

Experiencing, Remembering and Reporting Events
Ralph Norman Haber and Lyn Haber¹

University of California at Santa Cruz and University of California at Riverside

Abstract

Human beings frequently describe from memory events they have observed, and most people consider these descriptions to be accurate. However, scientific research on memory in the last few decades has revealed that people's memories are often inaccurate. These errors in memory are systematic and are especially likely to occur for the kinds of events that are reported in courtroom testimony: reports of strangers performing brief, violent or unexpected acts that are frightening to the observer/witness. We examine the research on factors that affect the accuracy of initial observation, encoding and remembering and forgetting such events. We consider the special memory issues involved in describing and identifying strangers, and how these can impair the accuracy of eyewitness identifications. Throughout our review of the research findings, we consider their impact on courtroom procedures governing eyewitness testimony and identification. We conclude with a set of policy recommendations based on this scientific evidence.

¹ Address for correspondence is E-Mail: haberhfc@telis.org or US-Mail: Rt 2, Box 2155 (Swall Meadows), Bishop, CA 93514. We are grateful for the comments of a large number of people who read earlier drafts of this article, and who assisted us with their thoughtful suggestions. We especially thank Gary Wells, Bruce Sales, Matthew Erdelyi, and James Whitehead for the extra time each of them gave us to help improve our presentation and logic.

Introduction

Most people feel they are well aware of what they can and cannot remember about the events they observe and in which they participate, and that they know about the factors that make their memory accurate. The ten statements of beliefs about memory listed below were presented by research scientists to typical people (who might become members of a jury), who were asked to indicate the strength of their agreement with the statements (usually by checking one of a number of alternatives ranging from strongly agree, agree somewhat, neither agree or disagree, disagree somewhat, to strongly disagree). The examples offered here are drawn from a number of different studies, so that not all people rated every one of the statements, although most of them were used in more than one study in exact or similar wording (for examples, see Garry, Loftus, Brown, & DuBreuil (1997), Lindsay (1994), or Loftus (1979).

1. Memory is like a video recording of your observations that can be played back at will to remind you of what you saw
2. When you are very confident about your memory for an event you observed, you are much more likely to be correct
3. Your memory is stable over time
4. Your memory for what you originally saw can be kept separate from things you learned after observing the event
5. People's faces stand out when you observe them and it is easy to remember faces, so recognition of faces is rarely in error
6. An eyewitness report is accurate evidence as to who was present and what happened
7. Having to tell the same story of what happened over and over reinforces it and makes it more resistant to change
8. When a weapon is visible during a crime, witnesses are more accurate in remembering the details of the crime.
9. Personally experienced traumatic events are remembered more accurately than everyday ones.
10. Observed violent events are remembered more accurately than everyday events.

Most people (in some cases nearly all of them) who have been asked agree or strongly agree with these ten statements. This finding provides a benchmark to use when considering what a typical juror might believe about how memory functions.

In contrast, when these statements are judged by memory experts—scientists whose profession is providing empirical demonstrations of how human memory actually functions—the majority of memory experts disagrees with each statement. (Some of the recent scientific descriptions of memory functioning can be found in Loftus, 1979; Ross, Read & Toglio, 1994; Rubin, 1996; Sporer, Malpass & Koehnken, 1996; and Davies, Ellis & Shepherd, 1981.) Further, as we will show in this article, these experts are right: there is sound scientific evidence showing that each of these statements is contradicted by the facts.

Now consider the following description of a bank robbery, drawn from actual cases. Several men entered a bank, tied up the only guard in the lobby, told the customers to lie down on the floor, and demanded that the tellers hand over all their money. The robbers then left. There were five tellers, two officers, one guard, and five customers in the bank at the time. When the police took their statements over the next hour, there was little consensus among the 13 witnesses as to the number of robbers, what they looked like, what they did, the presence of weapons, or the duration of the robbery.

Video cameras in the bank recorded the robbery. Comparing these recordings to the descriptions provided by the witnesses, it was found that no single witness gave an accurate report of the sequence of events; nor did any single witness provide a consistently accurate description of any of the robbers. Further, in subsequent photo identification line-ups, half of the witnesses made serious errors: four of the 13 witnesses erroneously selected as a perpetrator one of the other people who had been in the bank at the time of the robbery (a teller or a customer), and three of the 13 erroneously selected a photograph of someone who hadn't been there at all at the time. All seven of these witnesses asserted that they were sure they had correctly identified one of the robbers and that they were willing to so testify.

Law enforcement officials, lawyers, and memory experts treat this example as a common occurrence: they have discovered that multiple witnesses frequently give different descriptions of the same event; the report of not a single witness accurately mirrors the entire event; and misidentifications by eyewitnesses are often made even with great confidence. In contrast, the average person treats this example with incredulity. Most people (typical people, who might become members of a jury) expect an individual eyewitness's report to be accurate.

Different descriptions of a single event provided by observers reflect the difficulty any one observer has in encoding and then reporting the event the way it would be recorded by a video recording. Research has overwhelmingly shown that, contrary to what most people believe, human beings are neither unbiased observers nor veridical recorders.

As we will show, the probability that a single eyewitness can describe an event or a defendant with sufficient accuracy that a jury can exclude reasonable doubt and convict the defendant is rarely close to a certainty, and is often not very high at all. A number of factors, which we will describe below, act both singly and in combination to make a completely accurate report unlikely. To evaluate the probable accuracy of an eyewitness report, we have to know something about the event, about what the witness was doing when the event occurred, about what happened then and who talked to the witness after the event, about the prior experiences and beliefs of the witness as a person, about how the witness was interrogated, about the kind of line-up that was used, and about the procedures used in creating the line-up and asking the witness for an identification response.

In contrast to the scientific research evidence, however, people listening to the testimony of an eyewitness accept what the witness says almost uncritically. Jurors report that they find it very difficult to consider any alternatives to a confident statement by an eyewitness. The impact of this "tyranny of the eyewitness" is reflected in the outcomes of criminal trials, especially in those in which the only evidence against the defendant was the testimony of a single eyewitness (see Devlin, 1976). Conviction rates approaching 90% are found when there is just a single eyewitness, even in the absence of any forensic evidence linking the defendant to the crime, and even when there is overwhelming evidence arguing that the defendant could not be the perpetrator.

The purpose of this article is to summarize the scientific evidence on the accuracy of eyewitness testimony, with specific attention to the factors that enhance or impair the likelihood of accuracy. Our hope in writing this article is that the information presented here will be made available to juries now, and incorporated into the law in the future.

1. Observing and Encoding Events into Memory

In this first section we will consider the factors that might lead witnesses to make and remember differing observations of the same event. These factors include (a) observational point of view of the witness; (b) the attentiveness of the witness; (c) any

special attentional focus that might reduce the breadth of a witness's observations; (d) the witness's familiarity with the event and its details; and (e) the witness's expectations about what occurred and his/her understanding of its meaning.

(a) Observational Point of View and Perceptual Adequacy. In the bank robbery described above, the customers forced to lie down on the floor had less opportunity to view from the front those robbers who approached the teller booths, whereas some of the tellers had frontal views. Therefore, those tellers should be able to give more detailed descriptions of the appearance of those robbers; and, in the absence of other factors, those descriptions are more likely to be accurate. It is critical in evaluating a witness's statements about an event to be sure that the witness had a sufficient opportunity to view the event from a position consistent with the statements being given. For example, if a witness was too far from the event to have sufficient visual acuity to perceive the details being described, or was not wearing corrective glasses needed for adequate vision, or observed the event at twilight, then statements made under those conditions are not likely to reflect what really happened. In addition to distance, lighting conditions, especially back lighting, reflections, and shadows impact the ability to see fine details. Courtroom as well as research examples abound in which well-meaning witnesses report what they concluded **must** have happened, based only on partial or inadequate observation of the physical reality of the event.

(b) Allocation of Attention. Attention is memory's gatekeeper. At any moment your five senses are bombarded with vast amounts of external stimulation. In addition, you generate your own stimulation internally from your thoughts, feelings and emotions. Nearly all of this array of stimulation impinges on you only momentarily and leaves no accessible residue. For any part of this stimulation to create a lasting impact so it can be remembered, that component of stimulation must be encoded into memory. For that encoding to occur, you must **attend** to it during the time it impinges on your senses. If at some moment you do not attend to the swirl of stimulation around you, none of it will be retained in your memory of that moment. You will neither be able to describe nor to recall it at will².

However, you would be overwhelmed if you attended to and tried to encode all stimulation reaching your senses. Therefore, attention must be selective: on the one hand, to those aspects of stimulation that are noticeable, sudden, surprising, or might be potentially important; or, on the other, to those that are continuous with what has already been happening. While all the rest reaches your senses, it falls outside of your attention and is therefore not encoded into your memory. So, the deployment of attention has two consequences: it allows you to encode and retain memory of some aspects of what happens to you; and it allows the remainder to slip away and be lost forever. We shall consider both of these properties.

² A century of intensive scientific research has attempted to discover and identify cognitive mechanisms that could be capable of making a passive recording of the surrounding stimulation to which you do not attend at the time but that you can then examine later at leisure. While there have been some claims for such mechanisms, the amount that they can retain is usually so trivial as to be of little practical use in the real world. The general conclusion (see Allport, 1989; Erdelyi, 1996) is that, to have any memory of your surroundings at a given moment, you have to focus your attention on them at that moment.

To insure that the potentially important aspects of their surroundings are attended to, you have fairly automatic cognitive mechanisms by which you can switch attention quickly. Any change in stimulation, such as a loud noise, or a movement off to the side, will cause you to orient your attention to it. That re-orientation allows you to encode sudden changes in what is happening, though at the expense of what you had been attending to just previously, which then stops being accessible for encoding into memory. When driving comfortably, it is possible to divide your attention so you can control the car while conversing with a passenger. However, a sudden squeal of brakes refocuses your attention exclusively on the emergency, and you cannot remember what your passenger said during that interval.

This focusing is not simply like moving your eyes. Attention can also be tuned--you can extract from the vast array of stimulation around you just those parts you desire without any physical shifting of eyes or head; and, conversely, you can ignore even highly stimulating parts directly in front of you about which you do not care at the moment (see Posner, 1980; Posner & Peterson, 1990). Hence, what you as an observer will encode about an event depends on where and how your attention is focused, not just where you happen to be looking. Most importantly, it is possible for events to occur directly in front of you, well within your range of seeing and hearing, and yet make no impact on your memory if you were attending to something else at the time. This is quite common when your attention is toward internal thought or focused on only one aspect of the unfolding event.

Focusing your attention greatly improves the amount and quality of information you pick up from the specific stimulation on which your attention is focused; but that focus reduces the amount you pick up from the rest of the scene. Further, some focus by its very nature is so narrow that it impairs what is picked up even from what would normally be seen. For example, during the bank robbery, the guard who was tied up by one robber and threatened with a gun if he moved will have focused his attention on that robber and gun (see next subsection below). As a consequence, that guard was unable to report most of the events that then transpired, though all were well within his line of sight and acuity.

For any given person at a given moment in time, the vast majority of events that occur do so outside their attention. Therefore, nothing can be initially retained of those events, and there can never be any subsequent recall of them. For this reason, knowing where a witness's attention was focused is critical in evaluating what the witness reports s/he encoded and retained about an event.

