method to test memory empirically using a list of nonsense syllables. His methods changed the way

suggestive questioning can impair the original memory trace. In one study, he presents participants with a detailed picture of a farmer's room. After the picture is removed, the participants are asked nonleading questions such as, "How many persons are in the room?" and suggestive questions such as, "Did you see the stove in the room?" Results show that misleading questions are answered correctly less than 60% of the time. If the participant falsely claims seeing a stove in the room, additional questioning leads to obtaining further details about the nonexistent stove's location. Munsterberg called this false recollection, "the path of least resistance in his, (the subject's) own imagination" (Munsterberg 1907/1981, p. 182). Although Munsterberg urged the legal community to acknowledge the detrimental effects of suggestion on eyewitness memory, he also recognized the importance of suggestion in other areas such as art, education and religion. In using what is known today as a forced choice recognition task, Munsterberg finds that correct details can be removed from memory entirely by excluding the correct option in questioning. An example would be to ask if the farmer's dress was blue or green, when it was actually red. Seventy years later, Loftus (1974) use a forced choice questionnaire in her research on misinformation. Unlike Munsterberg, Loftus included the originally presented item and the newly suggested item in the choices.

Loftus and Palmer (1974) also investigated how the form in which a question is phrased affects the answer obtained. Participants were shown films of automobile accidents. They were questioned about the events in the films. The question concerning the speed of the cars upon collision was the main focus in this study. This variable was chosen because the estimation of speed results in great variability. Speed is not an easily identifiable or recognized factor. The manipulated variable is the verb used in the

question, "How fast were the cars going when they '_____' each other?" The verbs used are: smashed, collided, bumped, hit, or contacted. The estimated speed varies depending on which verb was presented in the question. Overall, participants asked "How fast the cars were going when they 'smashed'?" were more likely to estimate higher speed (40.8 mph) than participants presented with the other verbs biases: collided (39.3 mph), bumped (38.1 mph), hit (34.0 mph) and contacted (31.8 mph). Although the results of this study do not identify the statistical significance between verb biases, overall a graded effect of speed estimates is shown.

A second experiment was conducted to see if the details of the original memory can be changed by altering the verb bias (Loftus & Palmer, 1974). Participants view a film of a car accident in which there is no broken glass. Some participants are later asked about the event in terms of one car "smashing" into the other, whereas other participants are asked about the event in terms of one car "hitting" the other. Given that broken glass is expected of a high but not a low speed crash and that the verb "smashed" is more indicative of a higher speed than "hits", participants are more likely to claim falsely that they saw broken glass when presented with the "smashing" verb. That is, the impact of the verb used to describe the event provides "misinformation" which influences the participants' memories. It is noted in the study that broken glass corresponds with expectations of what would occur in a high-speed crash.

It can be assumed that Loftus and Palmer (1974) were expecting the subjects to call upon their knowledge of what would occur in a car accident. That is, one's generic script for a car accident would be activated and this information is then used when reconstructing the memory of the car accident. Based on these results, Loftus proposed

that two forms of information are introduced into memory. The first is the original memory encoded at the time of the event. The second consists of any additional information received after the event. These two sources of information become integrated into one memory for the event. It is no longer possible to differentiate which information came from which source. In a later study, Loftus, Burns, and Miller (1978) offered two possible explanations for misinformation effects. The first is the new information replaces the original memory trace. The second is that both the original memory and the misleading information exist in memory and the new information 'competes' with the original memory trace. Although it is inconclusive which phenomenon is occurring, what is clear is that misleading information distorts the original memory trace during retrieval.

The effects of misleading questioning have been investigated since the late 1800's. In the past 30 years, there has been extensive research on misinformation effects focusing on different variables including: age (Ceci & Bruck, 1995); event plausibility (Pezdek & Hodge, 1999); incriminating tone of interviewer (Lepore & Sesco, 1994); repeated retrieval (Roediger, Jacoby & McDermott, 1996); source credibility (Lampien & Smith, 1995); source monitoring (Giles, Gopnick & Heyman, 2000); and time intervals (Higham, 1998; Roberts, Lamb & Sternberg, 1999). There have been numerous theories on the processes by which misinformation effects are obtained (e.g. Belli, 1989; Loftus, 1991; Loftus & Hoffman, 1989; Roediger, Jacoby & McDermott, 1996). Misinformation effects can be obtained even in situations where the participant is instructed to ignore leading questions from the attorney (Holst & Pezdek, 1992).

The debate as to whether the original memory is actually changed, distorted or altered as a result of demand characteristics has not been clearly shown. There has yet to be a reliable and valid technique to distinguish between an original memory and one that has been suggested outside the laboratory. What is clear however is that misleading information results in memory distortion for the original event.

Chapter 3: Scripts in Memory

It is important to understand the underlying influence of previous knowledge on memory retrieval. In State v. Long (1986) the court acknowledged one's memory limitations. One such limitation is the inability to perceive all actions and details in a given event. The court recognizes a tendency to make inferences when memory gaps occur, inferences that allow us to believe we have a complete memory for the event. For example, if one observes a car accident, previous experiences observing or being involved in a car accident helps one to formulate some ideas about what is happening at the moment and what can be expected to happen later on. These previous experiences blend into a generic understanding, also called a script or schema, of an event. Schemas are knowledge structures that include a script of expected activity developed from previously experienced events. Scripts guide people's expectations as well as the inferences they make about a particular event (Bower, Black & Turner, 1979, Mandler 1976).

When an event has been experienced, a script for that specific event is formed which can later be modified or enhanced with additional experiences or similar events. A script is a temporally organized mental 'list' of expected actions or activities that are usually directed toward a particular goal. A frequently used example is a 'going to a restaurant' script. In this example, events that are expected to occur include: being seated, reading the menu, ordering, having the server deliver your meal, paying the bill and leaving the tip. Memory models for scripted events make specific predictions of the recognition rates for activities that are consistent (typical) and inconsistent (atypical) with the event (Schank & Abelson, 1977).

This chapter illustrates that scripts are an important role in many forensically relevant aspects of eyewitness memory. As previously discussed, the courts have adopted an information-processing framework in which to incorporate the results in adult eyewitness research. Numerous studies with children can also be broken down into aspects within the same framework (see Gordon, Baker-Ward & Ornstein, 2001 for review). Gordon et al (2001) outlined previous empirical findings with children within each stage of information processing. The review includes factors that are shown to influence memory in encoding (understanding of the event, stress), storage (passive v. active participation, age, time intervals, previous knowledge and misleading information) and retrieval (knowledge structures, distinctiveness of event, individual differences and types of interviews). The review also postulates that previous knowledge and expectations (i.e., scripts) are a critical factor in all stages of eyewitness memory.

Although some events are learned via another person's account of what happened, the listener nevertheless uses scripts to interpret and understand them. For example, passive receivers (such as jurors) reorganize information into a story structure. In a trial, the juror is frequently presented with many eyewitness accounts of the event in question. The events are not necessarily presented in chronological order. The juror can potentially hear multiple versions of the event in question. The juror must somehow organize these complementary or conflicting versions and reach a decision. One way in which this can be done is to integrate the information into a story format. Pennington and Hastie (1986) find that jurors translate the evidence into a representational story that can include inferences of causality. That is, the juror uses personal experiences and beliefs to aid in the construction of the story and inferences made.

Children also organize a script in a temporally organized, hierarchical structure similar to that of adults. Hudson, Fivush, and Kuebli (1992) review the developmental differences in the understanding of deviations with newly learned scripts. Children over 3 years of age are more able than younger children to understand script deviations and allow for variations in newly scripted activities. When one action from one episode deviates from what is expected, children under the age of seven have a difficult time distinguishing which specific episode the deviation occurred in (Farrar & Goodman, 1992). Because of this difficulty, children will often incorporate the deviation into their script and falsely identify it as having occurred in another or all episodes. Overall, children's experience with a repeated event reveals an updating of their scripted knowledge and structure. It is clear from the results of these studies that children also rely on script knowledge to organize information.

Although many researchers believe that scripts are analogous but not the same thing as stories, Schank and Abelson (1995) propose that all knowledge is stories. Even a short statement or word automatically elicits indexed experiences from memory. Schank and Abelson (1995) claim there is no factual knowledge, just stories that have been built upon previous stories. If this view is correct, then one would expect that typical script-based actions will be assumed to have occurred even when they did not. Recognition of typical actions in new episodes is derived from a previous story structure in which existing gaps are already filled in. This view is also supported by studies in which participants are visually presented with objects in canonical or noncanonical scenes (Mandler & Parker, 1976). Canonical scenes produced higher accuracy in attempts to

duplicate the placement of objects than unorganized scenes. This suggests that even our perceptions are influenced by expectations and previous experiences.

A script contains more than a brief synopsis of expectations. Not all actions within a script produce the same rate in recognition. The script pointer + tag hypothesis (SP+T), proposed by Schank and Abelson (1977), focuses on the memory of script-based stories and how schemas influence those memories. Schank and Abelson (1977) hypothesize that certain actions will be recognized more easily than others depending on typicality. When a person is exposed to a scripted event, the typical actions for that event become active in the memory representation of expected actions for that event. Since all or most of these typical actions are active in the memory representation, it then becomes difficult to distinguish typical actions that actually occurred from typical actions that were assumed to have occurred. For example, the police usually, but not always, take a report at the scene of an accident. It would not be surprising if someone falsely believed that the police took a report at a particular accident site when in fact they did not.

Schank and Abelson (1977) propose a separate memory store for unexpected actions. Unexpected actions occurring within a script are referred to as atypical actions. The SP+T hypothesis claims that atypical actions in script-based activities are 'tagged' into memory and therefore will be more accurately recognized than typical script-based actions. With brief intervals less than 48 hours between the actual event itself and a recognition test there should be better memory for atypical actions than typical actions. In fact, research reveals that recognition for atypical actions is better than recognition for more typical actions at delays less than a week (Bellezza & Bower, 1981; Bower, Black & Turner, 1979; Davidson, 1994; Davidson & Hoe, 1993; Grasser, Gordon & Sawyer,

1979; Graesser, Woll, Kowalski & Smith, 1980; Lampinen, Faires, Neuschatz & Tolia, 2000; Smith & Graesser, 1981). That is, people 'remember' atypical activities but will often erroneously say they remember typical activities that did not occur. Studies have also found this pattern with children (Davidson & Hoe, 1993; Hudson, Fivush & Kuebli, 1992). At much longer delays, atypical actions can be forgotten and relative to the atypical actions better memory for typical actions is found (Bower, Black & Turner, 1981; Smith & Graesser, 1981).

To summarize, atypical actions are "tagged" into memory and are more easily recognized than typical actions after short delays. This hypothesis has received considerable support (e.g., Bellezza & Bower, 1981; Davidson, 1994). Interestingly, atypical actions are also recognized better than typical actions in the types of details attached to the memory (Lampinen, Faires, Neuschatz & Toglia, 2000). When probed for details, correct atypical memory judgments are vivid and more likely to produce details about thoughts and emotions than typical actions. It is concluded that atypical actions are not only stronger in the memory representation but they also contain more perceptual details.

The memory representation for script-based actions, as proposed by the SP+T hypothesis, is presented in Figure 3.1. The memory representation is activated when one is presented with a story or observes a previously experienced event. All actions that typically occur (depicted inside the box) are activated as a whole. This includes typical actions that are mentioned or were actually witnessed to have occurred and typical actions that did not occur but are inferred to have occurred. Thus, this 'group' activation makes it difficult to discriminate which typical actions actually happened from actions

that commonly occur. When an atypical action is encountered, (see tag above the box) it enters into a separate memory store and these actions are 'tagged' individually. The individual tags make the actions more recognizable thus they are shown in Figure 3.1 as being above the box of typical actions. By looking at the vertical line in the left most portion of Figure 3.1, one can see that atypical actions are aligned as being more recognizable than typical actions.

