A Survey of the Research on Human Factors Related to Lethal Force Encounters: Implications for Law Enforcement Training, Tactics, and Testimony

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To effectively train and fairly evaluate the performance of an officer in a tactical environment, we must first fully understand how the brain perceives and processes information. This article will begin with an exploration of how the brain/mind processes routine information, followed by a discussion of the research on the effects of stress on perception. The *brain* refers to the actual organ contained in the skull that coordinates sensation and intellect, while the *mind* refers to consciousness/thought or intellect/memory. For our purposes, however, the terms will be used interchangeably. Common perceptual distortions and *mistakes of fact* will be identified, and their effect on reaction time will be discussed, taking into consideration the scientific and practical limitations governing human performance. Training recommendations designed to reduce both the rate and range of perceptual and processing errors while decreasing response lag time, or the time it takes to initiate a response, will also be proposed. Finally, improved methods for mining memory will be offered with the goal of increasing the accuracy of incident recall. The information will be presented as objectively as possible. It will be up to the reader to weigh the research, including potential organizational and/or political ramifications, and the pros and cons of any proposed changes to policies or practices.

To truly understand and explain human behavior, we must first make sense of the workings of the human mind. How information is perceived and processed ultimately determines both the level of performance and the subsequent memory of the event. The mind processes information from both internal sources (i.e., thoughts and feelings) as well as external sources (i.e., the senses such as visual and auditory). It is important for the reader to know that it doesn't matter where the information comes from; it is neither perceived nor processed in a vacuum. This is because both perception and memory are active processes. For example, each of us has a set of schemas and expectations that both color and form our view of our world and have significant potential to distort our perception and then recollection of a critical incident. The influence of this is so strong it literally means *perception is reality*. It is also important to remember that traumatic incidents, by their very nature, will result in some degree of perceptual distortion and memory impairment as an accompanying feature—usually, the greater the stress the greater their occurrence (Grossman & Siddle, 2005). This means that any two witnesses viewing the exact same incident can, and often do, have widely different perceptions of the event (Loftus, 1979). Their subsequent accounts of and responses

to the incident are also then likely to vary. The same is true of law enforcement personnel involved in a tactical situation. Heightened levels of stress, combined with increased elements of both focused attention and distraction, further magnify this effect (Morgan, 2004).

Characteristically, two types of errors exist that are related to perception and that subsequently effect both performance and memory. Type I errors, or false negatives, result from rejecting something that should have been accepted. An example would be failing to identify a suspect who does, in fact, have a firearm, resulting in actions or lack of actions on the part of the officer that may lead to that officer subsequently being shot or at least missing important clues. Research suggests the typical, false negative rate for officers is approximately 4% in a high-stress and rapidly unfolding situation such as a shooting (Lewinski & Hudson, 2003). A Type II error, or false positive, occurs, for example, when an officer incorrectly perceives that a suspect has a gun and, hence, responds with deadly force only to find that no gun exists. The false positive rate for such incidents averages 9% based in laboratory research (Lewinski & Hudson, 2003). Recent research just completed by Aveni et al. and still being analyzed indicates that in simulation testing, Type II errors, depending upon the department and the training and experience of the officer, may be as high as 30 to 40+%. Both types of error are inevitable and are inversely related; as the probability of one goes up, the probability of the other comes down. Subsequently, efforts to mitigate one type of error necessarily result in an increase in the probability of the other type of error.

Lessons Learned

- Perceptions and recollections are colored by prior expectations.
- The greater the trauma, generally, the greater the risk of perceptual distortion and memory impairment.
- Two types of error are inevitable and inversely related: reducing *false negatives* (Type 1 error) (e.g., failing to identify a weapon when one exists) automatically results in an increase in *false positives* (Type 2 error) (e.g., *seeing* a weapon when none exists).

The Science of the Mind

The three critical components of memory are often identified as the three "Rs": receive, retain, and recall. Information must first be *received* to be remembered. *Attention* is the primary process that undergirds and determines what we will receive, retain, and recall. The brain does not have an infinite capacity to observe, and so it normally picks and chooses what to attend to and then simply ignores the rest. Can the reader imagine how quickly they would experience a system overload if they were to attend to each and every blade of grass, leaf, or insect in their immediate environment? This process of selection is generally survival based, having been formed in earlier times when our ancestors' ability to observe critical aspects of their environment truly meant the difference between life and death. But, like everything else, the system is not perfect. Generally, information cannot be simultaneously attended to and processed from two different sources much less from competing senses (Lewinski & Hudson, 2003; Strayer, Drews & Johnston, 2003; Yantis, 2004). Increased focus on a visual cue, for example, automatically reduces the ability to attend to either a competing visual cue or auditory stimuli. At any given

moment, we can see either the forest or the trees but not both at the same time. This perceptual phenomenon is also related to and referred to as *figure-ground perception*. Readers familiar with Introductory Psychology texts will identify the "Vase/Two Faces" figure as an illustration of this phenomenon. It is difficult to see both the vase and the two faces at the same time. To identify both percepts requires the viewer to shift back and forth between the vase and the two faces.

