Criteria for Judging the Admissibility of Eyewitness Testimony of Long Past Events[1].

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Abstract

Currently, court cases of recovered memories of childhood abuse, in which the victim's testimony may constitute the only evidence available, and a growing body of research demonstrating the inexactitude and suggestibility of autobiographical memory of long past events, are forcing courts and cognitive scientists to seek scientific, principled criteria for admissibility of such testimony. We use as examples two recent court cases. In the first case, a concussion produced total retrograde amnesia for an accident for a period of three years, and then, over a few months, the driver claimed his memory returned. In the second, two adults reported to the police that they witnessed their sister's murder 35 years earlier, when they were three and five years old, respectively. We provide objective guidelines for courts to determine whether testimony about recovered or very long term memory for eyewitnessed events should be admissible. The principles we outline easily can be expanded to include eyewitness testimony in general.

Introduction

Central to courtroom battles over testimony based on recovered memory, and about criminal events that an eyewitness failed to report for a long time period, is whether the testimony is based on an independent memory of the original event, or is a false memory acquired or confabulated subsequently. An independent memory report by an observer is one that is untainted or unaltered by suggestion or post-event information acquired from others, or leading questions, or by interrogators' pressure for completeness or certainty (see Haber & Haber, 1998, for discussion of this definition and the factors that affect it). This definition proves useful in evaluating statements and testimony offered by witnesses in court, since typically in this setting only testimony based on a witness's independent memory of the event should be heard. The two critical points for testimony in court is that an independent memory report by a witness is the one most free of information acquired from or suggested by others; and it is the most accurate description of the event the witness will ever be able to offer.

Our purpose in this article is to propose objective, scientifically based, ordered criteria that can be applied to eyewitness testimony to determine whether the testimony should be admitted as evidence. We focus on testimony based on recovered memory and on memory for events in the remote past; however, the principles we propose apply to eyewitness testimony in general.

We first describe two actual cases in which the critical testimony (in the first case) was based on a memory that was recovered after being inaccessible, and (in the second) was based on a memory that was produced after more than three decades of silence. In each case, the plaintiff (prosecution) argued that the testimony was based on an independent memory and therefore should be admissible as testimony, whereas the defense argued that each was a false memory which should be excluded and not admitted into evidence. While the two cases differ in content and etiology of memory, the problems they raised for the court were identical: what criteria should be applied to the testimony to determine whether it should be admissible as evidence.

We present the circumstances of the case, the testimony of the eyewitness(es) whose memories are in question, and the other kinds of evidence that was offered in each case. We then describe an ordered set of objective criteria based on scientific knowledge that can be applied to the eyewitness testimony to determine whether it should be admitted as evidence. Finally, we apply the criteria to each of the two cases in turn to demonstrate the application of the criteria.

Recovery of Memory from Retrograde Amnesia Following Traumatic Brain Injury[3]

Mr. John Roland, aged 59, a highly educated, successful self-employed businessman, of above average intelligence, suffered a severe concussion, internal injuries, and broken bones in an accident in which his car veered off an interstate highway and crashed into a rocky berm alongside the road. Visibility was perfect, the highway was dry, the time was mid-morning, Roland tested negative for alcohol and drugs, and his wife reported he had a normal night's sleep and uneventful early morning. His wife and his regular family physician concurred that he was in good spirits and he had no record of psychological depression. There were no records of skid marks on the highway, no reports of paint or other marks noted on Roland's car to indicate a collision. There were no witnesses. Roland remembers someone banging on his windshield and telling him he

would be all right, and he remembers the flight surgeon in the helicopter cradling his head, but the medical records state he had intermittently lost consciousness during the several hours needed to extract him from his car and take him by helicopter to the hospital.

His Glasgow coma score on admission was 15 (maximum). A CT scan of the head revealed a small left to right midline shift, left subdural bleeding and a small amount of subarachnoid blood. When he was fully consciousness he had both antrograde and retrograde amnesia. He could not remember anything about his activities the morning of his accident, and his recollections of the several preceding days were confused and spotty. Subsequently, Roland also exhibited cognitive deficits as a result of the accident. Neurological testing showed deficits in short term memory, attention, and naming objects and people. Two weeks after the accident, a new hemorrhage occurred: A CT scan of the head revealed new blood in the left frontal lobe intraparenchymally. A week later a right frontal hemorrhage developed. Subsequently, Roland received speech therapy for a further anomic aphasia which was felt to be secondary to the new hemorrhages.

During his three months hospitalization, he underwent several surgeries to repair his injuries, and had a hip replacement shortly after leaving the hospital—direct consequences of his accident. During this period, Roland's retrograde amnesia for some of the very early parts of the morning of the accident and its preceding day lifted, but remained total for the entire hour before the accident.

While still in the hospital, and continuing for over a year, Roland attempted to find out what had caused the accident. He sought the records of the police response to the 911 call at the scene; he looked at pictures of his wrecked car taken by the insurance company after it had been towed away; he read the police and insurance company reports; and he talked with the policeman who responded. None of these provided much information, and what little they did contain evoked no inkling of his own memory.

In addition to the troublesome questions of what caused him to drive off the highway, the issue of what happened took on financial significance. His insurance company was prepared to provide generous benefits if a second vehicle was involved (regardless of fault), but would only cover his actual out-of-pocket expenses for a single vehicle accident. Since the insurance company concluded from the evidence at the scene that only a single vehicle was involved, and their client could not remember anything to the contrary, they declined to pay any additional benefits, so that Roland suffered severe financial hardship as a result of the accident.

Everyone to whom Roland talked told him to "remember," which to him implied "make it up." He went to a lawyer, who told him nothing could be done to justify a bigger claim without remembering something (assuming the memory was of another vehicle being involved). But in spite of all his efforts, he could remember nothing of the minutes preceding the accident. He resumed driving, and had no fear or discomfort in being behind the wheel, and cars and driving provided no retrieval cues of what might have happened that day.

However, his life was far from normal: he required a cane as a result of his injuries, and he was rarely free from pain. He also had some residual cognitive losses from the concussion, sufficiently so that he was unable to continue his former employment. Roland reported that he was now unable to read a book because he could not keep track of the characters. His level of frustration was high, and he was beginning to develop significant

symptoms of clinical depression. Two additional lawyers provided him with the same advice: remember or forget about it! He could do neither.

Just over three years later, Roland was an innocent party in a second accident: an automobile backed out of a driveway and into him as he was driving down the street. While he suffered no head injury, and was never unconscious, his knee was severely injured (which required a knee replacement two months later). Within days he began to develop a strong fear of trucks, especially when they were near the car in which he was riding or driving, and his memory for what happened to cause the first accident began to return to him.