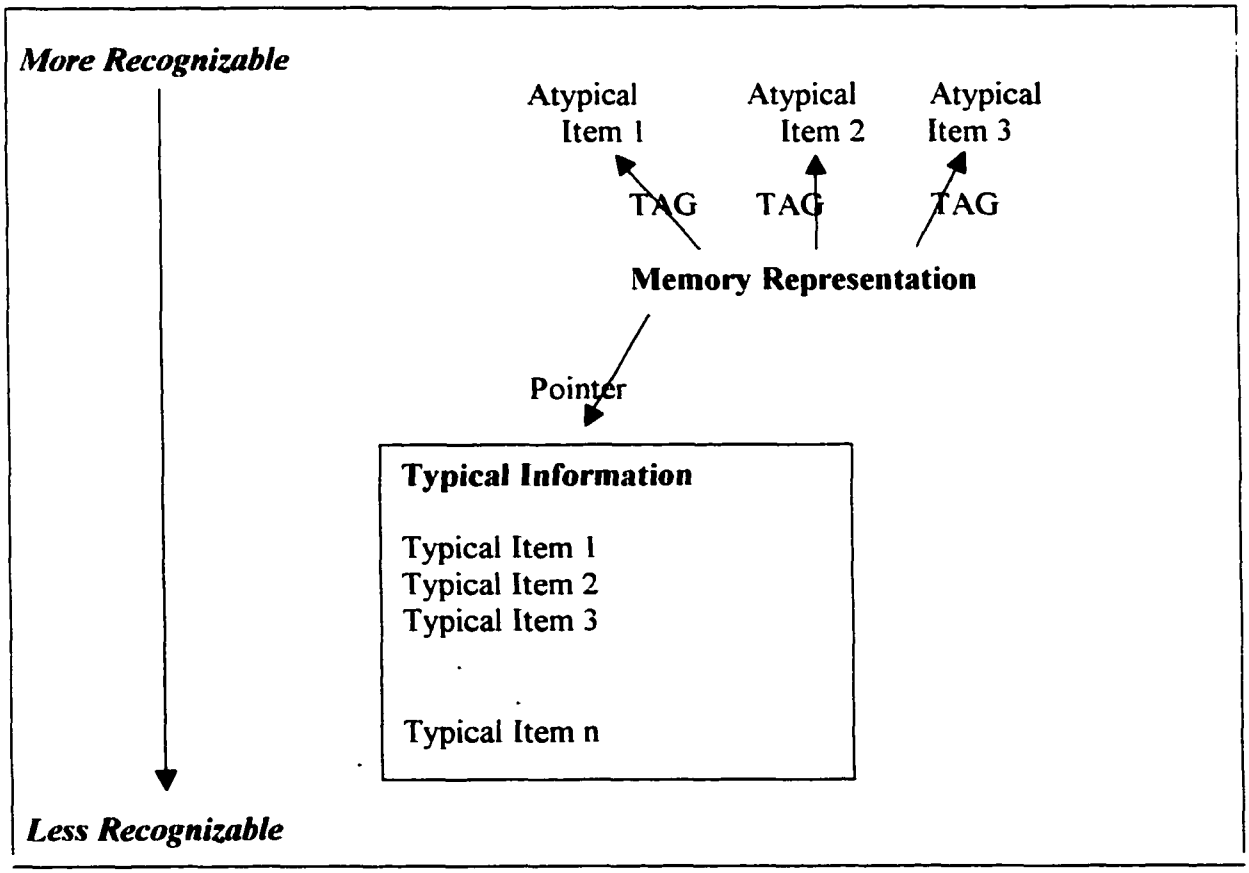

Figure 3.1. Memory Representation for Script-based Information (Schank & Abelson, 1977)

In investigating suggestibility for atypical actions it is important to note that atypical actions can be graded in terms of recognition rates by the type of the atypical action. For example, Davidson (1994) investigated the recognition rate of different types

of atypical interruptive actions. Atypical interruptive actions can be broken down into three types: Obstacles, Distractors and Errors (Schank & Ableson, 1977). Obstacles are actions that disrupt the goal of the story (e.g., someone blocking the view of the movie screen). Distractors are unanticipated mishaps (e.g., stumbling on the way to one's seat at the theater). In this study, Errors are actions that lead to undesired outcomes and are explicitly corrected in the stories used in this study. For example, when a central character makes an error such as getting in the wrong line to buy show tickets, the correct action is then stated (e.g. he gets in the right line). Obstacles and Distractors are not explicitly corrected and the participant must make an inference that the situation was resolved to make sense of the continuing actions.

Results from Davidson (1994) show that all interruptive atypical actions are well recognized on a recognition test after a 48-hour delay. Participants can also easily distinguish atypical actions in the story from atypical actions not in the story. Participants also have difficulty discriminating between script actions that were in the story from ones that were not. Finally, Obstacles and Distractors are more easily recognized than Errors. This shows different recognition rates for unfinished actions (Obstacles and Distractors) and finished (Error) actions. Error actions are corrected in the scripts, while Obstacles and Distractors are left unfinished. Previous research (Davidson, 1994) has shown that extra processing is needed to bridge the causal relationships, which in turn results in better recall for the unresolved actions such as the Obstacles and Distractors. Davidson claims this is due to the additional processing needed to complete or close the causal bridge for the unfinished Obstacles and Distractors, whereas the Error actions were explicitly corrected and therefore need less processing.

In an additional study, Davidson (1994) investigated the differences between Obstacles, Distractors and Error actions when they were all left unfinished. She found no differences for the recall rates of these three types of actions when the Error actions were left unfinished like the Obstacles and Distractors. This shows the importance of the extra processing needed to close the actions. Experiments 2 and 3 will look closer at the finished/unfinished factor in the recognition of actions.

Research has shown that atypical information (as shown as more recognizable in Figure 3.1) is less likely to be vulnerable to misinformation effects than typical information (Smith & Studebaker, 1996). Gap filling errors are more likely to occur with typical than atypical information, thus resulting in higher false recognition for misleading information that is consistent with actions typical to a script. Gap-filling errors have been found not only in story scripts but also in visual tasks. Greenberg, Westcott and Bailey (1998) have shown that unstated central (more typical) actions are more likely to produce gap-filling errors than peripheral (less typical) actions when presented in a visual slide presentation (Greenberg, Westcott & Bailey, 1998). Participants are also more likely to make false recognition errors on typical actions (more central to the story) than on less typical items. This effect increases as the time between the original presentation of the story and the recognition test increases. Thus, it is easier to mislead participants with information that is typical than with information that would be considered atypical. However, atypical actions should not be excluded from the assumption of being vulnerable to suggestibility effects.

Experiment 1 will investigate the relationship between the strength of recognition for atypical script based actions and vulnerability to misinformation based on the memory

representation as shown in Figure 3.2 (see next page). Next to the vertical line depicting the strength of recognition in the left most portion of the figure is another vertical line depicting vulnerability to suggestion. As previously noted the more recognizable atypical actions are less suggestible than the less recognizable typical actions. In the right most portion of the figure are the recognition rates for the three types of atypical actions: Obstacles, Distractors and Errors. As previously discussed Obstacles and Distractors are more recognizable than Error actions and as such are depicted higher in the figure. It is suggested that actions higher in recognition should be less suggestible. Therefore, Error actions should produce the largest margin of misinformation effects in comparison to Obstacles and Distractors. This prediction is based on the findings by Davidson (1994) in that Error actions have lower recognition rates than both Obstacles and Distractors. As such, the unfinished Obstacles and Distractors are predicted to have stronger recognition rates and therefore be less vulnerable to misinformation effects than finished Error actions as can be seen in the memory representation in Figure 3.2.

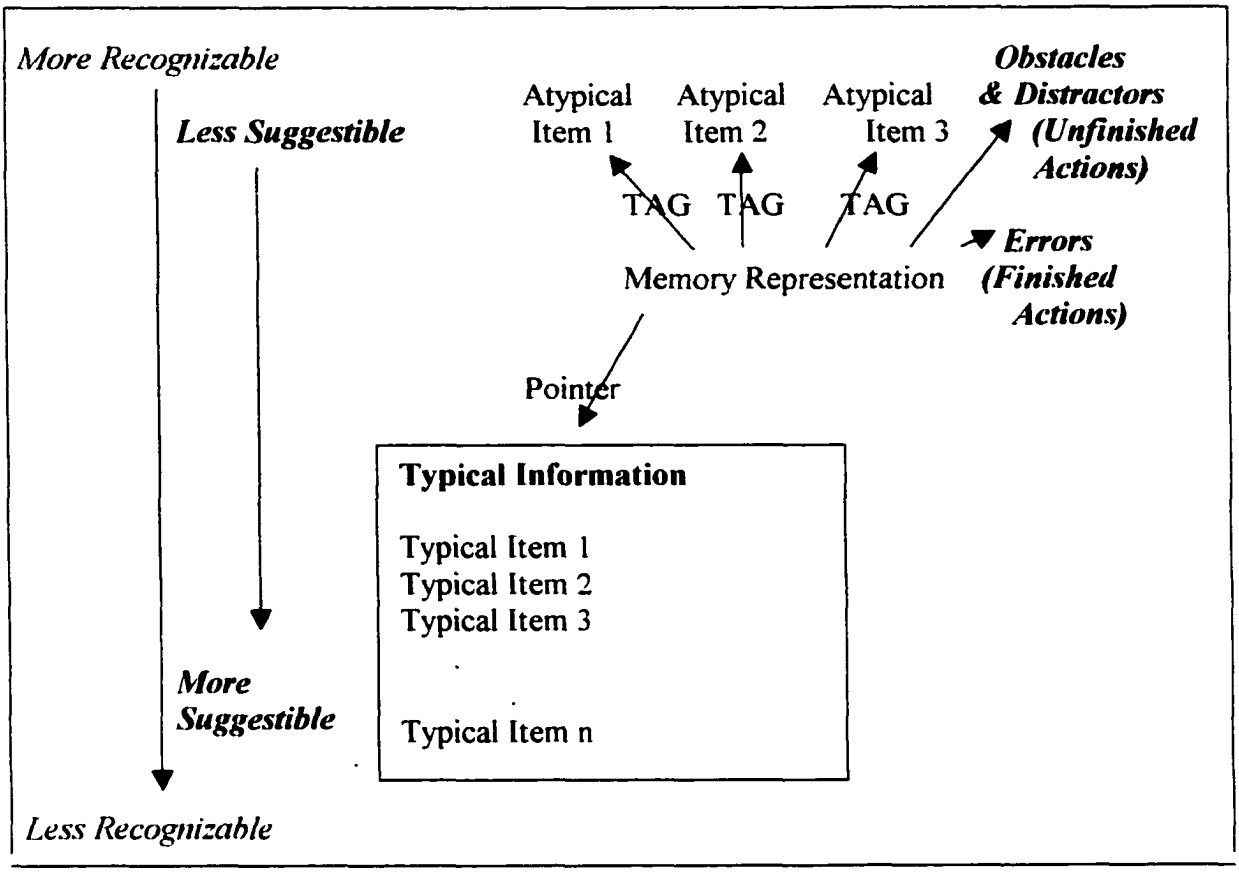

Figure 3.2. Memory Representation for 3 types of Atypical Actions

To summarize, scripts influence recognition for actions occurring in experienced events in encoding, storage and retrieval. Both children and adults use scripts in reconstructing memory traces (Hess, 1985; Hess, Donley, Vandermaas, 1989; Myles-Worsley, Cromer & Dodd, 1986). Specific predictions can be made for actions that are both typical and atypical. Predictions can also be made as a function of delay in recognition. Scripts help one 'fill in the blanks' or make inferences for information that is not remembered. When presented with a story, such as a convenience store robbery, one can call upon one's generic script of a robbery to help fill in the blanks to make sense of

the events. Through script recognition and gap-filling research, it is clear that scripts play an important role in the processing and retrieval of information.

Chapter 4: Scripts and Inferences

Inferences can be directly influenced by the particular script one has for an event. In the example of a car accident, one understands that one or more cars will probably sustain damage, that drivers and passengers may have some injuries that require medical attention, a police report will be made, and certain persons will be held responsible for the accident due to some error on their part. This background knowledge or script (i.e., knowing what commonly occurs in a car accident) is used to evaluate and encode the current event in terms of the details unique to that particular accident. Typical actions result in more inferences than atypical actions and increase as the delay increase (Lampinen, et al., 2000). This result is primarily due to the increased reliance on script-based information as memory decays.

Scripts are the source from which many inferences are made. For example, a birthday party script provides us with specific expectations as to what will occur during a birthday celebration. These expectations are based on previous exposures to birthday parties. For example, when presented with a sequence of actions, certain unmentioned actions can be inferred. For example, in the sentence, "They all sang to Jake and after the candles were blown out, they ate the cake", it can be assumed that the candles were blown out by Jake. This was never explicitly stated however our birthday party script provides us with underlying knowledge to aid in the cohesiveness of the actions. Without a previously developed script for a situation, it would be unlikely that one could make a correct inference for a sequence of actions.

The current research operationally defines an inference in line to that of McKoon and Ratcliff's (1992) definition as 'any piece of information that is not explicitly stated

in a text' (p. 440). As such, inferences are internally derived information from the external information (whether in the context of a text or in an actual event) received. As such, inferences can aid in the comprehension of a sequence of actions. Bridging causal gaps is cognitively economical in the encoding, storing and retrieval of information. Also important is knowing which details to include and which can be omitted when one is recounting a story or event follow certain conventions. According to the Gricean maxims of cooperative conversation, in order to effectively communicate, certain rules are implicitly understood (Grice, 1975). These rules include truthfulness, relevancy, clarity and, of particular interest here, quantity. The rule of quantity is to make your contribution with neither more nor less information than required by the situation. Although most people are not taught these rules when acquiring language, it is assumed that adults and older children nevertheless tend to follow these rules. For example, if you have a script-framework for an event to be described you assume that others have it or a version similar to it. This framework guides your decision to report the unique aspects of an event that are interesting or relevant to the listener rather than the redundant aspects the listener could infer.

It is clear that inferences aid in the comprehension of everyday activities and are beneficial. It would be unnecessary to ask or to mention who blew out the candles at Jake's party unless someone other than Jake did so. However in situations such as eyewitness testimony, it becomes imperative to recognize what has actually occurred from what has been inferred. As acknowledged in Holst and Pezdek, (1992), false recognition errors such as believing the eyewitness said the robber had a gun when it was only suggested by the attorney can have serious consequences on the interpretation of the

Not all unfinished actions result in inferences. Pezdek and Hodge (1999) showed that the plausibility of an event influences memory distortions. The results show that the majority of children (age 5 to 12 years old) correctly refute suggestions that any of the suggested false events occurred. However, some of the children did report a false event and in this case, the more plausible event (e.g., getting lost in a mall) was recognized as having occurred more often than an implausible event (e.g., receiving a rectal enema). Although the results suggest that it is difficult to convince a child an implausible event occurred in the laboratory, the Kelly Michaels' case suggests that through repeated misleading questioning and peer pressure, implausible atypical events can be falsely recognized as having actually happened.

Just as story actions can be categorized as typical or atypical, inferences can be categorized as either 'schematic gap filling errors' or 'causal-inference errors' (see Hannigan & Reinitz, 2001). When one fills in missing information from a script to aid in the cohesion of a story, they have made a 'schematic gap filling error.' If a person is presented with a story about a convenience store robbery, they call upon their generic 'convenience store robbery' script to aid in the overall comprehension and expectations. If it is stated "*The robber looked at the cashier and said, 'This is a stick up, give me all your money.' The cashier complied; she did not want to get shot.*" it can be inferred that the robber pulled out a gun, although this was never explicitly stated. If the observer claims that the story did state the 'the robber pulled out a gun', this would be an example of a gap filling error based on typical script based information.

