‘Gun! Gun! Gun!’: An Exploration of Law Enforcement Officers’ Decision-Making and Coping Under Stress During Actual Events

Kevin R. Harris [a], David W. Eccles [b], Carlos Freeman [a], Paul Ward [c]

[a] Department of Psychological Science and Counseling, Austin Peay State University, P.O. Box 4537, Clarksville, TN 37044-4594, USA; harrisk@apsu.edu; (931) 221-6505. Corresponding author.

[b] School of Applied Social Sciences, Durham University, 42 Old Elvet, Durham, DH1 3HN, UK; d.w.eccles@durham.ac.uk; 0191 334 6995

[c] The Applied Cognition & Cognitive Engineering (AC_2E) Research Group, School of Human and Health Sciences, University of Huddersfield, Queensgate, Huddersfield, HD1 3HD, UK,; p.ward@hud.ac.uk, 01484 471124

Word Count (excluding tables, references, and appendix): 4654

Acknowledgement

This work was supported in part by a grant from the US Office of Naval Research under Grant N00014-04-1-0588.

Abstract

Research on decision-making under stress has mainly involved laboratory-based studies with few contextual descriptions of decision-making under stress in the natural ecology. We examined how police officers prepared for, coped with, and made decisions under threat-of-death stress during real police events. A delayed retrospective report method was used to elicit skilled officers' thoughts and feelings during recent attempts to resolve such events. Reports were analyzed to identify experiences of stress and coping, and thought processes underpinning decision-making during the event. Officers experienced a wide range of events, coped with stress predominantly via problem-focused strategies, and adapted their decision-making under stress based on the available context. Future officer training should involve a greater variety of training scenarios than is involved in current training, and expose trainees to the possible variants of each situation to foster better situational representation and, thus, a more reliable and adaptive mental model for use in decision-making.

Keywords: Anxiety; coping; naturalistic decision-making; threat; training

Practitioner Summary

This study concerns decision-making and coping strategies used by skilled police officers during real threat-of-death situations. Officers' decision-making strategies differed according to the complexity of the situation and they coped with the stress of these situations via attempts to resolve the situations (e.g., by planning responses) and, to a lesser extent, via attempts to deal with their emotions.

1. Introduction

Stressful situations can lead to undesirable consequences such as heightened anxiety, which can compromise productivity and safety (Nieuwenhuys, Savelsbergh, & Oudejans, 2015). Consequently, researchers have been interested in human performance under stress for more than 50 years (Eccles et al., 2011). Attempts to understand performance under stress, it is thought, will provide insights into how best to train individuals to perform in stressful domains such as aviation, law enforcement, the military, and emergency medicine (Inzana, Driskell, Salas, & Johnston, 1996; Nieuwenhuys, Caljouw, Leijsen, Schmeits, & Oudejans, 2009).

Despite interest in performance under stress in these (real) domains, articles on this topic have mainly involved laboratory-based studies (Hancock & Szalma, 2008). The laboratory allows researchers to isolate stress factors and their causal effects on specific performance parameters. Nonetheless, this approach might be limiting our understanding of this topic, since there is an ‘unbound combinatorial explosion’ of stress factors that occurs when the participant leaves the laboratory (Hancock & Szalma, 2008, p. 2). Without specification of the mapping between laboratory tasks and complex and stressful work environments, it is difficult to make valid and reliable generalizations about performance under those circumstances. For example, Oudejans (2008) observed that most firearms training for police officers involves stationary nonthreatening targets that do not vary from test to test. Even where there are attempts to enhance the ecological validity of research and training environments (e.g., Oudejans, 2008), it is usually impossible to reproduce in such environments the stressors presented in the real world, especially when considering the potential for harm or death inherent within domains such as aviation, law enforcement, the military, and emergency medicine (Oudejans, 2008; Richters, Schraagen, & Heerkens, 2015). Thus, there is a limited understanding of performance under

stress in the natural ecology. One source of insight into the stress effects synonymous with these situations is the naturalistic, unstructured experiments that take place every day (Hancock & Szalma, 2008; Kahneman & Klein, 2009).

We took such an approach here. A retrospective interview method was employed to understand skilled police officers' attempts to resolve real situations requiring decision-making under conditions involving a threat of death and in which a police firearm was drawn and, in some cases, fired. The rationale for studying *skilled* officers' recollections of their thinking and behavior was that research indicates that individuals who train for, and gain experience of performing specific tasks under stress develop sophisticated psychological mechanisms that mediate such performance. They develop cognitive skills that enhance the efficiency with which task-relevant information is processed (Ericsson, Krampe, & Tesch-Römer, 1993) and self-regulatory skills that help them achieve affective states conducive to successful task performance (Eccles et al., 2011; Salas, Rosen, & DiazGranados, 2010). Describing these mechanisms will augment our understanding of skilled performance under stress and might inform the training of less-skilled performers (Ward, Suss, & Basevitch, 2009). This approach is consistent with the Naturalistic Decision Making movement, which is characterized by the use of field studies of real-world domains in which domain experts make decisions under conditions of uncertainty and time-pressure that typically preclude orderly efforts to generate and evaluate sets of response options (Kahneman & Klein, 2009).

This study had two objectives. The first was to better understand whether and how officers prepared for an impending event they knew would be stressful (e.g., because they had heard about the event via a radio) and coped with the stress presented by the event. It was predicted that officers would use problem- and emotion-focused methods to prepare for, and

cope during the event (Lazarus & Folkman, 1984) and that the problem-focused methods would include cognitive activities such as information-seeking as well as physical behaviors such as donning body armor. While there is little research on this topic in real-world domains, there have been calls for such research (Eccles et al., 2011; Szalma, 2009).