Roland experienced severe pain and depression as a consequence of the second accident, and felt great frustration at his physical and cognitive incapacities. Psycho-neurological tests showed that several aspects of Roland's cognitive function had improved as compared to the previous tests; however, because of the pain and the further physical restrictions on his mobility, he felt worse. Therefore, immediately following the second accident, he began a course of physical and then psychological therapy. The psychologist who treated Roland's depression kept a detailed record of the content of Roland's comments, which were dictated following each session. In his initial interview with Roland (two weeks after the second accident and 38 months after the first), the psychologist reports: "(Roland) keeps regressing from the second accident to the first accident and claiming that the second accident is bringing out symptoms of the first accident. Clinically, the second accident seems to be stimulating thoughts of the first accident in the form of tractor-trailer tires…He starts sweating and has autonomic reactions when driving behind a tractor-trailer."

In subsequent interviews the psychologist documents Roland's reports of increasing physical pain, emotional distress, and recovery of details of his first accident. The psychologist's reports reflect Roland's tragedy. For a memory expert, there is a light side: the psychologist wants to get on with the biofeedback therapy to help Roland deal with his depression and present pain; Roland wants to talk about his memory of truck tires.

Within three months of the second accident, Roland was able to give a fairly complete description of his first accident in a written statement. Shortly after he produced the statement, and for the first time since the first accident, Roland visited the location where it had occurred. There were virtually no discrepancies. His deposition, taken two years later, added little to what he had recovered in those three months. The following abbreviated summary draws on Roland's own words describing the first accident (proper names have been changed).

> I remember going to my first stop in New Town and calling on my distributor there. New Town Provisions: that was my first stop, as it was every time I went on that particular run. After I left them, I called ahead to confirm my next appointment, with the Rich Cheese Company. After that I had an appointment with another distributor, Healthy Harvest, both on them were on the route into Old Town. That was my morning agenda.

I remember where I made the call from, an outdoor phone booth in a strip mall outside New Town. I hadn't used that phone before; I always used to call the office from a bigger mall a bit further out of town. I remember thinking it didn't look like a very successful strip mall. The mall was an "L", like this (gesture) with the phone on the short side of the "L". At the foot of the "L", the anchor store had closed. I spoke with young Mr. Rich. He confirmed he was available for our appointment.

Then I remember getting into my van, a Lumina (one of several vehicles furnished by the sales company for my use). You felt like a bus driver: huge mass of glass up there (round gesture). I made a right turn to go onto the interstate.

I remember the sound of horns, and looking back through the rear view mirror and seeing two truck grilles. Terror! I remember a sensation of terror. I remember seeing huge tires, they filled the side view out the passenger window of the van. After I heard the horns blaring repeatedly, I was trying to find a way to move to the left shoulder. I remember hearing the tires singing as they went by. I did not hear brakes. Then a sensation of shaking.

Someone was banging on the window of the van, saying, "Are you all right?". He knew I was alive.

I don't remember them getting me out of the van. I do remember the young lady flight surgeon who sewed up my head in a chopper on the way to the hospital. I remember the chopper noise. She cradled my head in her arms. She held my head.

I vividly remember the activity in the emergency room.

With respect to the moments just before the accident, I remember climbing a long, several mile, hill, where the highway adds a third leftmost lane so faster traffic can pass the heavy trucks. The center divider was several hundred feet wide up and over the hill, so there was no visible opposing traffic. I moved into the added left lane, passing several slow trucks, and continued in that left lane after cresting the hill. I normally would have moved back into the center lane, because I knew the added left lane ended part way down the hill, but for some reason (I can't remember) I stayed in the left lane. I heard a blaring horn and saw in my rearview mirror two trucks bearing down on me fast. One was in the right hand lane, going much faster than I was, and rapidly

> overtaking me. Directly behind me was a second truck, also gaining on me. His grille was expanding rapidly. As the left lane began to merge with the center one, I must have driven off onto the left shoulder (I can't remember making that turn, but I must have). I do remember the second truck's tires, which were taller than my window sill, just outside the passenger side windows.

In summary, the testimony in this first case study is based on the driver's recovered memory of his traumatic automobile accident that had occurred three years earlier. Initially the driver could remember nothing of the cause of the accident. Three years later, he claimed that speeding trucks behind and alongside him caused him to decide to swerve off the highway, a claim that if true entitled him to a substantially larger financial settlement.

Should the court allow Mr. Roland's testimony? If so, on what basis?

A Thirty-Five Year Old Memory For an Assault Leading to Death[4]

In 1955, a one year old girl was admitted to the emergency room with a probable concussion; her stepmother reported the child fell out of bed. The child died several hours later, and the death certificate listed the cause of death as a concussion following an accidental head injury.

In 1990, thirty-five years later, the two sisters of the dead baby, now 38 and 41 years of age, respectively, went to the police to report that when they were three and five, they saw their angry stepmother pick up their one-year old sister by the heels, bang her down against the floor, and throw her across the room. When their sister did not move, they said their stepmother took all three of them to the hospital, where their little sister died several hours later.

The sisters explained they had done nothing about this before because they assumed there was a statute that limited the time period a criminal prosecution must commence. They recently learned that this did not apply to murder in Texas. Upon learning this, the elder sister went to the hospital where their sister had died to request the medical records. The hospital did provide the death certificate and cause of death statement, but said they required a subpoena to release the full case records. This latter requirement prompted the visit to the police.

The sisters did not claim they had a recovered memory of their sister's death: they each remembered it continuously for 35 years. They were haunted by the memory and wanted to know if it was true as they remembered it; had their stepmother really murdered their baby sister.

The policeman first interviewed separately the two (now adult) sisters, and then asked each to provide a separate detailed statement. Each sister described the continuous beatings they regularly received from both their father and stepmother prior to the murder; the beating the father gave the baby the day before her death; the apartment in which they lived at the time (the older sister made a drawing of the layout); the moments leading up to and following the murder; the trip to the emergency service of the local hospital; the visit with their natural mother the next day; and the funeral several days later. The younger sister described the funeral more fully, including a detailed listing of the bruises on the baby's face, neck, and arms. She also described the new yellow dress in which her baby sister was buried, which had been purchased from Sears the day before the funeral.

The two women also described their subsequent life with their stepmother. In their statements, the sisters reported that their stepmother moved them out of that apartment less than a year after their sister died, and to another state shortly thereafter. They said they never visited the apartment again. Each sister indicated that she had confided in two or three teachers in elementary school whom she had trusted. Each sister wrote in her statement that their stepmother continued to beat them frequently, so that each girl remained in terror of her. When the elder reached 15, they ran away and rarely saw their stepmother again. They had only periodic contact with their natural mother, but both said that the relationship between the natural mother and stepmother was hostile in the extreme. Each sister described an adulthood of fear and impoverished self-esteem, and a failure to adjust well to the demands of careers, marriage and parenthood.

What follows are two verbatim but truncated portions (the originals run to five single spaced pages each) of each woman's statement of her memory of the murder.