A causal inference is not based on typical script-based actions. Rather this inference is made for story coherence on atypical actions. When a casual bridge is made

with typical actions it would be considered gap filling from expectations consistent with script-based knowledge. In a script of a convenience store robbery one might encounter events that are not included in the script such as "*The robber stood at the entrance of the store for about 2 minutes and asked a passerby for a match. He threw his cigarette on the sidewalk and stomped on it with his black boot.*" An inference can be made that the robber smoked a cigarette. This action would explain and make a causal bridge between the two stated actions. If one falsely recognized the robber smoking a cigarette as an action mentioned in the story, a causal inference error has occurred.

Hannigan and Reinitz (2001) provided recent empirical support for both gap-filling and causal inferences through a series of three studies. The first experiment finds that participants falsely recognize typical actions that were never presented when making old/new judgments from a visual slide presentation. This supports evidence for gap filling errors with visual stimuli. A second visual recognition experiment investigated casual inferences for cause and effect relationships. This study presented participants with a series of ordered slides of actions within a scripted story, such as going grocery shopping. A cause slide shows a woman grabbing an orange from the bottom of a stack of oranges. An effect slide shows the same woman cleaning up the oranges off the floor. Participants shown the effect but not the cause slide are likely to falsely recall the cause slide, whereas participants shown the cause but not the effect slide do not falsely recognize the effect slide. This finding suggests that there is a backward gap filling effect. It is assumed that this backward inference effect occurs when participants cannot distinguish between externally experienced events and a self-produced inference. A forward inference effect

is not found due to the assumption that the effect cause would have been easily identified due to the uniqueness and saliency of the event.

In the third study, Hannigan and Reinitz (2001) found that when tested with a remember/know judgments, gap filling and causal inferences resulted in different responses. Based on Tulving's (1985) distinctions, 'know' judgments are based on familiarity without an explicit episodic memory trace of the actions and 'remember' judgments are made when there is an episodic memory trace. The results of Hannigan and Reinitz's third study show that gap-filling inferences were made on typical script-based actions which in turn resulted in incorrect 'remember' judgments. Incorrect causal inferences resulted in 'know' responses. According to Tulving's (1985) interpretation of remember/know judgments, this would suggest that participants have a feeling of familiarity for the unfinished atypical causal inferences. The gap filling inferences made on missing typical information is based on a false episodic memory trace for that action.

The results from the Hannigan and Reinitz (2001) studies offer additional evidence that typical actions are activated as a whole. The remember judgments suggests that these items are not distinguishable at recognition and this finding is consistent with empirical studies investigating recognition for typicality (Bellezza & Bower, 1981; Bower, Black & Turner, 1979; Davidson, 1994; Davidson & Hoe, 1993; Grasser, Gordon & Sawyer, 1979; Graesser, Woll, Kowalski & Smith, 1980; Lampinen, Faires, Neuschatz & Tolia, 2000; Smith & Graesser, 1981). The atypical inferences are based on a casual bridge made in order to keep the story cohesive and thus result in a feeling of familiarity without an episodic trace. It is clear from the empirical studies above that gap-filling errors are based on typical script-based information and causal inference errors are made

found in the lack of evidence for a forward inference effect (Hannigan & Reinitz, 2001). That is, in order to compare typical script based inferences with atypical causal inferences it is important to establish that one would make a suggested inference for the effect if given only the cause. Consider the example of a child named Samantha who was brushing her teeth and then forgetting to turn the light off when she left the bathroom. Forgetting to turn off the light might be considered atypical. When asked if Samantha went back and turned off the light, would the observer or listener mistakenly recognize the action as having occurred? If so this would be evidence for a forward inference effect. Experiment 2 will investigate recognition for unfinished atypical actions and evidence for a forward inference effect. Evidence for a forward inference effect will strengthens the predictions of the memory representation as shown in Figure 4.1. Mainly, this predicted finding should show that it is possible to obtain forward inferences for atypical as well as typical actions.

In establishing a forward inference effect for unfinished atypical actions a forensically relevant test could then be used to investigate misinformation effects for typical and atypical unfinished error actions. It would be predicted that the more recognizable unfinished atypical actions would be less vulnerable to suggestion than unfinished typical actions. The potential benefits in finding a relationship between these two variables could lead to further investigations of this phenomenon, which could then be generalized to other domains of research on recognition memory. These issues will be investigated in Experiment 5. Further research could also investigate less central, more peripheral cues in scripted events such as details of typical and atypical actions, which could have significant forensic value.

Chapter 5: Scripts and Source Monitoring

Source attribution is an important factor in the accuracy of eyewitness testimony. Source attribution refers to the ability to identify the actual source of information experienced or received. Was this information present in the original memory trace? Was it suggested after the original event? Was the information inferred or imagined? One can understand the importance of correct source monitoring in such situations as eyewitness testimony. As discussed in previous chapters, one type of memory error that can occur is when an individual claims that an imagined event actually occurred. As should be clear by the discussion above, the inability to distinguish internally produced vs. externally perceived information can have negative consequences. It is important to be able to determine what was experienced from what was just imagined. Source monitoring errors result in memory distortions and in recognition errors for post event information.

Neurologically speaking, the frontal lobes have been identified as playing a major role in source monitoring. In a review of studies on frontal-lobe damage, certain behavioral patterns emerge (see Johnson, Hashtroudi & Lindsay, 1993). Amnesiacs with frontal lobe lesions lose the ability to discriminate sources. Also, diminished frontal lobe functioning due to aging is associated with poor source monitoring ability while factual memory can remain intact. Given that the frontal lobes develop throughout adolescence, one can better understand why children are less accurate in source monitoring than adults. Frontal lobe lesions produce deficits in source monitoring but leave item recognition intact (Janowsky, Shimamura, Squire, 1989). For example, Cycowicz, Friedman, Snodgrass and Duff (2000) investigated the role of the frontal and medial temporal lobes in source monitoring and item memory through a series of recognition tasks with 7-8 year

old children and adults. Both the frontal and medial temporal lobes continue to develop throughout adolescence. Results show that frontal lobe function is correlated with source monitoring while the medial temporal lobe functioning is correlated with item recognition. Adults show superior performance on source accuracy, whereas the children have more difficulty on source monitoring tasks than item recognition. These neurological findings show a distinction between item and source memory. Research also shows that frontal lobe development is crucial in making inferences. Research on children with traumatic head injuries to the frontal regions also shows that the more severe the head injury, the more difficult the child has in making inferences (Barnes & Dennis, 2001). Experiments 2 and 3 will investigate the ability to discriminate inferences for atypical actions in script-based stories with children and adult participants. Given that children have less developed frontal lobes, the task should be more difficult and the error rates higher than with the adult participants.

Discriminating internally produced inferences from explicitly stated actions can be difficult, simply because inferences have been shown to be incorporated into the memory trace. One model of memory traces for stories is the Fuzzy trace theory. The Fuzzy Trace theory (Reyna & Brainerd, 1995) proposed two memory traces, one for verbatim (stated) information and one for the 'gist' of the story. In investigating false memory for typical and atypical actions it is proposed that inferences enter into a false verbatim trace (Lampinen, Faires, Neuschatz & Toglia, 2000) and are remembered as stated. As previously suggested in Figure 4.1: the inferred actions become part of the memory representation.

The ability to accurately identify what has been externally experienced and what has been internally imagined is often referred to as 'source monitoring.' When distinguishing between internal (self-generated) or external (other-generated) information the discrimination process is often labeled as 'reality monitoring' (see Roberts & Blades, 2000). Reality monitoring studies have shown that reality monitoring improves with age; younger children have more difficulty than older children and adults in internal/external distinctions (see Sussman, 2001 for review). As both children and adults use scripts in reconstructing memory traces (Hess, 1985; Hess, Donley, Vandermaas, 1989; Myles-Worsley, Cromer & Dodd, 1986) it becomes clear that reality monitoring can account for the inability to identify self generated inferences (Johnson, Bransford & Solomon, Lampinen, Faries, Neuschatz & Toglia, 2000; Hannigan & Reinitz, 2001),

Imagining that an event has occurred increases the confidence rating that the event has actually occurred. For example, Garry, Manning, Loftus and Sherman (1996) developed a procedure to investigate the relationship between the imagination of childhood events and how well confidence ratings map onto whether or not they actually occurred. First, participants are presented with a list of possible childhood events and asked to indicate if these events had occurred in their own childhood. Two weeks later, the participants imagine these events and answers several questions about them. The original list is then completed again in the participant's belief that the experimenter misplaced the original list. The results indicate that imagining an event increases the confidence rating that an event had occurred even when participants previously said it did not. Two possible explanations are offered. First, the actual imagining of the event can increase the familiarity of the event resulting in an increased rating that it did occur.

Retrieval can also be affected by the type of criteria set by the participant in a source -monitoring task. Johnson et al. (1993) proposed that a sense of familiarity is automatically used for source-monitoring judgments. The structure of the question asked can influence the criteria used in memory retrieval (Lindsay & Johnson; 1989, Multhaup, De Leonardis & Johnson, 1999). When misinformation is introduced after viewing several slides, the type of questions asked can elicit different results. Participants who are prompted for source are more accurate than participants who are asked if an item appeared in a first presentation of repeatedly presented stimuli (Lindsay & Johnson, 1989). The results of the Lindsay and Johnson (1989) study were replicated with aging adults (Multhaup, DeLeonardis & Johnson, 1999)

Lindsay and Johnson (1999) propose that a recognition test is based on familiarity whereas a source-monitoring task is based on stricter criteria by making participants aware of conflicting source possibilities. For example, in recognition tests the participants were asked if an item was in the first rather than in a subsequent presentation. In the source monitoring task the participant is asked if the item was in the first presentation, the second presentation, both presentations or none. The source-monitoring framework (Lindsay & Johnson, 1989), proposes that participants use a stricter criteria when they are asked directly for the source, whereas they use a less strict 'familiarity' judgment when they are asked if an object or action was presented in the original event. This suggests that recognition is tapping into an item identification process, whereas a source monitoring decision is attempting to make an attribution on source.

In conclusion, it has been established that scripts are the source from which inferences are made. Inferences are needed to aid in comprehension. It is important

however, to be able to identify and make a distinction between inferences and perceived events. Source monitoring literature makes it clear that less than ideal encoding and retrieval strategies result in source monitoring errors. What we do not know is how or if inferences will be affected by different types of retrieval tasks (recognition vs. identifying the source). Based on the empirical findings on recognition for typical and atypical actions and difference in retrieval task, a memory representation is proposed (see Figure 5.1). Inferred atypical actions are suggested to be more resistant to misinformation than typical actions, and should not be affected by the type of retrieval task. Thus, as presented on the right hand side of Figure 5.1, atypical inferred actions are presented higher in the memory representation, with the type of retrieval task (source monitoring v. recognition) close in proximity to each other, suggesting no differences in suggestibility for these atypical inferences. The typical inferred actions are more suggestible and are presented lower in the representation than the atypical inferred actions. As shown, the source-monitoring task for the typical inferred actions is higher in the memory representation suggesting higher recognition rates and less suggestibility effects than for the recognition task. Inferred typical actions are proposed to be differentially influenced by the two types of task, with source monitoring resulting in higher accuracy. Experiment 5 will test this memory representation model.

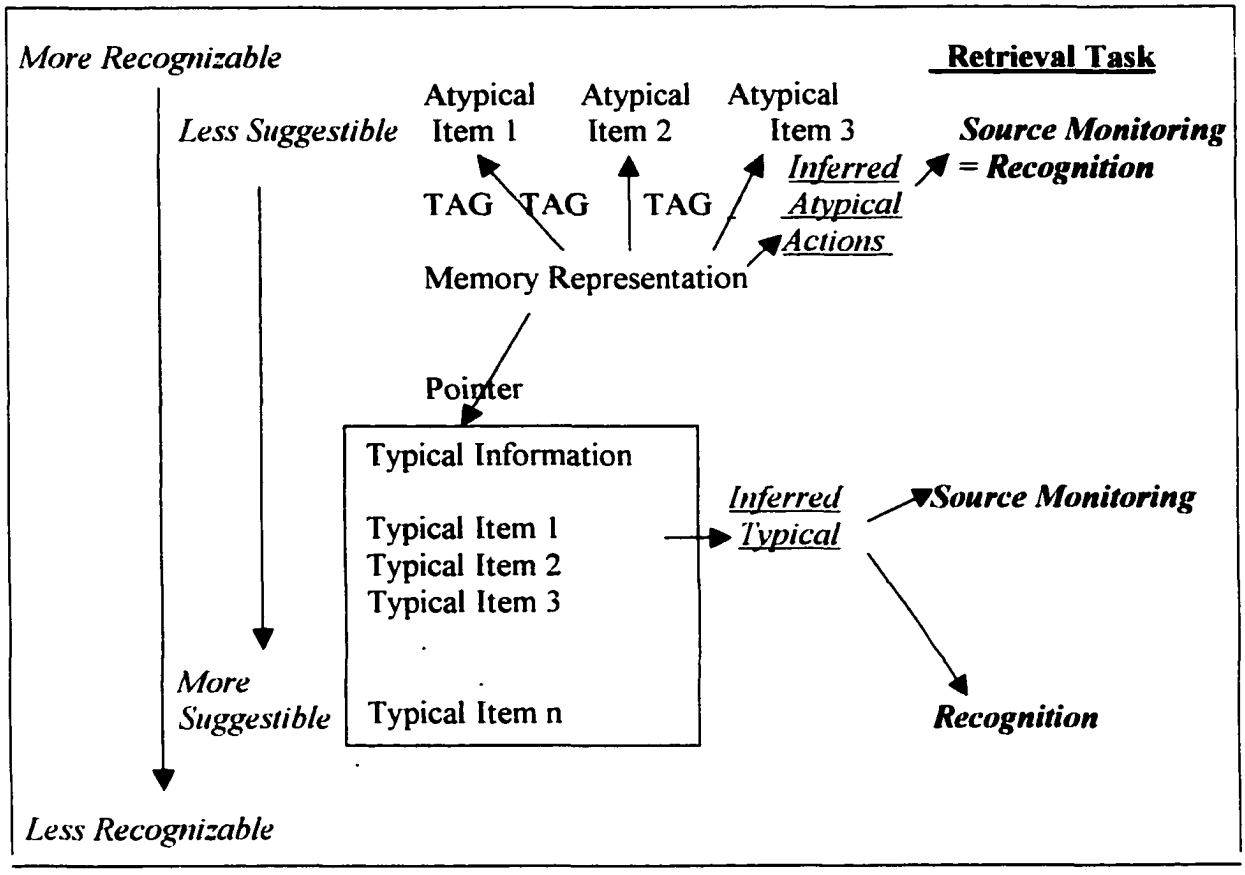

Figure 5.1. Memory Representation for Inferred Actions by Retrieval Tasks

Distractors (which are more recognizable) than participants in the control condition. It is also predicted that participants in the control condition should show a graded pattern of recognition similar to the results found by Davidson (1994). Specifically, Error actions should show more misinformation effects than Obstacles and Distractors. Whereas misinformation effects will be at least partially attributable to forgetting of the original story by both groups, the Misinformed group should show greater misinformation effects due to the second presentation of the story which contained the misinformation itself.

