The Future of Simulation Technology for Law Enforcement

Diverse Experience with Realistic Simulated Humans

By Chris Forsythe, Ph.D.

Placed in a life-threatening, rapidly developing situation, individuals with true expertise exhibit the capacity to assess the available cues, interpret events, and quickly reach a decision concerning an appropriate course of action. In contrast, when presented with identical circumstances, a novice will display either indecisiveness, failing to comprehend events, or reach a hasty judgment by overlooking or misinterpreting vital cues. This observation applies to interactions with suspects, bystanders, and the individual's own team members. What characteristics underlie expert decision making? How can simulation technologies be used both as training and tactical tools to accelerate and enhance decision making by law enforcement personnel?

People long thought, and often used as the basis for training, that expert decision making involved a thorough consideration of the alternative courses of action and careful evaluation of the pros and cons to identify an optimum decision. However, when experts in the field were studied making real-life decisions in stressful circumstances with accountability for the outcome of individual actions, a very different pattern of behavior emerged. These individuals rarely attempted to identify alternative courses of action, and, quite often, they only considered a single solution. Furthermore, instead of committing the resources of time, attention, and mental effort to an evaluation of alternative courses of action, experts devoted these resources to understanding the cues available to them. Once the expert had collected sufficient cues, familiar patterns emerged within these cues. The expert recognized the "situation" and, accompanying this recognition, implicit knowledge of the actions appropriate to the situation, as well as expectations of what might or might not happen, emerged. This pattern of behavior has been observed for expert decision making within a variety of contexts, including personnel involved in fire fighting, military and aviation operations, and medical and business professions.[1]

Simulation as a Tool for Training Decision Making

Because of the differences between expert decision makers and novices, how might technology and, in particular, simulation technology, be employed to enhance decision-making capabilities? Tremendous investment has been placed in technologies, such as expert systems and decision support systems that seek to automate the decision-making process. While offering great promise, such technologies often have failed to meet

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expectations. Researchers have documented several problems and, in general, these technologies tend to promote disengagement by the human decision maker. Humans step aside and let the technology take over, sacrificing situation awareness and, most alarmingly, sometimes doubting their own expertise in favor of the technology. Thus, the law enforcement profession must use caution when adopting any technical solution that removes the human decision maker from the process.

Experts have experience that covers a sufficient number of events to allow them to recognize subtle patterns of cues and see similarities between ongoing and past events. With this recognition, experts anticipate what to expect next, and what actions will, or will not, be successful.

> **"...simulated humans may be attributed experiential knowledge comparable to a life history."**

Simulation-based trainers have become commonplace tools for enabling individuals to acquire experience operating equipment, ranging from automobiles and aircraft to the control stations of nuclear power plants. However, in training law enforcement personnel, the requirements for simulation-based training are somewhat different. Law enforcement personnel need experience making decisions in situations in which other *people*, whether suspects, bystanders, or team members, are primary features. In these areas, future simulation technologies stand to have the greatest impact for law enforcement personnel.

Many current simulations, as well as computer games, incorporate human entities and allow participants to interact with those entities. It might seem that the ability for trainees to gain experience in a law enforcement role already exists. Many people are concerned that the synthetic humans used to populate most current simulations do not provide a sufficient level of behavioral realism.[2]

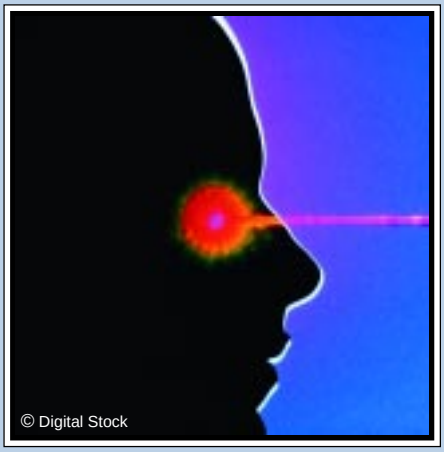
For many years, within the simulation and computer-gaming industry, researchers have placed a heavy emphasis on accurately modeling the characteristics of equipment and providing a high degree of realism in computer graphics, sound, and other sensory experiences. Substantially less emphasis has been placed on the behavioral realism of simulated humans. In many cases, synthetic humans have been provided simplistic and predictable behavioral routines that are highly susceptible to gaming (i.e., once the behavioral routine is recognized, players exploit this knowledge of the underlying software to their advantage).

In other cases, sophisticated artificial intelligence and machine learning have been employed to create simulated entities with a broad repertoire of behavior and flexibility to adapt behavior during the course of a single or multiple simulations. Behavioral breadth and flexibility are only two of many factors that contribute to the realism of simulated humans. Probably, the most important attribute missing with nearly all current artificial intelligence-based simulator entities is the ability to think like humans. Granted, countless illustrations of machine reasoning exist. However, human experts prove extremely competent without much reliance on the logical operations that characterize typical machine reasoning. In contrast, realistic, human-like entities should use the knowledge and experiences unique to them to extract patterns from cues present in the environment, resulting in their recognition of "situations." People base everyday interactions on

an implicit understanding of this basic human cognitive process, and simulated entities must behave similarly for simulation-based training to realize its potential as a source of experience in attaining expertise in a law enforcement role.