(c) Bias in Attentional Focus. Normally your attention is tuned at any moment to those activities of greatest interest to you. This tuning may be fairly broad, so that most of the components of the event fall within the range of your attention. But frequently, some aspect of an event causes an involuntary narrowing of attention to some particular detail, so much so that other parts of the event are not attended to at all, and therefore not encoded into memory³. One area of great legal importance concerns the narrowing of attention that occurs for most witnesses when they detect the presence of a weapon. People focus their attention on the weapon so much that almost everything else that's happening goes unnoticed and therefore unremembered. This exactly describes why the guard eyewitness later was unable to remember even the general sequence of events of the robbery. Specifically, scientific research on "weapon focus" has shown that, when a weapon is present, witnesses are far less able to remember distinctive features of the people present, including those of the person

³ Erdelyi (1996) reviews a number of experiments that show how emotional components of an event diminish accuracy for the event as a whole, which he interprets as a "sucking up" of attentional resources so that fewer are left over for encoding the remainder of the event.

holding the weapon. Hence, a witness's chances of making a correct identification of a person are greatly reduced if that person held a weapon (e.g., see Loftus, Loftus & Besso, 1987; Tooley, Brigham, Maas & Bothwell, 1987; Tullestrup, Turtle & Yuille, 1994).

It is equally likely that a narrowing of attention will occur, with its concomitant loss in encoding, whenever any component of the event is highly dramatic, frightening, violent, or distasteful to the witness. It should always be assumed that violence in any form narrows attention, and that which is outside the resultant narrowed attention is encoded less completely, if at all (Deffenbacher, 1991).

We have just reviewed three factors that affect what the eyewitness encodes of an event: his/her observational point of view and how well s/he could perceive the event; whether s/he was attending to the event; and where her/his attention was focused. These three factors are mostly governed by the characteristics of the event/scene itself and by built-in neural processing mechanisms. The two factors we describe next are determined by the background and experiences of the individual eyewitness.

(d) Knowledge, Familiarity and Expertise with the Content of the Event. In the course of your everyday life, you are highly familiar with aspects of your work, both inside your home and at your jobsite. If you work as a supermarket clerk, you are likely to be far more knowledgeable than most people about a wide range of edible products; if you are a car salesman you know a lot about the makes of cars. Within your own sphere, you are an expert. Bystander-witnesses are often required to testify about details of what they observed, such as the characteristics of a vehicle or a weapon. If the eyewitness has little knowledge of that class of objects, the witness's reports about the object are often incomplete or simply wrong. For example, when a witness who doesn't know one make from another is called upon to describe the distinctive features of a particular car involved in a hit-and-run accident, he will be able to provide few descriptors of the car, even fewer that are distinctive, and will often add details that "should have been present" but in fact were not remembered. In contrast, a witness who has learned to distinguish the different models and years of most cars can name and describe any particular instance of a car quite accurately (Davis, Kurvink, Mitchell & Robertson, 1996). While some experts acquire their expert knowledge through formal study and training, an eyewitness may also be considered an expert if he works with something (such as cars or guns or peoples' faces) as part of his everyday life. Scientific research has shown that the reports of such experts of their observations about objects or events within their expertise are more likely to be accurate than the reports of non-experts (see Wilding & Valentine, 1996).

Similarly, lack of familiarity has been demonstrated in scientific experiments to lead to inaccurate identification of people. The adage that "all Orientals look alike (to non-Orientals)" is in fact mostly true. In experiments on cross-racial identification, in which the race of the criminal is different from that of the witness and the witness has few close interactions with people of that race, the witness cannot provide as many identifying features of the criminal he observed, thereby making it less likely that subsequent identifications will be accurate (e.g., see Chance & Goldstein, 1996).

In general, if you observe a kind of person or object with which you are unfamiliar, (1) you observe fewer details, (2) you are less likely to be able to describe that person's or object's distinctive features, and (3) you are less likely to make a correct identification later, than if you are highly familiar with those kinds of people or expert with those kinds of objects. All three aspects of observing an unfamiliar person or object combine to make accurate identification less likely.

(e) Witness Expectations and Interpretation of the Event. The last factor that affects encoding accuracy also pertains to the individual observer: the beliefs and expectations he uses to organize and understand the event being observed. Research

has shown that the beliefs of the witness produce fundamental changes in the reports of what was observed.

For example, one study concerned with racial prejudice (Allport & Postman, 1947) asked subjects/witnesses to view a scene depicting two men in which one man held a knife: the witnesses were to describe the scene to other people who had not seen it. The two critical contents of the scene that were varied were whether both men were the same race, and which one held the knife. When both men were of the same race, nearly all witnesses correctly described the critical element of who held the knife, as well as most of the details of dress and the position of the two men. However, if one man was black and one white, most witnesses (black and white alike) reported that the black man held the knife even when it was held by the white man. Some witnesses who correctly described who held the knife incorrectly added that the white man was defending himself (there was nothing in either man's posture or position to suggest this conclusion). All of the witnesses stated that they believed that crimes were more likely to be committed by blacks than by whites. The results suggest that eyewitnesses sometimes encode and remember the event so as to be consistent with their beliefs rather than the way it actually happened.

Similarly, in a recent case, a witness testified that she saw the defendant in his car where the robbery occurred. On cross examination, however, she reported that she was unable to see any of the features of the man inside the car. It had been previously established that viewing was at night and from a substantial distance, so that it was unlikely that the witness could have identified the car's occupant. The witness testified that she "knew" it had to be the defendant because she knew it was the defendant's car. The witness used her expectation rather than her observation in giving her testimony.

The witness's understanding of the event also influences his memory of what he observed. In some of the most important scientific research on memory, Bartlett (1932)⁴ asked subjects/witnesses to read descriptions of ceremonies, some of which were consistent with their experiences (though still quite unfamiliar) and some unlike anything they had ever experienced before. He then asked his subjects to recall as much as they could of what they had read. He found that, while the former could be remembered and repeated with some accuracy, the latter could not. Rather, in their reports, the witnesses altered significant facts, deleted people and sequences that made no sense to them, and interpreted the motivations and intentions of the participants in ways that were consistent with their own understanding, but quite at variance with the actions that they actually read. Bartlett argued that if you cannot understand what you have observed, you change it into something that you can understand or that is at least consistent with what you know. These "Bartlett" effects are now so well documented that they are taken for granted by memory scientists as normal processes that occur whenever events are encoded. Bartlett effects are another important example of how individual witnesses will report events differently from what actually occurred: in this instance, the witness restructures the events so they make personal "sense" to them. The subjects looking at the knife fight restructured what they remembered so it was consistent with their expectations.

Summarizing this section on encoding of memory, diversity in reports from the memories of different witnesses can arise from differences in how the individual observers have encoded the event into memory. One witness may have been better located than another to observe completely. One witness may have been less attentive than another. One witness may have been very narrowly focused on some specific aspect of the event; another may have been able to focus more generally. One witness

⁴ See Erdelyi (1996) for a detailed discussion of Bartlett's work and its impact.

may be more expert about details than another. Witnesses may have different expectations about what might have happened, resulting in different encodings of the event. Finally, some witnesses might not understand the event, or the event itself may be strange to them, resulting in discrepant reports of the event.

These five factors (perception, attention, focus, expertise, and understanding) each may cause a different encoding of the same event by different observers. As we have shown, normal encoding processes can lead an eyewitness to make mistakes—mistakes sometimes as extreme as “seeing” the knife in the wrong person’s hand.

For all of these reasons, research scientists argue that an analogy between your memory and an unbiased video recording is misleading. Unlike the human observer, an unbiased video recording of an event picks up the sequence of events in front of its lens just as they occur: it cannot allocate its attention elsewhere, change its own focus to a closeup of a weapon, or record fewer details because it has never seen a knife before. On the camera’s film. Orientals look as different from each other as they really are. Further, the content on the film remains the same regardless of the violence of the event, its surprising course, and the likelihood of the people acting as they did.

Often human beings do remember events very much as they happened. But typically this occurs only when all of the factors just considered are favorable to creating (and preserving, to be discussed below) accurate memories. The rest of the time, what is encoded of events does not exactly match their actual unfolding. What you then remember is what you have encoded. There is no video recording of any kind contained in your head. You cannot go back to “look up” what actually happened.

2. Remembering Events

Experts on memory research refer to a witness's first report of an observed event, when it is given after the event, as an **independent memory**. A report of a memory is independent under the following three conditions: (a) the witness has not yet spoken with or listened to any other people about what happened; (b) the witness is describing the events for the first time; and (c) the witness provides the description in the absence of leading questions --the only kinds of questions asked are “And then what happened?”, or “What did you see/hear?....” A witness’s independent memory report of an event is normally the most accurate description the witness will ever be able to produce about what she observed. As we have just shown, a report from independent memory isn’t necessarily completely accurate: independent memories can be affected by some or all of the encoding factors just described. However, whether accurate or not, it is the only memory that reflects what the witness observed, without additions, taintings, or changes as a result of the witness’s exposure to new information after the event.

In normal life, your own independent memories often undergo influences that, in psychological parlance, “taint” them: you dress your stories up for your listeners who didn’t observe the events; and you discuss the events with other people who also observed them and you incorporate what they say as part of your memory. A tainted memory is not necessarily a false or inaccurate memory, but it is no longer your own, original, independent encoding of the event. It is a compendium of information and detail, some of which you yourself did not see or remember. In this respect, it is analogous to hearsay, and, for the same reasons that hearsay testimony is rarely admissible, testimony based on non-independent memories should also be excluded from the courtroom. (A number of attempts to develop “truth” tests for testimony through internal analyses of the content of the testimony itself have been tried, but so far there have been no successes sufficient for use in the courtroom—see Waggenaar, Koppen, & Crombag, 1993; or Stern & Dunning, 1996).

In this section we consider four factors that might cause eyewitnesses to change their memory, and therefore their report of an event. Such changes are part of normal memorial process and occur without the witnesses's knowledge or intention. These factors are: (a) the inevitably wrong focus of autobiographical memory; (b) systematic

changes with repetition of the report of the memory; (c) effects of similar events on the memory for an event; and (d) incorporation of post-event information acquired after the event.

(a) The inevitably wrong focus of autobiographical memory. An event has a physical reality, quite apart from what is remembered about it by witnesses. In contrast, an experience of an event is a particular observer's memory and interpretation of the event. For most people nearly all of the time, the function of memory is not to preserve an accurate record of what happened. Rather, your memories provide a psychological reality that helps you make sense of the world and especially of yourself: they are very personal and self-serving—see the papers in Rubin (1996).

Typically, as an event unfolds, you as an observer are not thinking about describing the other people and their actions: you see the event in terms of how it affects you. The event has all of the properties of a story, with a beginning, middle, and end, and a sequence of actions with one or more actors. The most important actor--the protagonist in your story--is you. The story answers the questions: What happened to me? What does it mean to me? This story's theme is the psychological reality of the event, defined in relation to the observer, not to the event itself (see also Mandler, 1984).

In contrast, when an eyewitness is required to report an event in the courtroom, that witness is being asked to describe the facts of the event: the physical, not psychological, reality of what happened. Because this demand in the courtroom is contrary to how memory is normally used, the report made by an eyewitness is often structured around the importance and meanings of the event for the witness herself.