Method

Participants

A total of 30 participants, 8 males and 22 females, were recruited from the Brooklyn College campus of CUNY Psychology Department's subject pool. The ethnic composition was 60% White, 20% Black/African American, 6% East Indian/ Pakistani, 3% Spanish/Spanish American and 3% Other/Did not provide information. All participants received partial course credit in an undergraduate introductory psychology class for their participation.

Materials

Three stories adapted from Davidson (1994) were used in this study, with changes made to the atypical actions. As can be seen in Appendix A, the stimuli consisted of three titled stories; both groups read the first version of the scripts containing the first action (the first word as shown in bold font in Appendix A). The misinformation group also heard the second version of the scripts containing the second action (the second word as shown in bold fond font in Appendix A). The critical items contained misinformation on three forms of each interruptive action: Obstacles, Distractors and Errors. The auditory

stimuli were recorded by a single female speaker for all three stories and presented on a Panasonic RN-502, micro cassette recorder. A filler task was also used. This task consisted of logic problems taken from a Mensa IQ test (Aero & Weiner, 1983) and was not scored.

Three multiple-choice tests were given as seen in Appendix B. Each test, labeled identically to the corresponding story title, contained 6 multiple-choice questions. For the six questions, the choices consisted of the original action and the misinformation. The action verbs used in the original and misinformation versions of the stories were matched for word frequency by condition and type of action as can be seen in Table 6.1 (Kucera & Francis, 1970). A one-way ANOVA on word frequency revealed no significant difference by type of action, $F=1.41$, $p=.27$. The presentation of the choices on the recognition test was counterbalanced.

Table 6.1

Mean Word Frequency for Atypical Action Verbs

Type of Action	Condition			
	Original		Misinformation	
	Mean	S.E.	Mean	S.E.
Error	27.68	16.87	38.17	11.77
Obstacle	30.83	21.89	23.83	15.33
Distractor	22.17	12.26	31.17	21.56

Procedure

All participants read the same version of the stories followed by the filler task of logic problems and were then dismissed and asked to return in 2 days. Participants were

scheduled to be tested in groups of five, but given the number of "no shows", many were tested in smaller groups or were tested individually. After a 48-hour delay, participants in the misinformed condition listened to a second presentation of the stories in which the action words for the critical sentences had been changed. An auditory presentation of the stories was used in order to keep the modalities of the original event and misinformation inconsistent as it would be in a real-life eyewitness experience, where the original event would be seen and the misinformation would be read or heard. A 10-minute filler activity, consisting of the same logic problems given on the first day, was given after which the recognition test followed. Participants were then instructed to answer forced choice questions based on the information read in the first series of stories, in which they had to discriminate between the originally occurring action and the misinformation received during the second presentation of the story. In order to access the number of incorrect responses due to forgetting and compare the error patterns to previous findings, participants in the control condition were not misinformed and therefore, did not receive a second presentation of the story, but were given the same recognition test after the 48-hour delay. All participants were then told about the hypothesis of this study and dismissed.

Results

A 2 (Condition) X 3 (Type of Action) ANOVA for repeated measures was conducted on the mean number of incorrect choices. No significant main effects for Condition (Misinformed vs. Control), $F(1,28)=.661$, $p=.42$, or Type of Action (Obstacle, Distractor, Error), $F(2,56)=1.846$, $p=.17$ were found. There was however, a marginally

significant interaction, F(2,56)=2.886, p=.06. Figure 6 shows the pattern of errors by Condition and Type of action.

As can be seen in Figure 6.1 there was a misinformation effect for Error actions but not for Obstacles or Distractors. Follow up analyses revealed that participants in the misinformed group produced more incorrect choices for the Error Actions than the participants in the control condition, t(28)=1.99, p=.057 (Misinformed M=2.2; SE=.30; Control M=1.4; SE=.27). There were no significant differences between groups for Obstacles (p=.26) or Distractors (p=.42).

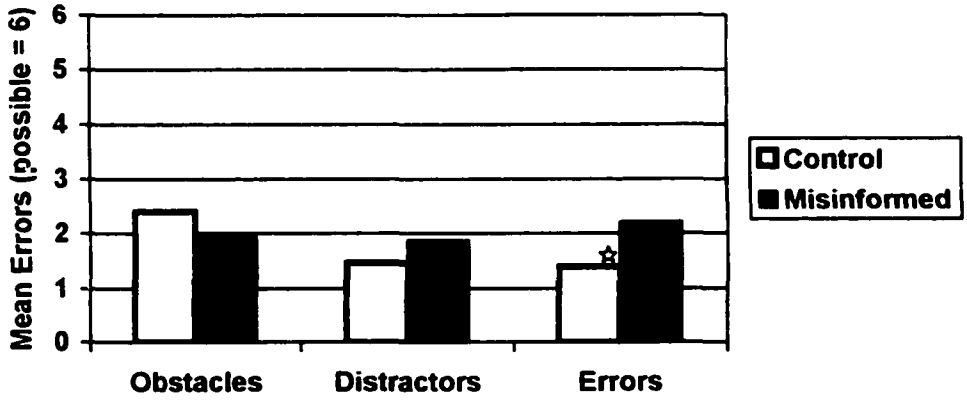

Figure 6.1. Participants' Mean Errors out of 6 possible for Condition x Type of Action

In order to examine differences within each group, one-way ANOVAs were conducted. A one-way ANOVA revealed no significant difference for type of action in the Misinformation condition F(2,28)= .430, p= .66. Obstacles, Distractor and Error actions did not reveal a significantly different number of incorrect responses.

The one-way ANOVA of incorrect choices in the Control condition revealed a significant difference for type of action, F(2,28)= 4.287, p= .02. Overall, more incorrect

choices were made for Obstacle actions (M=2.4, SE=.29) than for either the Error actions (M=1.4, SE=.27), t(14)=-2.485, p= .03, or the Distractor actions (M=1.47,SE=.31), t(14)=2.709, p= .02. Although, there was no difference between Error and Distractor Actions, (p=.87) there was a significant misinformation effect for the finished Error actions and not the unfinished Obstacles and Distractors. Unlike the Davidson (1994) study, the actions used in this version were matched for word frequency. This could account for the differences in overall recognition in the control condition, a finding that does not replicate Davidson (1994).

Discussion

The results showed a misinformation effect for the Error actions. These results suggest that these three types of atypical actions are not organized the same way in memory. Mainly, Obstacles and Distractors, which have been shown to be more recognizable by Davidson (1994), are less vulnerable to misinformation than Error actions. The findings in Experiment 1 strengthen the proposed memory representation previously shown in Figure 3.2. Mainly the more recognizable unfinished actions as shown by Davidson (1994) have resulted in fewer misinformation effects than the less recognizable Error actions.

One main difference between the 3 types of actions used in this study is the causal inference required for comprehension of the story across actions. Specifically, the Obstacles and Distractors were left unfinished in the script-based stories whereas the Error actions were finished. Davidson (1994) proposes that these results are consistent with text processing models (Trabasso, 1989) in which the self-generated causal inference needed to keep a cohesive script makes the information perceived as more

important, facilitating memory for those actions. This additional processing has been shown in Experiment 1 to be a significant factor in vulnerability to suggestion. Interestingly, in recall studies comparing Obstacles, Distractors and Error actions, leaving the Error uncorrected results in no recall differences between them (Davidson, 1994). This finding strengthens the argument that the additional processing accounts for the improved recognition rate for unfinished actions. The results of Experiment 1 established that not surprisingly there is a relationship between strength of recognition and vulnerability to suggestibility. It also suggests a link between text processing studies and techniques used in eyewitness memory research .

Chapter 7: Experiment 2

It has been shown that typical actions in a script-based story are activated as a whole and this makes it difficult for one to correctly identify stated typical actions from typical actions that have only been inferred to have occurred (Bellezza & Bower, 1981; Davidson, 1994; Davidson & Hoe, 1993; Smith & Graesser, 1981). Unstated typical actions become integrated into the memory and as time increases the ability to distinguish stated and unstated typical actions becomes more difficult. Are inferred atypical actions as difficult to identify? That is, is it possible to obtain false recognition rates for inferred atypical actions or are these actions 'tagged' in the memory trace so that they are correctly identified as inferred and never stated? Experiment 2 investigates these questions with preschool-age participants and Experiment 3 uses the same materials to address these questions with adults.

The present study uses three short stories combined with minimal intervals between presentation and recognition to maximize recognition with the least amount of decay. Based on previous findings, it was predicted that participants should not have difficulty accurately identifying finished actions stated in the stories. However, significantly more recognition errors for the inferred unstated actions are predicted. This finding would support evidence for a forward inference effect. A forward inference effect occurs when a causal (unfinished) action is presented and the unstated effect (finished action) is recognized as having occurred. Empirical studies have found difficulty in producing forward inference effects while backward inference effects (i.e., the outcome is presented and the cause is erroneously recognized as having been presented) are found (Hannigan & Reinitz, 2001). False recognition for the unstated finished actions at such

brief delays suggests an inability to identify the source of a self-generated inference. This finding would support the hypothesis that inferred atypical actions, like typical actions, become part of the memory trace. That is, inferences for atypical inferred actions enter into the memory representation as shown in Figure 4.1.

Methods

Participants

A total of 16 participants from the Carleton Washburne Early Childhood Center on the campus of Brooklyn College participated in this study. Participants ages ranged from 4 years, 0 months to 4 years, 10 months (mean age = 4years, 6 months). The ethnic composition was 68% Black/African American, 12% Latin American, 12% Other and 1% White/Caucasian. Parental consent was obtained for each participant. All participants received an inexpensive gift for their participation.

Materials

This study used three stories adapted from the typical script actions used by McDonough (1999) with changes to the subject in the story. McDonough used a teddy bear and had 24-month-old children imitate actions with real items or placeholders. For the present study, the teddy bear was replaced with the protagonist of the story. The stimuli consisted of three titled storybooks with a picture of the main character on the front cover. Inside each storybook were the two written versions of the stories. The typical actions in the script-based stories have been shown to be easily imitated in their canonical order by two-year-old children (McDonough, 1999). As can be seen in Appendix C, the stimuli consisted of three titled stories; Samantha brushes her teeth, Mother puts the baby to bed, and Jake eats breakfast. Each story contained an

introductory sentence, 3 typical script based sentences, and 4 error actions. Within each story, 2 of the error actions were corrected (finished) and two remained unfinished. To facilitate attention all error actions begin with an error term such as 'oops', 'uh oh', 'yikes' or 'oh no'.

The recognition test consisted of pictures of the protagonist and the resulting finished and unfinished action (Appendix D). For example, in the story 'Samantha brushes her teeth', the error action is 'Oops, as she reaches for her toothbrush, she knocks over a cup of water'. In this example, the picture cards will show Samantha wiping up the spilled water or standing over the spilled water. The participant is asked, "Did the story say Samantha wiped up the water? or According to the story could Samantha have left it there?". This experiment is a within-subjects design.

Procedure

Participants were individually tested in a quiet corner of the classroom during school hours. Each child was presented with three script-based stories containing finished and unfinished atypical actions. The participants were read one story at a time, followed by an immediate recognition test. After each story was read aloud, two visual cue cards were presented to the participant for each of the critical actions. The presentation of the order in which the finished and unfinished outcomes were presented was counterbalanced. For each action the participant was asked if they recalled the event (e.g., "Do you remember when Mama forgot to put grape juice in the bottle?") as shown in Appendix D. One cue card depicted an action being finished and one depicted the same action but as being unfinished. For example, in the 'Putting baby to bed' script all the participants were presented with the sentence, "Yikes, Mama realizes that she forgot to

put grape juice in the bottle and it is empty". Half the participants were presented with the finished action, "She fills the bottle with grape juice" and half were not presented with the finished action. The child was asked to correctly identify which action occurred in the story (e.g., the baby holding a bottle of grape juice v. the baby holding a empty bottle). The task is to identify correctly which action occurred in the story by pointing to one of two cue cards depicting the actions (Appendix D). The participants were instructed to point to the correct picture. The experimenter placed the chosen card in the vertical position and the other card in a horizontal position face down on the table after each choice. The presentation of the choices on the recognition test was counterbalanced. After all four critical error actions and the outcomes are tested, the next story was read.