Simulation Technology for Law Enforcement

As a training system for law enforcement, simulation technology must enhance the objective of allowing personnel to gain experience with a breadth of social interactions characteristic of those encountered by law enforcement. With simulation-based trainers, available technology spans a wide gambit with fully immersive virtual reality, using head-mounted displays and bodysuits at one end and text-based systems presented on a desktop computer at the other. Given a reasonably high level of fidelity with respect to the tasks being trained, little or no additional gain in training occurs from having high fidelity in other dimensions of the simulation.



A notional simulator trainer might include a three-dimensional computer graphic representation of a variety of residential, commercial, industrial, and other settings with an ability to naturally move about, look around, and direct actions (e.g., aim a firearm, point); a variety of computer graphic representations of human figures that move naturally, display appropriate gestures and expressions, and exhibit realistic patterns of speech; and a capability for the trainee to speak naturally and the simulator to comprehend that speech and direct the behavior of simulated humans accordingly. While an integrated system currently is not available off the shelf, each of these technical capabilities exists with varying degrees of maturity and integration. Fully integrated systems should be available and affordable within the next 5 to 10 years.

Current research and development at one research laboratory provides a framework for creating highly realistic simulated humans. Specifically, these synthetic entities process cues and interpret situations in a manner consistent with decision-making processes, presenting a computer-based entity human-like at the level of its most basis cognitive operations.

Within the framework developed by this laboratory, the behavior of simulated entities is a direct product of the knowledge attributed to those entities. At the most basic level, this knowledge consists of three components. First, situations occur where knowledge involves contexts conducive to specific actions, although the action may be to do nothing. For example, “take a hostage,” “don protective clothing,” and “hide” each might denote situations. Second, cues exist, such as “presence of marksmen,” “sound of a diversionary device,” or “availability of a hiding place.” Finally, knowledge of the patterns and combinations of cues that give rise to recognition of different situations must be present.

At a slightly more sophisticated level, the knowledge attributed to simulated entities would include emotional associations with cues and situations. Emotional processes are important to achieving realism due to their influence on the attention directed to cues and situations. Specifically, when a cue has a strong emotional association (e.g., association between a snake and fear), attention is focused on that cue while other

equally salient or important cues are neglected. Given simulated humans that respond in this manner, trainees may explore the use of tactics that seek to intentionally evoke an emotional response.

At an even more sophisticated level, simulated humans may be attributed experiential knowledge comparable to a life history. This is believed particularly important because, arguably, how people interpret a situation is as much a function of their unique life experiences as other knowledge that they might possess. In the course of a simulation scenario, various events may trigger the recall of past experiences, including emotional associations, with the simulated entity interpreting ongoing events relative to those past experiences. Furthermore, trainees may be provided full or partial knowledge of these past experiences, or even erroneous information, and allowed to use this information in their interactions with simulated entities.

> **"...simulation may be employed in a mission rehearsal capacity."**

Researchers are developing tools that will automate the process of creating simulated entities. Thus, unlike most current systems in which a single or a small collection of simulated entities exists, the number of simulated entities will be unlimited with each entity possessing unique knowledge, emotional associations, and life histories. Consequently, trainees may interact with a variety of individuals.

An even greater diversity of experience may be attained by presenting simulated entities that exhibit cognitive and behavioral characteristics consistent with various psychopathologies, as well as basic personality traits and degrees of intelligence. For example, by manipulating parameters underlying the cognitive operations of simulated entities, certain personality traits (e.g., extroversion/introversion) may be manifested. Similarly, other adjustments may produce cognitive behavior typically observed with certain psychopathological conditions, such as schizophrenia. In addition, it also should be possible to simulate the effects of fatigue and certain psychogenic substances (e.g., amphetamines).

Other developments focus on creating the ability to represent, in a simulated entity, the knowledge and, to some extent, experiences typical of individuals from specific cultures or groups. Taking these capabilities a step further, it becomes possible to create entities representative of specific high-profile individuals. For example, this technique may be used with cult leaders for whom a vast record exists of their past experiences, writings, correspondences, and speeches.

Other Applications for Simulation

While future capabilities for simulation technology primarily address the needs for law enforcement training, two other applications also may prove useful. First, simulation may be employed in a mission rehearsal capacity. Before being sent to clear a building, trainees may conduct the operation, including potential interactions, using simulation. This would expose personnel to a wide array of various contingencies that might arise during the course of an operation. Furthermore, in high-profile cases, this same capability also may allow negotiators to explore various approaches in dealing with known individuals and to see the range of potential reactions certain tactics may produce.

Second, simulation may be used as an analysis tool. In this capacity, alternative tactics and

team compositions may be explored, lethal and non-lethal weapons assessed, and vulnerabilities in facility and other security operations identified.

Conclusion

Law enforcement personnel exhibit various characteristics during the decision-making process. To further enhance decision-making capabilities, agencies can use simulation technology as a training method for their officers to gain experience in various situations.

The key development in simulation technology that benefits the law enforcement profession involves the ability to interact in a natural manner with highly realistic and diverse simulated humans. These capabilities are not yet available; however, rudimentary capabilities have been developed. Currently, research laboratories are working on simulation technologies to provide the full range of capabilities that the law enforcement profession needs, as well as to offer them in packages that departments can afford. ✦

Endnotes

[1] For additional information, see Gary Klein, "An Overview of Naturalistic Decision-Making Applications," in C.E. Zsambok and G. Klein, *Naturalistic Decision Making* (Mowah, NJ: Lawrence Earlbaum,1997), 49-59.

[2] R.W. Pew and A.S. Mavor, National Research Council, *Modeling Human and Organizational Behavior* (Washington, DC: National Academy Press, 1998).