Figure 1. Vase/Two Faces

In law enforcement, officers are still human and cannot perceive two elements of equally high significance at the same time. However, an officer's training and experience will provide for greater visual or auditory attention and acuity. The experienced officer will pay varying levels of attention to the elements in the encounter, depending on the situation at the moment and the officer's assessment of the relative importance of each cue to their basic survival (Hsieh, 2002; Yantis, 2004). This characteristic of the brain's functioning has often been referred to as tunneling. The more technical name for this phenomenon is *selective attention*. One consequence of this *tunneling* is that while the brain is attending to a particular internal or environmental cue, it may fail to observe another, theoretically equally important piece of information. The reason for this is that during selective attention, while the person is intently focused on one element in the environment, the perceptual system not only ignores other elements but also actively works to suppress their interference in distracting the person from what they were primarily focused on. Selective attention explains how an officer can fail to see or hear something occurring directly within his or her field of vision or range of sound (Rumar, 1990; Simons, 2003; Strayer et al., 2003; Strayer & Johnston, 2001; Summala, Pasanen, Räsänen, & Sievänen, 1996). In everyday circumstances, it also explains how someone "listening" to the radio, while otherwise engaged in thought while driving to work, can find themselves suddenly unaware of the content of the broadcast that they allegedly just "heard" (Brown, Tickner & Simmonds, 1969; McCarley et al., 2001).

If this selective attention can occur under even the most mundane low stress conditions, imagine its effect under high-stress conditions in which the reader's life or the life of someone else is "on the line"! Research has found that the impact of intense stress before, during, and after an event affects what an officer remembers and how he or she remembers it (Gold & Greenbough, 2001; Grossman & Siddle, 2004; Lewinski, 2002; Morgan, 2004; Welford, 1980). This then means that information subconsciously deemed unrelated to the perceived threat will have a low rate of recall as attention will have been focused predominantly on the threat and/or on personal survival. Officers, then, because of their *focused or selective attention* under these circumstances will *fixate*, or intently focus, on some element of the incident, resulting in a very specific and vivid, though not necessarily accurate, memory for a particular aspect of the incident while limiting their recollection of other facts (Bacon, 1974; Hockey, 1970; Mandler, 1982).

An important fact in relation to memory is that information is more readily *recognized* than *recalled* (Morgan, 2004). *Recognition* allows for comparison of new information against old information. It may be as simple as a yes or no query such as when someone is taking a multiple-choice examination. The mere presentation of the relevant information may itself stimulate the memory trace and allow for further recollections. *Recall* requires the individual to re-create the memory from scratch, a much more challenging task, which the reader would recognize as the process they would use when writing an essay exam. Recall memory, while more difficult to use, is less subject to contamination, suggesting that when investigating an incident, the officer should first ask individuals to provide a basic narration of an incident with as much detail included as possible (recall), followed by specific queries or comparisons (recognition). One type of memory can be used to stimulate another. For example, after a shooting, a walk-through would stimulate recognition memory, which would then facilitate recall memory and provide a more accurate and thorough report of the incident by the officer.

The second, and equally important, component of memory refers to the processing of information and how that information is *retained*. Not all information observed is retained. Just as it has limited capacity to *receive* or attend to information, the brain also has limited capacity to *retain* or store information. Can the reader imagine the clutter of our minds if we were to retain each and every observation, either internally or externally generated? We would never be able to sort through the frivolous to find the truly relevant information! To help us sort through the clutter and not remember too much, the brain utilizes both temporary and permanent storage areas. The most temporary of the short-term memory storage areas is reserved for information deemed only immediately relevant with no long-term utility. An example would be an anticipated one-time use phone number obtained with the intent of immediately dialing the call. This storage area has limited capacity, an average of only seven items. Absent reinforcement, the ability to recall this type of information is limited to approximately 30 seconds or less. We have all had the experience of remembering a phone number just long enough to dial it only to encounter a busy signal on the other end and then find ourselves unable to recall the number to redial it again!

The next level of short-term memory is reserved for information deemed slightly more relevant but not significant enough to be stored in long-term memory. These memories will fade and disappear on their own over time, with the exact

amount of time affected by such factors as repetition, significance, or relevance to an existing memory. Long-term memories take much longer to acquire and, once retained, they are retained for life. In fact, long-term memories, once stored, can also be located and accessed by stimulating various parts of the physical brain. Long-term memories may actually be *hard wired* in the brain. Long-term memories include experiences, training, and education and involve information for which meaning and/or emotion have been attached and understanding has occurred. The problem with long-term memory is not one of capacity but of accessibility. Like a large expanse filled with filing cabinets, the problem becomes more an issue of retrieval than storage. It should be noted that most of this processing occurs automatically at a subconscious level, though various conscious interventions can be implemented to impact the end result. For example, by connecting current information to information previously learned, we enhance our ability to recall both sets of information. Strong emotion also increases memory for specific details, though this may reduce the capacity to recall competing information.

Lessons Learned

- The three "Rs" of memory are *receive*, *retain*, and *recall*.
- The brain is capable of attending to only one source of information at a time. This is referred to as selective attention.
- Not all information is perceived and/or retained for later recall.
- Strong emotion increases memory for specific details though at the price of recall for competing information.
- Comparison or recognition tasks can enhance memory recall.
- Basic narration of an incident should be the first step in any investigative interview since recall is less susceptible to contamination than techniques that involve specific queries or comparisons.
- *Memories* are just as likely to be inaccurate as accurate. Level of confidence in the accuracy of the recall is not a reliable determiner of actual accuracy.

The Effect of Stress on Perception and Memory

Physiological arousal from stress has long been known to interfere with perception and memory at all levels, including the ability to accurately receive, retain, and recall information (Broadbent, 1971; Horowitz, 1976; Janis & Mann, 1977; Morgan, 2004; Welford, 1980). This effect results from among other factors, a chemical reaction occurring within our bodies due, most notably, to the effect of adrenaline and other hormones that mobilize us to fight, flee, or freeze. The fight, flight, or freeze response characteristic of arousal in high-stress conditions harkens back to an earlier day and time in our development as a species. This very primitive but effective survival response produces both positive and negative effects on both perception and performance in a modern society. The typical survival stress response results in a release of increased adrenaline and hydrocortisone, which produces an upsurge in heart rate, blood pressure, breathing rate, pupil size, perspiration, and muscle tension, resulting in improved blood flow to the brain, heart, and large muscles. Fine motor skills that require hand/eye coordination begin to deteriorate as resources are allocated elsewhere toward the utilization of gross motor facilities that are more effective for running or fighting.

