

CRITICAL INCIDENT AMNESIA: The Physiological Basis and the Implications of Memory Loss During Extreme Survival Stress Situations

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The law enforcement officer is constantly required to move to the most traumatic and stressful situations in our society, to respond instantly and appropriately in these critical incidents, and then to accurately remember and report everything that occurred. Unfortunately, by their very nature traumatic situations will inevitably result in memory impairment, which is referred to here as "critical incident amnesia." The greater the stress, the greater the potential will be for these memory problems to occur.

Officers who encounter an extremely stressful situation will consistently exhibit difficulty in transferring information into long term memory. Particular memory related phenomenon in traumatic situations include:

1. During the actual incident there is usually a "sensory overload" combined with a "fixation" on some particular aspect of the critical incident, often to the exclusion of all else.
2. Immediately after the incident, "post-incident amnesia" will often result in a failure to remember the majority of the information observed in the incident.
3. After a healthy night's sleep there is usually a "memory recovery" which will result in the remembering the majority of what occurred, and this memory is probably the most "pure."
4. Within 72 hours the final and most complete form of memory will occur, but it will be at least partially "reconstructed" (and therefore somewhat "contaminated") after the inevitable process of integrating available information from all other sources (media).

Critical incident amnesia is one of the ultimate horrors in a

law enforcement environment. Failure to understand and address this problem can cause grave injustices. Memory failure in law enforcement officers, victims, and witnesses can result in a failure to convict or even to apprehend the guilty, or it can result in the prosecution and even the conviction of the innocent. This paper will outline the aspects of critical incident amnesia, and will then address the implications and applications of critical incident amnesia to the law enforcement community.

Memory Influences Before the Critical Incident

All individuals have a set of schemes, inferences, and expectations that they bring into a situation, and which have significant potential to distort their memory of a critical incident. Some of the most classic and fundamental memory research (Bartlett, 1932; Allport and Postman, 1947; Carmichael, Hogan & Walter, 1932), research which has been built on and replicated for over half a century, demonstrates that human memory is not like a camera taking precise photographs of new experiences. Instead, it has long been understood that memory is a process of active construction in which old knowledge, beliefs, prejudices and expectations are constantly shaping (and potentially distorting) our memories.

This research demonstrates clearly how a witness who was physically abused as a child may see a standard or necessary police action as violently abusive, or someone who has racist beliefs or stereotypes may perceive a minority suspect as having a weapon when in fact that was not the case. Understanding the potential for memory distortion based on the baggage that the witness "brings to the table" is "step one" in understanding what is outlined

from this point on, and this should be considered as a possible explanation any time a single witness has a testimony that is significantly different from that of several others.

Fixation and Perceptual Distortion

Data perceived through each of the five senses is combined to create what we call "memory." Each of the sensory systems provides the brain with a constant source of information about the environment through a complex network of neural receptors. Memory is created when data perceived through the sensory network is collated and then "hardwired" into neurons in the brain. Since memory is a product of perception, it is clear that memory can be disrupted when perception becomes disrupted.

In extraordinarily stressful situations, there is almost always an overwhelming flood of information in a very short period of time. This sensory overload often results in a "fixation" on a particular aspect of the critical incident, resulting in very vivid memories of that aspect of the experience but severely limiting memories of anything else (Hockey, 1970; Bacon, 1974; Mandler, 1982). Indeed, individuals who experience these memories (such as a face, a weapon, or even a particular sound) often referred to them as being "burned" into their memory.

This fixation is due to "perceptual narrowing" in which the five perceptual senses collapse around a central point of focus as arousal or stress increases (Easterbrook, 1959; Schmidt, 1991). This powerful process will generally result in a situation where only vision is processed, and even very powerful cues from other senses (such as loud sounds or injuries) may be diminished or completely filtered out.

Perceptual narrowing is an effect of sympathetic nervous system (SNS) activation. The SNS is activated anytime the brain perceives a threat to survival, resulting in an immediate discharge of stress hormones, which is designed to prepare the body for what has been recognized as the "fight or flight response." The activation of the SNS is automatic and virtually uncontrollable. Once the SNS is activated the visual system goes through a series of automatic changes.

Breedlove (1995) has found that SNS excitement causes vasoconstriction to the blood vessels on the periphery of the retina, resulting in a collapse of the peripheral field which is referred to as "peripheral narrowing" or "tunnel vision." Thus, not only is an individual in a critical incident likely to be limited to only one sense (usually vision) but that one sense will also be greatly reduced or "narrowed."

Breedlove states that the visual field can be expected to narrow by 70%.