The second objective was to understand how officers make decisions under stress, a topic of historic interest within ergonomics and human factors (e.g., Cannon-Bowers & Salas, 1998; Klein, 2008; Klein et al., 1993). The focus on decision-making under stress is of particular relevance for law enforcement in the light of research (Nieuwenhuys et al., 2015) demonstrating that stress affects both effectiveness of decisions about responses (e.g., shoot vs. no-shoot decisions by police) and the responses themselves (e.g., shot accuracy). While the study was exploratory, our intent was to characterize the decision-making strategies underpinning officers' attempts to resolve these stressful situations.

While it has been suggested that for dynamic tasks, performers recognize an appropriate course of action via cues available in the situation (e.g., Klein, 1993), we were particularly interested in reports reflecting decision-making beyond these simple-match events. In situations requiring complex decision-making, the appropriate response might not be immediately clear and may evolve over time (e.g., Ward, Torof, Whyte, Eccles, & Harris, 2010) and multiple (albeit few) task-relevant situational options may be generated (Ward, Ericsson, & Williams, 2013). Also, the performer is likely to consider their own possible course(s) of action and the potential courses of actions of others (e.g., a suspect) to maintain an integrated and current mental model of the situation (Suss & Ward, 2012; Ward, Suss, Eccles, Williams, & Harris, 2011). Boulton and Cole (2016) recently studied the decision making processes of expert and novice firearms officers using cognitive task analysis methods requiring the recall of an armed confrontation

occurring in the previous decade. They found that experts were more flexible when responding to situational changes, while novices reported a more sequential and linear process of tactical decision making. We hoped to build on the study by Boulton and Cole by using an adaptation of Ericsson and Simon's (1993) verbal report method to more finely analyze the cognitive processes underpinning decision making..

2. Method

2.1. *Participants*

Participants were male officers (n = 14; M_{age} = 38.7 years, SD = 6.3) with on average 15.4 (SD = 6.5) years' experience serving in US police forces. They served within a special weapons and tactics (SWAT) unit and had received training for this role. Informed consent was obtained, anonymity was assured, and we adhered to American Psychological Association ethical guidelines. Participation was compensated monetarily.

2.2. *Measures - Delayed Retrospective Report*

The delayed retrospective report method (Eccles, 2012) was adapted from the Critical Decision Method (CDM; Hoffman, Crandall, & Shadbolt, 1998) and Ericsson and Simon's (1993) immediate retrospective verbal report method. The method was designed to scaffold participants' recall while maximizing the validity of verbal reports of thoughts, behaviors, and feelings collected after extended latencies in reporting.

Following Ericsson and Simon (1993), participants were first trained to recall thoughts from a specific, actual event (type I and II verbalization) and avoid generalizations about, and explanations of thoughts (type III verbalization). While type I and II verbalization provide a relatively valid reflection of the sequence of thoughts underpinning task performance, type III

verbalization offers a poorer reflection of such a process (Eccles, 2012; Ericsson & Simon, 1993; Ward, 2014).

Participants were then asked to briefly describe a stressful work-related event experienced in the last year in which they (a) were a protagonist making decisions directly affecting the outcome of the event, (b) unholstered their weapon, and (c) were required to adapt rapidly to the situation. Half of the participants (n = 7) could not recall such an event occurring in the last year. Consequently, these participants were asked to recall the last occurrence of such an event. Across all participants, the mean time from event to recall was 16 months and the maximum was 5 years. In a second pass through the event, the participant was asked to restate the order of the sub-events within the overall event as they had just recalled them. Per the CDM, one researcher generated an event timeline. The sub-events or 'anchors' were then used in a third pass through the event. Following Ericsson and Simon (1993), the participant was asked to recall the first thought he remembered having at the first anchor, and then the next thought he could recall, and so on, until he mentioned the next anchor in the timeline. This process was repeated until the timeline was covered. A fourth pass through the timeline involved probes for feelings of stress/anxiety, beginning with the first feeling a participant could recall (if any) at the first anchor, and then the next feeling, and so on. If a feeling of stress/anxiety was reported, the participant was probed to recall: any attempt to control these feelings; what effect an attempt had on the stress/anxiety experienced; and when the stress experienced was reduced to a more normal level.

2.3. *Procedure*

Participants provided informed consent and were then fitted with a microphone wired to a microcassette recorder set to record. Next, the study protocol began (described above). Participants were debriefed and thanked at the end of the protocol.

2.3.1. *Data Preparation*

All recorded data were transcribed verbatim. Names and locations within the transcripts were deleted and the tape recordings were destroyed.

2.3.2. *Coding and Analysis of Delayed Retrospective Report Data*

The transcribed stream of elicited reports was parsed into statements. Statements were identified according to the purposeful structure of the report stream; that is, meaningful units of knowledge within the stream such as 'I said "get back"' (Chi, 1997). Thought-related statements were coded in relation to event preparation and in-event decision-making processes, and feeling-related statements in relation to in-event stress and coping processes.

2.3.3. *Event Preparation*

Thought-related statements were searched for evidence of event preparation. A statement providing such evidence was coded according to whether it indicated the use of problem- or emotion-focused coping.

2.3.4. *In-Event Stress and Coping.* Feeling-related statements were those providing evidence of in-event experiences of stress. When these statements were identified, subsequent statements in the report were examined for evidence of attempts to cope with the stress experienced. Statements indicating such attempts were coded as evidencing either problem- or emotion-focused coping. To assess reliability, two researchers independently coded these statements. Total agreement was obtained (Cohen's kappa = 1.00). Next, subsequent statements

in the report were examined to identify whether coping was perceived as effective and identify the point within the timeline at which the stress experienced was reduced to a more normal level.