As an example of how an eyewitness describes events from a personal point of view, consider one of the eye witness accounts from a woman who was in the bank described above: "I stopped at the bank to cash a check. I was putting the money in my purse when armed men ran into the bank, waved their guns at everyone and ordered me to lie down on the floor. One gigantic man, who looked like a football player, stepped over me and I was afraid he would take all of the money I just got. I was so scared he would hurt me. He went to the same teller who had just helped me, threatened her with his pistol, and stuffed what she handed him into his bag. After what seemed like hours of terror, all the robbers ran out. They didn't take my money."

This report has little helpful content for the policeman who wants to identify the robbers. The policeman asked her: How many robbers were there? Which ones had guns? What did each of the robbers look like? What were they wearing? What did each of the other robbers do? Every investigator and every interrogator forces the witness to switch from "what happened to you" to "what happened in the bank". Hence, almost immediately, the eyewitness is required to change from an autobiographical and psychological focus to an objective focus. This translation usually produces changes in the report, changes that may introduce inaccuracies about the physical reality.

The most typical and pervasive changes occur when the observer is asked about details that were not in her perspective, or about links in the sequence that were not important to her at the time--details and links she did not notice, encode or retain in memory. In trying to answer the interrogator's questions, the witness often adds content and details that "must have happened"--details not present in independent memory. These added observations are much less likely to be accurate: after all, the witness did not witness them. They are an inevitable consequence of the mismatch between an autobiographical focus and the physical event.

As a result, the correspondence between the psychological reality of the witness's report and physical reality of the event can never be assumed to be perfect, or even high.

This perspective on the functions of autobiographical memory also suggests the reasons people believe that their own memories and those of others are accurate. People are rarely confronted with a contradiction between what they remember happened and the truth, so they have no way to test the accuracy of their memory; most discussions with other people about what is remembered are for the purpose of arriving at a consensus among people, not to check on what actually happened; and finally, most of the changes that occur in the content of memory occur without awareness so people never realize their memories have altered.

(b) Systematic changes in the content of memory with each repetition.

Unlike a video recording, which remains the same each time it is played, memory undergoes changes with rehearsal. While semantic memory for knowledge, facts, and language improve in its accuracy with rehearsal and repetition, this is not the case with autobiographical memory for events.

We have already mentioned the research begun by Bartlett, in which he provided the first powerful demonstrations of the effects of the witness's understanding and expectancy on what is encoded. That research produced a second and equally important discovery: he showed that each further repetition of the report produces **predictable** changes in the report. These predictable changes are, first, that many of the details drop out of the subsequent reports altogether and are never reported again; and second, other details are altered or additions are made to fit more consistently with the overall description provided by the observer.

For events familiar to the witness, these changes serve to smooth over discrepant parts, they provide explanations for what happened where there were no explanations before, and they make the story more coherent--a better telling. The two findings from Bartlett's work interact: the less coherent the event from the point of view of the witness, the more likely its encoding will be altered to make sense to the witness, **and** the more likely that each further repetition of what had been witnessed will be further changed, each alteration serving to make the event more coherent to the witness. In cases where the event itself is unfamiliar, outside the experience of the observer, or contrary to her expectations, the observer may, with sufficient retelling, restructure both the actual events and their sequence to make sense, ending up with a meaningful story which bears scant resemblance to the physical reality she originally observed.

Further, not surprisingly, observers also are shown to alter their descriptions depending on the audience to whom they are speaking. Thus, as a witness talks to different people about the event, with each person receiving a different version, the witness has provided multiple versions of the story. All of these are correct as far as the psychological reality vis-a-vis the witness is concerned, but only one, at most, reflects the physical reality. The witness is rarely aware of the different versions, and rarely aware that gradually they are intermeshed into a new story.

These facts about alterations of memory produced by rehearsal are particularly relevant to testimony made by witnesses in court. By the time the witness reaches the stand and is questioned by counsel, she has told her story dozens of times. Often, the first time the story is told is to other observers or to the first new arrivals at the scene. That description, the closest one available from the independent memory of the observer, is usually unrecorded. The first recorded description, taken down by one of the officers at the scene, may already have undergone many changes after several prior rehearsals, each with its smoothings, rearrangements of facts, and attempts to be congruent with what has been learned from other witnesses.

This is only the beginning of the rehearsals required of the witness. More than one policeman will demand a repetition; then come the investigators and the lawyers. All of these people press for accuracy rather than psychological (autobiographical)

meaning. All of these people also press for completeness, and are usually quite intolerant of responses such as "I don't remember that part," or "I'm not sure." To avoid having to say things that suggest being a poor witness, the observer has to fill in, or to fix the story so that the gaps in memory disappear. The inevitable wrong focus of autobiographical memory creates further alterations in memory. The more unusual or unexpected the event, the less familiar the observer is with its nature, or the less training or experience the observer has in careful observation and remembering, the more such alterations are to be expected with repeated retellings.

Quite different kinds of changes may be introduced when the witness tells the story to friends and family. Accuracy is not nearly as important as drama and excitement; and the witness's role is often enlarged. The extent to which these changes are also incorporated into future repetitions further compromises accuracy.

It has been demonstrated that predictable changes in the description of an event based on memory occur as a result of repeated rehearsals, filling in gaps, or adjusting to the audience. These changes may not be so extreme that the n-th retelling no longer resembles the initial one, but some of the changes may be critical in the courtroom. Frequently in the courtroom, witnesses are confronted with earlier versions they gave of an event that are in conflict with their present testimony. Such conflicting testimony is the consequence of these inevitable alterations.

(c) Post-event information can create new (and potentially) false memories.

The single most dramatic finding in recent memory research concerns changes in reports made by witnesses when other people give them information. Two insidious facts have emerged: first, witnesses are unaware that they have acquired new information from somebody else--the information is treated as if it were part of what they themselves originally observed; and second, witnesses usually are unaware that they have changed their report based on that new information.

Psychologists refer to the content of this new material as "post-event information." When witnesses are exposed to post-event information, their memory is no longer independent, or solely their own report of events; now their memory is said to be "tainted," "contaminated," or "false." The new information may or may not be accurate--the point is, the witnesses often can no longer distinguish between what they themselves observed and what some one else told them. Consider some findings from recent research (see Belli & Loftus, 1996; Loftus & Loftus, 1980): (1) embedding a false presupposition into a question (asking: "Did the red car stop or run the light just before the crash?" when the car's color has not been previously specified) will often change the witness's subsequent testimony as to the color of the car; (2) varying the intensity of verbs in a question (asking: " Did the car hit..., Did the car collide...Did the car smash... Did the car demolish...?") will often change the witness's subsequent testimony about the speed of the car; (3) showing a witness line-up pictures of people not involved in the observed event will often result in the witness subsequently choosing one of those innocent people as the criminal, even when the real criminal is present in the later line-up; (4) allowing the witness to overhear a new or different description about the event or about the persons involved will often lead the witness to include the divergent information in subsequent testimony.

The research on memory tainted by post-event information has identified several factors that make such tainting more likely. First, and probably most important, changes occur with each opportunity or request for a recall of the memory: the more times the witness is called upon to tell her story, the more firmly the contaminating post-event information becomes incorporated into the report. Second, the more times the witness is exposed to the divergent post-event information, the more likely it will become part of her memory and be included in all of her subsequent reports. Third, the more authoritative,

trustworthy or believable the source of the divergent post-event information, the more likely the information will become incorporated into a witness's memory. (Policemen and prosecutors are perceived as authoritative sources; other witnesses to the event are thought to be credible because they were also there.) Fourth, the less coherent or complete the original memory, or the greater the extent to which significant details have been omitted from the original telling, the more likely that new or divergent post-event information will become incorporated into subsequent tellings about the event. Fifth, the less attention called to any discrepancy between the original and the post-event information, or the less obviously a new source has been introduced, the more likely that the divergent post-event information will become incorporated into subsequent testimony.

In all of these post-event information experiments, the witnesses are unaware that they have changed their testimony, or that they have been influenced by the new information to which they have been exposed. Rather, the witnesses remain convinced that they are still reporting an independent memory of what they had originally observed. But the jury is no longer hearing from the witness what the witness herself observed.

Why is it so easy for post-event information to become incorporated into memory? Research has shown that the main reason is that human beings do not have a particularly good memory for the sources of their knowledge about events (Johnson, Hashtroudi & Lindsay (1993). When you acquire information about an event from several sources, regardless of how accurate you are in remembering the information itself, you are less accurate about remembering from which source you acquired it. This means that you often have information you directly observed **during** the event and information told to you **after** the event existing side by side and you cannot remember which is which. The outcome most often observed in the memory research is that the two become combined and are treated as both having originated with the original event. When the two sources of information are not compatible, the differences are resolved by deleting discrepant details, altering others to be more consistent, and filling in missing parts to improve coherence. The final result is a new description, sometimes one quite different from what you would have given just after you observed the original event.

How can the effects of post-event contamination be minimized? The research has shown that false memories are less likely to be produced when all of the following circumstances have occurred: First, when a careful and detailed initial recall at the time of the event has been given, preferably one that has been recorded and then reviewed by the observer. Second, when the event itself is coherent and understandable to the observer, so it has been initially encoded by the observer as a coherent and understandable story. Third, when the witness has not been exposed to divergent post-event information about the event, especially information suggested or presented by sources respected by the observer. Fourth, when the contents of the event are not traumatic or extremely dramatic. And fifth, when the observer is quite familiar with the people and the objects and the actions comprising the event.

The problem with this list is that people do not live in vacuums, and they are continually being exposed to new information about events they have observed. As we have described, the legal process itself as presently practiced in this country requires many rehearsals of the event and provides many opportunities for a witness to be exposed to post event information.

Contamination does not require a villain, someone who has something to gain by changing a witness's description of an observed event. All that is required is exposure. It should always be assumed that a witness has been exposed to new post-event information, and that new information has become incorporated into the witness's

memory. The question in court is whether such new information is divergent from what the witness had originally observed.

(d) Personal routines can cause memory alteration. Human beings are creatures of routine: a large part of your life is made up of repeating activities. You travel from home to work by the same means and route, park in the same lot, walk through the same building, perform the same tasks, and interact with the same friends and colleagues. You shop in the same stores; take your classes in the same school; play golf with the same group at the same club. The list of repetitions is endless. When unique events occur, they are interposed among the repetitions that provide the continuity of your life.

This continuity of similar repetitions has profound implications for the contents of memories: in most circumstances, it results in the loss of your ability to keep track of any one particular repeated event.

At one extreme is the "updating" problem (Bjork, 1978). While you may park your car in the same lot every day, the particular floor and location within the lot may differ from day to day. You do not want to remember where you parked yesterday; you only want to know where you parked today. So you must update, or erase the previous memory. Failures to update lead to delays in getting home to dinner, and may be disastrously embarrassing, as when you fail to update the name of your friend's current date. Research has shown that people are generally quite good at updating: you usually do know where you parked your car today, and do not act on the basis of an old memory. As a consequence, people are very poor at retrieving such earlier "erased" memories. When you are asked where you parked your car two weeks ago, any exact answer you give is likely to be wrong. Updating effectively erases the unique details of the past events from memory.

