**Adaptive Flexibility: Examining the Role of Expertise in the Decision Making of Authorised Firearms Officers during Armed Confrontation.**

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Laura is a Post-Doctoral Research Assistant in Policing at the University of Central Lancashire (UCLan). She completed her PhD in 2014 exploring how expertise, cognitive executive functioning, neuropsychology and human factors influence the decision making of Authorised Firearms Officers during armed confrontations. Providing an evidence base that can be practically utilised by Police practitioners to impact change was the underlying motivation for this research. She now lectures on Master’s Degree programmes at UCLAN.

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Jon is a Professor of Tactical Decision Making at the University of Liverpool. He completed his PhD in 1994 examining the psychopharmacology of defensive behaviour in a murine model of anxiety. Since then he has studied aggression and defensive behaviour in a range of different contexts, including armed confrontations. This latter work has been conducted in the UK, Canada, and Germany.

**Acknowledgements**

The authors of this report would like to thank the Authorised and Specialist Firearms Officers at Merseyside Police for volunteering to take part in the study. In particular the training staff who facilitated the interviews. We would also like to thank Merseyside Police for supporting this project and organising access to participants.

**Abstract**

Identifying the cognitive processes underlying tactical decision making is vital for two purposes; (i) reducing risk through improved training, and (ii) facilitating the public’s attitudes toward the legitimacy of the Police and criminal justice system. Despite this, very little research has been conducted into British Police decision-making involving the use of firearms. This study begins to address this gap by examining the impact expertise has on British Police use of force decisions during armed confrontations. In order to do so, the tactical decision making processes of twelve expert Specialised Firearms Officers (SFOs) and eleven novice Authorised Firearms Officers (AFOs) during armed confrontations were compared using Cognitive Task Analysis methods. Data were coded using categories derived from theory and patterns inductively emergent within the data. The results found expert SFOs to be more flexible in adaptive responding to situational changes, whilst novice AFOs reported a more sequential and linear process of tactical decision making. In identifying the key features of expertise within this specific environment (‘adaptive flexibility’), this study has both theoretical and practical implications for the acceleration of AFO expertise acquisition in order to bridge the existing expertise gap resulting from a lack of available qualified Operational Force Commanders.

**Keywords: Police, UK, cognitive task analysis, critical decision method, naturalistic decision making**

**Introduction**

Use of lethal force by police officers lies at the extreme edge of policing activity (Burrows, 2007). There is a fine line between the use of necessary force to achieve legitimate police objectives and the use of excessive force: when an officer uses force that may be considered excessive, public approval for police authority is shaken (McDonald et al., 2003). The salience of tactical decision making is evident in the incidents that attract widespread attention, evaluation and criticism. For instance, the death of Mark Duggan who was shot and killed by police in Tottenham, North London, sparked riots that spread across England in August 2011. On the other hand, the consequences of failing to act in circumstances which pose an imminent threat to life could be equally critical. Therefore, the performance of police firearms teams must be efficient and accurate (Kavanagh, 2006).

Nonetheless, there are a wide range of psychophysiological and cognitive factors that can influence the way in which Authorised Firearms Officers (AFOs) perform, many of which are often not taken into account while planning tactical operations and/or during the investigations that follow (Kavanagh, 2006; Thompson & Lee, 2004). External (e.g., suspect aggression, location of suspects, victims or officers, visual and physical cover and a constant re-appraisal of potential hazards) and internal (e.g., physiological arousal) factors can interact with an AFO’s perception and appraisal of an environment (Klinger, 2006; White, 2001; 2003). For instance, officers have been found to be more likely to un-holster and discharge their weapon, to do so earlier, and more often as a result of increased external (e.g., suspect aggression) and internal (e.g., physiological arousal) demand (Doerner & Ho, 1994; Vrij & Dingemans, 1996; Vrij, van der Steen & Koppelaar, 1994).

As British police officers are not routinely armed, the role of AFOs who are qualified to carry and use firearms in Britain is highly specialised. Out of the 126,818 full time equivalent police officers in the 43 police forces of England and Wales, only 5,875 (4.6%) are currently serving AFOs (Home Office, 2015a; 2015b). AFOs must meet entry requirements of very high levels of physical fitness in order to qualify for such a role (ACPO, 2011). Before they become operationally active, AFOs complete a rigorous and assessed training package which includes weapon handling, shooting skills, less lethal options, tactical procedures and scenario based training. After they are qualified as an AFO they must complete refresher training and assessment for all tactics on a regular (24 month) basis, during which failure results in the instant revocation of an AFO’s firearms licence (ACPO, 2011).

British AFOs are only deployed to incidents in which there is a perceived threat to life (ACPO, 2011). Circumstances that qualify for AFO deployment typically involve a ‘reason to suppose’ that the attending officer may have to protect the public and/or themselves from a person who is in possession of, or has immediate access to, a firearm/potentially lethal weapon (College of Policing, 2013). Deployment can be issued by a strategic firearms commander, an accredited tactical firearms commander, or through self-deployment. An AFO can self-deploy upon encountering a situation where they believe that delay in seeking authority would be detrimental to public or officer safety.