2.3.5. ***In-Event Decision-Making.*** Thought-related statements concerned with in-event decision-making were coded according to the thought typology from Ward et al. (2011). Within this typology, assessment-related thoughts reflect participants' efforts to gather task-relevant situational information, including the generation of courses of action that could be taken by other individuals (e.g., a suspect) or other things that could happen in the environment; and intervention-related thoughts reflect efforts to decide about a personal course of action. Assessment-related thoughts were coded as one of the following types: monitoring an act/event, recalling an act/event, inference, evaluation, prediction, or desired event. Intervention-related thoughts were coded as one of the following types: act, control, decision, plan, alternative decision, and desired action (see Appendix & Table 1).

Coded statements were then organized for analysis. First, control statements were identified (i.e., those evidencing an action taken by a participant to control the situation and, in particular, a suspect's actions or potential actions). Next, the researchers worked backwards from each control statement to identify thoughts preceding the decision to control the situation. If the initial attempt to control the situation was unsuccessful, the researchers then moved forward through the timeline to the next control statement until the attempt at controlling the situation was successful or the situation ended via other means (e.g., another officer's actions). To assess reliability, two researchers independently coded the thought-related statements concerned with in-event decision-making (~30% of the delayed retrospective report data). A high level of agreement was obtained (Cohen's kappa = 0.94).

3. Results

3.1. *Events Reported*

Pseudonyms are used here to protect participants' identities. The events reported were quite various. Examples included an isolated officer fighting to keep possession of his firearm from two suspects; and a suspect pulling a knife on an officer responding to a drunk-driver call. To aid interpretation of the data, a detailed description of one event follows. Two officers, including Jefferson (recounting the event), respond to a burglary at a motel. The officers arrive at the motel and identify a suspect running to a vehicle containing two other suspects. The officers exit their vehicles and draw their weapons. Jefferson orders one suspect out of the vehicle; he complies and is handcuffed. The vehicle passenger jumps into the driver's seat, closing the driver-side door. Jefferson breaks the window and begins pulling the driver through it but the suspect reverses the car, dragging Jefferson, who is caught in the window. Officer 'B' fires his weapon, hitting the driver. The vehicle crashes and officer B rushes to it to find Jefferson uninjured but the driver motionless. The driver then wakes and, bleeding profusely, yells 'You can't kill me!' before being handcuffed.

3.2. *Event Preparation*

Two of the 14 participants' (14%) reports indicated that the event unfolded too rapidly to afford use of preparation strategies. The remaining 12 participants (86%) reports indicated there was enough time before the event to prepare for it. All 12 participants used problem-focused strategies. Nine of these 12 participants reported planning as one such strategy; specifically, creating plan(s) based on information obtained about the current task status and/or contingent on probable changes to the task status. Some participants were able to begin implementing plans as part of their preparation; for example, by directing other officers to take certain actions. Participant Johnson provides an example of such planning:

> 'I'm thinking, Keep the oak tree between you and the door and watch the windows on the front of the house.'

The remaining 3 participants reported using two different problem-focused strategies. These included seeking more information about the event from the police dispatcher, preparing equipment (e.g., body armor) appropriate for the event based on information received, and creating external aides (e.g., writing on a hand) for memorizing novel task-relevant information.

One of the 14 participants (7%) used an emotion-focused strategy in preparation for the event (this participant also used a problem-focused strategy, described above). Upon receiving a call out to the event, he reported attempting to motivate himself to deal with the anticipated stress; he did not describe the means used to motivate himself.

3.3. *In-Event Stress and Coping*

Thirteen from 14 (93%) participants' reports indicated that stress was experienced during the event. The remaining participant's report indicated he did not experience stress but felt 'excitement.' Participant Nevada describes his experience of stress:

> 'I didn't really get the butterfly feeling until he turned away from me. One hand was…in a kind of flannel-covered pocket. That was right when I started to get that feeling again that his mannerisms are not consistent with what's going on but I'm hoping this is the keys…but I'm already feeling that little bit of trepidation….When I saw… his hand start to close…I can remember [the suspect] gripping the thing and getting ready…is it, is it, is it, is it? It is…it's a knife. Boom!' [As he voices 'boom', participant motions with the hands that he 'exploded' emotionally].

Of the 13 participants whose reports indicated they experienced stress, 5 (38%) reported attempting to control the stress during the event. Two of the 5 participants used problem-focused

strategies in the form of planning to this end; 2 other participants used emotion-focused strategies in the form of breathing strategies; and the remaining participant used both problem- and emotion-focused strategies.

The other 8 (62%) of the 13 participants who experienced stress did not actively attempt to control it. For 4 of these 8 participants, the nature of the event prevented such attempts being made. The event created little stress for 2 of these 4 participants until a suspect very suddenly drew a weapon, which provided no time for the use of stress-control strategies. For the remaining 2 of these 4 participants, the reports suggested the immediate task (e.g., giving orders to officers) involved their full attention, preventing them making appraisals and/or employing stress-control strategies. Of the remaining 4 of the 8 participants who did not actively attempt to control their stress: 2 participants interpreted their stress as 'energy', which they suggested improved their focus during the event; 1 participant reported having been trained on stress-control strategies (specifically breathing strategies) but choosing not to use them during the event as his level of stress did not warrant their use; and 1 participant reported feeling *too stressed* to attempt to use stress-control strategies.

Regardless of whether participants attempted to control their stress, their reports generally provided evidence that a decrease in stress was not felt until they perceived a substantially reduced threat to themselves and/or bystanders. Thirteen of the 14 participants recalled a single reduction in stress over the event timeline (detailed below); the remaining officer two reductions in stress. For the 'single reduction' participants, the reduction occurred when the ability of a suspect to cause harm became highly constrained or was predicted to become highly constrained imminently based on observed changes in the task status. Changes in the constraints on the suspect included 'back-up' officers arriving (n = 3), the suspect

committing suicide (*n* = 1), and the suspect being physically restrained or held at gunpoint by officers (*n* = 7). In addition, one participant described an event involving a baby held as hostage at knifepoint and reported that his stress decreased when the baby was released to safety. The 'two reduction' participant's reports indicated the first reduction occurred after discovering he was unharmed after being struck by a suspect's vehicle and the second when other officers led him away from the scene. Participant Truman provided a report typical of those concerning the timing of the stress reduction: 'Once we get him up and…walk out the front door, then you start relaxing a little bit because now we're in control.'