The eye and the brain work together to help us pay attention to information that is important to us. When stress levels are low, the mind can maintain a *soft* attentional focus across many senses and many elements within each sense as well as on internal thoughts and self-talk. However, as the level of stress increases and/or the task becomes more complex, the brain automatically narrows our focus and excludes and then suppresses information that is deemed not important (McCarley, et al., 2001; Strayer et al., 2003). Attention in particular focuses on the areas of the expected hazard at the expense of awareness toward less likely hazards (Rumar, 1990; Summala et al., 1996) or even those hazards with a sudden onset, which had previously been thought to capture attention automatically (Yantis, 1993; Yantis & Jonides, 1990). Besides high levels of stress narrowing the attentional processes and limiting the officer's ability to perceive and then remember all the elements in the encounter, research has also shown that the more complex the environment (i.e., the more distractions), the more pronounced will be the effect of stress on perception and memory (Langham, Hole, Edwards, & O'Neil, 2002; Strayer et al., 2003). Further, in complex circumstances, our response time slows (Broadbent, 1971; Miller & Low, 2001; Welford, 1980).

High levels of physiological arousal also characteristically lead to a phenomenon called *inattentional blindness*. Inattentional blindness occurs across all senses, but, for a visual example, it is a failure to see what is obviously directly in a line of vision due to an attentional focus on a competing visual input. This results in the unconscious rejection of information even from a single sensory modality in favor of an increased focus on something within that modality that is assessed to be more important at the time (Strayer et al., 2003; Strayer & Johnston, 2001). An illustration of this type of attentional process is the "figure-ground perception or selective attention referred to previously. Auditory exclusion or selective attention in the auditory sense also begins to occur with an increase in stress as attention is then focused on the perceived threat. Under these circumstances, information deemed not relevant to the primary task at hand is simply filtered out. An illustration of this is a mother who would recognize not only the voice of her child but also the location of her child over the noise and melee of a crowd.

Interestingly, the process of selection and attention occurs in the brain itself and not in the senses. For example, research has shown that subjects may view a scene, and then the resulting sensory information is reported to the brain. The brain then selects from the senses what it needs and actively rejects and/or suppresses the rest of the information, thus failing to create a durable, explicit memory of that information (Rumar, 1990; Strayer et al., 2003). Selection is determined in line with assessed survival priorities or even simply the importance of the information to the person. Peripheral information or information deemed at the time to be of little value is even more likely to suffer from factors of selective attention and be unconsciously rejected. This means that an officer in a life-threatening or a high-stress situation can be looking directly at something and literally be blind to it (Simons, 2003). This selective attention is not restricted to a particular sensory modality but can occur across the full range of senses (Simons & Chabris, 1999). Subsequently, an officer's perceptions and memories are, in fact, influenced more by what his or her attention is focused on during the incident than by what actually passes before the senses.

When confronted with a life-threatening incident, the body prepares itself to physically respond. The reader will be familiar with the characteristic sympathetic stress reactions of fight, flight, or freeze. This occurs because all of the stress response system's resources are allocated to the primary task of survival, and one of these responses in a life-threatening encounter will become the default option and will usually lead to survival. The increased blood flow to the heart and large muscles prepares the body for this physical response. As noted previously, one of the stress responses is an increased blood flow to the brain as the body prepares to respond to the life-threatening encounter. The brain prepares for this by not only narrowing perception and attention to focus on the life-threatening event, but also by changing the very way it processes information and makes decisions. While humans appear to be able to simultaneously think and perform various tasks, the brain does not give equal attention to those tasks—even in a non-stress situation. Two demanding tasks cannot be equally shared (Alm & Nilsson, 1995; Briem & Hedman, 1995; Hsieh, 2002). In reality, people switch between tasks versus actually doing them simultaneously. Since cognition and critical decisionmaking under high stress is also typically the least practiced and yet critical skill an officer needs, the officer's ability to accurately perceive and process information in the heat of battle is therefore further impaired through this lack of practice.

Under high stress, the focus and processes of the brain shifts from one of *thinking* to one of *reacting*. The focus of operation shifts from the *new brain* and the hippocampus to the amygdala, also known as the *old brain*. The adrenaline surge accompanying a high-stress encounter results in increased cortisol, which combines with a decrease in hippocampus functioning and an increase in amygdala functioning to improve the speed of our survival response. The hippocampus and other higher-level brain processes commonly referred to as our *thinking brain* begin to shut down (McGaugh, 1990). Phrased in another way, the survival system is predisposed to focus all of its resources on *responding* to the detriment of *cognition* or conscious thought and slower *reasoned* decisionmaking. Reactions are enhanced, but decisionmaking speed and ability are reduced as is our ability to make judgments. Cognitive processing deteriorates. Learning and memory becomes less of a priority (Squire, 1986). These higher, new brain functions, while having the potential to increase the accuracy and appropriateness of the response (Schweitzer, 2001), tend also to slow the response, potentially endangering both individual survival and survival of the species in events that are of a sudden onset and, thus, rapidly unfold and are of a life-threatening nature (Lewinski & Hudson, 2003).

Lessons Learned

- When stress levels are low, the mind maintains a *soft* focus across the senses as well as on internal thoughts and feelings.
- Failure to perceive what would otherwise appear to be obvious is caused by inattentional blindness and auditory exclusion.
- Physiological arousal interferes with perception and memory at all levels, including the ability to receive, retain, and recall information. This is particularly true of information that is deemed "unimportant."
- The system is predisposed to focus all of its resources on responding to the detriment of conscious thought.
- The ability to accurately perceive and process information is a perishable skill.