Kay (five year old):

I can remember Colleen (stepmother) dressing Carolyn of a morning and Carolyn turning her toes under because she didn't want to put her shoes on. Then one morning, while Colleen was dressing Carolyn, she grabbed Carolyn up by the top of the thighs and with a lot of force, threw Carolyn across the floor. Carolyn was crying before she was thrown because Colleen was slapping her. After Carolyn was thrown across the floor she stopped crying. Carolyn slid across the hardwood floor and under a rocking chair that was across the room. Colleen picked Carolyn up and was moving Carolyn's arms and legs around as if she was trying to wake her. She took her to the bedroom, and then to the bathroom and started throwing water in her face. I followed Colleen to the bedroom and bathroom. About this time Debra (three year old sister) walked up behind me and we stood in the bathroom door and watched Colleen throw water on Carolyn. During this entire time Carolyn was limp. Colleen then rushed past Debra and I out the back door into the yard and began throwing Carolyn up in the air. After she did this a few times she told Debra and I to get in the car.

Debra (three year old)

I do remember the apartment…I remember there being a hardwood floor in the front room. I don't know about any of the other rooms. There was a couch in the living room on the lefthand wall. I think it was an ugly green couch. It folded down to make a bed. It made a clicking noise. You had to click it two or three times before it would come down. It was heavy to put it up and down. My sisters and I slept on the couch at night. I slept against the wall, Carolyn slept in the middle of the crease, and Kay slept on the outside. This is the way we always slept. Always. Kay always done that to protect us.

Colleen was sitting in the rocking chair with Carolyn in her lap. Carolyn was dressed excepted for her shoes. Colleen was trying to put on her

> shoes and Carolyn was scrunching up her toes and Colleen was getting madder and madder and madder, because she couldn't get the shoes on. And Colleen slapping her. Carolyn was crying.
> The next thing I remember Colleen was standing in front of the rocker and she was holding Carolyn. I remember Colleen throwing her away from her. She just flung her away from her. I remember Carolyn sliding across the floor and hitting her head on the rocker of the rocking chair. I never remember hearing her cry no more. And then Colleen had her in the bathroom. She turned both hot and cold water on and threw the water in Carolyn's face. Colleen threw Carolyn up into the air and she blew into her face, but she never got any thing. She done beat her too long. I don't remember nothing else until we got into the car.

The policeman proceeded to check their story. The death certificate issued by the hospital confirmed the story on the surface: the baby had been admitted and had died. The policeman discovered that the attending physician had died himself and could not be interviewed. The apartment building was no longer in existence: the entire neighborhood had been razed years earlier for a civic center and park.

The policeman then interviewed the natural mother. She said that in 1955 she was informed by the hospital that her youngest daughter had died, and saw her two other daughters the next day. They told her they saw their stepmother throw their baby sister, who did not move again. The day after the funeral, the natural mother said she took the two young girls with her to the police (or an investigator—she could not remember) and reported what they told her. When the policeman attempted to question the two girls (aged three and five at the time), they would not speak a single word. The mother reported that the policeman indicated that even if the young girls had corroborated her story, there was nothing he could do: he could not use such young girls as witnesses, no one would believe them, and besides they were too young even to understand what they were seeing. Given their mute state, he told her to forget all about it. As her own life was one of continued adversity, she said she never pursued the matter again, she did not discuss it with her daughters on the occasions when they did see each other, and she did not approve of their bringing it up now all these years later.

When the 1955 police records were examined in 1990, no record whatsoever was found of the natural mother's alleged interview. When the policeman contacted retired members of the police who had been on duty at the relevant time, they were unable to recollect anything of that interview, nor did the natural mother's description of the policeman to whom she talked match that of anyone who worked there at the time.

The policeman was still sufficiently concerned about the sisters' story that he was unwilling to let the allegation simply drop. After a search, he found a carpet cleaner who knew the layout of the apartment building prior to its destruction. The carpet cleaner's drawing of the rooms closely matched that of the older girl. Next, he obtained by subpoena the complete 35 year old medical records from emergency and found that no X-rays survived of the baby's skull, nor any other tests that might have shed light on a more violent alternative cause of death, although detailed progress notes of medications administered and the baby's responses to them were given. Astonishingly, in the margin of one page of the medical records in a different handwriting from that of the physician, was penciled "This is a beaten baby" (note the younger sister's description of the body at the funeral). The

policeman consulted with two physicians who told him that from those medical records alone, today they would have called the police when they admitted to emergency a baby in this condition. Suddenly, the policeman had a real case.

On the basis of these findings, he asked for and was given a court order to have the body of the little girl exhumed and examined by a forensic pathologist. The pathologist was told nothing of the stepmother's statement (the baby fell out of bed), the two sisters' allegations (the baby was held by the thighs and tossed across the floor), or of the medical records at emergency. The pathologist found a massive and unusual skull fracture at the base of the skull. He said it was unusual because, in its location, it could not have been caused by the baby falling (the most common cause of skull fractures in children). Rather, he said, the baby was either hit by a blunt instrument at the base of the skull, or the skull was forcibly banged against a blunt object.

One further piece of evidence was obtained from the grave. Sufficient remnants of the dress were uncovered to document its original color (yellow), and the store from which it was purchased (Sears).

Investigators located four of the school teachers in whom the two sisters claimed to have confided about the murder when they were children: each confirmed that the sisters were frequently bruised, and had told them of their fear of their stepmother, based in part on their memory that their stepmother had beaten their baby sister and killed her. None of the teachers reported these conversations to the police at the time (this was back in the 1960s, when child abuse issues were not nearly as salient as they are today).

The police also interviewed the natural mother's sister, who was in the car with her when she picked up the two young girls on the day after the baby's death. When questioned, this sister reported that as soon as the two girls got in the car, they told their mother what they had seen.

On the basis of the new evidence from the medical records, that from the grave, and from teachers and aunt, the district attorney obtained an indictment against the stepmother for first degree murder and had her arrested, 33 days after the sisters made their first contact with the police, and 35 and a half years after the alleged murder took place.

In the murder trial, the district attorney offered the testimony of the two sisters as their independent memory of what they had observed over three and a half decades earlier. This approach was unusual, since the district attorney focused on the testimony of the very young eyewitnesses as the central evidence that he wanted the jury to hear and believe, and used all of the other evidence to support its accuracy.

The defense claimed that the two sisters' memory could not possibly be independent or accurate: that the sisters' detailed descriptions exceeded children's capacities to remember and describe; that the two sisters, in collusion with their natural mother, made the story up. The defense claimed that their memory was false because they had combined what they knew with what they were told. It was motivated by a wish for revenge, arrived at years latter.

In summary, the testimony in this second case concerns the description of abuse in early childhood reported by now adult witnesses. The testimonies of the two witnesses were not recovered memories: the memories were acquired when the witnesses were very young children, 35 years previously, and had been accessible thereafter. Should the court allow the admission of the testimony of the two eyewitnesses? If so, on what basis?