3.4. ***Decision-Making. 'Simple' Events:*** Seven participants' (50%) reports indicated either: simple matches; enacting pre-determined actions; or another officer's actions leading directly to attempts at exerting control. In 3 of the 7 reports, the event required a decision but the decision-making process was simple. These events unfolded rapidly, involved unambiguous stimuli, and the appropriate response was easily afforded because it was simple and relatively natural. Only one control statement was coded during each of these three events and this thought was preceded by only one other thought, which concerned monitoring the situation (i.e., was a monitor statement) and, specifically, the suspect's behavior. These events included a suspect in handcuffs fleeing. In this event, the participant was checking the suspect for weapons when the suspect suddenly sprinted away. The participant monitored the situation (i.e., 'when I got to his ankle he kicked my hands away and started running') and then responded accordingly ('so, I was…trying to sprint as fast as I could to catch him').

In the other four events, the participants did not recall any thoughts directly preceding a control statement. For example, they did not choose between explicitly stated alternatives or deliberate explicitly when making a decision (i.e., no statements were coded as alternative or

decision; see appendix). Instead, participants simply implemented a course of action without prior or additional deliberation. In two of these four events, participants reported that a team plan constructed prior to the event specified their actions. These two events involved no unpredicted elements requiring the participant to deviate from these actions. This is exemplified by participant Alabama:

> 'Well, yeah, everybody has a plan. Before we ever go to the door, everybody has …. a responsibility to secure certain areas of the house.'

For the two remaining events, despite having been asked to describe events in which they were active decision-makers, the participants' reports indicated that other officers present during the event were the protagonists and made decisions and/or took actions that largely controlled the situation and brought the participant's role in the event to a close. Participant Truman describes such an event:

> 'One of our guys came up and kicked the door…and it went off the hinges and the [suspect] rolled from behind the door and rolled over and dropped the gun….I didn't tell the guy to do that…The…guy did it on his own.'

3.5. *'Complex' Events.* The remaining seven participants' (50%) reports indicated the event required more complex decision-making. Events involved a mean of 4.57 (*SD* = 2.94) assessment-related thoughts and 8.43 (*SD* = 2.37) intervention-related thoughts. Of the intervention-related thoughts, 4.30 were control statements (*SD* = 1.80), indicating that multiple actions were undertaken per event. Control statements were preceded by a mean of 2.37 (*SD* = 1.45) thoughts of another type (e.g., infer). Reports from six out of seven events (85%) indicated at least two thoughts preceded each control statement within the event. Table 1 provides an example of a thought sequence during an event.

Regarding the nature of the thoughts preceding control statements, the following sequences were most common: monitor-evaluate (4x), monitor-infer (4x), and decide-act (3x). All reports included at least one thought coded as a monitor (12x) or inference statement (7x) (i.e., assessment-related thoughts) leading to a control or attempted control statement (i.e., intervention-related thoughts). The reports also indicated frequent reports of planning (7x), alternative decisions (5x), and desired actions (5x) leading to a control or attempted control statement (i.e., intervention-related thoughts). These results suggest the participants were doing more than simply monitoring the situation prior to attempting to control the suspect.

4. Discussion

In this study, police officers recalled a work-related event that was stressful because it involved a threat of death to the officer or others. We discuss below the results of the study as they relate to the two key objectives of the study, which were to gain insights into the officers' preparation for, and coping during the event, and to characterize the decision-making strategies underpinning officers' attempts to resolve these stressful situations. In these discussions, there is an emphasis on identifying how the preparation, coping, and decision-making strategies observed for the skilled police officers might inform the training of less-skilled officers. Evidence suggests that training based on identification of strategies used by skilled performers is effective for improving performance in less-skilled individuals (Ward et al., 2008; Ward et al., 2009; Hoffman et al., 2014).

The results concerning officers' event preparation showed that all officers prepared for the event and mainly via problem-focused strategies concerning planning. Other problem-focused strategies included seeking more information about the event. These strategies together suggest a desire to generate: plausible, task-relevant future situational states; and a relevant

response, including alternatives where appropriate (Ward et al., 2011; Ward et al., 2013). This interpretation is supported by data indicating additional contextual information both in-event (McRobert, Ward, Eccles, & Williams, 2011) and during preparation (Eccles, Ward, & Woodman, 2009) facilitates superior performance. A better understanding of the event and an increased readiness to respond to it also likely increased the officers' self-efficacy for, and perceived control over the task (Inzanza et al., 1996; Thompson, 1981).Future training studies should explore how encouraging less-skilled officers to engage in planning and information-gathering activities prior to stressful events may reduce their in-event stress.