Specialised Firearms Officers (SFOs) are a specialised group of AFOs who are trained in skills such as; (i) hostage rescue, (ii) specialist weapon and equipment use, (iii) complicated methods of entry, and (iv) pre-hospital trauma life support. SFOs volunteer themselves for the role, and upon initial approval by way of a rigorous five day assessment, they follow a prolonged training programme (18-19 weeks). SFOs receive refresher training every six weeks. Incidents dealt with by SFOs are deemed too dangerous for standard AFO response. These incidents often involve suspects that are mentally or emotionally distressed, are under the influence of alcohol and/or drugs, do not have clear goals, and resist attempts by others to resolve the situation. In order to conclude these incidents without incurring loss of life, very high levels of training, skill and operational expertise are required.

Klein’s (1997) Recognition Primed Decision (RPD) model (Lipshitz, Klein, Orasanu & Salas, 2001) suggests an expert recognises critical environmental cues that trigger analogues (i.e., previously encountered similar experiences). This activation is thought to support decision making and reduce associated cognitive demand by focussing attention and integrating related information (Fiore, Ross & Jentsch, 2012; Loveday, Wiggins & Searle, 2013). Recognition aids identification, evaluation and implementation of action through reproduction of a previously utilised solution or through more complicated mental simulation and evaluation of potential options and associated outcomes.

Under the dynamic, ambiguous and critical demands of an armed confrontation, officers will need ‘adaptive expertise’ in order to cognitively and behaviourally adapt to unpredicted and dynamic events (Kozlowski & DeShon, 2004; Mercier & Higgins, 2013). Adaptive expertise refers to understanding when and why particular procedures are appropriate or inappropriate, and recognising shifts in the situation that necessitate adaptability (Wiltshire et al., 2014). Adaptability can therefore be described as an initiated behavioural sequence triggered by recognition of an environmental cue that suggests a change in tactical decision making should occur (Fiore, Ross & Jentsch, 2012; Verschaffel et al., 2009).This recognition is dependent on conceptual understanding of cause/effect connections (insight) and the restructuring of initial mental models (Fackler et al., 2009; Klein & Jarosz, 2011).

Rasmussen’s (1976) decision ladder also sees flexibility and adaptation as the defining characteristics of expert decision making. The decision ladder is comprised of links between information-processing activities and resulting states of knowledge. Whilst a rational, knowledge-based and linear behaviour sequence is typically associated with novice task performance, experts are thought to flexibly shunt from one process to the next and automatically execute pre-set skill-based responses depending on the situational assessment (Jenkins, 2009; Naikar, 2010).

The purpose of this study was to explore expert tactical decision making during armed confrontations. Despite its critical role in effective policing, very little research has been conducted into AFO expertise and decision-making (Flin et al., 2007; Kilner & Hall, 2005). This knowledge gap reflects difficulties gaining access to Police samples, as well as challenges in the collection and analysis of police data that is both ecologically valid and scientifically objective. Identifying how tactical decisions are made and how expertise influences this process is vital for reducing risk within these complex and demanding situations and environments through training. The acceleration of expertise is specifically critical due to a lack of AFOs that were qualified as Operational Force Commanders (OFCs) at the time that the current study was conducted (2013), potentially leading to non-OFC qualified AFOs being required to lead operations in their absence.

Although some studies have attempted to establish models of police decision making during firearms incidents, these are often framed in terms of the outcome of armed confrontations, neglecting the importance of the antecedents of the (no) shoot decision in determining this outcome and rarely explore the importance of expertise (Amendola, 1995; 1996; Binder & Scharf, 1980; Terrill, 2005). Furthermore, current models of Police firearms decision making have typically been developed within routinely armed Police forces (e.g., USA) and therefore almost certainly lack ecological validity to non-routinely armed forces (e.g., UK) (Barton, Vrij & Bull, 2002; Knutsson & Strype, 2003).

In identifying the cognitive processes underlying expert tactical decision making, this study highlights specific skills found to be most appropriate and successful in British Police firearms domains and as a result, instructors can concentrate their training to these specific skills (Klein & Militello, 2001; WBI, 2007). In other professions requiring rapid decision making in risky environments there has been significant research to understand and train operational thinking skills, e.g., aviation (Orasanu & Fischer, 1997; Seamster et al., 1993), and prehospital/medical emergency (Gunnarsson & Stomberg, 2009; Wong & Blandford, 2002).

**Research Approach**

This exploratory study employed Cognitive Task Analysis (CTA) methods to examine the expert decision making of British firearms officers during armed confrontations. CTA is a set of methods used to identify and explain the “mental processes involved in performing a task” (Klein & Militello, 2001, p. 163), that is cognitively complex (requiring an extensive knowledge base, complex inferences and judgement) and that takes place in a naturalistic environment (O’Hare, Wiggins, Williams & Wong, 1998). Considering that AFOs are required to make decisions under high levels of uncertainty, time pressure and risk, this sample are considered to serve as a paradigmatic example of Naturalistic Decision Making (NDM) at work (Roth et al., 2010). As such, CTA methods were selected as the most appropriate approach for generating insight and understanding about cognition in this specific real world context (Crandall, Klein & Hoffman, 2006; Tofel Grefhl & Feldon, 2013).

CTA has been found to successfully support system operation and aid improvement through the development of effective training recommendations in many various domains (Prasanna, Yang & King, 2009), including; military and defence operations (Riley, Endsley, Bolstad & Cuevas, 2006), aviation (Endsley & Robertson, 2002), and air traffic control (Endsley & Rodgers, 1994). The results of these CTA studies identified which processes were of most importance and therefore ensured the support of these processes resulting in improved performance (Adams et al., 2009; Crandall, Klein, & Hoffman, 2006; Tofel-Grefhl & Feldon, 2013).