At the other extreme of the problems produced by a repetitive life are your difficulties in keeping track of the uniqueness of each almost identical repeated event. For example, you may remember that you saw an unusual and "sinister" stranger on the bus one day last week. But since you ride the bus daily, how can you remember on which day that occurred, even when subsequently it becomes vitally important to date the unusual incident? The answer is that you rarely can. Research has shown (e.g., Friedman, 1990; Linton, 1986) that human beings have little ability to remember accurately a particular instance of a repeated event, especially its timing, in which something unique occurred.

The loss in the marking of time does not occur instantly. Research has shown that you can remember the specific time until several further occurrences of the repeating event have taken place. Then all you can tell is a sense of recently or distantly in the past. Even that distinction may disappear after many repetitions (Larsen, Thompson, & Hansen, 1996; Thompson, Gibbons, Vogl & Walker, 1997). If a witness claims to remember an accurate time distinction in a routine of repeated events, the memory is likely to be inferred, "filled in," or tainted rather than independent.

In summary, we have considered four factors that can produce changes over time in what an eye witness remembers about an observed event: the wrong focus of autobiographical memory, repetitions, post-event contamination, and routines. In some cases, the changes produced are trivial, at least with respect to a description of what actually happened. However, in many cases, these factors can produce fundamental changes in what the witness reports, so that details or events have been omitted, changed, or filled in, the sequence of events has been changed, and the description given in the courtroom has become, unbeknownst to the eyewitness herself, a false description of the event.

3. Forgetting and Recovery of Memory

Much of the foregoing discussion has focused on the accuracy of memory: does the description from memory match the original event? Sometimes memory fails altogether—you cannot remember a word, a name, or an event that you once could remember. You may know you observed the event originally and knew the information once, but at this moment you cannot recall it. This kind of memory failure, often simply called "forgetting," is embarrassing and distressing. This is what most people mean when they say they have a poor memory: not that it is inaccurate, but that they cannot recall some part of, or even the entire event. It is a complaint that is heard more often as we get older!

Research on memory has shown that true forgetting of an event, as distinct from being unable to recall it at a given moment, is very rare, and some scientists of memory argue that it never occurs (see Erdelyi, 1996, for a review). Your memories are not irretrievably lost, but you are sometimes unable to remember one of them when you want to. Further, regardless of the difficulty you may have in **recalling** a memory at any given moment, current scientific research has shown conclusively that the content of a memory is not lost or destroyed simply with the passage of time. An event you observed 50 years ago, if unrehearsed, will not be altered, weakened, or lost. Finally, forgetting does not occur just because you have a large number of memories.

In some instances when you are unable to remember something at a given moment, the memory comes to mind later without further cognitive effort. In other instances, you need some reminders, and then, with their assistance, you can remember the word, name or event. Occasionally, a memory may be inaccessible for a long period of time but then is available to you again--what is called a recovered memory. Finally, there are some memories, often very early ones in your life, which remain inaccessible forever in normal experience.

In this section, we consider four factors that reduce the ability to recall a memory, and for each, whether recall can still be achieved.

(a) Without the right reminders, recall may fail. Normally, the memory for an event comes to mind (is recalled) whenever you are reminded of some aspect of it. Memory scientists call these reminders "retrieval cues." You often trigger your memory with your own retrieval cues, which you produce yourself by thinking about the event again. In addition, retrieval cues are frequently embedded in questions you are asked: "Do you remember the time when the black cat bit your leg?". Here, 'black cat,' and 'being bitten on the leg' are component parts of the original experience that you had encoded, and when you are reminded of those parts of the experience by the question, some or all of the rest of the event comes into your active memory.

Research has shown that when retrieval cues about an event are plentiful, varied, and easily encountered in your normal experience, there is a great likelihood that you will be able to remember the event at will, and only a small likelihood that you will never be able to recall it. In contrast, the absence of retrieval cues increases the chances that you will never be able to recall the memory. Retrieval cues can be missing if the circumstances and context surrounding the initial event are very different from those of the remainder of your life. For example, if you experienced the event as a small child, then the retrieval cues available to you as an adult simply would not match those that are related to the earlier event. Moving to a new environment or a new way of life makes it more difficult to remember the details of events that occurred prior to the move--the context is now so different that you encounter few retrieval cues associated with the earlier events. In these cases, the memory for these events might never be retrieved by any act of thought.

Researchers have shown that a number of procedures involving the presentation of retrieval cues improve people's recall. These procedures include instructing you to

think about the event or its details, to think about things related to the event or its details, or to suggest cues for yourself. Erdelyi (1996) calls these repeated recall efforts, and reviews the research. As long as care is taken to be sure that the instructions or suggestions do not contain new information or post-event suggestions about the event, then reports from memory that occur as a result of these procedures can be considered as based on the original encoding. They are, therefore, independent memories. Retrieval cues, especially when provided by someone else, can also be a source of post-event information that might produce false memories. When someone reminds you of an event, if you can remember other details, ones **not** suggested to you by the other person, then you can be more confident you are remembering the event yourself. The additional details that you now remember, beyond the content of the retrieval cues themselves, provide the evidence of an independent memory.

Consider an example of a very common inability to recall: what are the names of your classmates from your high school graduating class of 10 to 30 years ago? Most people, if asked, would respond that this is a waste of time. You only remember a couple of those names, and couldn't possibly remember the rest. In fact, in an experiment (described in Lindsay & Norman, 1972), that is what was found: when asked, subjects produced only a handful of names--a tiny percentage of the total in the class. The experimenter then suggested kinds of typical high school activities, which led subjects to name their own retrieval cues. For example, a subject was asked how he got to school, and when he reported by school bus (a self-produced retrieval cue), he was then asked who was on the bus with him. This question inevitably retrieved some further names. As another example, the experimenter asked, "What did you do after school?" The subject answered that he worked on the school newspaper (a retrieval cue), and then remembered the names of several fellow journalists. The experimenter never suggested the retrieval cues--these always were introduced by the subjects. Each such question produced a new retrieval cue, which reminded the subject of new names of classmates, as well as many events involving those classmates that had also been "forgotten." After this procedure every subject was able to recall the names of at least half of their class mates, and, for some of the subjects came close to their entire graduating class from decades earlier. The subjects were amazed at their ability to remember so many names. This kind of memory recovery result can be repeated with virtually any kind of autobiographical memory content, as long as you have access to the retrieval cues.

In general, any combination of circumstances that removes or distances access to the relevant retrieval cues impairs recall of the events and their details. In most cases, outside changes in your life create your lack of access to the relevant retrieval cues. But there are some cases, considered below, in which retrieval cues are internally blocked from reminding you about events you observed.

(b) Blockage of retrieval cues can cause apparent forgetting. You can keep a memory of an event from being recalled by a sustained effort of "not reminding" yourself about it. Freud enlarged the concepts of suppression and repression as active not-thinking about something to block access to recalling it (see Erdelyi, 1996). Freud argued that this active psychic process occurs when the memory, or some associate to it, is intrinsically traumatic in its meaning, or arouses sufficient anxiety (or shame, guilt, fear, etc.) that being aware of it creates too much psychic pain to be acceptable. In some cases (suppression), you may be aware of the content of the memory, but choose not to describe it to other people (nor even to think about it yourself). Many apparent recoveries of these kinds of memory are simply due to a change in the person's willingness to report what he had observed. From the witness's point of view, this is not a recovery of memory--the memory was always available, but the witness consciously

chose not to acknowledge this. Counseling sometimes changes a rape victim's willingness to describe her assailant.

When the blockage is extreme, you may not even be aware of the content of the blocked memory at all. Arrigo & Pezdek (1998) describe a variety of examples of psychogenic memory losses that followed experiences of disasters, accidents, combat, attempted suicide, criminal acts, violent deaths, and rape.

The traditional methods that have been used to reduce memory blocks include psychotherapy and hypnosis. These procedures frequently prove successful, in that the patient/witness now reports painful, traumatic memories that could not be reported before.

Several overlapping theoretical explanations have been offered to explain the success of these methods. One set of theories is based on anxiety reduction; the other set concerns access to retrieval cues.

Theorists who refer to anxiety reduction assert that psychotherapy allows the patient with the blocked memory to identify the source of the anxiety, to alleviate the anxiety sufficiently, or simply to relax sufficiently so that the recall of the memory no longer produces such discomfort. Other theorists claim that psychotherapy simply gives the patient more time to think about his memories and more time to retrieve them, thereby increasing access to new self-produced retrieval cues (see Erdelyi, 1996).

Similarly, researchers offer several different theoretical explanations for the success of hypnosis in allowing blocked memories to be recalled. Some theorists assume that the hypnotic induction instructions relax people sufficiently that their anxiety is no longer able to prevent recall; other theorists assume that the induction forces people to respond even if contrary to their natural reluctance (see Orne, 1979; Orne, Whitehouse, Dingess & Orne, 1988).

Whatever the explanations, there is general consensus among memory experts that psychotherapy and hypnosis frequently produce recall of memories that had not been previously accessible. In the past, the assumption was that when a person is able to recall a memory that had been previously blocked, that new recall is as accurate and independent as it would have been if it had never been blocked in the first place. If this assumption is correct, then the accuracy of a witness's description based on a memory made accessible by psychotherapy or hypnosis should be just as acceptable in the courtroom as if the memory had been always accessible. However, recent research has led memory experts to question whether these recovered recalls are independent memories and whether they are accurate. Two separate concerns have been raised about these "recovered" memories: first, are they contaminated by post-event information and suggestions; and second, are they the result of a shift in the person's criterion for accuracy.

The first concern about memories recovered after psychotherapy or hypnosis stems from the ease with which **post-event suggestions** can apparently be introduced. Patients can incorporate into their memory new information provided by the therapist or hypnotist during the course of treatment (see Belli & Loftus, 1996; and Pezdek & Banks, 1996, for reviews). Whether or not post-event information is supplied to the patient during psychotherapy is rarely documented in the case studies, but given the nature of the therapeutic relationship, it seems quite likely. This likelihood stems from the nature of the therapeutic situation itself, in which the therapist asks questions, and may interpret the patient's responses. In all innocence on the therapist's part, such questions and interpretations can incorporate assumptions and information the patient never provided or did not literally intend. (Remember how changing a word affects the response: how fast was the car going when it hit, or collided, or smashed...).

Further, under the relaxation conditions present during most psychotherapy and hypnosis, patients become much more suggestible than normally, which makes it more likely that they will incorporate new information into their memory. In addition, patients shown to be “highly hypnotizable” are more suggestible than most people. Thus, the very people for whom hypnosis is used are those most likely to be influenced by suggestion.

Whether the recovered descriptions of memories resulting from psychotherapy are due to post-event suggestion (and therefore possibly false) or anxiety reduction (and therefore possibly independent) is still unresolved in the research literature, though most memory scientists argue that the former must be at least partially correct. With respect to hypnosis, the recent consensus among memory experts is that hypnotic induction neither aids or hinders the recovery of independent memory. Thus, any new memory that is reported under hypnosis that was not accessible prior to treatment is not an independent memory. Most courts now do not permit testimony based on memory recovered through hypnosis. Some recent court decisions have resulted in the exclusion of recoveries produced after psychotherapy as well.

The second concern that the witness has altered his criterion for accuracy of report, is more general, and applies to any newly accessible recall produced after an initial failure to recall. Whether a witness chooses not to report something which he can remember because he fears some negative consequence, is unwilling to report something because he is unsure or uncertain of its accuracy, or is unable to report because it is blocked from awareness, if he now is able or willing to report it, the change that produced the report may be a change in the witness’s criterion about how accurate or inaccurate he is willing to be in what he says. If so, then the new recall may not represent a recovery of a previously inaccessible and accurate memory, but only the report of less accurate memory.