Scientific Criteria on which to Decide to Admit or Reject Testimony Based on Recovered or Very Old Memories

Figure 1 schematically presents a decision tree with five decision nodes, one for each of the scientific criteria that we propose should be used to evaluate the admissibility of eyewitness testimony based on recovered or very long term memory[5]. These decision nodes are ordered, so that the first time a “Yes / Admit Testimony” is encountered, no further criteria need to be considered, and the testimony should be admitted without the need to evaluate further criteria. The first three decision nodes (and the tainted identification node which would appear fourth if it were included here), unlike the remaining two, also include conditions under which testimony should be excluded unconditionally. If "No / Reject Testimony” occurs for any of these initial decision nodes, the testimony should be rejected and no further criteria for admissibility should be considered. For the last two nodes, if conditions are not met for admissibility, then lower nodes must be evaluated.

Insert Figure 1 near here

The five decision nodes considered here *only* apply to the admissibility of the testimony of this individual eyewitness: not to the case as a whole. Thus, the decision tree could dictate that an individual witness should not be permitted to testify about a recovered memory because there is evidence that the memory is tainted, even though ample corroborative evidence exists that the alleged events occurred. The case should obviously be tried, and the other evidence considered, but this individual witness should not be allowed to present testimony that no longer reflects an independent memory of the relevant events.

` Similarly, it may be shown that part, but not all, of an individual eyewitness’s testimony is tainted. For example, a witness observed a crime, independently reported that crime to the police, and then made an identification from a lineup that was determined to have been biased. The witness should be permitted to testify on all aspects of the events s/he observed except the identification of the perpetrator.

Criterion 1: Untainted Memory

The first node considers whether the memory is untainted: is the memory independent? Or was some of its content acquired from post-event information, or suggested to the witness; was the witness influenced or pressured by other witnesses or non-witnesses; or was the witness lying. If there is explicit and positive evidence that the relevant memory is independent (untainted), testimony based on this memory should be admitted, and no other criteria need be considered. In contrast, if there is explicit evidence that the memory has been tainted in some way, testimony based on this memory should not be admitted, again regardless of any other criteria. If there is no evidence one way or the other regarding tainting, the second decision node is considered.

Criterion 2: Scientific Justification for Why the Memory was Unreported, and then Eventually Reported.

The second node considers whether the eyewitness’s behavior is consistent with our scientific knowledge of why someone might fail to report and then come forward to report an important event. This node is critical to evaluate testimony based on recovered memory or for testimony based on memory that for some reason was not reported over a

long period of time. Any considerable delay in reporting events raises the suspicion that the now reported memory may not be independent. This suspicion is removed by accounting scientifically for why the memory was lost or its report suppressed, and then why the subsequent memory was recovered or reported. If a satisfactory scientific explanation can be offered that is consistent with the facts, then the testimony based on this memory should be admitted into evidence. If the loss and recovery are inconsistent with what is known scientifically about how memory functions, then the testimony should not be admitted into evidence. The same argument applies to both recovered and to delayed testimony of long ago memory, even if the witness had access to the memory continuously. Is the delay in reporting it scientifically justified? If there is no scientifically reasonable explanation one way or the other (or there was no delay in reporting the events that had been observed), then the next decision node is applied.

Criterion 3: Corroborative Content Analysis of the Memory Statements

The third node considers the memory itself: is the structure, syntax and semantic content of the memory statement consistent with validated scientific evidence of the content of an independent memory. If so, then the testimony should be admitted; if not, then the testimony should not be admitted. If a content analysis fails to provide evidence one way or the other regarding consistency with validated evidence of an independent memory, then the next decision node is applied. In the Discussion section below we consider the issues of the validation of this criterion.

Criterion 4: Additional Independent Eyewitnesses to the Event

The fourth node considers the weight to give to testimony from another witness(es) to the same event. If there is a second eyewitness, and that witness can provide independent corroborative testimony in addition to that of the first, then the testimony of the first witness should be admitted. If there were no other witnesses, or none of them were independent of the first witness, then the next decision node should be evaluated. The determination of independence of multiple witnesses is briefly discussed in Haber & Haber (1998).

Criterion 5: Corroborative Forensic Evidence

The final node considers whether any forensic evidence supports the testimony of the eyewitness. If there is corroborative forensic evidence, then the eyewitness testimony is admitted. In the absence of such evidence, the testimony should be admitted with cautionary instructions to the jury. We discuss this approach in the Discussion section under the last subheading (Should Testimony of a Recovered Memory be Admitted When Science Cannot Satisfy the Criteria?).

Application of the Five Criteria to the Case of Mr. Roland's Recovered Memory

1. Evidence of Untainted Memory. Because there were no other witnesses, Roland was never exposed to other versions of the accident which he could (wittingly or unwittingly) incorporate into his memory. All of the other potential sources of information were vacuous: there were no records of skid marks of of scratches on the paint of his van; and no information in the police statements or reports. Contamination from post event information could not have occurred in this case.

Further, the psychologist's records make it clear that the onset of his recovery of memory began before Roland started seeing the psychologist, and that Roland initiated all discussions of his memory of trucks, tires, grilles and lane changes. The psychologist's

clinical notes also indicate that in those sessions where memories of the first accident were brought up by Roland, the recollections occurred prior to the formal beginning of the therapy session, and Roland is telling the therapist what he had remembered on his own. The clinical documentation, session by session, is amply convincing that Roland's recovery of his memories of the accident did not arise from suggestions, hints, encouragements or questions posed by the therapist.

Finally, while Roland would certainly benefit personally if his testimony was introduced, and there is evidence both that he knew that and that he had been told that he had to remember in order to substantiate his claim, there is no evidence that he was lying.

Therefore, the evidence indicates Roland's memory is untainted: his testimony should be admitted into evidence. The structure of the decision tree means that no further criteria need be considered. We continue only to show how the additional criteria would be used had there been no evidence either way about tainting.

2. Scientific Justification for Why the Memory was Unreported, and then Eventually Reported. Is there a scientific reason, based on what is known about the neurological, cognitive and emotional functioning of memory processes, why Roland had no memory for the minutes prior to the accident, and why he then could recover the memory.

Consider first the scientific basis for the memory loss. Traumatic brain injury with accompanying unconsciousness routinely results in retrograde amnesia (forgetting events just prior to the injury) and antrograde amnesia (forgetting events immediately following the injury) (Squire & Butters, 1992; Baddeley, Wilson & Watts, 1995; Alexander,1995). The amount of a person's life that cannot be remembered after the injury (antrograde amnesia) is highly correlated with the seriousness of the injury (Levin, Lilly, Papanicolaou & Eisenberg, 1992); whereas the amount of a person's life that cannot be remembered before the injury is typically relatively short, and extends back in time for a few hours up to a few days at most.

Antrograde amnesia has been widely studied because it predicts the likelihood and rate of recovery from the injury, and because the identification of specifically impaired cognitive abilities post trauma permits better treatment choices for the victim (Squire & Shimamura, 1995). In contrast, the content of the memories lost under retrograde amnesia (and their recovery) has received less attention from researchers, mainly because the pattern of loss (and the likelihood of recovery) seems to have been taken for granted for over a century. Ribot (1882), in what has since been called Ribot's Law, stated that the older the memory prior to the brain injury, the more likely it will be perserved (or conversely, the most recently experienced events are more likely to be lost after the injury). Clinical and research reports of retrograde amnesia to which Ribot's Law has been applied have been consistent with it (Levin, et al., 1992; Squire & Shimamura, 1995).