Successful CTA should progress through a number of stages (Clark et al., 2008; Hoffman, Crandall & Klein, 2008), proceeding from preparatory steps to knowledge elicitation, data analysis and finally, knowledge representation (Yusoff & Salim, 2012). Through consideration of the available CTA knowledge elicitation techniques it was decided that the Critical Decision Method (CDM) interview protocol would be most suitable to retrospectively examine the tactical decision making processes of AFOs and SFOs during a previously experienced firearms incident which they considered to be non-routine. The CDM (Crandall, Klein, & Hoffman, 2006; Hoffman, Crandall & Klein, 2008) is structured as an intensive incident based interview protocol which aims to identify the decision making processes involved in the judgments made during a ‘challenging’ incident that have been personally experienced.

The CDM interview is a multi-stage process that utilizes multiple ‘sweeps’ through an incident. These sweeps build in intensity; from brief and general incident recall, to an intensive examination guided by the creation of a visual timeline, identification of decision points, and subsequent probing and hypothetical questioning regarding those decision points (Hoffman, Crandall & Shadbolt, 1998; Klein & Militello, 2001).

*Research Objective*

The objectives of this research were to identify the exemplifying characteristics of expert decisional processes involved in the decision making of British firearms officers during armed confrontations in order to identify potential training recommendations and/or serve as guidance for empirical evaluation. Although we propose our findings as instructional strategies, we acknowledge that future experimental research will need to be conducted in order to establish the effectiveness of these strategies. The use of CTA qualitative research methods can be used to generate meaningfully informed hypotheses suited to subsequent empirical testing (Crandall et al., 2006; Wiltshire et al., 2014). For the present purposes, CTA methods are used as exploratory means to derive an integrated theoretical framework, which can then be tested empirically in traditional settings in future studies.

**Method**

*Participants*

A total of twenty three firearms officers voluntarily participated in this study representing 20% of the AFOs in Merseyside Police. All were nationally accredited AFOs in the United Kingdom. This included twelve expert SFOs (all male) and eleven novice AFOs (nine male: two female). This sample size exceeds many CTA studies, which are typically based on a small sample size (<10) due to the large amounts of qualitative data that are generated by these approaches and limited access to experts of specific fields of interest (see Crandall et al., 2006; Wiltshire et al., 2014). The mean age of the expert SFOs was 46 (SD = 5.09) years old, and their length of service as a firearms officer ranged from 7 to 21 years, with mean and median of 17 (SD = 3.63) years. The mean age of the novice AFOs was 32 (SD = 4.59) years old, and their length of service as a firearms officer ranged from 10 to 48 months, with mean and median of 23 (SD = 13.43) and 21 months respectively. Data are not available in the public domain to determine the representativeness of the sample in terms of age and gender.

Based on the assumption that expertise is characterised by specialised skills or knowledge derived from extensive experience with a domain (Crandall, Klein & Hoffman, 2006), the level of expertise required for this investigation was SFO qualified participants with at least ten years’ experience working as a firearms officer. In contrast, to align with the statement that novices should have ‘minimal exposure to the domain’ (Hoffman, Crandall & Klein, 2008), novice AFO’s were chosen based on having qualified as an AFO, and therefore being competent enough to have done so and subsequently have enough experience to be able to complete the CDM process, but having three or less years’ experience as a firearms officer (relative novice status in comparison to expert sample). Only one participant in the novice AFO group was qualified as an OFC and SFO, the rest had qualified as AFO only.

*Materials*

In order to conduct the analysis, permission was sought to record the knowledge elicitation sessions in audio format using multiple Dictaphones (ALBA digital voice recorder and MP3 player: model number T858); one on the lapel of the analyst, one on the lapel of the participant and one on the table of the room in which the interview was being conducted. The participant was informed of this procedure before signing consent forms. The interviews were conducted guided by a script and an A3 blank page pad was used during the interviews to draw timelines of the recalled incidents. Qualitative data analysis software NVivo 10 (QSR International) was used to assist the qualitative analysis of the current studies and to create a transparent and ‘auditable footprint’ (Sinkovics & Alfoldi, 2012, p.5) of the analysis (NVivo toolkit, 2013).

*Procedure*

Access was granted from the head of the firearms department and the Chief Constable (ACPO level approval), but emphasis was placed on the importance of officer anonymity. To protect anonymity, the demographic information collected was kept to a bare minimum and participant numbers were used throughout analysis.Data collection consisted of knowledge elicitation sessions using the CDM. Each participant was asked to walk through a ‘challenging’ and non-routine armed confrontation that they have personally experienced as an AFO using the CDM script.The CDM interviews were conducted in the officers’ workplace. Each interview lasted between 1-2 hours.

*Data Analysis*

All knowledge elicitation session audio recordings were transcribed. The transcripts were reviewed for accuracy immediately after collection, utilising interview notes, timelines and any other drawings or notations to ensure quality control of the final transcript and to identify any discrepancies. For the current study, the data analysis reflected a framework analysis methodology, which allowed for both a ‘top-down’ (theory-driven) approach and a ‘bottom-up’ (data-driven) identification of emergent patterns (Wiltshire et al., 2014).