Cannon (1915) found that SNS excitement triggers pupil dilation, leading to the loss of near vision, and SNS activation also disrupts the ability to focus, which results in a loss of depth perception and the ability to focus on close objects.

How does this research apply to critical incident amnesia? First, memory is a function of collating perceptions, and in combat the visual system is the mother of all senses. But if the visual system is disrupted or narrowed, the amount of information to collate a complete picture will be incomplete. Second, the SNS causes vasoconstriction to the periphery of the retina resulting in a significant collapse of the visual field. In other words, the officer will fixate on major threat cues, but cues on the periphery of the visual system may not be processed into memory. This explains why individuals sometimes fail to remember "seeing" individuals or cues immediately adjacent to the threat. Finally, the loss of depth perception and near vision accounts for why individuals often fail to accurately identify distances after a survival incident.

Post-Incident Amnesia

Most memory results from when we "attended" to information. Every waking second of every day our five senses flood the brain with data, but we only attend (that is, pay attention to) a tiny percentage of what comes in. If we do not attend to something it is generally lost to memory (Cherry, 1953; Moray, 1959). Intense fixation of attention on a particular aspect of a critical incident can cause vivid memories in some areas, but by definition this focused attending in one area will cause a reduction in attending (and thus to memory) in all other areas.

Sometimes this fixation results in a kind of "flashbulb" effect. Brown & Kulik (1977) originated the term and others (Neisser, Winograd, & Weldon, 1991; Palmer, Schrieber & Fox, 1991) have done significant follow-up work. In critical incidents a Flashbulb memory is often seen when an initial image or aspect of the critical incident will be all that is remembered. (Other research (Haber, 1969, 1979; & Stromeyer, 1970) refers to a similar process, which has similar effect, as "eidetic" memory.)

This is similar to the process that would occur if you were moving down a familiar hallway or street, saw something new, and thought intently about that new stimulus as you continued to walk. At the end of the walk it is likely that you would have a vivid memory of this one new stimulus,

but could not remember anything else that you saw or did, even though you looked at and moved around things in your path. Most of us have experienced something similar many times. In critical incidents this common process can be greatly amplified by the surprise and intensity of the initial shock. The individual essentially functions on autopilot during the critical incident, while the mind continues to dwell on and try to make sense out of that initial image. Immediately afterwards, that image may be all that is remembered.

In addition to the failure to attend which results from fixation and sensory overload, there is a body of research which indicates that intense stress will result in a failure to recall anything learned in a situation (Duncan, 1949; Squire, 1986). McGaugh (1990) and Khalsa (1997) indicate that this effect is due to the flood of stress hormones in the brain which occurs during intense trauma. The combination of these factors will very often result in "post-incident amnesia" in which, immediately after a critical incident, the majority of information will not be remembered. (This can explain, for example, the common process by which most mothers tend not to remember the intense pain of childbirth, and are subsequently willing to have more children.)

The greater the trauma, the greater the impact of post-incident amnesia is likely to be. Key factors which will increase the stress include: the perception of threat or danger, the suddenness of the threat and the available time to respond or prepare, the amount of sensory input needing to be processed, and the degree of physical effort (aerobic and anaerobic output) that was engaged in during the incident. If the individual is physically wounded or injured the effect will be even greater, and the effects of post-incident amnesia will be greatest if the wound or injury results in unconsciousness.

Memory Recovery

Based on extensive combat experience, the U.S. Army has a common understanding that, "The first report is never right." The near universal occurrence and general understanding of post-incident amnesia (although not referred to by that name) is probably the basis for this expression. Furthermore, combat leaders throughout history have understood that it will be extraordinarily difficult to make sense out of a battle until the day after combat, when the troops have had a night's sleep, since information gathered from "shell shocked" soldiers immediately after combat is notoriously poor.

After a critical incident much of the information may still

be in the brain, but it has not been processed in such a manner that it can be retrieved. There is increasing evidence that it is possible for individuals to remember information that was not attended to at the time (Treisman, 1960, 1964; Corteen & Wood, 1972; Anderson & Pichert, 1978; Hasher & Zacks, 1984; Bennett, Davis, & Gianni, 1985; Kihlstrom et al., 1990). But one of the key factors in being able to retrieve this information appears to be sleep.

Sleep (and particularly the dreaming that takes place in REM sleep cycles during sleep) has increasingly been understood as a time when the brain is focused on problem solving and resolution of powerful emotional concerns (Webb & Cartwright, 1978; Cartwright, 1989, 1991) since depressed or highly stressed individuals have longer and more focused dream cycles. Integral to this process is the understanding that sleep (and particularly dreaming/REM cycles) is the period when information gathered during the day is processed into long term memory (Jenkins & Dallenbach, 1924; Cartwright et al., 1975; Benson & Feinberg, 1977; Tilly and Empson, 1978; Scrima, 1982; Schoen & Badia, 1984). In particular it appears that REM sleep helps consolidate unusual information that requires a good deal of adaptation in order for it to be absorbed (Pearlman, 1982).