Results

In order to examine the difference in error rates for finished and unfinished actions, a within subjects repeated measure ANOVA was conducted on the number of recognition errors. Action Type (finished, unfinished) is the within-subjects factor. The ANOVA revealed a significant difference for type of action, $F(1,15)=14.781$, $p=.002$. Overall unfinished actions produced more recognition errors, ($M=4.38$, $SE=.48$) than the finished actions ($M=1.56$, $SE=.33$) as shown in Figure 7.1. Although there was a 10-month age span between the youngest and oldest child, there were no clear developmental patterns. Only 3 of the 16 children in this study failed to show more errors for the unfinished actions in the recognition task and they were neither the youngest nor the oldest participants.

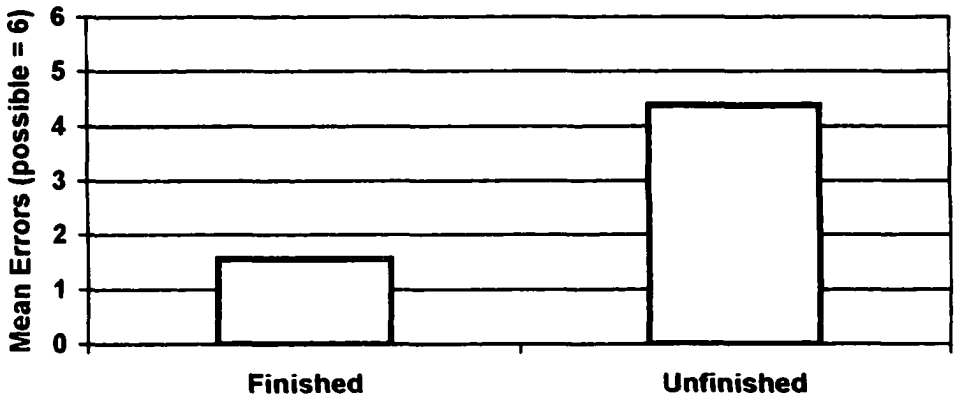

Figure 7.1. Participants' Mean Error rates for Finished and Unfinished Actions

Discussion

These findings clearly demonstrate that there is a forward inference effect in children's immediate recognition for unfinished atypical actions. That is, children are erroneously recognizing the effect of an action as having occurred when previously presented with only the cause. One main factor in our study is the plausibility of the action. Specifically, the finished actions can be inferred to have happened and are plausible, but the outcome of the story is not dependent on the inference being made (the baby *could* have gone to bed with an empty bottle). It is possible that participants are unable to distinguish between inferred and stated actions and therefore their recognition decisions were based on plausibility. While children use scripts to interpret and understand stories (Farrar & Goodman, 1992; Hudson, Fivush, & Kuebli, 1992), they do not have strong source monitoring skills due to the underdevelopment of the frontal lobes (see Johnson, Hashtroudi & Lindsay, 1993). Reality monitoring studies have shown that reality monitoring improves with age; younger children have more difficulty than older children and adults in internal/external distinctions (see Sussman, 2001 for review).

Experiment 3 will be repeated with adult age participants. The results of this study established that atypical inferences, like typical inferred actions, exist and are integrated into the memory representation as shown in Figure 4.1.

Chapter 8: Experiment 3

The results of Experiment 2 revealed that inferred atypical actions result in memory distortion in terms of recognition with preschool-age participants. What is not known is how adults recognize atypical inferred actions. Do inferred atypical actions enter into the proposed memory trace in Figure 4.1, or are these inferences easily and correctly recognized as never having been stated? Experiment 3 investigates recognition for atypical inferred actions with adult participants. Will atypical inferences occur with adult participants at minimal intervals using the same short script-based stories used with 4-year olds in Experiment 2?

Adult participants should not have difficulty correctly identifying the finished actions during the recognition task, due to the minimal interval between the story and retrieval. However, it is predicted that there may be higher recognition errors for the inferred unstated actions. Participants are likely to incorrectly identify the unfinished actions as having been finished in the recognition task. This prediction is based on the difficulty one has correctly identifying internally produced inferences. False recognition for the outcome of the unfinished actions at such brief delays suggests an inability to identify the source of a self-generated inference. This supports the hypothesis that inferred atypical actions, like typical actions, become part of the memory trace not only in children but also in adult participants as well.

Methods

Participants

A total of 16 participants were recruited from the Brooklyn College campus of CUNY Psychology Department's subject pool. The ethnic composition was 64%

White/Caucasian, 9% Chinese/Chinese American, 9% Other Asian, 9% Latino, and 9% Other/Did not provide information. All participants received partial course credit for their participation.

Materials and Procedure

The materials and procedure were identical to Experiment #3. Adult participants were tested individually in a laboratory setting.

Results

In order to examine the difference in error rates for finished and unfinished actions, a within subjects repeated measure ANOVA was conducted. Action Type (finished, unfinished) is the within-subjects factor. The ANOVA revealed a significant difference for type of action, $F(1,15)=5.28$, $p=.04$. Overall unfinished actions produced significantly more recognition errors, ($M=2.81$, $SE=.41$) than for finished actions ($M=1.56$, $SE=.20$). The results are displayed in Figure 8.1 along with those from Experiment 2 so that one can compare the performances of the two age groups.

In order to examine the differences in error rates for finished and unfinished actions between the children and adult participants, a 2 (Age) X 2 (Action Type) mixed design ANOVA was conducted. Age (children, adults) is the between group factor and Action Type (finished, unfinished) is the within-subjects factor. The ANOVA revealed a significant difference for Action Type, $F(1,30)=19.86$, $p=.001$. Overall there were more errors for unfinished actions ($M=3.59$, $SE=.34$) than for unfinished actions ($M=1.56$, $SE=.19$). There was also a significant main effect for Age, $F(1,30)=9.06$, $p=.005$. The children produced more incorrect responses ($M= 4.38$, $SE=.48$) than the adults ($M=2.81$, $SE=.41$) on the unfinished actions. There was no significant interaction,

$F(1,30)=2.94$, $p=.10$. It should be noted that the mean number of errors for the finished actions was very similar for children ($M=1.56$, $SE=.33$) and adults ($M=1.56$, $SE=.20$).

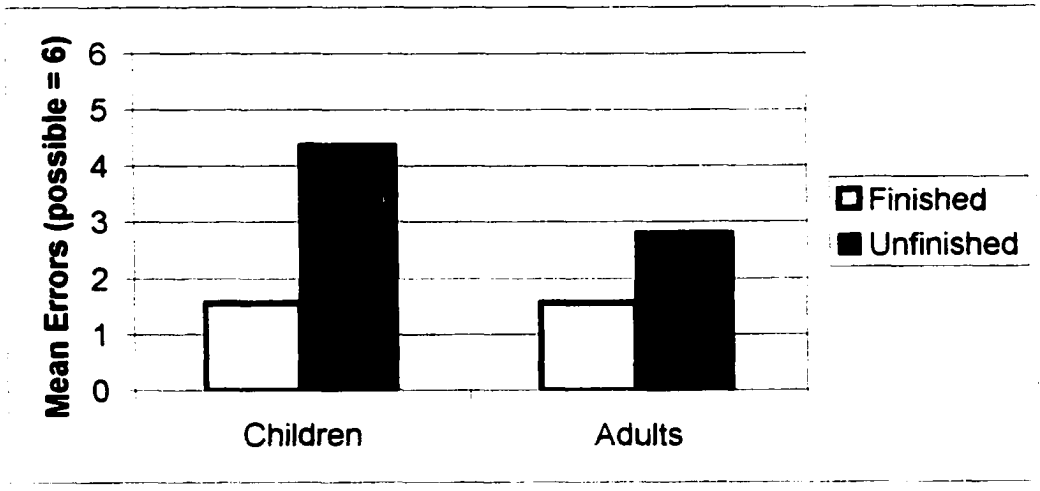

Figure 8.1 Mean Error rates for Finished and Unfinished actions with Children and Adults

Discussion

It has been determined that atypical actions that were only inferred to have occurred are recognized as having been stated by both preschool and adult participants. Finished atypical actions produced fewer recognition errors in both studies. Participants did not have difficulties recognizing finished atypical actions. Interestingly, there was no difference between the numbers of errors made by the preschoolers and those made by the adult participants in recognition for the finished atypical action (Figure 8.1). This can be explained in terms of the short stories and minimal delays. Yet, the high number of errors for the inferred actions suggests that both adults and children rely on inferences in recognition memory. The children produced more errors for these inferred actions, which is consistent with the empirical findings on source monitoring with children and adults

(see Sussman, 2001 for review). With less developed frontal lobes responsible for inferences, the children are likely making source-monitoring errors in recognizing the unfinished actions as finished. The less accurate source monitoring abilities of children in comparison with adults could explain the patterns in recognition found here.

The results of this study support evidence for a forward inference effect with atypical script-based actions. The results conflict with previous findings of the inability to produce a forward inference effect (Hannigan & Reinitz, 2001). Participants complete unfinished atypical actions in their memory representation. A memory representation for typical and atypical inferred actions can now be suggested as shown in Figure 4.1 (see page 31). What is not yet known is how inferred typical and atypical actions will respond to misinformation effects. Experiment 4 has been designed to establish typical and atypical actions in a script-based, forensically relevant story in order to investigate misinformation effects for typical and atypical inferred script-based actions.

Chapter 9: Experiment 4

Experiment 4 was conducted to generate forensically relevant scripts containing both typical and atypical actions to be used in Experiment 5. In order to categorize actions based on how typical they are to a given event, participants were instructed to list typical actions in a forensically relevant scenario.

Method

Participants

A total of 29 participants were recruited from the Brooklyn College campus of CUNY Psychology Department's subject pool. The ethnicity of the participants in this study was reflective of the general student population at Brooklyn College. All participants received partial course credit for their participation.

Materials and Procedure

All participants were tested in a classroom setting. Participants received a questionnaire as seen in Appendix E. The instructions were identical to the instructions used by Bower, Black and Turner (1979) with the event changed to fit a forensically relevant script. The page stated the question followed by twenty blank lines. Participants were asked to list actions that typically occur in a convenience store robbery scenario. The instructions were as follows "*Write a list of actions describing what someone would generally do when a person 'robs a convenience store'. We are interested in the common actions of a routine 'robbing a convenience store' stereotype. Start the list with arriving at the store and end it with leaving the store. Include about 20 actions or events and put them in order in which they occur*". The participants were given as much time as need to complete the question.

Results

In order to categorize typical actions all actions mentioned by the participants for the robbery script were tallied. Previous research has considered actions mentioned at least 25% of the time to be considered 'typical' (Bower et al, 1979, Greenberg, Westcott & Bailey, 1998; Holst & Pezdek, 1992). The percentages of participants mentioning the typical actions are presented in Table 9.1. Atypical actions were mentioned by only one participant or were produced by the experimenter (see Table 9.2).

Table 9.1

Percentage of Participants Mentioning Typical Actions.

Action	Percentage Mentioning Actions
Takes out weapon	73
Tells customers what they should do	34
Goes up to the cashier	50
Tells cashier to give him the money	69
Grabs the money	53
Runs away/leaves store	42

Table 9.2

Percentage of Participants Mentioning Atypical Actions

Action Action	Number of times Participant Mentioned
Smokes a cigarette outside the store	0
Takes a beverage	0
Looks at himself in the mirror	0
Customer starts to cry	0
Drops candy bars on floor	0
Takes off mask	1

Discussion

As can be seen in the Tables, actions typical and atypical to the forensically relevant robbery script were selected and generally agreed on by the majority of the participants. This script will be used as the stimuli for the next experiment.

Chapter 10: Experiment 5

Recent studies have focused on the role of scripts in eyewitness memory (Greenberg, Westcott & Bailey, 1998; Lampinen, Faires, Neuschatz & Tolgia, 2000; Misiurski & McDonough, 2000; Smith & Studebaker, 1996). The results of these studies reveal that the typicality of information can affect the vulnerability to inferences (Greenberg et al, 1998; Lampinen et al, 2000) and to suggestibility (Misiurski & McDonough, 2000; Smith & Studebaker, 1996). The recognition rates for typical and atypical information in scripts have been established. Research reveals that recognition for atypical actions is better than recognition for more typical actions (Bellezza & Bower, 1981; Davidson, 1994; Davidson & Hoe, 1993; Smith & Graesser, 1981). Recent research has also shown that atypical actions are indeed more resistant to misleading information than typical actions (Smith & Studebaker, 1996).

What is not known however is how information based on inferences, both typical and atypical to a given script is affected by misleading information. One way in which to investigate this would be to examine recognition for inferred typical and atypical actions in the context of a familiar script. Unfinished typical and atypical actions within a script can be used to create inferences. It has already been determined that inferred actions result in inferences or gap filling (Hannigan & Reinitz, 2001, Misiurski & McDonough, 2001). The most beneficial design in which to investigate suggestibility effects for inferred actions would be to include a manipulation that taps into different criteria judgments. One way in which this can be done is by using a source monitoring as well as a yes/no recognition task similar to ones used in previous studies (Lindsay & Johnson,

1989). By using script based stories in a forensically relevant content we can investigate how these inferred actions are influenced by post-event misinformation in a crime scene.