Firstly, the data set was read multiple times whilst considering cognitive issues which appeared to be relevant to the analysis and repeated ideas were noted in order to gain insight and evaluate the data set (Crandall, Klein & Hoffman, 2006). The 23 interview transcripts were then inductively coded for repeated ideas, which were reviewed and grouped into themes and subthemes. This process was iterative and involved multiple code and theme revisions. Summaries of the themes, sub-themes and supportive narrative are presented in table 1.

Data from the interview transcripts and field notes were consolidated into a decision requirements table (DRT) to represent key decisions (see table 2). The DRT was used to document and organise recalled cues (a sensory signal), information, strategies and practices associated with expertise, as well as identify specific challenges, potential pitfalls and errors that were typically associated with inexperience. The DRT helped to synthesise and integrate the data across the twelve recalled incidents from expert SFOs and the eleven recalled incidents from novice AFOs, revealing overall key trends (Crandall, Klein & Hoffman, 2006).

*Quality Control Procedures*

To demonstrate the objectivity of the research method, analysis and the conclusions, qualitative assessments were tested for inter-rater reliability to quantify the level of consistency among two independent raters who coded 30% of the data. The percentage of direct agreement for initial independent coding of the data was 62% and Cohen’s kappa coefficient was .71 (range across transcripts: κ = .48 to .83). Based on criteria set forth by Banerjee, Capozzoli, McSweeny and Sinha (1999), κ = .71 represents a fair level of agreement beyond that due to chance. Instances of disagreement between raters were discussed and the coding system was adapted accordingly. The percentage of direct agreement for the reconciled coding was 92% and Cohen’s kappa coefficient was .89 (range across transcripts: κ = .83 to .97). Based on the criteria of Banerjee and colleagues (1999), the reconciled coding had a substantial level of agreement beyond that due to chance.

**Results**

*Incident Demographics*

Out of the twelve SFOs interviewed, nine (75%) recalled spontaneous incidents that they were (self) deployed to whilst on armed response vehicle (ARV) patrol. Two (17%) recalled incidents that, due to circumstantial factors, involved a rushed and partial deployment briefing, and only one recalled a pre-planned operation. Recalled incidents had occurred between 2000 and 2011. Eleven incidents involved contact with the suspect(s), and only one was resolved without direct engagement with a suspect. In this case, the suspect had already left the scene before Police arrival; however, this information was only known retrospectively, therefore every incident recalled involved potential suspect contact.

 All eleven novice AFOs recalled spontaneous incidents which they were either deployed to by the Force Incident Manager via the back-to-back radio transmission system, or self-deployed to upon hearing the details of the incident through the radio whilst on ARV patrol. Two participants were required to act as the OFC during the recalled armed confrontation; however neither were formally trained to perform this role at the time of the incident (due to a lack of qualified OFCs available to lead the operation). Both incidents were resolved with the security of a trained OFC available to verify the participants’ decisions; however in both cases, the participant continued the role of OFC until the conclusion of the incident. Nine (82%) officers recalled an incident in which a contact with the suspect was encountered, whilst two (18%) recalled incidents incurring no contact, (i.e., suspect had already escaped before the Police had arrived).

*Qualitative Results*

The incidents described by both expert SFOs and novice AFOs could be broadly split into three general phases; pre-arrival, arrival/contact (active involvement of tactical performance and/or contact with a suspect), and post-incident procedures. In general, expert SFO decisional processes were not consistently distinct across the phases in a linear manner, but instead were applied flexibly throughout the armed confrontation. Expert SFO decision making was adaptive to circumstantial demands either leading to an establishment of control and typicality, or to a ‘tipping point’ of struggle for dominance and perceived time critical threat to life that initiated defensive behaviours. Compared to the flexible experiential based decisions of expert SFOs, novice AFOs reported a more sequential and linear process of tactical decision making which involved extended verbalisations and continued conscious processing throughout. Flexibility and adaptation to dynamic and time pressured changes was therefore postulated by the SFOs to be the distinguishing feature of expertise in this context.

Our analysis generated four main themes with related subthemes that were relevant to the influence of expertise in decision making during armed confrontation. The details of these themes (organised numerically and indicated by title in bold) and related subthemes (organised alphabetically and italicised title) are discussed in turn, whilst examples and supportive narratives from the transcripts for each (sub)theme are provided in table 1. Together these themes reflect the importance of adaptability to expertise in this context. In this sample, adaptive expertise reflects the flexible application of experiential knowledge, strategies and skills with confidence in response to situational demands.

1. **Experiential Knowledge**

Whether declared explicitly or as a guiding force behind tactical confidence, all expert SFOs described their extensive firearms experience as a positive influence on their situational assessment and tactical decision making during the recalled incidents. The influence of SFO experiential knowledge was broadly described in the utilisation of assumptions and expectations that were mentally modelled based on personal or working experiences. These assumptions and expectations identified typicality and anomalies in the current set of cues, and indicated appropriate tactical strategies based on this assessment. Such processes were often described as intuitive and were believed to be shared with their partner/team.