Now consider the scientific basis for the recovery of memory following traumatic brain injury. Here again, Ribot's (1882) century old summary and generalization about the recovery from retrograde amnesia is still accepted: the older the lost memory, the more likely for it to be recovered and to be recovered sooner during the process of healing. The most general summary of the neurological research and the clinical literature cited above is that neurologists expect patients with brain trauma to have some retrograde amnesia for the events preceding the injury, and most if not all of the memory loss is typically recovered, and recovered in the order predicted by Ribot's Law. This overwhelming evidence of memory recovery means that the brain injury does not permanently destroy the memory; it

only renders it inaccessible to recall and report for some period of time during which the brain is healing. Further evidence from the neurological research literature shows that in general, holding the extent of injury constant, the younger the patient the more likely is recovery of memory. Finally, neurologists expect that memory recovery will be paralleled by other improvements of cognitive functioning that had also been impaired by the brain injury.

Roland's memory loss and subsequent course of recovery are consistent with the scientific basis for memory dysfunctions following traumatic brain injury. His retrograde amnesia did gradually shrink to just an hour pre-injury, though the amnesia for the final hour took three more years to begin to lift. Most recoveries occur sooner than this, although the clinical literature cited above includes many examples of even longer delays in recovery from retrograde amnesia. Roland's recovery of memory for the events preceding and following the accident was highly typical and consistent with Ribot's Law, and his relatively young age made it more likely that he would eventually recover. Finally, the test/retest measures showing his improved cognitive functioning with time are consistent with healing that might allow his memory also to recover.

For all of these reasons, Roland's loss and then recovery of memory are consistent with our scientific knowledge about memorial processes subsequent to traumatic closed head injury. Therefore, his testimony should be admitted. Again, given the decision tree structure, no further critera need be considered. We continue for illustrative purposes only.

3. Corroborative Content Analysis of the Memory Statements. While attempts to develop "truth tests" based on content analyses are not yet validated (Waganaar, 1996; Waganaar, Koppen & Crombag, 1993), the research on discourse analysis (Weaver, Mannes & Fletcher, 1995), schemas for scripts and understanding (Mandler, 1984; Schank & Abelson, 1977), and recovery of percepual memory (Haber & Erdelyi, 1967; Erdelyi, 1996) provide examples of structural, perceptual, syntactic and semantic markers that are consistent with memory contents based on direct experiences and understanding, and not consistent with contents that are not understood, or are only known in abstract as compared to directly experienced observation. We have used these markers in a number of contexts to document our expert (clinical) judgment of whether the content under analysis represents an independent memory of what had been experienced, in contrast to one based on conjecture or confabulation. We will return to the scientific basis for this kind of analysis in the Discussion, but in what follows, we list examples of our analysis as they apply to Roland's memory statements.

First, actual memories may contain a mixture of minutely detailed sensory components; confabulations are more likely to consist of an overall description, usually devoid of supporting sensory details. Roland's memory of his accident includes many such minute sensory observations: he remembers seeing the silver grille in his rear-view mirror looming as it got closer; seeing a tire filling the view outside the side window of his car; hearing a truck air-horn that sounded alarming rather than just alerting; hearing the tires swish as they passed so closely. He does not say he remembers tires or horns, he sees and hears them, and describes the properties of those sensory impressions.

Second, actual memories conform to the sequence of what actually happened, even when it might seem silly or inconsistent or unlikely. Confabulations, on the other hand, rearrange facts to make better sense, smooth gaps, or make the rememberer look better. Roland reported that he did not know why he remained in the left lane after he started the down grade; but he remembers that he did.

Third, actual memories inevitably contain gaps that were forgotten. Further, memories of what had been actually experienced are anchored in the perspective or point of view of the observer: he cannot see what was behind his back. In contrast, gaps are normally filled in or completed in a confabulation, again to make the story complete or consistent. Roland's memory report is silent on the truck drivers' appearances (because Roland was too low in vantage point to have seen and therefore remembered the drivers). Roland's memory is silent on the color, printing, or kind of truck or trailer (except for the grille), for the same reason. Roland's memory is silent on the last moments before the crash (rarely recovered after severe retrograde amnesia, but often added in a confabulation).

Finally, actual memories are described as "I remember," with missing parts described as "must have beens," or acknowledged guesses. In contrast, confabulations often omit any acknowledgment that there are gaps in memory, using the identical description and syntax for what is remembered and what cannot be remembered but is assumed. In his report, Roland distinguishes what he can remember (for example who he saw in an appointment a half hour prior to the accident), from what he guesses occurred but cannot remember (the content of the conversation they had). He distinguishes that he "reasoned" that he turned left at the final moments to avoid the trucks, but says he has no memory of doing that.

The presence of all of these markers in Roland's memory statement suggests that his is an independent memory of what he had experienced earlier, not a made-up collection of suppositions and inferences. If Criterion 3 had adequate validation (see Discussion), then Roland's testimony should be admitted.

4. Additional Independent Witnesses. There were no other eyewitnesses to the accident, so this criterion is not met, and cannot be used to decide whether the testimony should be admitted or not. The next decision node is considered.

5. Corroborative Forensic Evidence. There was none, so this criterion is not met, and cannot be used to decide whether the testimony should be admitted.

Conclusion. Had the decision tree been followed literally, Roland's testimony would have been admitted on the basis of the first criterion alone (evidence it was untainted), and the remaining criteria ignored. Because a settlement was reached prior to trial, the court was not required to exercise these criteria.

Application of the Five Criteria to the Case of the 35 Year Old Memories

1. Evidence of Untainted Memory. While 35 years elapsed between when the girls witnessed the event and when they reported it to the police, their mother and their aunt testified that the girls described the event the day after it happened, and reported it themselves without influence or suggestion; and further testimony confirmed that the girls described the event during their childhood. Finally, the aunt's testimony also ruled out the question of collusion with the mother: the aunt heard the girls tell the mother about the beating on the first occasion they saw her. The information came from the girls, not from the mother. With respect to the possibility of lying, the girls, their mother, their aunt, and their teachers would all have to be in a highly unlikely collusion, and there appears to be no motive. There certainly is no positive evidence of lying.

However, during the interval following the beating and when the girls saw their mother and aunt the next morning, the girls may have talked together about what they saw.

Their statements include no information about their interactions with each other or with their stepmother or father during this time. Therefore, it is possible that they influenced each other's memory about the event during this time period.

Because we have no evidence one way or the other as to whether either girl reported an independent memory the next day, following the decision tree in Figure 1, the decision whether to admit their testimony is considered under the next criterion.