In this next experiment the convenience store robbery script that was normed in Experiment 4 is used to test participants' recognition or source monitoring for inferred typical and atypical actions. Half of the participants received misinformation, finishing the unstated inferred actions. To control for effects attributable to forgetting, control groups were also tested and received no misinformation. Based on previous findings there are several predictions that can be made. First, it is predicted that misinformed participants will make more errors than participants in the control condition. This finding would be consistent with results typical of suggestibility effects (Ceci & Bruck, 1995; Lepore & Sesco, 1994; Loftus & Palmer, 1974; Higham, 1998; Pezdek & Hodge, 1999; Roberts, Lamb & Sternberg, 1999). Next, misinformed participants tested with a recognition task are expected to show more errors than participants tested with a source-monitoring task. This prediction is based on a previous finding that a source-monitoring task can minimize the suggestibility effect (Lindsay & Johnson, 1989). By giving the participants the option of identifying the source of the action, they should produce fewer errors (see Figure 5.1).

Finally there should be main effect for type of action. Specifically, atypical actions are predicted to show fewer suggestibility effects than typical actions. This prediction is based on previous findings that atypical actions are more resistant to misinformation effects than are typical actions. However, a significant interaction is expected between typicality and type of task. As previously discussed in Chapter 5, there is no reason to expect more errors on the atypical actions in a source-monitoring task than

or intonation of the storyteller across subjects. Participants were then instructed to solve logic problems for 10 minutes as a filler task. This task consisted of logic problems taken from a Mensa IQ test (Aero & Weiner, 1983) and was not scored.

After the filler task, participants were asked to answer several questions about the details of the robbery. Two of the groups (Misinformed Groups) received misleading questions on the typical and atypical actions. The actions that were inferred, but not stated in the auditory version were stated within the questions. The remaining two groups (Control Groups) did not receive any misinformation (completion of the inferred actions) in the questions. Upon the completion of the questionnaire, participants are instructed to continue working on the logic problems for 10 minutes as a filler task. Next participants received either a recognition or source-monitoring task where they were asked to identify actions that occurred only in the auditory version of the crime. The students were then debriefed and dismissed. The participants were asked not to discuss the nature of the study with anyone who had not yet participated.

Materials

The 'convenience store robbery' script used in this study is in Appendix F. The inferred actions are in parentheses and were not included in the auditory version of the story. The typical actions are underlined. The atypical actions are in italics. The misinformation procedure used in this study has been previously shown to produce misinformation effects (Smith & Studebaker, 1996). The questions to be used in this study were designed to be similar to the questions used by Smith and Studebaker (1996), in which the misleading information is stated and a question is presented (e.g. "When the robber approached the cashier, did the cashier gasp?"). It is assumed that the participant

will answer the nonmisleading question ("did the cashier gasp?") and not the misleading statement ("When the robber approached the cashier"). Embedded within the 24 questions used in this study, are 12 critical questions in which the inferred typical and atypical actions are stated for participants in the Misinformed Group (see Appendix G). Participants in the control condition received the same questions without the completion of the inferred action. The correct answers to half of the critical questions are a 'yes' response and half is a 'no' response. Twelve filler questions were also used, half requiring a 'yes' response and half requiring a 'no' response.

Two types of retrieval tasks were used; recognition and source monitoring. These retrieval tasks are similar to the tasks used in the Lindsay and Johnson (1989) study. The recognition task required the participant to respond 'yes' or 'no' when asked if the inferred action was stated in the auditory version of the robbery (see Appendix G). Participants in the source monitoring condition were asked to indicate if the inferred actions were mentioned (a) in only the auditory version, (b) present only in the questions, (c) present in both the auditory version and the questions, or (d) present in neither the auditory version or the questions (see Appendix H). Participants who falsely identify the inferred actions as having occurred in the auditory version of the story (both 'a' or 'c') will assumed to have produced a misinformation effect. Both (b) and (d) answers are considered correct since the participant is not identifying the inferred action as having occurred in the auditory version.

Results

A 2 (Group) X 2 (Task) X 2 (Typicality) mixed design ANOVA was conducted on the number of recognition errors. Group (Misinformed, Control) and Task

(Recognition, Source Monitoring) are between group factors and Action Typicality (Typical, Atypical) is the within-subjects factor.

The results showed a significant main effect for condition (Misinformed, Control) $F(1,104)=7.901$, $p=.006$. As predicted, misinformed participants produced higher recognition errors ($M = 5.06$, $SE=0.10$) than participants in the control condition ($M = 4.61$, $SE=0.12$) as shown in Figure 10.1. There were no interactions for Condition X Task $F(1,104)=.014$, $p=.91$ or Condition X Typicality $F(1,104)=.000$, $p=1.00$.

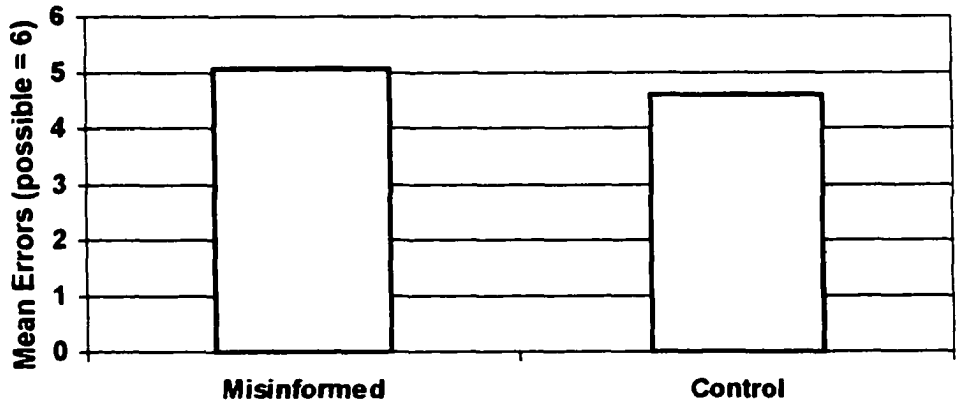

Figure 10.1 Participants' Mean Error Rates of 6 possible by Condition

A main effect for Typicality was predicted. Specifically, atypical actions were predicted to show fewer suggestibility effects than typical actions. This prediction is based on previous findings that atypical actions are more resistant to misinformation effects than typical actions. Results revealed a significant main effect for Typicality (Typical, Atypical) $F(1,104)=4.54$, $p=.04$. Overall, there were more recognition errors for atypical inferred actions ($M=4.96$, $SE=0.11$) than for typical inferred actions ($M=4.70$, $SE=0.10$), as shown in Figure 10.2.

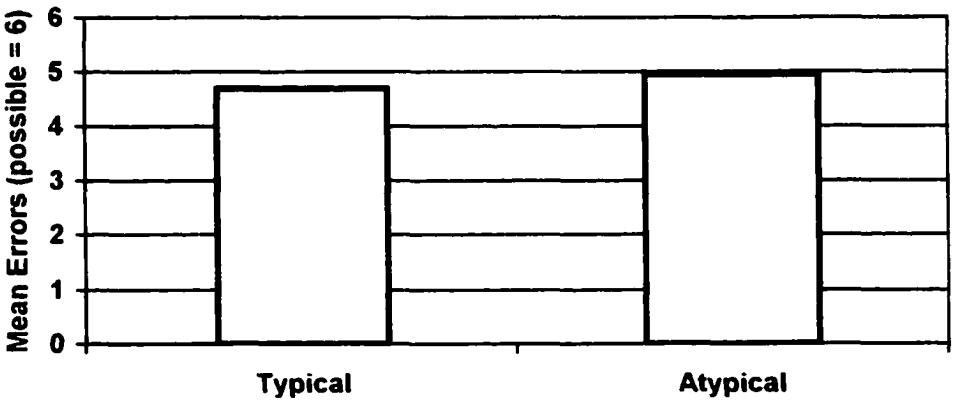

Figure 10.2 Participants' Mean Error Rates for Typical and Atypical Actions

Next, participants tested with the recognition task were expected to show more errors than participants tested with a source-monitoring task. This prediction is based on previous findings showing that a source-monitoring task can minimize the suggestibility effect. However, the results revealed no significant difference by type of task (Recognition, M=4.77; SE=0.12; Source Monitoring, M=4.90, SE=0.11) $\underline{F}(1,104)=.672$, p=.41.

Although it was predicted that there would be no difference for type of task for atypical actions, it also was assumed there would be a difference for typical actions. Thus, an interaction was expected between Typicality and Type of task. However, the results showed no interaction between Typicality and Task $\underline{F}(1,104)=2.80$, p=.10. The type of questioning was not a significant factor in error rates by typicality.

Discussion

Consistent with the previous experiments presented, the findings reveal a misinformation effect for inferred actions. It is important to note that participants in both the misinformed and control groups produced errors on the inferred actions. This is

consistent with Experiments 3 and 4, which revealed that inferred actions are identified as having been stated. However, what is of interest here is the finding that Misinformed participants produce more recognition errors than nonmisinformed participants. This finding is consistent with empirical findings that misleading postevent information distorts the memory representation of the original event (Ceci & Bruck, 1995; Lampinen & Smith, 1995; Lepore & Sesco, 1994; Giles, Gopnick & Heyman, 2000; Higham, 1998; Pezdek & Hodge, 1999; Roberts, Lamb & Sternberg, 1999; Roediger, Jacoby & McDermott, 1996;).

What is interesting in this study is the use of inferred actions. These actions were never stated, only inferred to have occurred yet they revealed significant difference when exposed to misinformation. Mainly, atypical inferred actions are more vulnerable to suggestion than typical actions. This finding was not expected. It was expected that the atypical information leading to the inferences would be highly recognized, thus resulting in fewer suggestibility effects for the inferred typical action. This was not found. One explanation for the current finding is that the inferred actions enter into a memory trace as stated facts. As in the Script Pointer plus +Tag hypothesis, the inferred atypical actions are more recognizable in memory. This means that the inferred atypical actions were more likely to be identified as having been stated on a recognition or source-monitoring task. This suggests that inferences enter into the memory representation as facts and the recognition rates of these inferences are based on typicality.

Chapter 11: General Discussion

The present research has demonstrated that typical and atypical inferred actions react differently to post-event information. There are three main findings. First, there is a relationship between strength of recognition and vulnerability to misinformation. The less recognizable finished actions produce misinformation effects while the more recognizable unfinished actions produced no misinformation effects. Next, similar to typical actions, inferred atypical actions result in a forward inference effect. Finally, the results of the last study suggest that inferred atypical actions are more not less suggestible than inferred typical actions. These findings suggest a different representation mapping for stated and inferred typical and atypical actions.

The Script-Pointer plus tag hypothesis (Schank & Abelson, 1977; see Figure 3.1) offered a memory representation of typical and atypical actions. This model predicted better recognition for atypical actions at interval of less than a week. It also predicted that all typical actions within a script are activated as a whole making it difficult to distinguish stated typical actions from typical actions that have not been stated. Numerous empirical studies have supported these predictions (Bellezza & Bower, 1981; Bower, Black & Turner, 1979; Davidson, 1994; Davidson & Hoe, 1993; Grasser, Gordon & Sawyer, 1979; Graesser, Woll, Kowalski & Smith, 1980; Lampinen, Faires, Neuschatz & Tolia, 2000; Smith & Graesser, 1981). Almost a decade later it was found that typical actions are more likely to produce misinformation effects than atypical actions (Smith & Studebaker, 1996). When looking back at one of the original studies on misinformation the manipulated variable was chosen because it was not easily recognizable (Loftus & Palmer, 1974). This suggests that less recognizable actions are more vulnerable to

suggestion than more recognizable actions or that there is indeed a relationship between strength of recognition and vulnerability to misinformation.

Misinformation effects for typical and atypical actions have been tested in the eyewitness literature, but the predictions were not based on the text processing SP+T hypothesis. The current research sought to make such a connection between text processing studies and eyewitness recognition. One text processing study found that different types of atypical 'interruptive' actions produce a graded effect in recognition: unfinished 'obstacles' and 'distractors' are more recognizable than finished 'error ' actions (Davidson, 1994). It was proposed that the extra processing used in making the causal bridge to complete the unfinished actions resulted in better recognition for these actions. Davidson (1994) also found that by leaving the error actions unfinished, the differences in recognition rates for these three types of atypical actions disappeared. Experiment 1 investigated the misinformation effects for these three types of atypical actions.

It was proposed in Experiment 1 that the least recognizable finished 'error' actions would produce more misinformation effects than the more recognizable unfinished 'obstacle' and 'distractor' actions. The findings supported this prediction. Only the finished 'error' actions produced differences in error rates from the control condition. The recognition rates for finished and unfinished actions (Davidson, 1994) combined with the difficulty in obtaining misinformation effects for atypical actions (Smith & Studebaker, 1996) found in previous research can help support this finding. The finished error actions resulted in a greater vulnerability to misinformation. The lack of misinformation for the other atypical actions can be explained in the resistance to accept

post-event information on highly atypical actions. These findings also support a relationship between strength of recognition and vulnerability to misinformation (see Figure 3.2).

Experiment 1 warranted further investigation of recognition for unfinished atypical actions in that the unfinished atypical actions were resistant to misinformation. Experiments 2 and 3 investigated the recognition rates for unfinished error actions. These experiments were designed not to replicate Davidson (1994) findings that unfinished actions are highly recognizable, but to investigate the recognition rates for the *unstated atypical inference*. It has been previously found that when given an effect of an action (e.g., oranges on the grocery store floor), the cause (e.g., someone taking an orange from the bottom of a pile) is recognized as having occurred in the original presentation (Hannigan & Reinitz). This is referred to as a backward inference effect. Experiments 2 and 3 investigated recognition for a forward inference effect. That is when give the cause (e.g., Jake spilling cereal on the table) one will recognize the effect or likely finished actions (i.e., Jake picking it up). The results showed a forward inference effect in children's and adult's immediate recognition for unfinished atypical actions (see Figure 4.1). It is noted that in this study, the finished actions can be inferred to have happened and are plausible, but the outcome of the story is not dependent on the inference being made (i.e., Jake could have left the cereal on the table). It is possible that when participants are unable to distinguish between inferred and stated actions a recognition decision is based on plausibility.