1. *Assumptions*

The influence of SFO experiential knowledge was broadly described in the utilisation of assumptions regarding the unfolding incident based on personal or working experiences. Individual situational awareness (SA) of audio cues, visual cues, intelligence feeds interacted with previous expectations to generate assumptions regarding incident legitimacy, suspect intention, and appropriate tactical action. In particular, intelligence feeds (e.g., initial report, background checks on the address, and suspect previous offences and/or mental health history) informed assumptions of suspect intention and capability, which indicated expected tactical roles, responsibilities and actions. These assumptions were predominantly influential during the five recalled incidents that involved suspects who were deemed to be emotionally or mentally distressed and/or intoxicated. The overall underlying concern when dealing with an emotionally or mentally distressed suspect was the potential negation of achieving compliance as a result of an assumed unpredictability and lack of rationality or reasoning. This is supported by previous reports that acknowledge that the unpredictability of these suspects typically negate the assumption of rational compliance (Police Complaints Authority, 2003; Squires & Kennison, 2010). Therefore, additional tactical consideration, caution and urgency was emphasised in these cases as a reflection of the increased risk associated with suspect unpredictability

1. *Prototypes & Analogues*

Supporting previous studies that suggest experiences merge in memory with increasing expertise, nine expert SFOs were found to use analoguesnon-specifically, as a prototype rather than specific stand out cases (Fackler et al., 2009; O’Hare, Wiggins, Williams & Wong, 1998). These prototypes built assumptions regarding the suspect's mentality, capability and intent. In six cases, the suspect was known to the SFO. This experience helped build strong assumptions and expectations regarding their potential behaviour.

In contrast, six novice AFOs recalled utilising specific analogues in their tactical decision making. For instance, analoguesof training events in which a mistake was made were used as a reminder to be vigilant to potential error. Analogue recall was described as a visual process; AFOs would picture themselves at an analogousscene of training, run through what happened in these scenarios and marry up similarities in order to guide predictions and preparation. One AFO recalled using specific past experiences as a “portfolio of jobs” which are matched to the current context in order to identify appropriate tactical options (AFO9).

1. *Mental Modelling*

Information received on deployment and any other further intelligence feeds interacted with officers’ models of typicality, or ‘schemata’ (Plant & Stanton, 2012; Plant, Stanton & Harvey, 2013), to build mental models of the unfolding events. Mental model refers to a representation of the core relationships within a domain based on conceptual knowledge and understanding (Wiltshire et al., 2014). Mental models enabled officers to consider potential tactical options and appropriate Standard Operating Procedures (SOPs) in accordance with projected events, and also initiated consideration and preparation of associated equipment (ballistic protection and/or weaponry).

Mental modelling was described by eleven expert SFOs as a preparatory process, which aided later adaptation (Klein & Militello, 2001; Pirolli & Card, 2005). Eleven expert SFOs used mental models to mentally simulate potential solutions and the associated outcomes in order to assess these options and adapt their behaviour accordingly. This was formally acknowledged as ‘contingency planning’ and included physically preparing to deal with predicted events and outcomes (e.g., positioning self and equipment).

Predictive mental modelling was described as a preparatory skill that is developed over time based on previous knowledge, experience, and training. Nevertheless, all novice AFOs also described a process of mental modelling (i.e., 'what if'), and for ten novice AFOs this involved mentally visualising potential actions and ‘worst case’ outcomes in order to prepare contingencies for such events. Both expert SFOs and novice AFOs described mental modelling as a visual process which directs choice, however whilst expert SFOs exclusively discussed predictive mental modelling pre-arrival, AFOs reported mental modelling to be most influential on contact with a suspect.

1. *Typicality*

By comparing environmental cues to schematic models of typicality, officers were able to either identify a match or were able to recognise an anomaly. Identifying a match between cues and typicality triggered procedural knowledge and action known to be successful in previous analogous situations. In contrast, anomaly recognition heightened SA to notice and address critical cues (Crandall, Klein & Hoffman, 2006; Klein & Militello, 2001), and therefore was crucial to AFO/SFO tactical decision making. Eleven expert SFOs reported that the ability to quickly recognise anomalies was accounted for by their experience. The most common and influential recognised anomaly was instances in which the suspect did not meet the officer’s expectations of compliance. As a deviation from typicality, non-compliance instigated suspicion of the suspect’s intent.

1. *Intuition*

AFOs development of expertise was emphasised in reports of intuitive assessments regarding incident legitimacy, severity, address, and suspect identification. This was described as a skill that developed over time with experience. Expert SFOs reported having a ‘feel’ for an incident, which helped them judge safety, priorities, and tactical decisions. Some novice AFOs also reported beginning to utilise intuition in this way (see table 1). Expression of the incident ‘not being right’ indicated intuitive anomaly recognition, triggering subsequent redirection of attention to focus on these anomalous features.

1. *Shared Situational Awareness*

If afforded time to do so, individual SA was verbally shared between team members in order to promote inter-team coordinated responses. Team communication often reflected a prescribed script of routinely practised verbal drills, which confirmed that an officer was currently conforming to tactical expectations. Nonetheless, eight expert SFOs described a lack of overt communication between the team during contact with the suspect(s) that reflected an implicit shared understanding and trust between the team. As a result of this shared understanding, eight expert SFOs said that they could make predictions regarding their colleagues’ actions and utilise these predictions to speed up their own response in support. This supports literature that identifies expert team decision making in terms of shared cognition and shared mental models which relies on a common knowledge base and aim (Cannon-Bowers & Salas, 2001; Salas, Cooke & Rosen, 2008; Sonesh, Rico & Salas, 2013). Furthermore, as an alternative to verbal discussion, expert SFOs sometimes established and exchanged visual communication with each other to ascertain their safety, shared knowledge, and/or collaborative understanding. A lack of ability to establish this visual communication resulted in a sense of isolation and vulnerability.

