The Impact of Visual Complexity, Decision Making and Anticipation

The Tempe Study

Experiments 3 & 5

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Introduction

In the last edition of *The Police Marksman* we wrote about the initial results of a study conducted with the support of some very talented individuals in the Electrical and Computer Engineering Department at Minnesota State University, Mankato. Although we received tremendous support in the form of graduate assistants, equipment, etc. from the University, and unbelievable cooperation from Tempe Police Department, the study still cost the senior author almost $20,000 and a month of his life. So while you're reading this article and wondering why someone would research something so unusual, especially when it cost them so much, the answer is not that we're university professors and have no life. The real reason is because there are at least three officers in this country currently facing homicide charges, of some form, because we believe a prosecuting attorney is judging their shooting based on romantic notions of right and wrong, or legal notions of the rational man, without an understanding of basic human limitations. This research at some point may enter and influence the arena of training. Right now we would be very gratified if it entered the world of Internal Affairs, department administrators, judges and attorneys, so that officer involved shootings could be based on hard science. The purpose of this series of studies is to bring some of these concepts into the world of law enforcement. In some cases we'll simply prove what you have known all along. In other cases we will break new ground in human performance in lethal force encounters. Either way we hope it will prove as informative and entertaining for you as it is gratifying for us.

In the Temp Study 102 officers from Tempe, Arizona Police Department were tested in five separate experiments. This article will give the results of primarily one of the experiments – Experiment Number three. Data from Experiment Number Five will be introduced to help us understand the role of anticipation on the trigger pull reaction time results we got from Experiment Number Three. Experiment Number Three was an attempt to understand the impact of simple decision-making and visual complexity on reaction time. Experiment Number Five tested the influence of anticipation on reaction time when an officer, in a visually complex situation, has to make a decision, anticipates an expected outcome and gets it. Hopefully these studies will lead to a better understanding of the broad parameters of an officers' trigger pull reactions and human limitations in the lethal force equation.

History and Principles

An analysis of officer-involved shootings tells us that a number of well-studied psychological principles are in operation in every shooting. These principles are connected to perception (the act of seeing and understanding a stimulus,) processing (the act of making sense of what is seen and making decisions on it) and then reacting (the act of responding to what is seen and processed.) For review, the focus of the first experiment of the Tempe Study was basic reaction time. The results from Experiment Number One, as printed in the September/October 2003 edition of *The Police Marksman*, are following. The average trigger pull reaction time to a simple, light stimulus was 31/100^{ths} of a second. Because of the specialized equipment constructed for this study, we were able to break the reaction time up into two separate components. The act of seeing the stimulus light come on, processing that information and sending a message to the finger, on average, took 25/100^{ths} of a second. The average time for the mechanical action of actually pulling the trigger on the research gun was 6/100^{ths} of a second. This was the time it took to move the trigger from its normal resting position to a position at the rear of the trigger guard.

Experiment Number Three

In the Tempe Study, after we determined the reaction time for a simple visual reaction, we wanted to study the reaction time of these same officers under more demanding circumstances. First, we introduced the simplest decision-making element possible. It is called a "go/no go" decision model. In the Tempe Study, this meant the officers were to pull the trigger when all three lights in a three light cluster came on. They were not to pull the trigger when only two of the three lights or when none of the lights in a three light cluster came on. They were not to pull the trigger when only two of the three lights or when none of the lights in the cluster came on.

To add to the complexity of the task, the cluster of three lights was in a row with two other clusters of three lights. The combination of two or three lights could go on in any one of the three sets of clusters. The officers were distracted with random bursts of two lights across all three clusters and finally the three light stimulus came on. Because the clusters were only separated from each other by four inches and the officers stood six feet away from the stimulus board, the officers did not have to move their eyes very far, but the number of possibilities of right and wrong were now tripled. It was still nowhere near the complexity of a real life-and-death lethal force encounter, but the officer's visual processing and reaction were stressed more than in the simple "go" trigger pull reaction to a light coming on or a target being exposed.

In the laboratory, when researchers introduced the simplest decision-making model and some visual complexity, as we did in Experiment Number Three, the average civilian's reaction time was doubled. That's the result we got in this study. The officer's trigger pull reaction time was doubled. Remember, in Experiment Number One, on simple visual reaction, the time to the start the trigger pull was 25/100^{ths} of a second, with the actual trigger pull taking an additional 6/100^{ths} of a second. In Experiment Number Three, which is minimally more complex the time of the perception, processing and nerve/motor impulse component was doubled to 50/100^{ths} of a second. The added 6/100^{ths} of a second for the trigger pull resulted in an average time for an officer to complete a reaction trigger pull of 564/1000^{ths} of second or 56/100^{ths} of a second.