Evans (1984) argues that sleep (and dreaming/REM cycles) occurs because the brain must periodically shut out sensory input so that it can process and assimilate new data and update what has already been stored. Research indicates that during sleep the brain divides new information into "wanted" and "unwanted" categories, and makes new associations in light of the day's experiences. Numerous research projects (Luce, 1971; Roffwarg, Muzio & Dement, 1966) support this contention by demonstrating that REM cycles (which is when most dreaming occurs) happen more frequently and are longer for individuals who are placed in circumstances in which they must process great quantities of new information.

Thus it can be observed that, immediately after experiencing a critical incident, individuals have not had an opportunity to mentally process and refine what they have experienced. But after a night's sleep there should be significant memory recovery. If an individual has been kept isolated from other sources of information, the memories at this point (approximately 24 hours after the incident) should be the most "pure" since they have not yet integrated data from other sources.

It should be noted, however, that if the initial night's sleep has been disturbed, then the memory recovery which should occur as a result sleep will be potentially disrupted.

If the trauma encountered in the critical incident resulted in unconsciousness, or an operation requiring general anesthesia, then there is a good possibility that normal memory recovery will be greatly disrupted. The ability for an officer to convict the guilty and defend the innocent in a court of law, or even to defend himself against spurious charges, is greatly influenced by understanding the memory recovery process and by safeguarding this first night's sleep.

Memory Reconstruction

Inevitably an individual who has encountered a critical incident will seek information from outside sources in order to make sense out of what has occurred. In many cases this process of exchanging information will provide "retrieval cues" which will aid in the retrieval of information (Tulving & Pearlstone, 1966; Brown & McNeil, 1966; Reason & Mycielska, 1982; Geiselman, 1988), and slowly but surely the memory will be "reconstructed" (Williams, 1976; Lindsay & Norman, 1977; Loftus, 1980).

If a group debriefing is conducted 24 hours after an incident (preferably after an individual debrief), then the exchange of information within the group will serve as legitimate memory cues which will greatly aid in memory retrieval. Additionally, there is strong evidence that the moods and emotions generated by reliving an experience will generate accurate memories (Diamond, 1969; Kaiser, 1970; Bower, Monteiro, and Gilligan, 1978; Bower & Gilligan, 1979; Teasdale & Fogerty, 1979; Bower, 1981; Blaney, 1986; Chang, 1986). Indeed, one research team has speculated that when victims of violent crimes have trouble recalling details of the experience, it may be in part because they are far less emotionally aroused than they were at the time of the crime (Clark, Milberg, & Erber, 1987).

Most of this memory reconstruction will be legitimate, but from this point on (and particularly after another night's sleep in which the group debrief is processed into memory during REM sleep) there is a slight but increasingly significant danger of memory contamination.

The desire for the brain to seek patterns and sense out of chaos is powerful, fundamental and basic to human nature. Hobson (1988) states that the brain "is so inexorably bent upon the quest for meaning that it attributes and even creates meaning when there is little or none to be found in the data." This process of creating memory and meaning is the basis for much memory contamination, and it must be constantly taken into consideration in law enforcement procedures. Contamination occurs when information

outside actual experience is integrated into the reconstruction of memory. This is an inevitable process in most memory reconstructions, and if reliable information (for example, the narratives of fellow law enforcement officers on the scene) is incorporated into the reconstruction process it can be very helpful in ensuring that the most accurate possible picture is preserved (Loftus, 1979a; Loftus, Miller, & Burns, 1978; Loftus & Green, 1980). Furthermore, there is evidence that the influence of outside factors in contaminating information will be greater over time (Loftus, Miller & Burns, 1978) if the information is not locked into memory by recounting it (Loftus, 1977).

Applications and Implications to Law Enforcement

The implications of critical incident amnesia on law enforcement are profound, and it is vital that procedures be established which will ensure that the most accurate and most complete memories are protected and preserved as a part of standard procedures. The following procedures are recommended:

1. Educate all officers on the effects of stress on memory, in order to ensure that they understand and apply the procedures outlined below. This education process is also vital to reduce guilt and confusion over memory loss, and to reduce the potential for post-traumatic stress disorder. Administrators, internal affairs personnel and prosecutors should also be educated so that all individuals are working together to ensure that the most accurate possible information is being retained.
2. An initial post-incident interview (or debriefing, or report) should be conducted as soon as reasonably possible after a critical incident. This should be a quick narrative review of what occurred, and it should be remembered that it is very likely a subject (officer, victim or bystander) will not remember the majority of events that occurred in the incident. The subject can generally be expected to recall:
 - a. Type of weapon (handgun, knife) but not the characteristics of the weapon.
 - b. General information about the suspect.
 - c. General details about the encounter.