Consider the report given earlier by the eyewitness to the bank robbery who had just gotten her money from the teller. She says that armed men ran into the bank, waved guns at everyone, and ordered her to lie down. One gigantic robber who looked like a football player went to the teller she used, threatened the teller with a pistol, stuffed the loot in his bag; then, after time, all the robbers ran out. In this initial report, assume she used a strict criterion: she reported only those details about which she was quite confident. Her report may be mostly accurate as far as it goes, but it is incomplete. If she then relaxes her criterion and provides more details, some of these may in fact be correct--she encoded them correctly, even if she was less certain about them. Hence the interrogator’s pressure produces an improvement in the witness’s description from her memory. However, the greater the number of details she reports about which she is uncertain, the more likely she will be to report some details that are incorrect as well.

In the last 50 years powerful experimental and methodological research techniques have been developed that have investigated subjects’ willingness to report what they have experienced as a function of accuracy of their report (see Swets, 1996). Research in which subjects are asked to try harder, to think about their memory, or pressured to tell more has shown that subjects are in effect being asked to slacken their accuracy criterion, in every case resulting in an increase in reports of erroneous details along with correct ones (e.g., Erdelyi, 1970). It is likely that most psychotherapy, hypnotic, and relaxation procedures, as well as pressure tactics applied to witnesses, have this joint consequence: increases in correct memories recovered are offset by increases in false memories recovered. The problem for the court is that there is no way to determine in any particular instance whether the newly recovered memory is an accurate or an erroneous one.

Given the high probability that the therapeutic method may have altered the witness's memory **and** that the recovered memory may also contain greater inaccuracies, we, in company with most memory experts, argue that, in the absence of other converging evidence, such testimony be inadmissible in the courtroom.

(c) Memory blocks can result from physical trauma. Many forms of brain injury produce a temporary amnesia for the events surrounding the time of the injury, both just before (retrograde amnesia) and just after the injury (antrograde amnesia). Numerous case studies report instances of physical trauma that show grave deficits in initial recall followed by subsequent "recovery" (see articles in Squire & Butters, 1992; and Baddeley, Wilson, & Watts, 1995). The recovery from retrograde amnesia following brain injury means that injuries to the brain can block the ability to recall the content of the events that occurred just prior to the injury. Retrograde amnesia is usually explained as a retrieval problem: the brain injury blocks access to the encoded information, probably because the encoding itself is unstable in nature. With time and/or neurological repair, the encoding is better consolidated, so that retrieval cues can better access it.

In general, the recovery of memory subsequent to brain trauma follows a systematic pattern well documented and described in the literature. The amount that is recovered and the speed of recovery depend on the severity of the brain injury, though if the patient recovers general cognitive functioning, most memory of the event is also eventually recovered as well. Further, memories more distant in time prior to the moment of injury are usually recovered first.

In many case studies, the content of the recovered memory produced by the patient has been compared to reports made by other witnesses of the events causing the injury. In nearly all of these cases, memory recovered after amnesia induced by brain injury is largely accurate; it may have gaps and missing details (the moment of the injury itself is rarely ever recovered at all), but the parts recovered agree with reports by independent observers. Therefore, while reports of clinical cases rarely include any control over post event suggestions made by family members or other witnesses, it seems likely (in the absence of information to the contrary) that most improvements in memory following physical brain trauma are accurate.

(d) Childhood amnesia: Can adults remember the events they observed when they were young children? Nearly all memory research shows that adults have virtually no access to memories of events that happened to them prior to their age 5 or 6 (see Fivush & Hammond, 1990). Most adults can remember a very few early events, but this is a tiny fraction of the number that a 6 year old can remember from the same earlier years. This difference between what an adult and a child can remember from the same early ages is called "childhood amnesia."

The exceptions, the few events for which as an adult your early memories survive, are typically those for which there have been many reminders in the form of photographs of the events, continual family discussion about them, or your own retellings to family members or others. These repetitions can easily introduce post-event changes into the memory, so that an adult memory of a second birthday may be quite different from the way it was remembered at age three or four.

Many of the controversial "recoveries" of memory introduced in the courtroom have involved adults suddenly being able to remember an event that happened to them as a child, even though they have not reported this event to anyone during the intervening years. From the evidence we have reviewed in this article, in principle you are capable of remembering something correctly that was previously not accessible to you. This recovery is much more unlikely if the original event occurred in early childhood and you have never reported it before. However, if all of the reminders had been blocked from your awareness when you were a child (perhaps because of the traumatic

feelings aroused by the event), **and** no relevant reminders had been available in adulthood that could make contact with the childlike memory, then encountering an appropriate reminder as an adult might be sufficient to bring it to mind. For this possibility to occur requires a large number of assumptions and coincidences, which have a low (but not zero) probability of happening in real life.

Memory researchers have been skeptical of the validity of many of these kinds of recovered memory reports. Pezdek and Banks (1996) and Loftus & Belli (1996) have provided a detailed summary of the research and clinical evidence of the status of recovered childhood memories, especially those that become relevant in the courts. First, given the overwhelming evidence that the few early childhood memories adults retain are those that they rehearse or for which they have access to appropriate retrieval cues, it is difficult to find a way to account for the sudden reoccurrence of the memory in adulthood in the absence of those retrieval cues. Second, these “recovered memories” frequently appear to have been suggested to the witness or have occurred under conditions in which suggestion is possible. For these reasons, we, like many memory researchers, remain unconvinced of the independence of recovered memories retrieved under these conditions, and recommend that without corroborative evidence obtained from other sources, such recovered memories be inadmissible in the courtroom.

In summary, we have considered four factors that account for why memories of prior events may be inaccessible for a moment or for a lifetime: absence of retrieval cues; active psychic blockage; physical brain trauma; and childhood amnesia. In addition, we have considered circumstances in which the forgetting may be reversed, so that a previously inaccessible memory can be recovered. In everyday life, most recalls of previously inaccessible memories occur when the proper reminders are provided. In the courtroom, whenever the recovered memory may be tainted by the therapeutic process, or may result from the witness’s own shift in his accuracy criterion, neither the witness nor the court can discriminate whether the new memory is independent and whether it is accurate.

4. Encoding, Remembering and Identifying Strangers

In the preceding sections, we have discussed memory processes without differentiating between memory of events and memory of people. An eyewitness is frequently required to identify an unfamiliar person who might have perpetrated a crime. Such identifications often comprise the only evidence against the defendant. In this section, we focus specifically on what is known about the accuracy of a witness’s identification of unfamiliar people from memory.

When an eyewitness to a crime is asked to identify the perpetrator in a line-up, the witness’s task is to match her memory of the criminal who had been observed at the scene of the crime to real people shown to her in a line-up. The witness’s response, to each person in the line-up, is “yes,” this is a match—my memory and this person are the same; or “no,” this isn’t a match—this is not the same person I saw commit the crime. Initially we will consider four possible outcomes for this identification task, as shown in Table 1.

Insert Table 1 near here

In two of the four outcomes (the upper left and lower right cells), the witness **correctly** identifies, for each person in the line-up, this person as the criminal (a true positive response), or not the criminal (a true negative response). In both cases, the eyewitness has made an accurate identification response. However, there are also two kinds of **mistakes** the eyewitness can make when trying to identify whether a perpetrator is in a line-up. The witness can say “Yes,” my memory and this person are the same

(upper right cell), when in fact this person is not the true criminal (a false positive response); and the witness can say “No,” this is not the criminal (lower left cell), when in fact this person is the true criminal (a false negative response).

The two mistakes are not equivalent. When the witness wrongly identifies an innocent person as the criminal (a false positive), that innocent person is at serious risk of being indicted and even convicted. This must be considered a much more serious error than the false negative, in which the guilty defendant is incorrectly identified as innocent⁵. As we will show, research results show that eyewitness identifications often have false positive rates that exceed 25%. This means that in a quarter or more of the identifications made, the witness claims that the perpetrator and defendant are the same when in fact they are two different people. When juries convict on the basis of false positive identifications, innocent people are sent to prison⁶.

A test is accurate when only true positive and true negative outcomes occur. The test is flawed to the extent that either false outcome occurs⁷. When any new forensic matching test is introduced into evidence, courts require scientific evidence of the test's accuracy, primarily with respect to the likelihood of false positive outcomes. This has been the requirement for new DNA tests, blood tests, polygraph tests, and voice recognition tests. Testimony based on new tests with high false positive rates (for example, on polygraphs) is routinely excluded. Older more familiar matching tests such as firearm ballistics (matching the bullet in the deceased to the gun of the defendant), or

⁵ Western legal policy and procedure is heavily tipped toward avoiding false positive convictions, even at the expense of accepting false negative acquittals. Great abhorrence is felt at the possibility of an innocent person being falsely convicted, so that any test with a significant likelihood of producing false positive results is normally excluded or greatly restricted in court.

⁶ Wells & Lindsay (1980) makes an additional distinction in Table 1, noting that some of the people in the line-up are known innocents, whereas some might be suspects that the police have placed in the line-up. If an eyewitness makes a false positive identification of a known innocent, that person is not at risk, because she can prove herself innocent. This means that an overall false positive rate may overstate the amount of risk that non-perpetrators may suffer when placed in a line-up. However, Wells's analysis is irrelevant to the point made here: any false positive response (saying that a person in the line-up is the criminal when in fact that person is not the criminal) is an error in identification, and indicates failure in the ability of witnesses to make accurate identification responses.

⁷ We have ignored other possible responses which could have been considered in Table 1. For example, the witness can report being unsure about one of the pictures, or give an “I don't know” response. Since police have different criteria for their actions following these responses, we have excluded their consideration here.

fingerprinting (matching the prints at the crime scene to those of the defendant) all have been shown by empirical research to have false positive rates of a fraction of 1%.

At present neither the courts nor the person-on-the-street who may become a juror consider eyewitness identification as a fallible matching test with a substantial false positive rate. Rather, human memory—the ability of the eyewitness to remember and then identify a stranger—is incorrectly treated as highly accurate and reliable.

In the sub-sections that follow, we review the scientific research on two sets of factors that potentially can reduce eyewitness identification accuracy. The first set of factors concerns events at the scene of the crime when the original observation occurred; the second set concerns the subsequent identification procedures.

(a) Observation Factors. In a large number of controlled experiments (see Ross, Read & Toglia, 1994; Davis, Ellis & Shepherd, 1981; Sporer, Malpass & Koehnken, 1996; Goldstein & Chance, 1981; Defenbacher & Harvey, 1981), witnesses have been asked to observe a realistic enactment of a crime committed by a stranger and then to give descriptions of the criminal. Then, after differing periods of time, these witnesses have been asked to attempt to identify whether the perpetrator they observed is present in a line-up. The observation factors studied have included the type of event being observed, length of time of observation, distance and viewing conditions, amount of activity by the stranger, presence of a weapon, presence of frightening events, number of different strangers, amount of stress felt by the eyewitness, and post-event exposure to other people who had been present at the event or who talk to the eyewitness about the event.