- The ability to turn off the adrenaline response is critical to maintaining conscious thought and control.
- Emotion activates the amygdala or old brain, increasing recall of central details at the expense of peripheral details.

Common Perceptual and Informational "Errors"

Under conditions of high stress or threat, a variety of perceptual and informational errors are to be expected. The first of these to be addressed is vision.

Vision

Central vision increases at the expense of *peripheral vision* and *depth perception*. This is true even for the typical officer involved in a shooting at high noon under a bright sky. Central vision relies on the cones of the eye, which then leads to both high visual acuity for areas of primary attention and the ability to see color. Improved ability to see objects at *optical infinity*, 20 feet and beyond, occurs, though, at the expense of near vision (Brebner & Welford, 1980). Vasoconstriction of the blood vessels on the periphery of the retina contribute to *peripheral narrowing* or *tunnel vision*, with up to 70% narrowing of the visual field (Breedlove, 1995, cited in Siddle, 1995; Easterbrook, 1959). As a result, an officer will likely be unable to accurately identify individuals or objects next to them or in their periphery under these conditions. These circumstances might even be a factor in deadly crossfire situations, which can result when involved personnel are seemingly unaware that a fellow officer is directly within their line of fire. They can also result in an officer having such a narrow visual and attentional focus that the officer sees and reacts to one shooter when there may actually be two or more.

Low-light conditions, on the other hand, activate the rods of the eye and facilitate peripheral vision. The rods see only in black and white and are responsible for *night vision*. Rods are very sensitive to motion. They are the reason why people see "something" out of the corner of their eye. They are responsible for helping us do a variety of things, including judging speed and time to target, which are important elements in sports like soccer or baseball. Distance, or farsightedness, now becomes the main focus of concern as our night vision rods are not very effective at distance judgments or at judgments regarding depth of field. The officer, operating under these conditions, may fail to accurately identify individuals or objects in close proximity and will be more vulnerable to respond to *furtive movements*. An irony in the law enforcement world is that statistically more officer-involved shootings occur at night or in low-light conditions, while law enforcement training typically occurs under static daylight conditions.

Perspective

This factor in perceptual and informational distortions can either be defined in terms of an individual's physical location in space and, hence, their actual vantage point, or more generally, an individual's philosophical view of the world. *Environmental conditions*, including such factors as lighting, distance, and visibility, as well as an individual's internal environment or *psychological condition*, including issues of fear, anxiety, and stress, all have the potential to cause perceptual distortions. In a study of more than 900 officers involved in shootings, 89% reported experiencing

some perceptual distortions (Honig & Sultan, 2004) and that only accounts for the distortions that they were aware of!

Also, people naturally vary in their ability to perceive, process, and respond to their environment (Lewinski & Hudson, 2003). *Personal needs or biases* and *prejudices*, inherent in all of us, can subconsciously impact perceptions and, hence, performance (Bartlet, 1932). *Biases* are unspoken assumptions, while *prejudices* are basic stereotypes. Both biases and prejudices are frequently relied upon as a means of simplifying the world.

Attention

In addition to the problems noted above, both perceptions and memory are subject to a variety of alterations. These factors of distortion can occur at any point in the process, including the initial observation or attention phase (i.e., whether and/or how accurately the information is received), the transfer of information stage where information is re-coded from short- to long-term memory (i.e., the information is deemed significant enough to retain), or the act of information retrieval (i.e., the ability to accurately recall the stored information). To further compound the problem, an officer's belief or level of confidence in his or her perceptions and/or memory is unrelated to the accuracy of that information (Morgan, 2004). This is true of information that an officer might remember during an interview or that he or she may independently recall at some later point.

Experts in athletics are known for their facility with processing information, making decisions, and reacting in a rapidly unfolding environment. For example, great tennis players do not necessarily *react* to just the ball coming at them over the net. They often are reading the zones of coverage, the body dynamics, the positioning of the opposing player, and the swing of that opponent as factors that contribute to the speed and direction of the ball. This instant pre-assessment of the elements of each shot facilitates their ability to respond and control the play of the game. Factors these athletes are using, such as *selectivity*, which causes us to focus in on some things to the exclusion of others, and *expectation*, which allows us to compare this situation with its similarities to others, gives us the ability to generalize from previous experience and learning, thereby allowing us to quickly assess situations and decrease our reaction time. However, when we do this, we risk increased errors because we may "skip over" critical information. To explain this in terms that we have used already, selective attention can interact with selectivity and expectation to serve to focus our attention on where it is most needed, so we can understand and react to these rapidly evolving situations; however, inattentional blindness can create literal blind spots in our perceptual and attentional processes and, subsequently, lead to errors in our perception and judgment. Depending upon the situation, these processes can either enhance or impair performance in a high-stress situation, sometimes even leading to deadly crossfire situations.

Contextual Cues

These are cues that allow us to generalize from previous experiences to this incident. They arise from information that we acquire about an event before we encounter it or that we learn about as an event unfolds. These cues help us to compare the situation we are in to others that we have been in and facilitate both

our understanding and analysis of new or unknown situations as well as speed up our reaction time to threats that might occur in that incident. Contextual cues mostly lead to accurate interpretations of an incident—which is why we have come to rely on them—but sometimes they lead to inaccurate judgments about an incident or the behavior perceived. Since these cues typically stem from personal experience, they also may include personal biases and prejudices. Subsequently, while they are intended to significantly speed response rates, they can also increase the possibility of an "error in judgment."