Regarding experiences of in-event stress and coping, several participants interpreted their stress as excitement or energy. This could be explained by these participants appraising the events as challenging rather than as threatening because they perceive they have sufficient personal resources, such as skills acquired through training, to cope with the demands imposed by the situation (Kassam, Koslov, & Mendes, 2009). Research has provided evidence that performers who appraise situations as challenging experience increased physiological arousal (e.g., increased heart rate) (Blascovich & Tomaka, 1996), which in our study might be verbalized by the officers as excitement and energy. This research has also shown that performers who appraise situations as challenging experience decreased vascular resistance and that the pattern of changes to physiological arousal and vascular resistance is essentially the reverse for those experiencing situations as threatening (Blascovich & Tomaka, 1996). It is reasonable that the physiological changes accompanying a challenge (vs. threat) appraisal would facilitate officer performance in the events described in the present study. Training for less-skilled officers that is focused on modifying officers' perceptions of stress and their ability to operate effectively under stress may provide an alternative means of maintaining performance in a zone of maximal

adaptability or ameliorate the rate of decline potential under pressure (Hancock & Warm, 1989). For example, officers could be trained to adopt performance routines that encourage challenge appraisals of confrontation events, which might involve simple self-talk scripts reminding the performer that they are well-trained in how to operate effectively during confrontations (i.e., they have the resources to cope with the stress imposed). Research has shown that instructional sets promoting challenge (vs. threat) appraisals prior to task performance care are effective in eliciting challenge appraisals and in turn promoting facilitative physiological responses (Blascovich & Tomaka, 1996).

Other participants reported that the event unfolded too rapidly (e.g., the sudden production of a firearm) to allow the use of coping strategies. These events might be considered 'shock' events, where a shock event is defined as a sudden transition in the task status leading to marked increases in stress but that is preceded by few environmental cues predictive of this transition (cf. Huey & Wickens, 1993). Future studies of training for less-skilled officers might emphasize: (a) reducing the chances of being shocked by engaging in perceptual-cognitive training on low frequency cases (e.g., via simulation) to increase their predictability (Ericsson, Whyte, & Ward, 2007; Hoffman et al., 2014; Ward et al., 2009); and (b) effective coping following (simulations of) shock events via the use of generic, systematic responses involving emotion-focused coping strategies such as breathing and focusing.

Several participants actively attempted to control the stress they experienced via problem-focused coping strategies and, to a lesser extent, emotion-focused coping strategies. The problem-focused strategies involved planning processes similar to those used in preparing for the event (described above). The emotion-focused strategies involved breathing strategies, which likely reflects the officers' training because it often covers breathing-related coping strategies.

The result is also consistent with the findings of other studies that breathing strategies are common strategies used in attempts to perform effectively under stress (Kudlackova, Eccles, & Dieffenbach, 2013). Our participants' lower use of emotion-focused strategies compared to problem-focused strategies may reflect the greater emphasis within police officer training on tactical, technical, and physical strategies focused on solving the problem than on psychological strategies that might be used to cope with disruptive emotions arising from the problem (Nieuwenhuys et al., 2009). This and other studies (e.g., Nieuwenhuys et al., 2015) have provided evidence that high stress levels are enduring in police work involving confrontations. Therefore, it may be beneficial to include some instruction in emotion-focused coping within police training and to ensure that tactical, technical, and physical training in confrontation resolution takes place under stressful conditions (Renden, Landman, Savelsbergh, & Oudejans, 2015).

The results concerning the officers' decision-making strategies showed that the context of the confrontations experienced by the officers was quite varied, and the decision-making process depended on the context experienced (Hoffman et al., 2014). In half the events described, decision-making appeared relatively simple. One reason for this was that decision-making involved simply recognizing an appropriate course of action based on relatively unambiguous cue(s) available in the situation, a simple-match process consistent with Variation I of the recognition-primed decision model (Klein, 1993, 1998). An example event involved a participant checking a suspect for weapons when the suspect suddenly sprinted away, and the immediately matched response was to pursue the suspect.

For the remaining events, decision-making appeared more complex. The nature of the events involved participants considering both their own possible course(s) of action and the

potential courses of actions of others (e.g., a suspect). The numbers of reported assessment and intervention thoughts support this claim, as does the finding that intervention thoughts were preceded by ~2 thoughts on average of another type, suggesting that participants were doing more than simply monitoring the situation. The reports indicated that after initial monitoring of the situation, participants typically evaluated or made causal or predictive inferences about the current situation and then attempted to implement control over a suspect based on these thoughts. Participants then assessed the success of the control attempt, re-assessed the current situation, and then made another control attempt. Thus, the description of thinking at the critical moments appears consistent with a dynamic process that cycles through pre-emptive situation assessment (of task relevant information) and proactive intervention (Ward et al., 2011). Table 1 comprises a representative excerpt of a thought sequence reflecting multiple attempts to control a situation. The sequence suggests that participants attempted to maintain an integrated and up-to-date mental model of the situation allowing them to make necessary evaluations and (both causal and predictive) inferences to motivate their response (Suss & Ward, 2012; Ward et al., 2011). This form of decision-making process is consistent with two variations of the recognition-primed decision model that are more complex than the simple-match process described by Variation 1. (Klein, 1998). In Variation 2, situational cues may not clearly match a typical case and the performer must gather more information to make a diagnosis. Also, the performer may misinterpret the situation but not realize it until some expectancies, based on the interpretation, have been violated, at which point the performer must check which interpretation best matches the new features of the situation. In Variation 3, performers evaluate a response option that comes to mind by imaging how it will play out; if difficulties are anticipated, then the option is adjusted or changed.

Our study can be compared with the study of police officer decision making during armed confrontations by Boulton and Cole (2016). These authors concluded from their findings that officer decision making could not defined by either simple-match or more complex decision processes but rather flexible use of both of these forms modes of decision-making that was shaped by changes to the nature of the situation over time. Both modes of decision-making were also evidenced in our study and, furthermore, the use of these modes depended on the nature (i.e., complexity) of the situation. However, our findings also differ from Boulton and Coles' in some important ways. In their study, expert officers, who were comparable for training and experience to our participants, appeared to utilize simple-match processes in some situations. This was also true for our study, but specifically for events that, in relative terms, unfolded rapidly, involved unambiguous stimuli, and for which the appropriate response was easily afforded because it was simple and natural.