In real life, the police frequently are uncertain whether the perpetrator is present in the line-up or not, but they create the line-up to include at least one person they have reason to suspect as being the perpetrator. Further, in real life, eyewitnesses are rarely invited to testify in court when they have failed to make a positive identification, so courts are concerned primarily with the accuracy of positive ('Yes') identification responses—are they false positive or true positive responses?

First, consider identification accuracy for research line-ups that are constructed with the known perpetrator present. The first kind of accuracy of concern is whether the witness can discriminate between the true perpetrator and the remaining foils who are innocent of the crime. Based on a large number of experiments, about 75% of the time the perpetrator is correctly selected (true positive): the remaining 25% of the time the witness identifies someone who either was not present at the crime scene, or was a bystander at the scene, but not the criminal (false positive). If no weapon is present, no violence, no bystanders, no post-event contamination, and little delay, true positive rates can approach 90% (with false positive rates dropping to a low of about 10%). Conversely, if a weapon is present, the scene is violent, bystanders are present, post event information is available, the witness feels great stress, and there is a long time delay between observation and identification, the true positive rate for correct identification of the perpetrator drops well below 50%, with the false positive rate exceeding 50%. These percentages just quoted are rough consensual estimates, based on the results of perhaps 100 experiments with line-ups..

These results are very distressing, because they indicate that eyewitnesses are not very good at telling the difference between the person they saw commit a crime and other people. Even under the most favorable observational conditions, eyewitnesses pick the wrong person one in ten times.

The fallibility of the eyewitness becomes even more evident when results of line-up research are considered in which the perpetrator is known not to be in the line-up. Now the correct response for the eyewitness is to say 'No', none of the people in the line-up is the perpetrator. The results show that, on average, under normal observation

conditions, eyewitnesses still say 'Yes' (that someone present is the perpetrator) about 60% of the time when the perpetrator is known to be absent! All of these 'Yes' responses are false positives: the eyewitness has identified an innocent person. Only under the most favorable observation conditions (as described in the previous section) is there some reduction in the false positive rates (with the perpetrator absent). Even more seriously, 'Yes' responses are found to increase to a high of 90% (a 90% false positive rate of identifying an innocent person incorrectly as the perpetrator who committed the crime) when the observation conditions are poor, **and** the eyewitness is led to believe that the perpetrator is present (see the next section regarding instructions).

We offer two conclusions regarding this brief review of research. The first is that the conditions of observation impact the accuracy of identification of perpetrators, just as those conditions impact accuracy of all other aspects of memory for events observed at the scene of a crime. The second conclusion is more dramatic: eyewitness identification responses produce drastically unacceptable levels of false positive outcomes.

Before we consider the implications of this second finding, we turn to the second set of factors that affect identification accuracy.

(b) Identification Procedural Factors. We shall review the evidence concerning eight factors which may decrease the likelihood that an eyewitness will correctly identify the criminal, each of which pertains to the way in which an identification is elicited.

(i) Type of Line-up. Typically, an eyewitness is asked to make an identification by selecting a person from among a number of photographs of people (photo spread line-up), by selecting a person from among a number of people who appear in person (in-person or live line-up), or by selecting or rejecting a single person who appears in a photo or in person (show-up⁸). The type of line-up may affect identification accuracy.

It has been difficult to compare photo spreads with in-person line-ups directly, since photographs are often poorer in quality. However, using good and appropriate photographs, the few studies that directly compare photo with in-person line-ups find little difference in eyewitness identification accuracy (Cutler, Berman, Penrod & Fisher, 1994). Participants in in-person line-ups are often asked to turn around so the witness sees different views of them, to walk, and even to utter specific phrases spoken by the perpetrator. While there have been no tests of the extent to which adding movement and speech to in-person line-ups increases identification accuracy, it seems obvious that significant improvements in accuracy would be found.

Show-up identification procedures, considered below, present a number of serious problems of tainting.

(ii) Construction of the Line-up. The criteria used to select the participants can easily affect the accuracy of identifications. It is trivially obvious that if the perpetrator is described by witnesses as a woman, and then the witnesses are shown a line-up of five men and one woman, the woman is likely to be picked for her gender alone, even if the witnesses are unsure whether she is the same woman observed at the crime scene.

Line-up construction procedures have come under careful scrutiny by research scientists, so that what constitutes bias in the construction of the line-up is well defined (see Loftus & Doyle, 1987, and Ross, Read & Togliola, 1994, for general reviews; and Wells, Leippe & Ostrom, 1979; Malpass, 1981; and Wells, Rydell & Seelau, 1993, for individual experiments). In part, the results of this research have become incorporated

⁸ It should be noted that in-court identifications are invariably show-up procedures, because the defendant is marked by location, clothing, or evidence of incarceration. The only question being asked is whether the single person so marked is the perpetrator.

into procedures police are required to follow. However, in practice, it is often difficult to meet all of the requirements, and sometimes these failures distort the identification process sufficiently that the identification should be challenged. Perhaps the most important requirement, and the one most violated, is that all line-up members fit the general description of the perpetrator as given by witnesses.

(iii) The instructions given to the witness. The accuracy of the identification in a line-up is very heavily affected by instructions given to the witness. When police present an eyewitness with a line-up, the presumption naturally exists that a suspect is included. The research evidence shows when the witness is led to believe that a suspect is present, the chances of picking the wrong person substantially increase, because the witness is more likely to make an identification (a positive response). When the witness is told explicitly that the suspect “may or may not be present”, the number of Yes identification choices made greatly decreases: witnesses are more likely to say that none of the participants in the line-up is the perpetrator (Stebly, 1997, Wells, Rydell & Luus, 1994).

Research studies have attempted to assess the impact of the witness’s expectation that the perpetrator is present in the line-up. In research, when a “blank” line-up is used (one that intentionally does not contain the perpetrator), and the witness is led to expect that a suspect is present, false positive responses approach 90%. Further, witnesses persist in their mis-identification, even when subsequently presented with another line-up containing the perpetrator. These extremely high false positive rates justify the requirement that witnesses should be given the explicit instruction that the suspect “may or may not be present in the line-up.” In the absence of this instruction, testimony based on this identification should be excluded.

The research on instructions also demonstrates the serious bias that is introduced by “show-up” procedures, in which only a single person is shown, and the witness is asked if that person is the criminal or not. Regardless of the care used, the implication invariably communicated to the witness is that the person being shown is a suspect. While police often see no alternative to the show-up procedure, there is serious question whether the procedure, by itself, has any validity. Some courts already prohibit the introduction of show-up identifications. However, an in-court identification, which is also a show-up procedure, should also be restricted or prohibited for the same reasons.

(iv) Sequential presentation of the line-up. Wells has shown conclusively that if the witness views and responds to each person in the line-up one at a time, the accuracy of each response is much greater, as compared to looking at all photos or people simultaneously (Lindsay & Wells, 1985; Sporer, 1993). The reason for the difference is that with simultaneous presentation, the witness effectively is making relative judgments: which of these people is most like the perpetrator, rather than whether any of them **is** the perpetrator. While this is an easy requirement to meet, in practice it is rarely followed. Wells has shown that this failure reduces accuracy of identifications dramatically.

(v) “Blind” presentation of the line-up. Scientific research has overwhelmingly shown that if the policeman presenting the line-up to the witness knows which person in the line-up is the suspect, even when the officer is trying to be impartial, witnesses are able to pick up cues that greatly increase the chances that they will select the person the officer knows or believes is the suspect (Wells, 1990). This process is related to the general category of post-event information, and, like most such tainting, the witness is unaware that the choice she made has been influenced by the behavior, voice, or attitude of the officer. The only way to avoid such contamination is to require that the officer presenting the line-up is “blind” and does not know which person is the suspect. So well documented is this effect in general, that “blind testing” is **de rigueur** experimental

procedure throughout all science; unless testers are blind, scientific journals will not accept their work for publication. Therefore, if the officer does know who is the suspect, testimony based on the identification should be excluded.

(vi) Viewing multiple line-ups. Frequently, a witness has been asked to view more than one line-up, but what is introduced into evidence is only the results from one of them, usually the last one. Experts on line-ups are concerned that the earlier line-up exposures may increase the chances that identification errors are made in the latter line-up exposures (Read, 1994, Ross, Ceci, Dunning & Tolia, 1994; Brigham & Pfeifer, 1994; and Gorenstein & Ellsworth, 1980).

Evidence has been reported for two different kinds of errors. If an initial line-up exposure does not contain the perpetrator, but does include some bystanders who were present at the crime scene, then in a second line-up which now contains the perpetrator as well as at least one of the initially present bystanders, witnesses are less likely to identify the perpetrator than if they had never seen the initial line-up. More witnesses will identify the repeated innocent as the criminal (a false positive match) than identify the actual criminal who has appeared in the line-up only once. The witnesses know they have seen the innocent somewhere before, but confuse the previous line-up exposure with the scene of the crime. This kind of memory failure is another example of the difficulty human beings have in keeping track of the sources of information that have entered memory.

The research has also shown that the multiple line-up exposures can produce a different kind of error: if a witness makes a false positive erroneous identification in an initial line-up exposure (in which the perpetrator was not present), and that wrongly identified person is present in a subsequent line-up, that same person stands a greater chance of being identified again, even if the perpetrator is now present in the subsequent line-up.

For both of these reasons, the last identification made after one or more previous line-up exposures may be less accurate.

(vii) The verbal overshadowing effect. Nearly always an eyewitness first gives a **verbal** description of the perpetrator of a crime (to bystanders, police, and other investigators), and later is asked to make a **visual** identification by picking a person out of a line-up or show-up. Research has shown that giving a verbal description first makes witnesses **less** accurate in their subsequent visual identification (Dodson, Johnson & Schooler, 1997)—the verbal overshadowing effect. Three causes for this effect have been demonstrated experimentally. First, when an eyewitness is asked to give a verbal description, especially in the context of being asked about the features of the criminal, the eyewitness is necessarily forced to describe separate features of the person's face. Research shows that this discrete featural attempt results in a less accurate description than when the eyewitness makes an overall global or configurational one (Fallshore & Schooler, 1995). Second, when confronted with the actual face in the line-up, the recognition process may depend more on memory of the overall configuration of the face than of separate or individual features, so that starting with a verbal featural description interferes with the best strategy to make an accurate identification. Third, most people, having given a verbal description of a person, remember their words better than they remember the face itself. This means that distinctive details or unique features that the witness may have noticed, but did not capture in the verbal description, then become lost. Each of these three explanations suggests that the identification process itself can increase identification errors.

Verbal descriptions of people also pose several problems for criminal investigators. The witness can only convey part of her visual image of the criminal by words; many aspects of the visual image are left out. Further, descriptors of facial and

body features have little common denotation. Consequently, the verbal descriptions given by witnesses immediately after a crime may not match how other people, such as the police, would have described the same suspects (for discussion of “identikit” procedures and problems, see Davies, 1981). This communication gap makes it quite possible for the police to choose the wrong person as a suspect.

(viii) Eyewitness identification accuracy as a function of confidence.

Typically, eyewitnesses testifying about identification are also asked about their confidence in being correct. When they say they are certain their identifications are accurate, does that confidence mean they are more likely to be right? When research results already discussed above are grouped into those containing witnesses who say they are very certain that their identification is correct and those who say they are not sure or they are uncertain, there is not much difference in the identification accuracy between the two groups (Luus & Wells, 1994). Being sure doesn’t necessarily mean being right!