The brain also processes different types of information differently, and the various senses rarely operate in isolation. For instance, auditory cues or sounds are processed faster than visual cues, with visual cues taking longer to reach the brain and to be processed (Brebner & Welford, 1980; Sanders, 1998; Welford, 1980). Touch is the next fastest, and the detection of smell, though not the ability to discriminate its source, is the fastest of all the senses. In terms of auditory stimuli, frequency is processed before direction, and perceived directionality can be affected by environmental factors. Motion is perceived before color, and color is processed before shape. The color yellow is processed faster than other colors. These factors, in just the right combination, contribute in some fashion, with the other factors we have discussed, to the majority of *mistake of fact* shootings. This is particularly true for those involving *furtive movements* wherein the officer perceives the suspect's motion, sees a dark-colored object of unidentified shape, and based on his or her prior experience, expectation, and contextual cues, *perceives* a handgun and responds accordingly. It should be noted that all of this is occurring in milliseconds without the luxury of time, additional perspective, and hindsight that Monday morning quarterbacking affords.

The effect of *contextual cues* is enhanced by the brain's innate ability to *recognize patterns* and compare these patterns against existing sets of patterns in our brains. The recognition of patterns relates to information processed by every sense and includes everything from rhythm and physical movement patterns to social patterns. These patterns are embedded in our brains in the form of *schematics* (called *schemas*) so that we do not need to see everything and process everything before we recognize what we are processing. Instead, the evolving information from an incident is rapidly compared to the schematics that we have about similar situations. We then build our reaction on a brief comparison with the schematic. Schemas evolved as a time-saving mechanism meant to enhance analysis and reaction by building on existing information. This same propensity, however, can also result in incorrectly anticipating or seeing a pattern and, hence, responding, when such a response may be unwarranted. Someone walking along a jungle path and hearing the rustling of the underbrush and the soft cough of a leopard does not need to process more information before they begin to flee. If they are correct and they flee, they may survive. If they are incorrect and they flee, they have only wasted energy. Compare these possibilities to the opposite situation wherein the person walking the jungle path ignores the information comparison and hangs around to confirm that what they heard really was a leopard and ends up as lunch for the leopard. The problems generated by our use of schemas has been further identified and researched. One of the most important problems for law enforcement is *pattern correction/completion*. Pattern correction/completion refers to a tendency to subconsciously correct for errors and omissions, often never even registering the fact that an error, omission, or even an addition occurred.

Confabulation

Confabulation means the tendency of the subconscious mind to "fill in the blanks" in an effort to make sense of our actions; it is a close cousin to pattern correction/completion. Human beings have a need to make sense of their world and both understand and explain their actions—not only to others, but to themselves as well (Hobson, 1988). Officers may even have difficulty returning to the streets, especially if they fear facing a similar dangerous encounter, if they cannot make sense of their behavior. When answers are not readily available, and they are desperately needed, the tendency is to fill in the blanks with assumptions based on a combination of prior experience and the situation at hand. These false memories are often spontaneous productions of events or facts that did not occur or memories of events that are displaced in space and time. They can be quite precise and elaborate, but they are not real, and, forensically, the evidence at a scene might directly and convincingly show that the officers' report of what happened did not in fact occur. Therefore it is important to note that confabulations are not lying. They are not deliberate attempts to mislead. In fact, the officers are generally unaware that their memories are inaccurate and may argue strenuously that they are telling the truth. Confabulations occur at a subconscious level and cannot be totally avoided, especially in very high-stress situations such as a sudden, rapidly unfolding, dynamic, complex, and life-threatening situation in which the officer is scrambling to save his or her life or the life of a fellow officer or citizen.

Contamination

This is the unintended influence of new information on a prior recollection, subconsciously altering the prior recollection to again create a memory that "makes sense." *Contamination* is inherent in recall. Memories are vulnerable to *post-event information*. When information gathered at the time of an actual experience is combined with new information acquired later, a smooth, seamless memory may be formed. Quickly, it becomes very difficult to tell which facts came from which time. Post-event information can do more than alter memory for specific details; it can create entirely false memories. Psychological studies have shown that it is virtually impossible to tell the difference between a real memory and one that is the product of imagination or some other process (Loftus, 2002).

Lessons Learned

- Perceptual distortions can occur at any point (e.g., when the information is received, retained, or recalled).
- The mind will see what it expects to see and miss or misinterpret other potentially significant details.
- Tunnel vision or narrowing of the visual field under stress results in loss of peripheral and depth or distance perception causing visual blind spots to occur.
- Heightened situational awareness reduces tunnel vision.
- Sound is perceived before sight; motion is perceived before color; and color is perceived before shape. This difference in perception and processing time can profoundly affect the decisionmaking process and, hence, the resulting action taken.

- Confabulation occurs when the subconscious mind "fills in the blanks." Confabulation can never be totally eliminated.
- Contamination is the unintended influence of new information on a prior recollection. Contamination can never be totally eliminated.

Reaction Time

Arousal level is critical to perception, response time, and performance. Too much or too little arousal impairs performance. Fatigue slows reaction time, particularly for complex tasks (Welford, 1980). *Mental fatigue* has the greatest effect on reducing reaction time. Response speed slows after error, and for a variety of reasons, error begets further error (Sanders, 1998). This can translate into poorly placed rounds on a target frequently being followed by additional "misses." Positive practice, on the other hand, increases response time through improving both motor memory and mental processing (Ando, Kida, & Oda, 2002; Etnyre & Kinugasa, 2002; Sanders, 1998).

Distractions increase cognitive processing and, hence, reaction time by forcing an officer to discern the essential from the unimportant. Physical fitness speeds reaction time by improving the speed of motor contraction (Welford, 1980). In general, reaction time becomes more variable with age (Hultsch, MacDonald, & Dixon, 2002). Advancing age leads to slower reaction times, with the initial effect beginning in the mid to late 20s and becoming more apparent after age 50 (Jevas & Yan, 2001). Sensory integration, or the ability to take information from different sources and combine it, decreases with increasing age, while physical reaction time in response to a stimulus increases.