1. **Strategies**

Experiential strategies included the active pursuit of control, a reliance on an automated “training mode” and a process of ‘chunking’ that involved compartmentalising and prioritising tasks.

1. *Control*

Ascertaining a level of control over the incident was repeatedly reported by eleven expert SFOs to be a prioritised aim. For expert SFOs a lack of control reflected a lack of predictability, on which the likelihood of a successful and safe conclusion was presumed to be reliant. Having sight of the suspect(s) whilst working within a prescribed and familiar tactic enabled a greater sense of control. Ascertaining physical control of the suspect(s) signalled an end of the immediate perceived threat and instigated post-incident considerations.

In order to ascertain early incident control, expert SFOs initially used covert tactics. Covert methods allowed SFOs to be completely prepared to enforce a tactic within a highly controlled and rehearsed framework. By alerting the suspect to the on-going police operation, six SFOs feared that “blowing the job” would give the suspect preparation and reaction time to escape and/or pose a lethal threat. Initial police dominance on arrival was reported by ten expert SFOs as a method of establishing early compliance in order to ease the pressure of the subsequent phases by negating unplanned, responsive and therefore more risky methods and outcomes.

Whilst eleven expert SFOs heavily emphasised gaining and maintaining control as the strategy behind their tactical decisions, only one novice AFO discussed this. Yet, despite a lack of explicit discussion of this issue, novice AFOs did prioritise covert methods as a means to maintain an advantage over a suspect and to reduce their opportunity to escape.

1. *Training Mode*

Through repeated practice, certain behaviours are automatically initiated in response to specific situational cues without conscious cognitive deliberation (Shachak et al., 2009). Supporting this, if situational assessment indicated that control was achievable, officers from both samples (eleven expert SFOs and five novice AFOs) automatically reverted to tactical responses in accordance with SOPs (referred to as “training mode”). Because they require little monitoring, automatic responses are fast and efficient, freeing limited cognitive resources to consider other aspects of the incident (e.g., situational assessment, recognition of critical cues and adaptation). Training mode was more readily utilised by expert SFOs than novice AFOs; however only up to a ‘tipping point’ of a perceived immediate threat to own life which instead automatically initiated defensive behavioural responses.

1. *Chunking*

Seemingly endless lists of considerations and simultaneously occurring events and/or tasks were described to generate an overwhelmingly high level of perceived cognitive demand (referred to as “spinning plates”; AFO9). As a result of this overwhelming demand, six expert SFOs reported ‘chunking’ (Gobet et al., 2001) the incident into separate tasks to be dealt with in order of priority. This ‘chunking’ process helped expert SFOs identify and prioritise tasks, reducing cognitive demand whilst serving to highlight anomalies and tasks to be addressed: it increased SA. Supporting NDM claims of an expert ‘in-built prioritisation’ scheme of environmental cues (Seamster et al., 1993), prioritised judgments were made subconsciously and quickly as an outcome of SFOs’ expertise. Novice AFOs did not report this strategy in their description, indicating a discrepancy between the strategies across differing levels of expertise.

1. **Adaptation**

Armed confrontations involve highly dynamic and changeable threats; therefore in addition to tactical proficiency to take immediate action (i.e., “training mode”); officers must be prepared to behaviourally adapt. All twelve expert SFOs referred to adaptations in their decisions, roles, positions, and tactical actions. Most adaptation reported was made in response to situational limitations (e.g., threatto own life, time pressure, and resource strategies). Threat to own life resulted in adaptations such as sacrificing speed for safety, whilst time pressured adaptations included going without their preferred (primary) weapon or quickly implementing tactics in a non-preferred location to affect a quick arrest. Sometimes, this adaptive need meant resorting to a satisficing ‘best fit’ option to avoid ‘worst case’ outcomes.

1. *Flexibility*

Through experiential knowledge, SFOs were aware of the unpredictability of armed confrontations, could recognise when they needed to be flexible to changing circumstantial demands, and adapt their decisions, roles/positions, and tactical actions accordingly (i.e., deciding to enter a house as a team of two, rather than contain it and wait for further resources in accordance with policy and guidelines based on the intelligence of an injured victim inside). Whilst expert SFOs intuitively recognised a need for flexibility and implemented adaptation quickly, novice AFOs relied more heavily on SOPs and were reluctant to implement change. For example, one novice AFO described how, following SOP guidance towards baton gun availability and access they prioritised this in the recalled situation, However, in hindsight this participant declared that they would not do so again based on their experience that freedom of movement and speed in that situation was more advantageous than access to use a baton gun.

1. *Confidence*

Confidence enabled expert SFOs to be flexible with tactics or decisions, and to do so quickly. In contrast, novice AFOs were more cautious in their tactical decision making and reluctant to adapt, preferring to act within a prescribed tactical framework despite contextual redundancy. Novice AFOs were able to recognise anomalies and identify when SOPs could no longer be adhered to under the demands of the armed confrontation, however they were not always confident enough to adapt to these demands. Instead, novice AFOs dealt with their inexperience by seeking verification before implementation of a decision from a more experienced officer.

Five novice AFOs sought verification from an officer of higher authority and/or with more experience before implementing a tactical decision or action. This “safety net of other, more experienced colleagues” (AFO1) acted as a “cushion” (AFO9) that was used to verify decision making. Such verification involved “appraising ideas” (AFO2), the assessment of response appropriateness (checking for glaring mistakes), and/or reassurance. One officer described this process through the analogy of a child looking to an adult for verification of their answer when learning a new word (AFO4).