Research shows that the witness’s confidence in having made an accurate identification while looking at the line-up is positively but weakly related to her accuracy. While the lack of a strong correlation may seem strange, the research has shown that there are many factors that affect what witnesses say about their confidence, only some of which are related to how accurate their identifications are. Further, these factors change over time. By the time the witness is called to testify in court, her confidence is likely to have been altered by events that occurred **after** the identification was made. These include: (a) the witness is exposed to new post event information (for example, she learns that another witness identified the same person (Luus & Wells, 1995), or is told by the police that she chose the person the police suspected (Wells & Bradfield 1998); (b) the witness is asked after the identification to justify the reasons she had for making the choice she did; (c) the witness anticipates cross-examination questions that are likely to be asked about an identification (Wells, Ferguson & Lindsay, 1981); or the witness has to repeatedly answer the same memory questions (Shaw & McClure, 1996; Shaw, 1996). Obviously, increasing your confidence after you have already made the identification does not make your identification more likely to be accurate. Evidence is rarely introduced about the witness’s confidence at the time the identification was first made: the jury hears only the witness’s current confidence, which is not at all predictive of accuracy.

Unfortunately, present United States judiciary practice (e.g., Neil v. Biggers, 1997) recognizes and accepts witness confidence as legitimate evidence for the jury to use in deciding the accuracy of the witness’s testimony. The negligible correlation between accuracy and confidence at the time of identification, and the several factors that can subsequently increase confidence that have no relation at all to accuracy, all suggests that this part of testimony should be excluded.

We have reviewed a number of factors that decrease the likelihood that a witness will correctly identify the criminal she observed: these include some of the same factors that affect the accuracy of memory in general. In addition, the identification procedures themselves introduce a number of factors that can also reduce the accuracy of identifications. We think of all of these factors as obstacles to accuracy: they decrease the likelihood of accurate identification even by witnesses who are good observers and are diligent in their attempt to be careful and accurate. These factors, in addition to reducing accuracy of correct identifications, increase the chances that an innocent person will be identified.

(c) When Are Two Witnesses Better than One? In principle, more confidence can be placed in the accuracy of a match test (with a known false positive rate) if two or more **independently** instances of responses on that match tests each give the same

outcome (i.e., both instances make the same identification). The results from multiple match tests can be combined into a single result with a lower overall false positive rate whenever the factors that might produce a false positive outcome in one instance are unrelated to the factors that might produce a false positive outcome in any other instance. In contrast, the statistical combination of **non-independent** tests does not reduce the overall false positive outcome rate below that of the best false alarm rate of any of the individual tests.

With respect to eyewitness identifications, multiple identifications of the same individual made by several eyewitnesses who observed the individual under different conditions **and** made their identifications under different conditions, greatly increase the probability that each of their identifications is correct. As an example of two independent identifications, if a teller in a bank gives a description of the perpetrator and then later identifies him in a line-up, research has shown that there is roughly a 75% chance the identification is accurate. If a second witness, who from the sidewalk observed the robber fleeing the bank, gives a similar description and identifies the same individual in a different line-up (also with a 75% accuracy rate), the probability of the identification being correct increases to over 90%.

In contrast, multiple identifications of the same individual made by eyewitnesses who observed the crime and then made their identifications under comparable line-up presentation conditions do not increase the likelihood that the combined outcome is more accurate than any single identification alone. As an example of two non-independent identifications, if a teller in a bank gives a description of the perpetrator holding a gun, and then later identifies him in a line-up, and a guard standing near the teller gives a similar description of the perpetrator and later identifies the same person as the teller did, from the same line-up administered by the same policeman, the chances of the identification being correct do **not** increase, even though the two witnesses agree. The two eyewitnesses faced the same conditions at the time of **observation** of the perpetrator (lighting conditions, stress, fear, focus on possible weapon, etc.), so that the factors that would decrease accuracy of observation for one eyewitness are not independent of those affecting the other eyewitness. Instead, these impediments to accuracy apply fairly similarly to both eyewitnesses. Further, the two eyewitnesses were tested for **identification** in the same way (same instructions, same photos or people in the line-up, same police officer), so that again, whatever factors might reduce accuracy or produce tainting apply equally to both identifications. In these much more common circumstances, if several eyewitnesses identify the same person, the identification is **no more likely to be accurate** than if only one individual witness had done so.

(d) Identification of Familiar People. Thus far our discussion has concerned the identification of strangers. A witness can err even when identifying a familiar person. Most people have had the experience of identifying someone whom they thought was very familiar, only to discover that it was a stranger (a false positive response). Research has shown (Baddeley, 1979) that nearly all people report having the experience at least once of confusing a stranger with a familiar person. However, an identification of a person familiar to the witness is much more likely to be correct than identification of a stranger.

5. Do Some People Have Better Memories than Others?

Just as with every other cognitive ability and skill, people differ in how well they can remember. Memory abilities are included on every test of intelligence or school admission, so it might be assumed that people who are more intelligent will be better witnesses. However, there are few items on such tests that measure the abilities to remember autobiographical events, to be a good observer, or to make accurate

identifications of persons. It is unknown whether an eyewitness of higher than average intelligence is more likely to be an accurate observer than one of lower intelligence.

In this section we consider some of the known sources of individual differences in the ability to remember⁹.

(a) Mnemonic systems and training to improve memory. Although innate special memory skills are exceedingly rare, a number of people ranging from waiters to stage performers are able to achieve extraordinary accuracy for particular kinds of facts, such as names, telephone numbers, or menu items. Such accuracy is almost always achieved by extensive, highly focused practice.

Systems to improve specific aspects of memory are well worked out, and generally succeed with everyone (Wilding & Valentine, 1996). However, besides requiring lots of practice and diligence, these systems have dramatic limitations: what you learn is specific to what you practice. A man who learned to be able to repeat without error a string of 100 digits he had just heard once was no better than anyone else at repeating letters, names, lines of poems, or anything else (Ericsson & Faivre, 1988). He became a specialist in the one kind of memory he practiced.

Most entertainers who can perform special feats of memory have learned this way. There is nothing fake about their performance, nor is it due to some special ability they were born with. It is directly tied to their intense practice of a single kind of memory, and they are only good at that one kind.

A few police training programs include a section on becoming better observers of people and of sequences of actions. In such programs, trainees are asked to observe videotapes of different kinds of events and are then asked to describe what they observed. Following that, the trainees discuss differences among their reports and consider those aspects that made observation difficult or less accurate. Since the physical reality (the videotape) is available for comparison, the feedback they receive along with the identification of the aspects of observation that create problems help them become better observers. Police officers who have graduated from this kind of specialized training can correctly claim that they have a greater level of expertise in their observational skills than most people, and their descriptions are more likely to be accurate. However, merely being employed as a policeman does not impart this expertise; and, in the absence of this training, a policeman's ability to observe and remember events should be considered to be as good as, and as fallible as, that of any other eyewitness.

(b) Individual differences in suggestibility. Research has shown that people differ in their susceptibility to suggestion (Reyna & Titcomb, 1997). Such people are more likely to incorporate post-event contaminants into their reports, thereby becoming less accurate reporters of what they originally observed.

⁹ We shall not consider photographic memory, since while some people claim to be able to merely glance at a page or scan faces in a crowd and then reproduce what they saw afterwards, scientific tests of such performance have shown that virtually nobody has this ability, with the exception of "experts" who have deliberately trained themselves, practicing extensively (see next section). However, the memorial skills developed by such "experts" rarely if ever serve to increase accuracy of recall. Likewise, the eidetic imagery ability found in some children improves neither their accuracy of recall nor of identification (see for a review Haber & Haber, 1988).

(c) The memory of children. Because children are frequently called upon to provide eyewitness testimony, research scientists have focused on the ability of children to understand and remember the events they have observed, and their ability to report on those events. This research has provided three important conclusions that are relevant to children's testimony in court.

First, nearly all of the research finds that the memories of children younger than about 5 or 6 are different from those of older children and adults. Even so, very young children are able to observe, understand, and describe events that have happened to them (as any parent can testify), and these abilities steadily improve from the time they can talk. But children younger than 5 or 6 are not as accurate as older children, they are more susceptible to misunderstanding what they observe and changing what they report, they are more inconsistent in what they may decide to mention, and the courtroom setting is often frightening. For all of these reasons, most courts are very reluctant to allow children younger than 6 to testify. In contrast, by the age of 6, most children can give nearly as accurate and complete an account of what they observed as can adults who saw the same event (Fivush, 1993).

Second, the way in which testimony is elicited makes a far greater difference in children than in adults. Children usually provide accurate and complete reports of their observations and knowledge only in low pressure, accepting, and familiar surroundings. In contrast, if asked by a stranger to tell what they observed, did, or had done to them, especially in unfamiliar surroundings, children often truncate their reports, leave out details, or even deny the entire event. If the events being described are themselves traumatic to the child, then the child typically refuses to speak or denies previous testimony, in the absence of familiar surroundings and supportive questions by a trusted interrogator (Davies, 1996). Many courts appropriately now prohibit putting a young child on the stand in a crowded courtroom; instead, the child testifies in chambers in the presence of familiar supportive adults. Videotaped testimony recorded at home has been accepted by some courts. Even these supportive procedures are not always sufficient, so that it is not always possible to elicit from a young child witness what he knows or has observed.

Third, the testimony of children is also subject to change if they are exposed to post event information. Research has focused on whether children are more susceptible than adults: will their memories (and their testimony) be more changed as compared to adults, as a result of post event contamination? Most current memory research (Bruck & Ceci, 1997) indicates that children are substantially more suggestible than adults, though not in all circumstances. For example, Pezdek and her colleagues (e.g., Pezdek & Roe, 1997) have shown that attempts to alter children's reports through suggestion are no more successful than with adults when the events are familiar aspects of their lives, or have occurred with some frequency. In contrast, children's reports from memory about unfamiliar events, imagined events, or unrepeatable events can be altered through suggestion more easily than comparable events experienced by adults. Since most events being described in court are unfamiliar or infrequent, this research suggests that children's susceptibility remains a serious problem with respect to their testimony in court.

Summarizing what is known regarding child eyewitnesses, the research evidence suggests that the testimony of children about events they have observed should be accepted in the courtroom, but with extreme caution. Great care is needed to protect children during the interrogation and cross-examination process, both for their own health, and to insure that their testimony is accurate and complete. Concern about suggestibility is appropriate, but not to the degree to preclude children from testifying in

court. Rather, just as with adult witnesses, careful scrutiny should be given to all circumstances in which suggestions may have been incorporated into their testimony.

(d) Aging and memory. A frequent complaint of older people is that their memory is poorer than it used to be. The research literature supports this: regardless of the kind of memory being tested (autobiographical, events, facts, languages, etc.), people over 70 years of age remember less in quantity and remember with less accuracy compared to younger subjects (Hertzog & Dunlosky, 1996). In most cases, however, the differences produced by age are so small as to be irrelevant to questions of testimony in court. Significant differences between the old and young do occur when something about the event is difficult to encode, such as when its contents are very unfamiliar, it unfolds very quickly, or many distractions are present.

It was once believed that as you grow older you have more trouble remembering recent events but could still retain very old memories accurately. Research has now shown this belief to be false: there is no change in the balance of recent to old memories that you retain as a function of your age.