These findings are of significant value. It has previously been shown that typical actions result in inferences. When given a script-based story, all typical actions are

correctly identifying misinformation for inferred actions. Finally, typicality effects were investigated. The experiment was designed to test the predicted memory representation as shown in Figure 5.1. The results of Experiment 5 have significant implications in how we store typical and atypical actions. The results suggest that inferred actions are stored as factual information and are identified as having occurred. It was also shown that the atypical inferred actions are stronger in the memory representation than typical inferred actions.

While many studies have explored factors in obtaining misinformation effects for stated actions, few have looked at how misinformation affects inferences. The results of the last study show that an action does not need to be stated to be vulnerable to misinformation. While the tendency to make an inference is strong (as shown in Experiments 2 and 3), the exposure to misinformation falsely confirming these inferences results in greater memory distortion. These inferences become 'factual' and the ability to distinguish an internally produced inference that has been strengthened by misinformation becomes difficult. An overall misinformation effect for these 'hard to recognize' inferences clearly suggests that more research is needed to understand this process.

The lack of significant differences for the two types of retrieval tasks indicates that inferences are not made at retrieval. This was unexpected, as previous research found differences by type of tasks for stated information (Lindsay & Johnson, 1989; McKelvie. & Eberman, 2001; Multhaup, DeLeonardis & Johnson, 1999). However, Experiment 2 and 3 showed an inability to distinguish an inferred action even without misinformation (as did Experiment 5 with the control condition). These findings suggest the inferences

are done at encoding and become part of the memory trace. Would an open-ended interview aid in the correct recognition of the internally produce inference? Based on the present series of studies it seems unlikely.

Inferred atypical actions were more likely to be recognized as having been explicitly stated in the auditory version of the crime than the inferred typical actions. One possible explanation for this effect is that participants were 'garden pathed' into making the atypical inference. The atypical statements led them to make a causal bridge to tie in the unusual action for story cohesion. For example, when presented with the statements, "*The robber stood at the entrance of the store for about 2 minutes and asked a passerby for a match. He threw his cigarette on the sidewalk and stomped on it with his black boot.*" an inference can be and was made that the robber smoked a cigarette. This inference would explain and make a causal bridge between the two stated actions. It is possible that one is accepting the inference as having occurred and it now becomes false verbatim memory (see Lampinen, Faires, Neuschatz & Toglia, 2000 for discussion). Therefore when asked in both the recognition and source monitoring task where the inference occurred, it was assumed that it was originally presented. Thus, when asked to identify this atypical action, it is recognized in the same way as stated atypical actions. That is, the correct answer would be to claim these actions did not occur, but these atypical actions are very active in the memory trace and are recognized as having been stated in the original presentation. The falsely inferred atypical action is considered to be more recognizable, producing higher error rates when asked if it occurred, resulting in more suggestibility.

One shortcoming in the predictions was assuming that the atypical inferred actions would be less vulnerable to misinformation than the typical actions. It was assumed that the atypical stated actions would be highly recognizable and therefore resistant to misleading statements about any inference made from these actions. Unfinished actions were shown to be resistant to misinformation effects in Experiment 1. The result revealed that the inference was highly active in the memory representation and produced false identification errors. In hindsight, the results of Experiments 2 and 3 suggest this outcome. Specifically, inferred actions do not enter into the memory representation as 'inferences made from stated information' as suggested in Figure 5.1, instead they enter as stated actions. The inference itself was *not* recognized as an internally produced event. Therefore when exposed to misinformation, the atypical inferred action *was* falsely recognized and became a stated fact in the memory representation resulting in more misinformation effects than the inferred typical actions as shown in Figure 11.1. The major finding is the significant effect of typicality on misinformation for inferred actions. Contrary to previous findings that show atypical actions are more resistant to misinformation that typical actions, this study revealed the opposite pattern for inferred actions. There is a crossover effect on suggestibility for typicality with inferred actions. Mainly, atypical inferences are more vulnerable to misinformation than typical inferences due to the acceptance and saliency of these actions (see Figure 11.1).

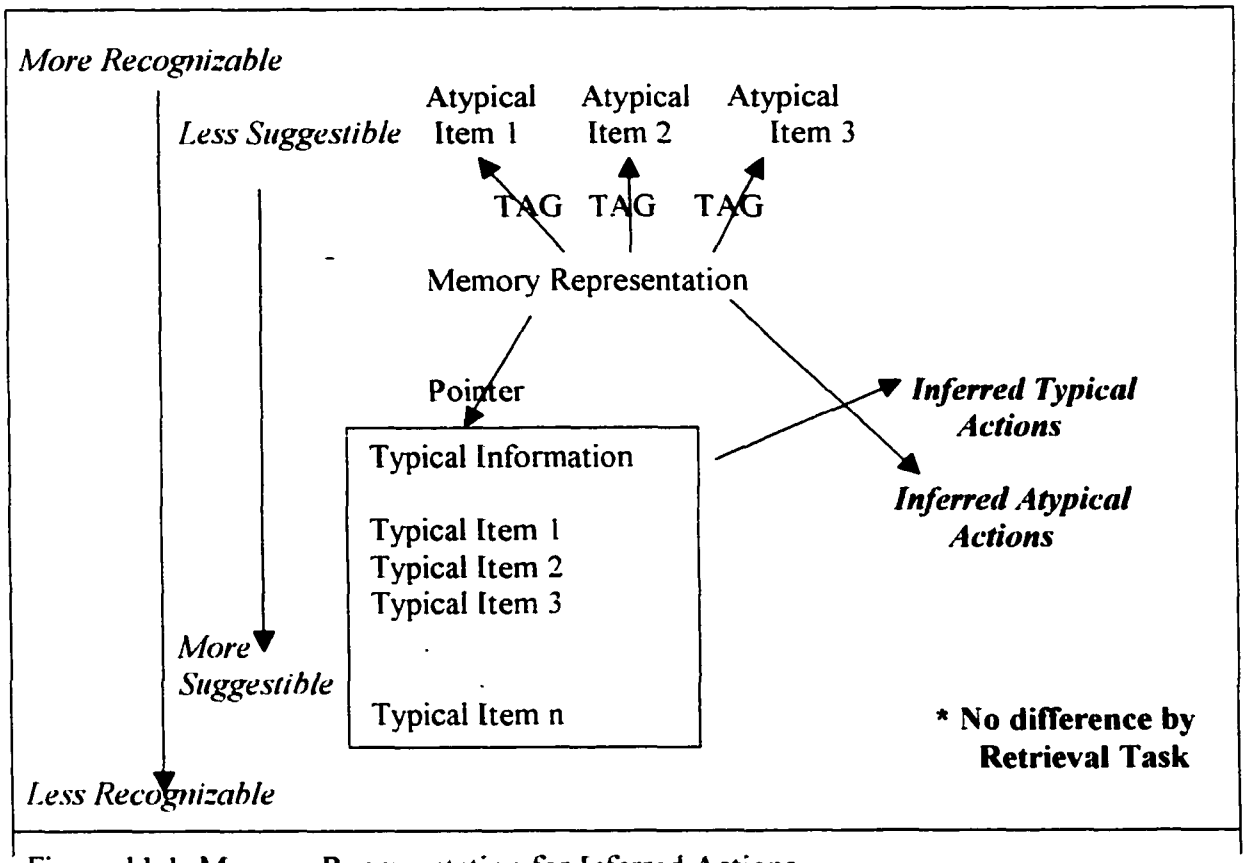

Figure 11.1. Memory Representation for Inferred Actions

One limitation of this study is that it cannot be directly applied to eyewitness memory. It is not often the case in a real life eyewitness experience that one is asked to retrieve the information immediately after the event in question. It has been shown that a delay between the original experience and the recognition test produces higher gap-filling errors (Greenberg et al. 1998). A delay would also be more reflective of what would actually occur in a real eyewitness experience. It would be interesting to replicate Experiment 5 using a delay between encoding and retrieval. It is expected that a delay would enhance the difference between suggestibility effects for atypical and typical

inferred actions. The potential benefits in finding a relationship between these two variables could lead to further investigations of this phenomenon, which could then be generalized to other domains of research on recognition memory. Further research could also investigate less central, more peripheral cues in scripted events such as details of atypical actions.

In summary, the results in this series of studies reveal that typicality plays an important role in predicting rates of suggestibility. Specifically, there is a relationship between strength of recognition and vulnerability to suggestion. This relationship can be affected by extra processing required to bridge causal inferences (as in Experiment 1), or the inability to recognize an internally produced inference (as found in Experiments 2, 3, and 5). Future research should address these issues, perhaps using different modalities more consistent with what would be encountered by a witness, such as a visual presentation of a script-based story followed by misleading information in the form of a written narrative or verbal questioning. It would also be of interest in juror research where the information is heard in no chronological order and the misinformation could be presented by either the attorney during a mock trial or in the decision making process when judgments of guilt are made. In addition to these findings, this research also offers a bridge between the research on text processing memory and the eyewitness paradigm. Future research based on the memory representation in Figure 10.1, investigating these factors could have significant forensic value.

Appendix A

Script-base Stories Experiment 1

The following are the three stories used in this study. The critical items are in bold, with the original action listed first, followed by the misinformation action, and received in the second presentation. Participant were presented versions of the stories without identifying action labels; *–E, Error Action; -O, Obstacle Actions; -D, Distractor Action.

Going to the Movies

A young couple, Sarah and Sam, decide to spend Saturday evening at the movies. It's been a long week and they really want to go out. They look in their newspaper to see what's playing. When they arrive at the theater they get in line to buy tickets. At first, they ***waited in/approached*** the wrong line but then they got in the right one and purchase their tickets *-E. Sam sees a very strange and loony woman he knows from work. The usher tears their tickets in half and gives them the stubs. A child runs through the theater and ***collides/smashes*** head on into Sarah -D. Sam notices that the carpet is red. Sarah sees two very good-looking ushers talking. Then Sam and Sarah buy a large tub of popcorn and some diet cokes. Before going into the viewing room, they take off their hats that look like cones but are warm. As they are going into the viewing room, Sam ***hiccups/sneezes*** and spills his popcorn all over the floor -D. They then walk down the aisle until they spot some good seats. They sit down. Two people sit by them. Another couple, both of whom are very tall, ***leans/sits*** in front of them and blocks their view -O.

The theater ***announces/begins*** the wrong movie but then it is corrected -E. Sarah mentions to Sam that the screen is big. They watch the movie. Someone in front of them starts ***coughing/talking*** loudly and they can't hear -O. When the movie is over, they get up and leave.

Getting Up in the Morning

Julie shuts off her alarm clock and sits up in bed. She has a great job downtown. The only problem is that she has to get up early in the morning to catch the train. Julie turns on her radio and listens to the news which reports it will be 20 below zero today. She walks to the bathroom. On the way to the bathroom she gets a new bar of soap from the closet. Julie turns on the water for her shower. Julie ***adjusts/turns on*** the cold water instead of the hot -E. Finally she gets the water right. As she is getting out of the shower she ***slips/steps*** on a bar of soap -D. As she is falling, she grabs the shower curtain and ***rips/pulls*** it off the shower bar -D. Julie goes back to her bedroom to get dressed. On the way, she ***bumps/stumbles*** into her closet door -O. She decides to wear her custom-tailored suit that an old lover had given her. Julie sees her cat sleeping on the rug. She then goes to the kitchen to fix herself breakfast. She ***notices/realizes*** that she forgot to buy her favorite cereal, so she has a grapefruit instead -O. While eating, she glances at the newspaper headlines which say that the stock market might crash. After she eats she brushes her teeth. Julie doesn't pay attention to what she's doing and she ends up ***dripping/squirting*** toothpaste on the sink but cleans it up -E. She then looks out the window and notices the sun coming up. Finally, she leaves her apartment to catch the train.

Dining at a Restaurant

Lauren just got a big raise at work, so to celebrate, she and her husband are going to a fancy restaurant. Lauren calls the most exclusive restaurant in town and makes reservations. The roads to the restaurant are not clearly marked and they ***drive/headed*** the wrong way -E. They almost get lost. When they arrive at the restaurant, they let the valet park their car. Inside, Lauren's husband John confirms their reservation with the hostess. At first, she says that she can't find their reservation but then she ***sees/remembers*** it -O. The hostess asks them to wait a few minutes so they can get a table ready. While they are waiting, Lauren notices several original and very expensive pieces of artwork on the walls. John comments that the piano player sounds good. Inside, John ***trips/stumbles*** as he is walking to the table -D. They notice that the menus are very pretty; they are handwritten in Gothic script. Unfortunately, the menus are written in Italian and they can't ***understand/pronounce*** the names to the items -0. There are flowers on the table, and two lit candles. A waiter comes over, introduces himself, and takes their cocktail order. The waiter has long blond hair, pulled back into a ponytail. A busboy ***carries/fumbles*** a tray of glasses right by their table -D. The waiter ***delivers/prepares*** the wrong food at first and has to go back and get their order -E. They eat their meal. Their food is very good. When they are finished, Lauren pays the bill and her husband leaves a tip.

Appendix B

Recognition Test Experiment 1

The following multiple-choice test were given to all participants. The presentation of the choices (original/misinformation) was counterbalanced in the test given to the participants. Listed below are the correct-choice/misinformation in bold. The following instructions were printed on the top of the page, "The following sentences are from the stories you have been presented with. Please read each sentence carefully and circle the action that occurred in the story that you read on the first day."

Going to the Movies

1. At first, they ***waited in/approached*** the wrong line but then they got in the right one and purchase their tickets.
2. A child runs through the theater and ***collides/smashes*** head on into Sarah.
3. As they are going into the viewing room, Sam ***hiccups/sneezes*** and spills his popcorn all over the floor.
4. Another couple, both of whom are very tall, ***leans/sits*** in front of them and blocks their view.
5. The theater ***announces/begins*** the wrong movie but then it is corrected.
6. Someone in front of them starts ***coughing/talking*** loudly and they can't hear.