Boulton and Cole (2016) also reported that expert officers engaged in more complex and "analytical" modes of decision-making when under low levels of time-critical threat such as before or after the actual confrontation. By contrast, our participants' engagement in the use of more complex modes of decision-making was not limited to before or after the actual confrontation. In some cases, complex decision processes were evident *during* confrontations, including those involving time-critical threats, and especially if the confrontations were characterized by ambiguous stimuli and a requirement to consider multiple response options. The difference between the two studies' findings may lie in our use of a relatively fine analysis of thoughts recalled. In summary, on the basis of our findings, we agree with Boulton and Cole's conclusion that officer decision making in armed confrontations relies on flexible use of both simple-match and more complex modes of cognition that is shaped by the nature of the situation.

However, unlike Boulton and Cole, we do not believe that complex decision processes are exclusive to conditions of low time-criticality that are relatively peripheral to the confrontation event; in contrast, in some cases, complex decision processes appear central to online performance under stress (see also Arsal, Eccles, & Ericsson, 2016).

Researchers have proposed decision-making exercises (e.g., crystal ball technique) that increase awareness and/or exploration of task-relevant decision alternatives (e.g., Klein, 1997). This procedure could be extended to incorporate option generation during situation assessment and decision-making to increase trainee officers' awareness of the structure of the ecology and the viability and quality of their response (Boulton & Cole, 2016; Suss & Ward, 2015; Ward et al., 2011, 2013). By requiring trainee officers to also anticipate the future state of the situation, the types of situational representations and strategies that support performance could be further developed (Ward et al., 2008; Ward et al., 2009). In this vein, Hoffman et al. (2014) provided two suggestions for training in complex domains. First, the use of variable training methods to expose participants to the possible variants of any given situation would result in a better current and future situational representation and, therefore, a more reliable and adaptive mental model for use in decision-making. This approach would appear particularly relevant here because, in many studies of decision making, there is limited variance in the nature of the scenarios presented, at least in relation to armed confrontations in police work (Oudejans, 2008). The present study has illustrated that stressful scenarios experienced in police work are more varied than those often presented in training, and in some cases, are more complex, uncertain, and dynamic than those presented in training; as Oudejans (2008) remarked, most officer firearms training involves stationary nonthreatening targets that do not vary from test to test (see also Boulton & Cole, 2016). Second, perceptual-cognitive training aimed at the boundaries and

intersections of a participant's existing mental models will promote new, more effective representations that better map the ecology (cf. Klein & Baxter, 2009). These methods might be used in future research to enhance our understanding of skilled performance under stress and create knowledge- and cognitive process-driven interventions to mitigate deleterious stress effects.

A limitation of this study was that participants sometimes reported how one might think or act generally in the situation (e.g., 'What you do in this situation is…') despite being guided to recall thoughts experienced during the event. These 'general reports' (Ericsson & Simon, 1993) appeared to reflect general procedures taught in training or beliefs about how officers typically should or do think and behave in prototypical situations (cf. Nisbett & Wilson, 1977). These reports constitute type III reports and may not reflect what actually occurs in these types of situations (Ericsson & Simon, 1993). Researchers or practitioners attempting to capture participants' recall of events should listen for this reporting mode and, when detected, direct participants to recall whether this general way of proceeding was true for this specific event. In addition, delayed retrospective reports ideally should concern very recent events to minimize retroactive interference (Eccles, 2012). However, police officers experience threat-of-death situations infrequently and thus in the present study it was necessary to extend the recall window to the point at which the last such event occurred, resulting in a mean time from event to recall of 16 months. Consequently, the results should be treated with some caution, given the potential for interference in long-term memory.

In this study, we provided insights into skilled police officers' preparation for stressful events and how these officers coped with stress experienced during the events. We also described the process of decision-making within these events and how the nature of the event

shaped this process. Future attempts to provide ‘contextual descriptions’ of expertise in real-world, high-stress environments will augment our understanding of decision and coping strategies that are feasible and useful under conditions of uncertainty and time-pressure (Kahneman & Klein, 2009), which will allow us to effectively train individuals to operate safely and productively in these challenging environments.

References

Arsal, G., Eccles, D. W., & Ericsson, K. A. (2016). Cognitive mediation of putting: Use of a think-aloud measure and implications for studies of golf-putting in the laboratory. Manuscript submitted for publication.

Blascovich, J., & Tomaka, J. (1996). The biopsychosocial model of arousal regulation. *Advances in Experimental Social Psychology, 28,* 1-51.

Boulton, L., & Cole, J. (2016). Adaptive flexibility: Examining the role of expertise in the decision making of authorized firearms officers during armed confrontation. *Journal of Cognitive Engineering and Decision Making, 10,* 291-308.Doi: 10.1177/1555343416646684

Cannon-Bowers, J. A., & Salas, E. (Eds.) (1998). *Making decisions under stress: Implications for individual and team training.* Washington, DC: APA Books.

Chi, M. R. H. (1997). Quantifying qualitative analyses of verbal data: A practical guide. *The Journal of the Learning Sciences, 6,* 271-315. Doi: 10.1207/s15327809jls0603_1

Eccles, D. W. (2012). Verbal reports on cognitive processes. In G. Tenenbaum, R. C. Eklund, & A. Kamata (Eds.), *Measurement in sport and exercise psychology* (pp. 103-117). Champaign, IL: Human Kinetics.

Eccles, D., Ward, P, & Woodman, T. (2009). Competition-specific preparation and expert performance. *Psychology of Sport and Exercise, 10,* 96-107. Doi: 10.1016/j.psychsport.2008.01.006

Eccles, D. W., Ward, P., Woodman, T., Janelle, C. M., Le Scanff, C., Ehrlinger, J., Castanier, C., & Coombes, S. A. (2011). Where's the emotion? How sport psychology can inform

research on emotion in human factors. *Human Factors, 53*, 180-202. Doi: 10.1177/0018720811403731

Ericsson, K. A., Krampe, R. Th., & Tesch-Römer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review, 100,* 363–406. Doi: 10.1037//0033-295X.100.3.363

Ericsson, K. A., & Simon, H. A (1993). *Protocol analysis: Verbal reports as data* (rev. ed.). Cambridge, MA: MIT Press.