Anticipation of an event improves reaction time by 20%, but only if the warning occurs right before the presentation of the stimulus. This directed foci, however, could also increase error as discussed previously. Hyper-vigilance can only be maintained for a few minutes, and prolonged hyper-vigilance can negatively impact both response speed and accuracy (Lewinski & Hudson, 2003).

Numerous factors, in addition to those already mentioned above, can affect performance in general as well as reaction time specifically. For example, the weaker the stimulus, the longer the reaction time. Faint light and shadows take longer to process thereby increasing reaction time while at the same time reducing performance accuracy (Luce, 1986). The perception of distance is often miscalculated, and both motion and shadows are frequently mistakenly seen. The perception of any of the three can also be affected by a number of environmental variables.

Finally, gender has an effect. Males tend to react faster than females, while females tend to be more accurate than males (Adam et al., 1999; Barral & Debu, 2004). These differences are most likely the result of the greater reliance on metacognitive skills such as *self talk* and *thinking about thinking* by females (Botwinick & Thompson, 1966). As noted previously, there tends to be an inverse relationship between reaction time and accuracy, at least in part due to decisionmaking as a moderating variable. As one goes up, the other goes down.

Scientific and practical limitations governing human performance must be taken into account when evaluating an officer's performance. Reaction time includes both the processing of information as well as the time it takes to physically respond. In a shooting scenario, processing takes about four times longer than the actual response phase (Lewinski, 2000). This applies to both the initial processing of information that ultimately drives the officer's actions as well as the processing of any change in information intended to cease the officer's current course of action. Research has found that the speed of reaction can be increased by practice (Lewinski, 2002).

To react, an officer must first perceive a threat, which will typically result from *processing* the actions of the suspect and then determining the appropriate response. The suspect, however, will by then already have moved in to the shorter response phase (e.g., pulling the trigger), resulting in *action* always being faster than *reaction*. The greater the intensity of focus on a prior stimulus at the time of stimulus change, the longer it will take the officer to notice and respond to the change, including ceasing fire. Increasing the complexity of the scenario further increases the response lag. In practical terms, this will frequently result in it being physically impossible for an officer to immediately cease fire upon cessation of a threat (Lewinski & Hudson, 2003). In general, slowing the actual response allows for increased accuracy, including increased ability to respond to a change in the environment. As with most things, practice responding to change can improve performance, though, again, within the practical limitations governing human performance. Given these factors, tactical planning and positioning are critical to minimizing deadly force encounters (Lewinski, 2000).

Lessons Learned

- Action is faster than reaction.
- Distance is often miscalculated, and both motion and shadows are frequently mistakenly seen.
- In general, increasing the speed of response increases the probability of error.
- Positive practice increases response time and accuracy by improving motor memory and mental processing skills.
- Too much or too little arousal impairs performance.
- Information processing takes four times longer than the actual time to respond. This also applies to information intended to cease action.
- The greater the intensity of focus, the longer it will take to notice and respond to change.
- Scientific and practical limitations governing human performance must be taken into account when evaluating performance.

Memory: Fact or Fiction?

Two types of amnesia have been found to occur following a traumatic event. *Retrograde amnesia* refers to the loss of memory for events that occur up to two minutes prior to the traumatic event. *Hyper amnesia* refers to the fact that memory for emotionally charged events tends to improve over time. High arousal typically interferes with recall of *peripheral details* or those deemed to be less important, while recall of *central details* or those perceived most critical to survival increases under conditions of high arousal. An officer involved in a highly stressful event

may be unable to accurately recall many of their own actions, much less those of other officers, even those in close physical proximity. This is particularly true of actions taken just prior to the shooting or other highly stressful event.

The passage of time, in and of itself, generally has a positive effect on memory recall and consolidation. Research has found that within 24 hours, approximately 30% of information will be recalled, with 50% recalled after 48 hours and 75 to 95% recalled after 72 to 100 hours (Grossman & Siddle, 2005). This appears to result from both a general reduction in arousal combined with the memory consolidating effects of sleep (Anderson & Pichert, 1978; Hasher & Zachs, 1984; Kihlstrom et al., 1990). Sleep, particularly the REM or dreaming cycle, is normally the time when information from the day is processed and consolidated in with existing schema (Cartwright et al., 1975; Tilly & Empson, 1978; Pearlman, 1982; Schoen & Badia, 1984; Scrima, 1982). Over time, a *personal narrative* or story develops to tie the incident information together. The officer attempts to integrate this current experience into existing mental schema to make sense of his or her actions. Twenty to forty percent of officers involved in a shooting report loss of memory for at least some significant aspect of the incident (Artwohl, 2002; Honig & Roland, 1998; Honig & Sultan, 2004). The true effect is likely significantly greater as most officers would be unaware of the full range of details for which they cannot account.

Memory is an active, constructive process that is susceptible to being altered by associated prior experiences and the emotional state of the officer at the time of recall. *Cognitive dissonance*, the internal conflict that arises when confronted with choosing between various options or points of view, produces *blind spots* for information that does not fit within the *accepted* recalled scenario. Conflicting information is ignored to avoid the associated discomfort. It should be noted that this process, like so many of the processes previously discussed, occurs *automatically* on a subconscious level.

Returning to the incident site commonly referred to as a *walk through* and discussing the incident with other involved parties can have a positive effect on stimulating the memory trace. On the other hand, it is also at this point that the officer is most subject to factors of contamination and confabulation. Emotions generated by re-creating the experience can help in recalling accurate memories as long as the officer has had time to both reduce his or her overall state of arousal and begin the process of memory consolidation (Blaney, 1986; Bower, 1981; Chang, 1986; Clark, Milberg & Erber, 1987; Teasdale & Fogerty, 1979). Research has found that not only does participation in a realistic training scenario deliver close to the same emotional and physiological arousal as would be expected from an actual incident but that both internally replaying and externally recounting the incident produces essentially the same effect (Lewinski, 2006).