2. Scientific Justification for Why the Memory was Unreported, and then Eventually Reported. While the witnesses did not claim a recovered memory, they did fail to act on their memory for half of their lifetimes, and then suddenly chose to do so. In this case, three threads of evidence are required to meet this criterion. First, is there scientific evidence that witnesses this young have the ability to understand, retain, and describe these events? Second, is there scientific evidence that explains why the witnesses did not go to the police to report what they had observed, especially when free of their stepmother? Third, is there a scientific explanation for why they did so years later? Strong evidence consistent with scientific knowledge supported the children's ability to understand and to retain such events, and why the particular event went unreported for a long time. The science supporting their behavior in finally reporting the event is far less clearcut.

The content of the women's memory was entirely consistent with research evidence showing that children as young as three years of age have the ability to accurately understand, retain and report a traumatic experience such as they described. Research (Goodman & Bottoms, 1993; Davies, 1996; Fivush & Hammond, 1990; Pezdek & Banks, 1996) shows that even very young children observing traumatic events (a) get the central facts right (as measured by who did what to whom), (b) are especially accurate when the "who" is a familiar person, (c) are more accurate for novel as compared to routine events, (d) can retain the central features of these memories for years, and (e) can resist suggestion to change central features of such memories.

Why had the women not reported their story as soon as they could, such as when they ran away from their stepmother or when they reached adulthood? One plausible explanation is that women abused as children suffer from Post-Traumatic Stress Disorder (Terr, 1989; 1990; American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders, 1993; also Alpert, Brown & Courtois, this volume, pp. xxx), a condition which frequently leads victims to exhibit very low self esteem. Such people do not expect others to listen to them or believe them, and are often uncertain of themselves. It would not be typical of such adults to pursue these allegations (Terr, 1989).

Finally, on why they came forward at all, the women themselves reported that they doubted their own memories. Their purpose in coming forward was to substantiate a memory that haunted them, not to get their stepmother convicted. They asked the police to get the medical records, not to arrest their stepmother. Even so, the 35 year lapse is dramatic and unusual, and seems neither consistent or inconsistent with a scientific understanding of abused women. A defending attorney could reasonably argue that we have only the women's statements as to why they came forward; and they in fact did approach the police, a behavior inconsistent with Post-Traumatic Stress Disorder (American Psychiatric Association, 1993).

Given the ambiguity, the court should choose one of two alternatives: decide to admit the sisters' testimony on the basis of the strong scientific evidence pertaining to the ability of children to understand, retain and report traumatic events, and the scientific

evidence explaining why they delayed reporting these events; or decide, because their behavior in reporting the murder cannot be justified unambiguously by scientific criteria, to proceed to the next criterion on the decision tree.

3. Corroborative Content Analysis of the Memory Statements. An examination of the structural, perceptual, syntactic and semantic markers present in the statements made by the two women suggest that each is reporting an actual memory, not a confabulation. First, actual memories, in contrast to confabulations, are likely to contain minutely detailed sensory components. Debra's description of the clicking noise the couch made; the report that the baby 'turned her toes under' (Kay) 'scrunched up her toes' (Debra) are examples. Second, actual memories conform to the sequence of what actually happened, even when it seems silly or inconsistent or unlikely. Confabulations smooth events, or rearrange sequences to make better sense. Both girls described their stepmother's sequence of actions in trying to revive the baby, and both commented that they had no idea what she was doing or why. Third, actual memories, in contrast to confabulations, contain gaps that were forgotten; they are also anchored in the perspective of the observer at the time. Both sisters testify to gaps in their memories. Further, the two girls indicated that they were in different places during the beating of their sister, and what they reported reflects those different perspectives. Fourth, both girls freely commented that there were some things they did not see, and therefore did not know at first hand—a critical distinction that is found in abundance in testimony based on independent memories, but rarely in a confabulation. Fifth, when an adult testifies about an event she observed as a child, we can examine whether the report is consistent with what a child could understand, or whether the adult has provided the interpretation of what "must have happened." Although the two women are describing the same events, the version given by the elder sister contains many sequences of events; the younger sister's does not. This is consistent with the relative cognitive ages of the children as they experienced these events. These observations, taken together, make it unlikely that their testimony is a confabulation, and much more likely that it is based on independent memories of what the two sisters had observed 35 years earlier.

If the content analysis procedures are eventually demonstrated to have scientific validity to discriminate between independent and tainted memory, then the testimony of the two girls would be admitted by this criterion.

4. Additional Independent Witnesses. There were none; so Criterion 4 is not met, and cannot be used to decide on the admission of the eyewitness' testimony.

5. Corroborative Forensic Evidence. Substantial forensic evidence supported statements made by the two women: medical evidence of the injury matched the description given by the witnesses of the beating that lead to the death; the notation on the medical records matched the description of prior beatings and the appearance of the body at the funeral; the testimony of the nurse who made the notation in the records that the baby was covered with bruises; the dress found in the grave matched the description of that dress; and the layout of the apartment matched the remembered layout. This criterion would admit the eyewitness' testimony, if it had not already been admitted by earlier criteria.

Conclusion.

In the actual trial, the testimony of the women was offered, objected to, and ruled admissible by the judge, who primarily used the grounds described in Criterion 2 (Scientific Justification). In our analysis, the testimony could have been admitted under Criterion 2,

and would have been incontestably admitted under Criterion 5 (Corroborative Forensic Evidence).

In the trial, the jury returned a verdict of murder in the second degree. After the verdict, the District Attorney told the judge that the State of Texas would accept a suspended sentence and no jail time if the defendant accepted the verdict without appeal. This was agreed to, and the verdict of murder stood, supported by 35 year old memories of a three and a five year old eyewitness.

Discussion

The criteria for admissibility of eyewitness testimony are based on scientific principles. In the following section, we discuss ramifications and qualifications of these criteria.

Tainted Memory in the Critical Witness Does Not Mean Throw out the Case The criteria offered here concern whether an eyewitness's testimony based on memory of an observed event should be admitted into evidence. The criteria do not concern whether any other kind of evidence should be admitted. It is entirely possible that by Criterion 1 (untainted memory), the critical eyewitness should not be permitted to testify, even though there is substantial corroborative forensic evidence (fingerprints and ballistics, for example). The forensic evidence should be introduced if it passes its own scientific tests of admissibility, and must stand on its own right; but it cannot be supported or rebutted by eyewitness testimony that is based on a tainted memory. Testimony based on tainted memory should not be heard in court: the witness is not reporting personal observations of the event—and no longer can make such a report.

This means that if the *only* evidence available is the tainted memory of a single witness, the case itself cannot be tried. However, in all other circumstances, the case can be heard even if by the decision tree, the critical witness's testimony is excluded.

Are Recovered and Very Old Memories Different from Immediate Memory?

The decision criteria we have proposed here should be applied to all eyewitness testimony pertaining to what the witness observed and remembered. However, when the event occurred in the past, and the eyewitness did not report the event until after a significant delay, then the criteria become much more important. This is because the opportunities for exposure to tainting are significantly increased: from post-event information, influence, pressure or attempts at memory enhancement. Further, in addition to tainting, the reasons for the delay in reporting the event themselves must be evaluated (by the second criterion), an issue that does not arise with immediate reports.