Ericsson, K. A., Whyte, J., & Ward, P. (2007). Expert performance in nursing: Reviewing research on expertise in nursing within the framework of the expert-performance approach. *Advances in Nursing Science, 30,* E58-E71.

Hancock, P. A., & Szalma, J. L. (2008). Stress and performance. In P. A. Hancock & J. L. Szalma (Eds.), *Performance under stress* (pp. 1–18). Farnham, UK: Ashgate.

Hancock, P.A., & Warm, J. S. (1989). A dynamic model of stress and sustained attention. *Human Factors, 31,* 519-537. Doi: 10.7771/2327-2937.1024

Hanton, S., Mellalieu, S.D., & Hall, R. (2004). Self-confidence and anxiety interpretation: A qualitative investigation. *Psychology of Sport and Exercise, 5*, 477-495. Doi: 10.1016/S1469-0292(03)00040-2

Hoffman, R. R., Crandall, B. & Shadbolt, N. R. (1998). Use of the critical decision method to elicit expert knowledge: a case study in the methodology of cognitive task analysis. *Human Factors, 40,* 254-276. Doi: 10.1518/001872098779480442

Hoffman, R. R., Ward, P., Feltovich, P. J., DiBello, L., Fiore, S. M., & Andrews, D. H. (20134). *Accelerated expertise: Training for high proficiency in a complex world.* New York, NY: Psychology Press.

Huey, B. M., & Wickens, C. D. (1993). *Workload transition: Implications for individual and team performance.* Washington, DC: National Academy Press.

Inzana, C. M., Driskell, J. E., Salas E., & Johnston, J. H. (1996). Effects of preparatory information on enhancing performance under stress. *Journal of Applied Psychology, 81,* 429-435. Doi: 10.1037//0021-9010.81.4.429

Kahneman, D., & Klein, G. (2009). Conditions for intuitive expertise: a failure to disagree. *American Psychologist, 64,* 515-526. Doi: 10.1037/a0016755

Kassam, K.S., Koslov, K., & Mendes, W. B. (2009). Decisions under distress: Stress profiles influence anchoring and adjustment. *Psychological Science, 20,* 1394–1399. Doi: 10.1111/j.1467-9280.2009.02455.x

Klein, G. A. (1993). A recognition-primed decision (RPD) model of rapid decision making. In G. A. Klein, J. Orasanu, R. Calderwood, & C. E. Zsambok (Eds.), *Decision making in action: Models and methods.* Norwood, NJ: Ablex.

Klein, G. (1997). Developing expertise in decision making. *Thinking and Reasoning, 3,* 337-352. Doi: 10.1080/135467897394329

Klein, G. (1998). *Source of power: How people make decisions.* Cambridge, MA: MIT press.

Klein, G. (2008). Naturalistic decision making. *Human Factors, 50,* 456–460. Doi: 10.1518/001872008X288385

Klein, G., & Baxter, H. C. (2009). Cognitive transformation theory: Contrasting cognitive and behavioral learning. In D. Schmorrow, J. Cohn, & D. Nicholson (Eds.), *The PSI handbook of virtual environments for training and education; developments for the military and beyond, Vol. 1, Education: Learning, requirements, and metrics* (pp. 50-65). Santa Barbara, CA: Praeger Security International.

Klein, G., Orasanu, J., Calderwood, R., & Zsambok, C. E. (Eds.). (1993). *Decision making in action: Models and methods.* Norwood, NJ: Ablex.

Kudlackova, K., Eccles, D. W., & Dieffenbach, K. (2013). Use of relaxation skills by differentially skilled athletes. *Psychology of Sport and Exercise, 14,* 468-475. Doi: 10.1016/j.psychsport.2013.01.007

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping.* New York, NY: Springer.

Matthews, G., Dorn, L., Hoyes, T. W., Davies, D. R., Glendon, A. I., & Taylor, R. G. (1998). Driver stress and performance on a driving simulator. *Human Factors, 40,* 136–149. Doi: 10.1518/001872098779480569

McRobert, A, Ward, P., Eccles, D. W., & Williams, A. M. (2011). The effect of manipulating context-specific information on perceptual-cognitive processes during a simulated anticipation task. *British Journal of Psychology, 102,* 519-534. Doi: 10.1111/j.2044-8295.2010.02013.x

Nieuwenhuys, A., Caljouw, S. R., Leijsen, M. R., Schmeits, B. A. J., & Oudejans, R. R. D. (2009). Quantifying police officers' arrest and self-defence skills: Does performance decrease under pressure? *Ergonomics, 52,* 1460-1468. Doi: 10.1080/00140130903287981

Nieuwenhuys, A., Savelsbergh, G. J. P., & Oudejans, R. R. D. (2015). Persistence of threat-induced errors in police officers' shooting decisions. *Applied Ergonomics, 48,* 263-272. Doi: 10.1016/j.apergo.2014.12.006

Nisbett, R. E., & Wilson, T. D. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological Review, 84,* 231-259. Doi: 10.1037//0033-295X.84.3.231

Oudejans, R. R. D. (2008). Reality-based practice under pressure improves handgun shooting performance of police officers. *Ergonomics, 51,* 261-273.

Renden, P. G., Landman, A., Savelsbergh, G. J. P., & Oudejans, R. R. D. (2015). Police arrest and self-defence skills: performance under anxiety of officer with and without additional experience in martial arts. *Ergonomics, 58,* 1496-1506.