These interviews should probably be tape recorded and transcribed, since the residual sympathetic nervous system effects on fine motor control will often make hand written reports illegible. Of course, during this and all other

interviews, the interviewers should make a conscious effort not to contaminate the process by suggesting ideas about the crime or the suspect to any witnesses.

The interviews should be conducted on an individual basis, and reasonable efforts should be made to ensure that the subject is isolated from other sources of information (such as news reports or other witnesses) until the next interview, which will take place after a good night's sleep.

Every effort should be made to ensure that the subject receives a healthy night's sleep after the incident. Drugs which are administered to the subject (sleeping pills, anesthesia, etc.) should be held to a minimum and should be screened by a physician for potential impact on memory retention.

3. After the first sleep period (generally 24 hours later) the subject should be interviewed again, and the subject can be expected to remember the majority of the details regarding the incident and to refine many of the fine points. In the case of law enforcement officers a written report at this time may be appropriate, and it should be understood that the officer may add significantly to his or her earlier statements.
4. A group interview or group debriefing should then be conducted as soon as reasonably possible after completion of the second set of individual interviews. The memories related in the second interview may be the most pure, but the subject will almost certainly not recover all available memory of the incident until exposed to the retrieval cues that can be provided by other witnesses. It is important that the subject get a chance to formally complete this process in an environment in which each individual is required to completely relate their experiences and observations. Very often this environment will create comments such as, "So that's what that was, I saw that too!" The ultimate goal of this process should be to completely reconstruct the entire critical incident.

This kind of group debriefing was pioneered by Brigadier General S.L.A. Marshall in WWII where it was found to be extraordinarily effective at achieving a complete picture of what occurred in combat situations (Marshall, 1978). Recently the U.S. Army has created Combat Stress Teams which are assigned at brigade level in every combat unit. These teams have the responsibility to conduct post-combat debriefings of the sort pioneered by Marshall.

It has been demonstrated that in this group interview

environment individuals are very carefully to tell exactly the truth, even when it reflects poorly upon themselves, since they know that others are there who can catch them at any misrepresentation of the event (Williams, F.D., 1990). Thus the post-combat group interview provides the most accurate and truthful information, in the best possible environment to trigger recall of important data. It also allows the maximum possible training and learning value and the applications of lessons learned which will assist officers in the execution of their duties in the years to come.

But perhaps the most important aspect of this group debriefing is that it is considered to be the single most powerful therapeutic tool in preventing post-traumatic stress disorder (Belenke, G., 1996). The moral requirement to provide the therapeutic aspects of this vital group debriefing has been essentially acknowledged by the U.S. military, and law enforcement agencies are probably under increasing legal liability for any post-traumatic responses which would occur among law enforcement officers who have not been given this opportunity.

Because of this mental health aspect it is reasonable that mental health professionals should be present during group interviews. However, the overall objectives of the mental health practitioner, the prosecutor, the internal affairs officer, and the criminal investigator are all the same in this interview: to simply find out what happened. One experienced individual should be placed in charge of the interview, and he or she should guide the group toward the objective of reconstructing the incident and extracting all available information. Mental health practitioners should address any additional requirements in subsequent group or individual sessions.

The only negative aspect of the group debrief is the potential for contamination in the reconstruction process. This danger is slight, but nevertheless it must be acknowledged that there is potential for individuals to accept the memories of others (which may or may not be correct) as their own in the reconstruction process. It must be pointed out that this is inevitable in any memory reconstruction, and by formalizing this group process it can be ensured that the individuals will be basing their reconstructions on the best possible information.

5. To be absolutely thorough in the information collection process, it is recommended that a second group interview be conducted 48-to-72 hours after the incident. This will permit one or two nights sleep to process the data presented in the group debriefing, and should

therefore provide an opportunity for the most thorough and complete memories to come forward. At this time the possibility for contamination is greater, but if the process has been properly handled the contamination should be minimal, and far less than would have occurred if this overall process had not been followed systematically.

Conclusion

The overall application of a scientific understanding of memory processes in a law enforcement environment has potential for tremendous payoff. From better quality eyewitness accounts, to lessons learned and applied, to the long term mental health of the participants, the payoff is simply enormous. The price for failing to apply these lessons is equally enormous, and the victims of such a failure will inevitably include citizens, officers, the community and, ultimately, Justice.

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