The Importance of the Untainted Criterion

Three reasons account for our placement of this criterion at the top of the tree, where its location assures the greatest impact. The first is legal: courts already exercise a gatekeeper function with respect to other evidence that might be tainted or biased, or obtained through illegal means. There is extensive legal precedent as well as law for this function. Its consequence is that the trier of fact is not allowed to hear evidence that does not meet tests of independence. In deciding about the admission of eyewitness testimony based on memory, the courts should exercise the same function before admitting the testimony.

The other two reasons are practical. One is that research shows that an untainted report is the most accurate account of the events the witness will ever be able to give, so

restricting testimony to that only based on the independent memory of the witness increases the chances that accurate testimony will be offered. The other is that jurors place very heavy emphasis on eyewitness testimony in deciding whether to convict; and even when substantial evidence contradicts the eyewitness's testimony, jurors tend to accept the eyewitness's version of the events (Loftus & Doyle, 1989). This predilection makes it even more important that juries hear only testimony based on independent memory.

Taken together, these reasons make untainted memory the central issue in judging eyewitness testimony. Therefore, we have stated the decision to admit such testimony unconditionally as requiring *positive evidence of the lack of tainting.* This is a difficult criterion to meet, although the testimony offered in one of the two court cases presented here did so.

Procedures and Events that Lead to Tainted and False Memory

Current research has already identified a number of conditions that can produce tainted memory (Haber & Haber, 1998; Belli & Loftus, 1996). These include (a) exposure to post event information from other witnesses; (b) exposure to post event information from anyone who purports to know something (accurately or otherwise) about the events that had been observed; (c) exposure to influence from anyone by whom the eyewitness is subject to influence; (d) delay in time or any other condition known to reduce the ability of the eyewitness to remember the different sources of information about the event; (e) pressure on the eyewitness to increase the completeness of a report, or to express more confidence in its completeness or accuracy than had been initially felt; and (f) exposure to memory enhancement or memory manipulation procedures. In addition, a witness may deliberately lie to achieve some personal gain.

Most of the debate between memory researchers and therapists, in the context of memories recovered as a result of psychotherapy, concerns whether the memory enhancement and memory manipulation procedures built into most forms of psychotherapy inevitably produce tainting of memory. The researchers frequently appear to claim that every memory enhancement procedure (e.g., hypnosis; narcotherapy), and every memory manipulation procedure (e.g., psychotherapy; biofeedback), by its very nature, changes a potentially independent memory into a tainted one. The clinicians frequently seem to claim that these procedures, properly used, never introduce taint.

Abundant research shows that directive questioning, such as may occur in psychotherapy, leads to tainted memory (Belli & Loftus, 1996). Further, the importance of blind questioning (where the "examiner" does not know the right answer) is so accepted by the scientific community that, if not met, research based on non-blind testing cannot be published. Similarly, a policeman who shows witnesses a lineup may influence the outcome if he knows who is the suspect (Wells, 1990). In psychotherapy conditions where the therapist has reason to suspect child abuse (or any unexpressed emotion, behavior, or past event), suggestions may be posed, however unconsciously, by the therapist, which may give rise to false memories. Two kinds of research are needed to assess these likelihoods. First, empirical demonstrations are needed that examine the kinds of changes that occur in patients' memories during the course of different kinds of psychotherapy treatment. Second, research is needed to determine scientifically acceptable criteria for non-suggestive behavior (verbal and non-verbal) by the therapist; and how to document to a level acceptable in court that no suggestive behavior occurred.

Memory enhancement procedures may pose yet another problem. Erdelyi (1996) reviews the strong evidence that memory can be enhanced (the subject reports more memory) without being tainted (no suggestions or guidance was provided). The procedures used in these studies meet these critical criteria: the questions asked are non-directive and non-directional, and contain only information the subject him/herself has provided; and the tester does not know the answer ahead of time. Yet, Erdelyi's (1966) own research shows that while enhanced memory procedures do enable a subject to report more memory that is accurate, the subject simultaneously produces more memory that is false: the additional memory includes *both* accurate and false reports. Therefore, even enhancement procedures that are free of tainting do produce false memories. This means that researchers also need to document the extent to which "untainting" memory enhancement procedures can lead to increased false memory.

Psychotherapy, along with other forms of memory enhancement procedures, are not necessarily sources of memory tainting. However, inherent in their methodologies is the potential for introduction of new memories that are not independent. Until there is sufficient evidence that specific memory enhancement and manipulation procedures do not taint the memory being produced, and do not produce false memories, the conservative scientific view must prevail: reject as inadmissible testimony based on the results of such procedures, because it may have been tainted or include false memories. The reasons for this decision are carefully considered in the review and responses made by Ornstein, Ceci & Loftus (this volume).

Most of our comments have concerned testimony based on recovered or very old memories. But loss of independence (tainting) of memory frequently occurs in the normal course witnessed crimes, including instances where the police appear promptly and question witnesses in a timely way. The most typical source of such tainting comes from discussion among witnesses before and while the police are taking formal statements. While good police procedure calls for the isolation and separate questioning of witnesses, victims and others making statements, witnesses frequently have ample opportunities to compare their stories before the police arrive, and may continue to do so after giving statements to the police. In addition, the pressure and influence processes that occur during questioning itself also can lead to tainting, especially when the questions are overly directive, or include false presuppostions, or demaning more completeness than the witness can comfortably provide.

There have been several attempts to formalize police interview procedures to avoid coercive and misleading questioning (Fisher, McCauley & Geiselman, 1994), but so far the importance of inter-witness tainting has not been recognized in those attempts. If the police interview of each witness included documentation of which other witness(es) this witness discussed the crime with, and who said what to whom, then the court could determine whether some portions of a witness's testimony should be excluded because it might be tainted by what that witness heard from another.

Courts now exclude testimony where there is evidence that it was obtained under coercive or other inappropriate questioning procedure. Under present protocols, courts have no way to determine the extent of tainting that might have occurred among witnesses, and to bar testimony that is not independent.

Testimony based on deliberate lies is also tainted. Occasionally there is independent evidence of the impending perjury, and in such cases, the testimony is

normally excluded. More frequently, there is evidence that the witness stands to gain an extraordinary benefit from the testimony, which raises the question of the possibility of deliberate fabrication. However, without positive evidence of perjury or impending perjury, it must be left to the trier of fact to evaluate the credibility and truthfulness of the witness; the testimony should not be excluded simply on the grounds that the witness might benefit from it.

The Importance of the Justification Criterion

In order to admit testimony based on recovered memory, the court needs to be very sure that the failure to report criminal events at the time of their occurrence is consistent with good scientific justification of the cognitive, neurological or emotional reasons to account for the delay. The offer of the testimony should be accompanied by scientific evidence that the event was observed and understood correctly at the time, by a scientific justification for why it was not reported originally, and by a scientific justification for why it is now being offered. The scientific evidence concerning the occurrence of and recovery from retrograde amnesia provides a clear underpinning for Mr. Roland's loss and recovery of memory. Such appeals to science are needed for all instances of testimony based on recovered memories.