There are a many ways to present the data from an experiment like this. It might be helpful in understanding the scores to look at how the main body of officers did on this experiment. In Experiment Number Three, the majority of (68%) of officers were able to perceive, process and react to the stimulus between 44/100^{ths} of a second and 69/100^{ths} of a second. This apparently, astounding 30% range reflects many things including variability in innate reaction and processing ability, concentration and attention ability and skills, test anxiety, etc. that normally vary considerably across any group of people. However, given the sample size and the number of repetitions per person, as well as the fact the scores on this experiment are consistent with other research, we can conclude that the trigger pull reaction time we got in this experiment is a very accurate and credible time, not only for Tempe, but for all law enforcement officers across the nations.

The "Oops" Factor

Even though the stimuli the officers were reacting to were emotionally, socially, racially and economically neutral, as well as being of relatively low stress, we still got errors in decision-making. We got errors because we introduced simple decision-making. Anytime decision-making is introduced into an experiment, errors become possible. Thirteen percent of the officers' responses in Experiment Number Three were incorrect, meaning that the officers pulled the trigger when they shouldn't have (9% of all trigger pulls) or the officers failed to pull the trigger when they should have (4% of all pulls). This error rate is to some degree, due to the nature of the experiment. The stimuli lights were on for only half a second. The officers who failed to respond on four percent of the shots were composed of two groups. A small number of officers, who failed to react, did so because they did not detect the onset of the stimuli to pull the trigger. More frequently, they detected the stimuli and confirmed it, only to have it go off before they could react

Therefore most of the “failed to respond” category, belong in the “really slow” reacting category rather then in the “failed to respond” category.

The trigger pulls of the officers who pulled the trigger on the wrong stimuli made up nine percent of all of the trigger pulls. This is not an unusual rate of error for this kind of experiment in the laboratory. Before discussing this point further, we need to examine the role of anticipation on trigger pull reaction.

Experiment Five – The Role of Anticipation

In Experiment Number Five, the officers were confronted with a variety of lights on the full stimulus board. All of the lights lit up at irregular intervals. Within the array of lights, a pattern of green lights would start to appear. The pattern would either become complete, at which point the officer was to pull the trigger, or the pattern would disappear, at which point the officer was not to pull the trigger but instead, wait for the build up of the next pattern. This presented the officer with a visually complex picture that involved reacting in a go/no go fashion as in the previous experiment. It also gave the officer a better chance to focus on the relevant stimuli (threat.) And, it gave him the opportunity to anticipate or expect a particular outcome.

Anticipation had a significant effect on the officer’s reactions. It decreased the officer’s reaction time by 20% - the average reaction time under the anticipation condition was 46/100^{ths} of a second, instead of the 56/100^{ths} of a second in Experiment Number Three. It almost eliminated the slow and/or no trigger pull responses. Anticipation also dropped the incorrect trigger pulls to 5%. This error rate is rally good for a decision-making test, under these conditions, in a laboratory. This is still a very unacceptable level for a street encounter. The dilemma is that these are normal parameters and error rates for human beings in a laboratory situation.

BASE RATES

(All measurements include the **6/100^{ths} of a second**, which is the actual time for the mechanical action of pulling the trigger)

Reaction Time for Simple Visual Situations = **31/100^{ths} of a second**

Reaction Time for Simple Decision-Making in More Complex Visuals Situations = **56/100^{ths} of a second**
(Total Error rates = 13%)

Reaction Time for Simple Decision-Making in More Complex Visual Situations, Moderate By Anticipating a Specific Outcome = **46/100^{ths} of a second**
(Total Error Rates – 5+%)

Conclusion

Remember, this research is done in a controlled laboratory situation. The stimuli are simple, immediate on/off colored lights. The officers’ responses are unaffected by issues of race, sex, economic status, street experience or the emotional status of the officer, etc. The researchers were only interested in measuring reaction to very neutral situation – in essence to establish simple base rates of reaction time under a variety of circumstances.

The next level of research to be conducted is to test the concepts explored in this series of experiments, in a controlled, near real situation and begin to examine the impart of higher levels of stress on perception, processing and reaction.

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