Both confabulation and contamination, combined with the normal process of deterioration of the memory trace over time, will inevitably lead to at least some distortions and errors in recall. The process of ultimately recounting information subsequently hardens the memory against further contamination (Loftus, 1977; Loftus, Miller & Burns, 1978). As stated previously, this increased level of confidence, however, does not necessarily mean the recalled information is any more accurate.

Lessons Learned

- Memory for specific emotionally charged events improves over time. This is referred to as hyper amnesia.
- Memory loss frequently occurs for up to two minutes prior to a traumatic event. This is referred to as retrograde amnesia.
- Twenty to forty percent of officers involved in a shooting report loss of memory for at least some significant aspect of the incident. This is likely an underestimate of the true effect.
- An officer involved in a highly stressful event may be unable to accurately recall many of their own actions, much less those of other officers, even those in close physical proximity.
- Reducing arousal increases memory recall.
- Sleep combined with the development of a personal narrative to tie incident information together speeds memory consolidation and facilitates recall.
- Re-creating the emotions generated by the incident, including returning to the site and discussing the incident with other involved parties, can increase recall. This must be balanced, however, against the risks of contamination and confabulation.

Implications for Training and Tactics

Many of the natural physiological propensities described above contribute to the generally low "hit ratio" of officer-involved shootings, typically no better than 25%, experienced by most law enforcement agencies. Highly perishable skills that in some sense require an officer to perform in a manner counter to what natural selection originally designed requires many more realistic training opportunities than the vast majority of agencies provide. Critical to performance under stress is the ability to quickly control the stress reaction and, hence, reduce the release and effect of adrenaline on the system. In fact, one difference between a novice and an expert is the level of physiological and psychological arousal and activity experienced by each before, during, and after an incident, including the expert's improved ability to more quickly return to baseline or normal functioning condition.

Inoculation training helps an officer compensate and respond under conditions of physiological and psychological arousal. While it is unrealistic to expect that all perceptual distortions can be prevented, practiced efforts to maintain activation of the *thinking brain* and, hence, cognition and critical decisionmaking under stress can increase an officer's ability to simultaneously respond and remain in action mode and at the same time perceive and process incoming information in the heat of battle. Focusing on decisionmaking as a specific skill will, at least temporarily, result in a reduction in speed of response, though a concomitant gain in the quality of the response should be achieved. Performance under stress becomes a calculated, planned reaction rather than solely an automatic, autonomic action.

Realistic, complex scenario-based training that includes the full range of physical and mental tasks an officer is required to perform in a deadly confrontation, up to and including the recall and reporting of critical scenario details, is essential to improving an officer's performance and resiliency following such encounters. Repetition, then, further increases motor memory and mental processing as well as provides for positive practice of these critical perishable skills. Realistic training,

which includes the unexpected, also reduces an officer's tendency to overanticipate and preemptively react with a pre-programmed response when a novel response may be more appropriate, thereby enhancing mental, interpersonal, and physical adaptability (U.S. Army Research Institute for the Behavioral and Social Sciences, 2005).

Metacognitive skills, such as positive self-talk and the playing out in one's mind of potential scenario sequences of action/reaction, can improve focus and increase the officer's response repertoire, allowing for a more seamless transition to "Plan B" if needed. This ability, in fact, is a critical determiner of expert status. While the novice must first consciously evaluate and decide the appropriate course of action prior to initiating a response when presented with a situation that is contrary to his or her initial expectations, the expert automatically moves between a range of "Plan B" responses while simultaneously evaluating incoming information.

Personal feedback, provided both visually through the use of video as well as verbally to the involved officer(s), completes the loop. All elements of an officer's performance, from the manual to the mental, including both perceptual and decisionmaking components, benefit from this comprehensive training approach. Initial implementation of any new training should be both gradual and stepwise, with all skills developed to the level of proficiency prior to the introduction of new skills.

Lessons Learned

- Short-circuiting the adrenaline response is critical to enhancing physical and psychological performance.
- Realistic, complex, multi-tasking training scenarios produce the same physiological and emotional arousal as an actual incident, both inoculating and reinforcing highly perishable skills.
- Repetition increases motor memory, mental processing, and intuitive decisionmaking under stress.
- Good decisionmaking requires analysis, synthesis, and evaluation of information.
- Rote training instills quick response based upon expected cues. Conversely, novelty in training encourages intuitive decisionmaking and the ability to innovate under pressure. Both are essential.
- Recurrent training maximizes skill proficiency and officer confidence.
- Personal feedback provided both visually and verbally is critical.

Interviewing and Incident Recall

Striving for perfection in the total recall of an officer after an incident, particularly in the areas of perceptual processing and memories of performance, may be a worthy ideal; however, as a practical goal, it is not achievable. Error can never be entirely eliminated. The goal of the interview is to find the truth; it is as simple and as complex as that. Officers, investigators, and the police executives who evaluate performance must have a basic understanding of the critical factors that affect both perception and performance under stress. Efforts to maximize opportunities for the integration of the most reliable information (e.g., event narration, viewing videotapes of the incident, doing a walk through of the scene, discussing the incident

with other officers on scene) while at the same time reducing contamination from outside sources (e.g., the media, uninvolved peers, etc.) can enhance accurate recall (Loftus, 1979; Loftus & Green, 1980; Loftus et al., 1978; Marshall, 1978). However, these same techniques, in addition to guided imagery, context reinstatement, mild social pressure, and encouraging repeated attempts to recover the memory, are also the ones most at risk of eliciting a false memory (Loftus, 2002). Ultimately, the risk of contamination and confabulation, deliberate or not, must be weighed against the benefits of improved recall.