While a substantial body of research literature describes organic memory loss and recovery, little research has explored the course of memory recovery following psychogenic loss. The evidence that psychogenic memory losses *occur* is very strong (Arrigo & Pezdek, 1997); however, that *recovery* is an expected outcome of such losses is rarely documented (and not even mentioned in the review by Arrigo & Pezdek, 1997). Nor has research explored the accuracy of such recoveries. We need such documentation to provide a scientific basis to evaluate the admissibility of testimony based on recovered memory of traumas that are psychogenic in nature.

The scientific justification criterion is especially critical because of the fierce debate over psychogenic memory losses following child abuse. Specialists treating patients who have suffered child abuse claim that these experiences are particularly likely: (a) to be understood as traumatic by even very young children; (b) to become "dissociated" or otherwise lost from accessible memory as a result of the trauma; and (c) to be recoverable after appropriate memory enhancement and manipulation procedures. Whether child abuse comprises a particular etiology for loss and then recovery is beside the point. It remains to be scientifically demonstrated that such memories are understood as traumatic, and because of that are lost, and then are recoverable as still independent memories of the original events. Until these scientific demonstrations have been amply carried out, the admissibility of testimony based on the recovery of psychogenically lost memory cannot be determined by the Justification Criterion, and must rest on later criteria in the decision tree.

Independent vs. Accurate Memories

When an eyewitness reports an observation from memory, two separate evaluations are required. The first concerns the independence of the memory: is it the witness's own direct observation, understanding, encoding and recollection of what s/he observed, or has it been tainted by information provided by others, or by other procedures which can alter memory or produce false memories? The second is whether the testimony is accurate: does it reflect the actual state of affairs as they unfolded as the event was observed?

The scientific criteria described in this article are concerned with the first of these evaluations. It is the court's responsibility to assure that only unbiased and untainted

evidence be admitted. Thus, the court has to be assured that forensic evidence is untainted, that identifications are unbiased, and that testimony is based on independent memory, before it can admit any of these into evidence. The scientific criteria we propose are designed explicitly to assist the court in making these determinations.

These criteria are not concerned with the accuracy of the testimony, and do not purport to discriminate between accurate and erroneous facts. While testimony based on an independent memory is likely to be the most accurate description of the events a witness can provide, there is no guarantee that it is accurate at all. Voluminous research has shown how error prone are human attention, perception, encoding and remembering of events (Haber & Haber, 1998). The determination of accuracy, as well as of credibility and truthtelling, is the responsibility of the trier of fact.

Scientific Support for Content Analyses of Memory Statements

We offered content analyses of the memory statements for both of the case studies presented here. We have suggested, based on our experience and expertise, that these analyses support the conclusion that the eyewitnesses in these cases are reporting their independent memories of what they had originally experienced. However, there are no explicit validation experiments to support this conclusion as yet.

Content analysis has proved itself a powerful scientific procedure, and has been subjected to a variety of scientific validations in different contexts, including memory (Brewer, 1997). We strongly expect such procedures to discriminate whether testimony based on memory is of an independent memory or a confabulation of memory. Again, the independent memory so discriminated need not be accurate, nor do we expect content analysis to be a tool to discriminate between accurate and inaccurate statements made from memory.

Pezdek & Taylor (in press) have examined three areas of current research designed to differentiate between reports of events actually observed and reports of events not personally observed. Although they conclude that no adequate procedures to differentiate these reports have been identified as yet, they describe a number of powerful lines of evidence to suggest that content analysis of descriptions from memory will differ depending on whether the memory is independent or has been tainted.

We urge cognitive research scientists to explore content analysis procedures in much greater depth. However, until validation of content analysis procedures to determine the independence of memory has been demonstrated, the Content Analysis Criterion cannot be used as a scientific justification for the admission or rejection of testimony based on the independence of memory. In Figure 1, this current indeterminant state is illustrated by the dashed lines.

An Additional Criterion for the Admissibility of Eyewitness Testimony

In many criminal cases, an eyewitness provides two kinds of testimony: a description of a crime, and an identification of the perpetrator. When eyewitness testimony concerns the identification of a *stranger* as the perpetrator of a crime, then the procedures used to elicit the identification must meet additional scientific tests for validity, bias and tainting. Research in the past three decades has overwhelmingly shown that some identification procedures introduce substantial bias, or are subject to unacceptably large false positive error rates (identification of an innocent person as the perpetrator). This work is summarized in the APA-ABA committee report and recommendations on line-up procedures (Wells, Small, Penrod, Malpass, Fulero & Brimacombe, 1998).

Because neither of the two case studies presented here involved eyewitness identification of strangers, we have not included this criterion in the decision tree. For completeness, however, it must be included, and would function in the same way as criteria 1, 2 or 3: an identification elicited and reported under conditions known to be free of bias should be admitted into evidence; a biased or tainted identification should not be introduced into evidence; and an identification obtained under conditions in which the bias or taint cannot be determined should be subjected to additional criteria before a decision on admission can be made.

This criterion, when relevant, only applies to the identification portion of the eyewitness's testimony. The eyewitness may have an untainted description of the events of the crime, and, if so, testimony based on that description should be admitted. However, if the eyewitness also provides an identification which is shown to have been elicited under conditions that produce biased results, then the identification portion of the testimony should be excluded.

Should Testimony of a Recovered Memory be Admitted When Science Cannot Satisfy the Criteria?

One route through the decision tree is still undescribed here: when the test outcomes at each decision node point downward (see Figure 1). This route occurs when there is no evidence either way whether tainting occurred; there is no justification one way or the other for why the memory went unreported and then was offered; (the content analysis cannot be applied because it is not validated); there are no other eyewitnesses; and there is no corroborative forensic evidence to support the critical witness. Here science fails to provide a decision choice.

We recommend that under this circumstance, the court accept the proffered testimony and admit it into evidence, but only after instructing the jury that there is no scientific basis for deciding if this testimony meets acceptable criteria for admission. The trier of fact is thereby alerted that the task is more complicated because neither facts nor science supports either plaintiff or defendant. If the route of scientific evaluation follows straight down through the decision tree, the case will inevitably be one where there is a single plaintiff and a single defendant with contradictory stories to tell and no factual evidence either way. The jury will have to decide who is telling a more credible story, a decision that juries have been charged with throughout our legal history.

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Figure 1. A decision tree flowchart illustrating the six criterion tests and their outcome with respect to acceptance or rejection of testimony based on memory.

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[3] No citation to this case is given, and all proper names have been changed, because a settlement was reached outside of court with agreement by both parties that it remain confidential. Som (non-biographical) details may be obtained from the authors.

[4] State of Texas vs. Colleen Parker McMorris, 72nd Williamson County District Court, Lubbuck, Texas, Cause No 413865, trial August 6-12, 1992.

[5] We introduce a sixth decision node, concerning tainted identification procedures, in the Discussion section, but it is not included here because it is not relevant to these two cases.