Six novice AFOs acknowledged that since the recalled armed confrontation, their confidence had grown. This increase was described as a predicted behavioural change; from seeking verification to informing their team mates of their decisions and enforcing own judgment, even if it contrasts the actions of a more experienced officer. Such changes were expected to involve the confidence to act quickly on own intuition as opposed to waiting for instructions. These behavioural changes may reflect the development of trust in own adaptive decision making and/or mental modelling skills over time.

1. *Defensive Adaptation*

Upon a struggle to acquire control, expert SFOs’ threat perception was heightened resulting in internal changes, recognition of a need for adaptation, and defensive behaviour. Eight SFOs and nine AFOs reported perceiving there to be a direct threat to their own life at some point during the recalled incident. Perceiving there to be a direct threat to their own life reflected three factors; (i) an increase in the suspect’s physical or verbal aggression, (ii) the presence, perception, or presentation of a weapon, and/or (iii) dangerous environmental conditions (a lack of ballistic or visual cover). Considerations of self-preservation influenced positioning and tactical options. Under personal threat, tactical considerations (e.g., victim, containment of house, and public cordons) were sacrificed in favour of prioritising a “reactionary gap” (AFO8), i.e., enough distance between themselves and the suspect to enable effective defensive behaviour in response to any potential threat posed by the suspect, full focus on the threat posed to self, and addressing that threat). Novice AFOs’ explained that without the prioritisation of their own safety, their ability to safely conduct a tactic is compromised. After surpassing a ‘tipping point’ of a perceived time critical threat to own life, final (no) shoot decisions were instinctual defensive responses based on a dual judgment of self-preservation, i.e., “me or him” (SFO11), which took precedence over tactical objectives.

**[Insert Table 1]**

**Discussion**

This study sought to compare the processes underlying the tactical decision making of expert SFOs and novice AFOs. Comparing these results highlighted similarities and differences. This information was consolidated into a DRT that was used to synthesise and integrate the data across the two groups revealing key trends and disparities, which highlight potential areas of training (table 2). Noted disparities included; (i) a difference in coping with cognitive load, (ii) SFOs’ confident implementation of intuitive decision making vs. AFOs’ reliance on instruction and/or verification before decision implementation, and (iii) SFOs’ recognition of situational changes and subsequent tactical adaptation vs. AFOs’ reluctance to move away from SOPs despite their contextual irrelevance.

**[Insert Table 2]**

The results from both CTAs suggest adaptive flexibility to be a distinguishing factor of SFO expertise. SFOs are proposed to have adaptive expertise, which consists of the ability to; (i) understand when and why particular procedures are appropriate or inappropriate, (ii) recognise shifts in the situation that necessitate adaptability, (iii) respond to situational cues which indicate the prioritisation of speed and/or accuracy (Verschaffel et al., 2009), and (iv) implement rapid, accurate, and contextually appropriate tactical changes (Kavanagh, 2006; Kozlowski & DeShon, 2004).

Both SFOs and AFOs formed and tested mental models, and relied on schematic models of typicality for pattern and anomaly recognition (Klein & Hoffman, 1992). However, experience enabled expert SFOs to use these processes more flexibly in response to dynamic situational demands. For instance, both samples recognised situational cues that indicated the need for adaptation of SOPs in favour of more appropriate tactical actions, but expert SFOs understood the interactions between the cues and the unfolding incident, and responded by quickly and intuitively adapting appropriately. In contrast, novice AFOs preferred to stick with SOPs for as long as possible, even when doing so inhibited the progress of the incident, only adapting their tactical actions if faced with an immediate threat to own life (in which case, defensive behaviours took over), or when doing so is verified by a more senior/experienced officer. This disparity may reflect a different reliance on perceptual and conceptual knowledge between the two groups. Perceptual knowledge, which enables recognition of critical environmental cues, is thought to develop much quicker than conceptual knowledge (the ability to interpret the relevance and meaning of such cues) (Melcher & Schooler, 2004). Supporting this, novice AFOs were able to see when current SOPs were not working (perceptual knowledge) but were not always able to understand how they could adapt to these cues (conceptual knowledge) (Fiore, Ross & Jentsch, 2012).

The ability to flexibly transfer and apply experiential knowledge to new contexts is dependent on the ability to recognise the underlying principles that govern the situation (Verschaffel et al., 2009). For instance, as expert SFOs described, mental modelling reflected a process of ‘picture developing’ in order to; (i) causally connect and explain the situation in a meaningful way, (ii) build expectations, (iii) direct decision making, and (iv) prepare for subsequent actions and outcomes (Fackler et al., 2009). Mental models (conceptual knowledge) not only enabled expert SFOs to immediately recognise contextual changes and when standard tactical options were failing in the current context (based on previously projected occurrences, outcomes, and own responses), but also enabled the understanding of how and why they could adapt their training or assigned role to the identified situational changes (Fiore, Ross & Jentsch, 2012). Both samples utilised mental modelling strategies, however, expert SFOs were able to quickly generate a larger number of hypothesised potential occurrences. A greater number of anticipated task-relevant options have been found in previous studies to help experts predict actions and outcomes more accurately under uncertainty, enabling greater flexibility to respond to projected events (Gutzwiller & Clegg, 2013; Ward, Ericsson & Williams, 2012). Similarly, expert SFOs described mental modelling before arriving at the scene as a preparatory process that aided adaptation in later phases of the armed confrontation. In contrast, novice AFOs’ inexperience was shown in their lack of confidence and reliance on verification of tactical decisions before implementation of adaptive action.