While there are officers who, for any number of reasons, may intentionally fabricate the facts of an incident, skilled interviewing by an investigator familiar with the research related to perception and performance, combined with a solid forensic assessment of the scene, should provide ample opportunity to differentiate mistakes of fact from conscious attempts at manipulation of the evidence (Fisher & Geiselman, 1992). Memory for stressful events must be understood in terms of complex interactions between the types of event (emotional versus neutral), the type of detail (central versus peripheral), time of interview (immediate versus delayed), and retrieval conditions.

Interventions, including removing the officer from the scene to a lower stress environment, recommending exercise to burn off excess adrenaline, providing the opportunity for a normal sleep cycle, and allowing for the passage of time prior to participation in a detailed interview to mitigate the need for the officer to "fill in the blanks," can minimize the risk of confabulation. The resulting personal narrative that is critical to traumatic incident recall, while not perfect, will likely be more reflective of the true facts of the incident. Admonitions to the officer to avoid outside influences, including participation in discussions of incident details with family and friends or colleagues, as well as to avoid viewing media reports prior to the initial interview, should also occur. If a detailed interview must be immediately conducted following a critical incident, a follow-up interview should occur the next day with the understanding that additional and potentially conflicting information may result as a normal part of the memory consolidation process and cannot be automatically assumed to be indicative of lying.

Lessons Learned

- Error can never be eliminated entirely.
- Memory enhancing techniques work to maximize accurate recall but also increase the risk of eliciting false memories.
- Discrepancies should not automatically be assumed to be the result of conscious deception but, rather, a function of the memory consolidation process.
- Utilization of state-of-the-art interviewing techniques is critical to maximizing accurate incident recall while minimizing the effects of contamination and confabulation.
- Following involvement in a traumatic incident, affected officers should be removed to a low-stress environment to reduce the negative impact of heightened physiological and emotional arousal.
- The officer should then be provided with the opportunity to give a basic, detailed incident narration with specific questioning to occur at a later time. Admonitions to avoid contamination from outside information sources relative to the incident should be given and the officer should be sent home to sleep.

Memory consolidation and the development of a personal narrative will further enhance recall. The officer should then be re-interviewed the next day, first with an opportunity to provide additional, unsolicited information followed by utilization of accepted memory enhancing interviewing techniques, including context reinstatement, guided imagery, and specific queries as well as an opportunity to participate in a walk-through. A subsequent interview should then be conducted within a few days. This protocol maximizes the quantity and quality of the information obtained. Some variations in reported information will naturally occur as a side effect of the memory consolidation process.

Implications/Recommendations

An understanding of the various factors that contribute to errors in perception, mistakes of fact, performance deficits, and inaccurate incident recall is essential to the modern-day law enforcement executive and should serve to guide a department in effectively training and fairly evaluating the actions of its personnel. A large body of research reflects how common these phenomena really are. An understanding of the science of human factors in force encounters needs to become an integral part of the investigation. Expectations that officers can defy the laws of science and exceed the limits of human performance are unrealistic. Therefore, law enforcement agencies and the public must come to understand that it is unrealistic to expect infallible judgment, flawless performance, and comprehensive recall from every officer in every circumstance wherein the officer is tasked with making split-second decisions involving life or death.

A given organization must weigh the relative risk and liability that the organization wishes to assume for, for example, failing to shoot an armed combatant, potentially resulting in the death of an officer, versus accidentally shooting an unarmed suspect. Likewise, the benefits of enhanced incident recall must be weighed against the risk of intentional falsification of evidence by involved personnel. These should be conscious decisions made in line with an organization's mission and core values, and clearly articulated to all its constituents. Life and death encounters involve difficult decisions with significant ramifications. It is a mathematical reality that error cannot be completely avoided and, in fact, efforts to reduce the likelihood of one type of error will automatically result in an increase in the opposite type of error. Agencies must decide the acceptable level of risk and liability and provide appropriate training to their personnel in line with that risk.

Corrective action plans emphasizing retraining and remediation versus discipline and punishment are more appropriate in response to officers who make mistakes, have misjudgments, or err in making these split-second decisions. Law enforcement personnel at every level need to increase their sophistication and understanding of the scientific research that defines the limits of human performance; focus on improving the training of all personnel, including investigators; and use this opportunity to enhance public dialog with the intent of minimizing conflict resulting from unrealistic expectations of officer performance. Public trust can be maintained through thorough education and investigations with serious discipline for those rare officers who betray the public trust by willfully manipulating the details of a critical incident.

Lessons Learned

- There are no "superhuman" people. Physical and mental limitations are the same for everyone. No exceptions.
- An understanding of the factors that contribute to errors in perception, performance, and inaccurate incident recall is essential for the modern-day law enforcement officer, investigator, supervisor, manager, and executive.
- Agencies must analyze their own use-of-force patterns and develop training scenarios that mimic lighting, distraction, movement (predominantly lateral) by both the officer and the suspect, and task complexity (pursuit followed by a shooting, hand-to-hand struggle followed by a shooting), including comparable physical and emotional exhaustion levels.
- Training must occur on a repetitive basis so that the officers develop a high level of proficiency and confidence in their performance. The exact frequency of training will vary based on a combination of individual characteristics, prior experience, and job demands.
- The scenario training should be videotaped and include the officer recounting verbally and in writing the incident details in a manner similar to what would occur following an actual incident. This will provide the officer first-hand experience of the factors affecting perception, performance, and memory recall and provide the necessary feedback loop to further refine performance.
- Scientific and practical limitations governing human performance must be taken into account when evaluating performance.
- Corrective action plans in response to mistakes and misjudgments made as a result of split-second decisions should emphasize retraining and remediation.

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