Richters, F., Schraagen, J. M., & Heerkens, H. (2016). Assessing the structure of non-routine decision processes in Airline Operations Control. *Ergonomics, 59,* 380-392.

Salas, E., Rosen, M. A., & DiazGranados, D. (2010). Expertise-based intuition and decision making in organizations. *Journal of Management, 36,* 941-973. Doi: 10.1177/0149206309350084

Suss, J., & Ward, P. (2012). Use of an option generation paradigm to investigate situation assessment and response selection in law enforcement. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 56,* 297-301. doi: 10.1177/1071181312561069

Suss, J., & Ward, P. (2015). Predicting the future in perceptual-motor domains: Perceptual anticipation, option generation, and expertise. In R. R. Hoffman, P. A. Hancock, M. Scerbo, & J. L. Szalma (Eds.), *Cambridge handbook of applied perception research* (pp. 951-976). New York, NY: Cambridge University Press.

Szalma, J. L. (2009). Individual differences in human-technology interaction: Incorporating variation in human characteristics into human factors and ergonomics research and design. *Theoretical Issues in Ergonomics Science, 10,* 381-397. Doi: 10.1080/14639220902893613

Thompson, S. C. (1981). Will it hurt less if I can control it? A complex answer to a simple question. *Psychological Bulletin, 90,* 89-101. Doi: 10.1037//0033-2909.90.1.89

Ward, P. (2014). Verbal protocols. In R. C. Eklund & G. Tenenbaum (Eds.), *Encyclopedia of sport and exercise psychology* (777-780). Thousand Oaks, CA: Sage Publications.

Ward, P., Ericsson, K. A., & Williams, A. M. (2013). Complex perceptual-cognitive expertise in a simulated task environment. *Journal of Cognitive Engineering and Decision Making, 7,* 231-254. Doi: 10.1177/1555343412461254Ward, P., Farrow, D., Harris, K. R., Williams, A. M., Eccles, D. W., & Ericsson, K. A. (2008). Training perceptual-cognitive skills: Can sport psychology research inform military decision training? *Military Psychology, 20,* S71-S102.

Ward, P., Suss, J., & Basevitch, I. (2009). Expertise and expert performance-based training (ExPerT) in complex domains. *Technology, Instruction, Cognition, and Learning*, *7*, 121-146.

Ward, P., Suss, J., Eccles, D. W., Williams, A. M., & Harris, K. R. (2011). Skill-based differences in option generation in a complex simulated task: A verbal protocol analysis. *Cognitive Processing, 12,* 289-300. Doi: 10.1007/s10339-011-0397-9

Ward, P., Torof, J., Whyte, J., Eccles, D. W., & Harris, K. R. (2010). Option generation and decision making in critical-care nursing. In *Proceedings of the Human Factors and Ergonomics Society 54th Annual Meeting,* San Francisco, CA. September 27-October 1, 2010. Santa Monica, HFES. Doi: 10.1177/154193121005400418

Appendix

Provided here are definitions and examples of thought types from the Ward et al. (2011) thought typology.

Monitor: Heeded information that was present in the current environment (e.g., 'He's reaching into a bag')

Recall: Previous information that was heeded in the current environment and that is no longer available but subsequently recalled (e.g., 'The daughter says she thinks he has a gun but is not sure' [participant is recalling an earlier conversation with a witness])

Infer: Information that is inferred about some aspect of the current scenario but where that information is not present in the current environment (excluding evaluative inferences) (e.g., 'I heard scuffling inside [monitor] and I'm thinking, okay, they're trying to get out the back door')

Evaluate: A relative value-based inference about some aspect of the past, current or future environment but where the inferred value or information is not present in the current environment (e.g., '…which was a good tactical position on his part' [the participant is describing the location assumed by another officer during the event])

Predict: An anticipated future situational event (e.g., 'One of us is [about] to get run over')

Desire: A desired current or future event/state/outcome or desired current or future action (e.g., 'Let's try to get down there without him seeing us pull up')

Plan:	A decision to pursue a specific course of action in the future based on a future context (e.g., 'So we've got a little green area of pavement right here where if I decide to go after him, that's where we're going')
Alternative:	A possible course of action that was imminently available without a decision to pursue it (e.g., 'I consider laying the Taser down and getting up on his back and waiting for my partner to come back around')
Decide:	A decision to pursue a specific course of action imminently (e.g., 'I've got to go up, give up cover and concealment to go get him')
Act:	A verbal or physical action and/or execution of a decision (e.g., 'I pulled the pepper spray')

Table 1.

Example of part of a delayed retrospective report, and codes applied to the statements within the report, relating to an event requiring relatively complex decision-making

Delayed Retrospective Report Statement	Code Applied To Statement
He's reaching into a bag	Monitor
He's fixing to try and fish out a gun or whatever	Infer
And I draw and then gave him, and tell him to show me his hands	Act [constraint]
I said if you don't show me your hands, you're gonna get shot	Act [constraint]
And he takes his hand out of the bag and he curses some obscenities at me	Monitor
I've got control of his hands, now he's not a lethal threat to me	Evaluate
So I have to de-escalate	Decide
I holster	Act
Spray him with the OC spray	Act [constraint]
And it has very little effect	Monitor
And my first instinct was he's on something	Evaluate
Turn around, go to your knees, let me handcuff you, put your hands behind your back	Act [constraint]
He's not compliant	Evaluate
So I holster the OC	Act
I take out my baton	Act [constraint]
And then I realize at that second the OC's starting to take effect.	Monitor
I think well maybe I won't have to hit this guy right now	Evaluate
And then his eyes started really blurring up and you see him squinting. And he goes over the kitchen sink	Monitor
I'm thinking uh-oh, he's looking for a knife or weapon	Infer
Am I gonna have to shoot this guy?	Alternative
Do I need to hit him real quick with the stick?	Alternative
Guy's going to his knees	Monitor