Getting Up in the Morning

1. Julie ***adjusts/turns on*** the cold water instead of the hot.

2. As she is getting out of the shower she ***slips/steps*** on a bar of soap.
3. As she is falling, she grabs the shower curtain and ***rips/pulls*** it off the shower bar.
4. On the way, she ***bumps/stumbles*** into her closet door.
5. She ***notices/realizes*** that she forgot to buy her favorite cereal, so she has a grapefruit instead.
6. Julie doesn't pay attention to what she's doing and she ends up ***dripping/squirting*** toothpaste on the sink but cleans it up.

Dining at a Restaurant

1. The roads to the restaurant are not clearly marked and they ***drive/headed*** the wrong way.

2. At first, she says that she can't find their reservation but then she ***sees/remembers*** it.

3. Inside, John ***trips/stumbles*** as he is walking to the table. 4. Unfortunately, the menus are written in Italian and they can't ***understand/pronounce*** the names to the items.

5. A busboy ***carries/fumbles*** a tray of glasses right by their table.

6. The waiter ***delivers/prepares*** the wrong food at first and has to go back and get their order.

Appendix C

Script-based Stories Experiments 2 and 3

The following are the 2 versions of the three stories used in the study. Participants are read versions of the story without identifying script labels; Introductory sentence (I), Typical script based action (S), Error Action (E), Finished error action (F).

VERSION A
MOTHER PUTS A BABY TO BED

Mama needs to put her baby Natalie to bed (I)
OOPS, She goes to the crib but notices there is no pillow (E)
She gets a pillow out of the closet (F)
She puts the Natalie in bed and covers her up (S)
UH OH, MaMa hands Natalie a diaper instead of a teddy bear (E)
She then gives the Natalie a bottle (S)
YIKES, Mama realizes that she forgot to put grape juice in the bottle and it is empty (E)
Mama turns off the light (S)
OH NO, She forgot to give the Natalie a kiss (E)
She goes back and gives the Natalie a kiss (F)

VERSION B
MOTHER PUTS A BABY TO BED

Mama needs to put her baby Natalie to bed (I)
OOPS, She goes to the crib but notices there is no pillow (E)
She puts the Natalie in bed and covers her up (S)
UH OH, MaMa hands Natalie a diaper instead of a teddy bear (E)
She takes back the diaper and gives the baby a teddy bear (F)
She then gives the Natalie a bottle (S)
YIKES, Mama realizes that she forgot to put grape juice in the bottle and it is empty (E)
She fills the bottle with grape juice (F)
Mama turns off the light (S)
OH NO, She forgot to give the Natalie a kiss (E)

VERSION A

SAMATHA BRUSHES HER TEETH

Samantha needs to brush her teeth (I)
OOPS, As she reaches for her toothbrush, she knocks over a cup of water (E)
She wipes it up (F)
Samantha puts toothpaste on the toothbrush (S)

UH OH, A little toothpaste misses the toothbrush and falls on the sink (E)
Samantha brushed her teeth (S)
YIKES, As she is brushing, she leans against the towel rack and a towel falls into the sink
She picks it up (F)
After she brushes her teeth, she rinses her mouth (S)
OH NO, She leaves the bathroom but does not turn off the light (E)

VERSION B
SAMATHA BRUSHES HER TEETH

Samantha needs to brush her teeth (I)
OOPS, As she reaches for her toothbrush, she knocks over a cup of water (E)
Samantha puts toothpaste on the toothbrush (S)
UH OH, A little toothpaste misses the toothbrush and falls on the sink (E)
Samantha cleans it up (F)
Samantha brushed her teeth (S)
YIKES, As she is brushing, she leans against the towel rack and a towel falls into the sink
After she brushes her teeth, she rinses her mouth (S)
OH NO, She leaves the bathroom but does not turn off the light (E)
She goes back and turns off the light (F)

VERSION A
JAKE EATS BREAKFAST

Jake decides to have cereal for breakfast. (I)
OOPS, He gets out the orange juice instead of the milk (E)
He prepares his cereal (S)
UH OH, Jake tries to take a bit but he has a fork instead of a spoon (E)
He grabs a spoon (F)
Jake eats his cereal (S)
YIKES, He spills a little cereal on the table (E)
After he is finished he wipes his mouth on a napkin (S)
OH NO, He gets up from the table but forgets to put his bowl in the sink (E)
He goes back and gets the bowl (F)

VERSION B
JAKE EATS BREAKFAST

Jake decides to have cereal for breakfast. (I)
OOPS, He gets out the orange juice instead of the milk (E)
He puts the juice back and gets the milk (F)
He prepares his cereal (S)
UH OH, Jake tries to take a bit but he has a fork instead of a spoon (E)
Jake eats his cereal (S)
YIKES, He spills a little cereal on the table (E)
He picks it up (F)

Samantha brushed her teeth

Question #1. "Do you remember when Samantha reached for her toothbrush and knocked over a cup of water? According to the story could Samantha have left it there? Or did the story say Samantha wiped it up?"

Question #2. "Do you remember when a little toothpaste missed the toothbrush and fell onto the sink? According to the story could Samantha have left it there? Or did the story say Samantha cleaned it up?"

Question #3. "Do you remember when Samantha leaned against the towel rack and a towel fell into the sink? According to the story could Samantha have left it there? Or did the story say Samantha picked it up?"

Question #4. "Do you remember when Samantha left the bathroom without turning off the light? According to the story could Samantha have left the light on? Or did the story say Samantha went back and turned off the light?"

Mother puts the baby to bed

Question #1. "Do you remember when Mama went to the crib and noticed there was not a pillow? According to the story could Mama have forgotten to get the pillow? Or did the story say Mama got a pillow from the closet?"

Question #2. "Do you remember when Mama handed Natalie a diaper instead of a teddy bear? According to the story could Mama only have given Natalie a diaper to hold? Or did the story say Mama took back the diaper and gave Natalie a teddy bear?"

Question #3. "Do you remember when Mama forgot to put grape juice in the bottle? According to the story could Natalie have gone to bed with an empty bottle? Or did the story say Mama filled the bottle with grape juice?"

Question #4. "Do you remember when Mama forgot to give Natalie a kiss? According to the story could Natalie have gone to bed without a kiss? Or did the story say Mama went back and gave Natalie a kiss?"

Jake eats breakfast

Question #1. "Do you remember when Jake got out the orange juice instead of the milk? According to the story could Jake have just gotten out the orange juice? Or did the story say Jake put the orange juice back and got the milk?"

Question #2. "Do you remember when Jack grabbed a fork instead of a spoon? According to the story could Jake have just used a fork? Or did the story day Jake grabbed a spoon?"

Question #3. "Do you remember when Jake spilled a little cereal on the table? According to the story could Jake have left the cereal there? Or did the story say Jake picked it up?"

Question #4. "Do you remember when Jake got up from the table and forgot to put his bowl in the sink? According to the story could Jake have just left the bowl on the table? Or did the story say Jake went back and got the bowl?"

Appendix E

Script Generation Experiment 4

Write a list of actions describing what someone would generally do when a person "**robs a convenience store**". We are interested in the common actions of a routine '**robbing a convenience'** stereotype. Start the list with arriving at the store and end it with leaving after the store. Include about 20 actions or events and put them in order in which they would occur.

1.
2.
3.
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Appendix F

Convenience Store Robbery Script Experiment 5

The following story was used in this study. The critical items, the inferred actions, are in parentheses and were not included in the auditory version of the story. The typical actions are underlined. The atypical actions are in italics.

Convenience Store Robbery Script

An unidentified man robbed the convenience store at 2nd and Broadway on Tuesday at 7 p.m. The store had been previously robbed three times this year. The owners had just recently installed a camera in the store and a video recorder was set up behind the register. According to witnesses, the man arrived at the store at approximately 6:45 p.m. in a dark color sedan but did not immediately enter the store. When it seemed there was no one entering or exiting the store, the man got out of his car. Witnesses from across the street claimed he was tall and thin and walked with a very slight limp.

He stood at the entrance of the store for about 2 minutes and asked a passerby for a match. ***(He smokes a cigarette)*** He threw his cigarette on the sidewalk and stomped on it with his black boot. There were only 4 customers in the normally crowed store at the time of the robbery. Witnesses outside the store said the man was carrying a ski mask and black gloves. No witness inside the store noticed him when he came in and did not see his covered face during the robbery.

He entered the store and nervously began to look around for video and surveillance equipment as he pretended to shop. He appeared to be very thirsty and headed straight for the refrigerated beverages. ***(He takes a beverage)*** This appeared to make him feel much better. There were several large circular mirrors mounted in the

upper corners of the store. He seemed to like the way he looked and smiled at himself. (***He looks at himself in the mirror***). He decided the time was right. The cashier looked up and gasped. (**He approaches the cashier**)

He looked at the cashier and said, "This is a stick up, give me all your money." The cashier complied; she did not want to get shot. (**He pulls out a gun**). He yelled loudly at the remaining customers, they all got down on the floor (**He tells the customers to lay on the floor**). He became agitated at one customer and told her loudly to stop crying. ***(One customer starts to cry).***

He spoke nervously to the cashier. (**He demands the money**). She did not want to anger the robber and put all the money in a bag. (**He grabs the bag of money**). He then grabbed some candy bars from the counter. As he turned to look at the customers, his boot got caught on the torn red carpet and he fell. (***He drops the candy bars***). He picked up items off the floor and uttered several profanities. He noticed the video recorder behind the register and requested the video of the surveillance tape. The cashier gave the tape to the robber. He also grabbed several items from the counter. The robber thanked the cashier. (**He leaves the store**). When he was outside, he threw his ski mask on the sidewalk. ***(He takes off his mask).***

3. When the robber looked at himself in the mirror, did the robber like the way he looked? / Did the robber like the way he looked? Yes

4. When one customer started to cry, did the robber tell the customer to stop crying? / Did the robber tell the customer to stop crying? Yes

5. After he dropped the candy bars on the floor, did the robber grab some mints? / Did the robber grab some mints? No

6. When the robber took off his ski mask, did the robber throw it in his car? / Did the robber throw his ski mask into his car? No

FILLER QUESTIONS

1. After being robbed three times, did the store owners have a security guard? No

2. Was the store robbed around 7p.m.? Yes

3. Did the robber wait until the store appeared empty before he entered the store? Yes

4. Did the robber pulled up to the store in a light color hatchback? No

5. During the robbery, was there a video camera behind the register? Yes

6. Did this robbery occur in the morning? No

7. During the robbery, were six customers in the store? No

8. When he pretended to shop, was the robber looking for video surveillance equipment? Yes

9. Was the store located on Main Street? No

10. Did the robber's boot get caught on the red carpet? Yes

11. Did the robber speak during the crime? Yes

12. Did the robber leave the videotape behind? No

Appendix H

Recognition Task Experiment 5

The following question were used for participants in the 'Recognition task' conditions. The first 12 items are the critical questions (6 typical, 6 atypical) and the last 12 items are filler questions. The presentation of the questions was randomized.

Instructions: For each of the items on the following page, please indicate whether or not the item was explicitly stated in the *auditory version* by checking the box in the appropriate column. If the item was present in the auditory version, check the box under the word "YES." If not check the box under the word "NO."

	YES	NO
1. The robber approached the cashier		X
2. The robber pulled a gun		X
3. The robber told the customers to lay on the floor		X
4. The robber demanded the money		X
5. The robber grabbed the money		X
6. The robber left the store		X
7. The robber smoked a cigarette		X
8. The robber took a beverage		X
9. The robber looked at himself in the mirror		X
10. One customer started to cry		X
11. The robber dropped candy bars on the floor		X
12. The robber took off his mask		X
13. The robber waited for the store to empty	X	
14. The robber pulled up to the store in a car	X	
15. The robber was tall	X	
16. The robber drove a hatchback		X
17. The robber pretended to shop	X	
18. The robber wore tennis shoes		X
19. The robber walked with a limp	X	
20. The robber asked for the video tape	X	
21. The robber tripped on a box		X
22. One customer ran out of the store		X
23. One customer called the police		X
24. The robber used profanity during the crime	X	

Appendix I

Source Monitoring Task Experiment 5

The following question were used for participants in the 'Source Monitoring' conditions. The first 12 items are the critical questions and the last 12 items are filler questions. The presentation of the questions was randomized.

Instructions: For each of the items on the following pages, please indicate whether the item was (a) present in only the auditory version, (b) present only in the questions, (c) present in both the auditory version and the questions, or (d) present in neither the auditory version nor the questions. Indicate your answer by checking the appropriate column.

	Source?			
	'auditory'	'questions'	'both'	'none'
1. The robber approached the cashier		X		
2. The robber pulled a gun		X		
3. The robber told the customers to lay on the floor		X		
4. The robber demanded the money		X		
5. The robber grabbed the money		X		
6. The robber left the store		X		
7. The robber smoked a cigarette		X		
8. The robber took a beverage		X		
9. The robber looked at himself in the mirror		X		
10. One customer started to cry		X		
11. The robber dropped candy bars on the floor		X		
12. The robber took off his mask		X		
13. The robber waited for the store to empty		X		
14. The robber pulled up to the store in a car			X	
15. The robber was tall	X			
16. The robber drove a hatchback		X		
17. The robber pretended to shop			X	
18. The robber wore tennis shoes				X
19. The robber walked with a limp	X			
20. The robber asked for the video tape		X		
21. The robber tripped on a box				X
22. One customer ran out of the store				X
23. One customer called the police				X
24. The robber used profanity during the crime	X			

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