The evidence regarding age and memory suggests that the age of a witness is nearly irrelevant to the validity of his or her testimony. Concern should be raised only when there is some question about the ability to encode what was observed. This concern is not trivial, however; eyewitnesses are frequently called upon to describe a brief, unexpected, and unfamiliar event. Older eyewitnesses can be expected to be somewhat less accurate in such circumstances (but for some cautions, see Yarmey, 1996).

6. A Comparison of Memory for Everyday Events and for a Crime.

We began this article with a bank robbery case, in which a number of people who observed the crime gave testimony. The witnesses' descriptions of the sequence of events and of the robbers differed greatly. We have considered a number of factors that have been shown in scientific research to impede each individual eyewitness from encoding, remembering, and reporting events accurately. In light of these factors, finding this divergent testimony is to be expected, because the accuracy of each individual eyewitness's report, to a greater or lesser extent, is affected by each of these factors.

We have presented so many difficulties that beset a diligent, well-intentioned eyewitness from giving an accurate report that you may wonder, on the one hand, whether we haven't grossly overstated our case; or, on the other, whether such testimony can be used in court at all. To contrast these alternatives, compare how your memory functions in everyday life with when you attempt to report a crime.

In general, your memory for events is quite accurate in the short term: you know what you did today, you know where you parked your car, you remember to meet your wife for lunch. Your memory for the expected and familiar things in your life is also excellent: you know where your house is and how to get there; you find items quickly in a familiar supermarket. In everyday life your memory is sufficiently accurate to meet your needs very well.

When you relate an event to family or friends, and the central character is you: only a spouse, teenager or boor would challenge your accuracy. Accuracy, as we pointed out, is not the point of your stories: you are.

Some conversations between family members and friends contain arguments about differing memories for shared events. You rarely treat such disagreements as instances of your inaccurate memory. Instead, you assume the other person is wrong, or you incorporate the other person's memory into your own, and then forget your former version of events. Only very rarely are you forced to confront having an inaccurate memory, so you continue to believe your memory corresponds to events as they happened. Your memory for events isn't as accurate as you think. But you rarely ever

find out about the errors, and even if you do, your errors rarely cause you or anyone else any discomfort.

Events surrounding a crime differ in many ways from those you normally encode. Every one of these differences can make you less likely to be able to give an accurate report later. Usually strangers are involved, instead of familiar people. Your view of the criminal and the crime is likely to be brief, not prolonged. The event itself is extremely unfamiliar. Further, it is frightening and usually traumatic. If a weapon is present, you may attend to little else, in contrast to your normal mindset. The policeman or investigator to whom you tell your tale asks you for details about people and sequences, details that have nothing to do with your autobiographical story and that you may not have encoded at all. These listeners, instead of displaying shock or astonishment at your distress and misfortune, interrupt you with questions irrelevant to your narrative. They restructure your story into a sequence of events in which you are an observer rather than the protagonist. They require you to tell your story over and over.

Your memory, not precisely accurate at best, is being asked to function in a very different way from ordinary life. Each one of these differences makes you more likely to err.

7. How Should the Legal System Respond to the Scientific Evidence on Eyewitness Testimony?

In the final section of this article, we consider appropriate legal responses, given the scientific evidence on the potential inaccuracy of eyewitness testimony.

We have presented an array of scientific research evidence showing that, by the time an eyewitness testifies in court, the identification and testimony offered may not accurately reflect either what actually happened, or what was originally observed. Post-event information, suggestion, and repetition may alter the memory on which eyewitness testimony is based. Further, the false positive rates for eyewitness identifications are unacceptably high by any standards¹⁰. All of these combine to increase the chances that evidence acquired from a single eyewitness may be flawed. The recent examples of DNA evidence being used to reverse convictions that had been originally based on only eyewitness identifications suggest that there are in fact many innocent people who have been wrongly convicted on the basis of erroneous eyewitness testimony (see the work of the Innocence Project at the Baruch School of Law at Yeshiva University in New York).

Research has also documented that the typical juror is unaware of the impediments to accuracy faced by an eyewitness. Not just unaware: rather, jurors incorrectly believe they know the factors that make memory accurate, and also incorrectly believe that these factors are the ones most likely to make eyewitness identifications highly accurate. Finally, jurors treat eyewitness identifications as they do fingerprint or ballistics tests. Jurors cite identifications provided by eyewitnesses as one of the most critical factors in reaching a decision to convict. In most criminal trials in this country, jurors do not have any way to gain access to knowledge about the contrary evidence concerning accuracy.

¹⁰ Recent Federal District Courts decisions (e.g., Massachusetts U.S. v. Varoudakis, No., 97-10158-RGS) and U.S. Supreme Court (U.S. v. Scheffer, No. 96-1133) have applied criteria of reliability, including false positive rates, as the basis for excluding the introduction of polygraph evidence. If these same reliability criteria were to be applied to eyewitness identifications, a great deal of testimony based on these identifications would be excluded from many trials.

To correct the mismatch between scientific knowledge and the beliefs held by everyday people who become jurors, and to avoid treating eyewitness identifications as equally or more reliable than ballistics tests, we, as memory experts, suggest that the legal profession consider six procedural changes when eyewitness identification and testimony are to be introduced into trial. The first four recommended changes are analogous to new rules of evidence that would restrict or exclude specific kinds of eyewitness testimony, so that the jury is not exposed to them; the fifth concerns procedures to give the jury more access to the scientific descriptions of normal memory processes; and the last recommends a change in judges' instructions to the jury.

(a) *Unis testis* rule of evidence. Perhaps the most important legal solution to the tyranny of the eyewitness problem is the application of the old Roman “*unis testis*” rule, which is used in part in some other countries, though not at all here. “*Unis testis*” as applied in this context holds that the testimony of only a single eyewitness should never be sufficient to convict a stranger. There must be corroboration from at least a second **independent** eyewitness or from other evidence. If a single eyewitness provides the only evidence, (that is, there is no corroborating forensic evidence), and the defendant is a stranger, the case would be dismissed.

We recommend that in cases in which all the evidence comes from a single eyewitness, the Court carefully examine all of the conditions of the single identification, and exclude the testimony of the single witness except when all of the following conditions are met: a long period of time occurred in which the witness viewed and interacted with the perpetrator; sophisticated line-up procedures were used to elicit the identification; there was prior cause to place the suspect in the line-up; and that witness confidence in the identification was assessed prior to feedback or postevent information. Failure to meet these conditions should allow the Court to apply the “*unis testis*” rule. Police would also know then that in cases of sexual or physical assault and abuse (typically those in which the only evidence is the testimony of the victim/witness), the collection of evidence must proceed with all of these safeguards in place.

(b) Tainted identifications rule of evidence. The courts already have rules regarding some categories of tainted evidence. When evidence is obtained under conditions prohibited by law, when there is a sufficient likelihood that the evidence has been altered during the process of its collection, or when testimony was acquired under coercion, that evidence is considered tainted and cannot be used against the defendant. Many memory experts have already argued that identification testimony should be treated in the same way and automatically excluded when line-up procedures are used in which the probability of inaccurate (especially false positive) identifications is high. These unacceptable procedures include: a biased line-up; a simultaneously presented line-up; a line-up in which the witness is not told the suspect “may or may not be present;” a line-up in which the officer conducting it knows which person is the suspect; a line-up (or showup) in which the witness knows who is the suspect; and a line-up which contains pictures (or people) who have already been seen by the witness in previous line-ups or requests for identification. All of these potential taintings are easily avoided by proper police procedure, so adoption of this new rule should only protect innocent people from being improperly convicted. The above recommendations are also spelled out in the position paper adopted by the American Psychology-Law Society (Wells, Small, Penrod, Malpass, Fulero & Brimacombe, 1998).

(c) Tainted testimony rule of evidence. Some courts in the United States already exclude eyewitness testimony that has been elicited under hypnosis, on the grounds the chances are very high that suggestion and/or introduction of post-event information has altered the memory on which the testimony is based. For the same reasons, in the last several years, a few courts have prohibited testimony based on a

childhood memory recovered by psychotherapy. We, in company with many memory experts, argue that eyewitness testimony should be excluded if the witness was clearly exposed to post-event information or suggestive influences. For such testimony, the assumption must be that the post-event information has altered the memory on which the testimony is based.

The potential alteration of memory means that what the eyewitness may be reporting is not based on what she directly observed and encoded: it is not based on her independent memory. Just as the hearsay rule of evidence now in force in this country prohibits a witness from testifying about information acquired from third parties, so should the witness be prohibited from testifying about information that is not part of her independent memory. That is also “hearsay.” The jury must be allowed to hear the testimony about the facts directly from the original observer and source, thereby avoiding potential contamination from second-hand sources (Wagenaar, 1996).

(d) Fleeting glance rule of evidence. The fleeting glance rule is designed to insure that the witness had adequate opportunity to observe before she is allowed to testify about her observations. As presently applied in England, this rule refers to adequate **time**. We suggest that the fleeting glance rule be expanded to include all adequate viewing conditions. The scientific evidence is overwhelming that a witness is much more likely to err in her report if she could not see very well what was happening (Wagenaar & Schrier, 1994); such a witness should not be allowed to tell her story about what happened. . These observation adequacy conditions include: lighting levels; backlighting, shadows and contrast; distance; time; and detail and color acuity of the observer (and presence of glasses if required). These scientific criteria should be applied by the Court, and not left for expert testimony presented to the jury, or for debate by counsels or within the jury.

The above four proposals concern the introduction or expansion of new rules of evidence. The remaining two proposals concern courtroom procedures.

(e) Inform the jury about the factors that affect the accuracy of eyewitness identification and testimony. The evidence overwhelmingly shows that people typical of jury members have beliefs about how memory functions that are at sharp variance with the facts. These beliefs make it difficult, if not impossible, for members of a jury properly to evaluate the accuracy of eyewitness testimony and identifications. We recommend that to correct this mis-information in cases in which eyewitness testimony is crucial, the court should permit, and even encourage, a memory expert to describe to the jury in hypothetical terms those factors that could affect the accuracy of the eyewitness identification and/or testimony (Leippe, 1995).

(f) Include in jury instructions reference to factors that might affect accuracy of memory. Whether a memory specialist has provided expert testimony or not during the trial, the judge should provide guidance to the jury in final jury instructions regarding how to weigh evidence that is based on potentially inaccurate memory.

Without the adoption of these rules and procedures, in US courts, as well as many others throughout the world, the jury is exposed to substantial inaccurate testimony (much of it given in all innocence by well intentioned witnesses), and it is left to the jury’s judgment how to separate accurate from erroneous testimony. Because this is not a task that juries are presently equipped to handle, innocent people run great risks of being convicted—a distortion of the moral intent of our legal system.

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	True Criminal Present	No Criminal Present
Witness says "Yes"	True Positive	False Positive
Witness Says "No"	False Negative	True Negative

Table 1. Four Possible Outcomes of an Identification Task

False Positive Rates for Eyewitness Identifications: Too High?

Ralph Norman Haber and Lyn Haber
University of California at Riverside and at Santa Cruz

A Two by Two Classification of an Identification Matching Task

	True Criminal Present	No Criminal Present
Witness says "Yes"	True Positive	False Positive
Witness Says "No"	False Negative	True Negative