Reflecting Rasmussen’s (1976) decision ladder, novice AFOs were found to respond to the circumstances occurring during a firearms incident in a linear process of reasoning compared to expert SFOs who flexibly shunt from cue to cue depending on the contextual demands (Jenkins, 2009; Naikar, 2010). The parallel between these findings and Rasmussen’s decision ladder suggest implication for training recommendations.

**Theoretical implications**

In all, the current findings complement previous models of expertise. For instance, models such as Klein’s RPD Model (1997; 2008) indicate expertise to be exemplified by a recognitional shift from analytical processes towards automatic intuitive response (Benner, 2004; Lipshitz et al., 2001). The current results support the gradual development of reliance on intuitive processes: expert SFOs reported having a 'feel' for an incident (SFO1), which helped them judge priorities and tactical decisions. In addition, almost all expert SFOs reported relying on an automatic response they referred to as “training mode” which echoes a simple match process using the RPD model (Klein, 2008). However, the data shows that under some circumstances (low levels of time critical threat i.e., pre-arrival and post incident procedures), experts continue to utilise analytical planned processing such as compartmentalisation, i.e., “you’re kind of ticking the boxes” (SFO11), and mental modelling, i.e., “I always try and pre-empt the ‘what if’ factor” (SFO4). Therefore, the current data would suggest that expertise in the context of tactical decision making during an armed confrontation is not defined by either intuitive or analytical processing alone, but rather is exemplified as the flexibility to adapt their responses quickly and confidently to situational changes under increased demand. Consequently, this study provides support for the RPD model (Klein, 1997; 2008), theories of adaptive expertise (Mercier & Higgins, 2013; Verschaffel et al., 2009; Wiltshire et al., 2014) and Rasmussen’s (1976) decision ladder, which similarly sees flexibility and adaptation as the defining characteristic of expert decision making (Jenkins, 2009; Naikar, 2010).

**Practical implications**

*Applications to Police policy*

The current study presents an evidence-based framework of tactical decision making during armed confrontations that accounts for contextual influences on performance. Increased general understanding of the complexities involved in AFO decision making during armed confrontations may similarly improve public trust in the accountability of Police decision making around the use of firearms. While it is currently unclear whether the attentional capacities of AFOs can be improved, an awareness of the limitations of attentional processes in high demand situations is crucial, both for the AFOs themselves and for those investigating their responses (Kavanagh, 2006).

*Police training*

The comparative results of both CTAs highlight adaptive flexibility to be associated with firearms expertise and therefore, it is suggested that Police firearms training could enforce adaptive expertise more strongly to enhance AFO flexibility to changing task demands under high stress conditions. Cognitive Transformation Theory claims the development of adaptive expertise is dependent on pattern recognition, perceptual discrimination, understanding of the interconnections between knowledge, and the ability to modify knowledge to the specifics of situation and/or domain (Klein & Baxter, 2009; Wiltshire et al., 2014). Therefore, in order to promote adaptive expertise, it is recommended that the development of mental models (Gutzwiller & Clegg, 2013; Klein & Militello, 2001; Pirolli & Card, 2005; Ward, Ericsson & Williams, 2012; Ward et al., 2013), sense making skills to recognise conflict between mental models and current situational cues (Fiore, Ross & Jentsch, 2012; Morrison, Wiggins, Bond & Tyler, 2013), and the ability to revise or reject mental models in response to situational assessment is enforced (Ando, Kida, & Oda, 2002; Wiltshire et al., 2014).

Speculatively, this may be accomplished by systematically exposing AFOs to a variety of scenarios where, through guided practice and feedback, they can develop the models of typicality necessary for rapid and accurate situation assessment and anomaly recognition (Fiore, Ross & Jentsch, 2012). Exposure to high fidelity ‘worst case’ armed confrontation simulations which involve situations that cannot be solved through traditional methods (tactical SOPs) may encourage adaptive flexibility in order to complete the exercise (Ando, Kida, & Oda, 2002; Williams & Westall, 2003). Future research is needed to fully examine how the acceleration of adaptive expertise can be implemented in practice, and any implementations should be fully evaluated to assess their effectiveness.

*Limitations*

As previously discussed, because of the automaticity, and therefore often unconscious, nature of expert decision making, experts in particular may find it difficult to articulate any intuitive processes via interviewing techniques (Feldon, 2010; Smink et al., 2012; Tofel-Grehl & Feldon, 2013). Whilst, CTA has been shown to succeed in extracting up to 43% more decision performance-relevant information from experts than standard interview protocols (Clark & Estes, 1996), it must be acknowledged that as a form of interview methodology, CTA is likely to suffer from the same limitations in terms of extraction of intuition. However, the publication and high citation of reports that utilise interview methods such as CTA for the extraction of expert intuition in a variety of decision making environments (i.e., Benner, 2004; Klein, 1997; 2001; Klein et al., 1998; Wong & Blandford, 2002), support the use of interview methods for the study of expertise

The length of time passed between the incident and expert SFOs recall was substantial in some cases, and therefore could present a methodological issue, however the recall of unverified retrospective events must be considered as a possible limitation of both CTAs. Previous studies have used the CDM technique to interview participants regarding the decisions made during an observed event (Brezovic, Klein, & Thordsen, 1990). Therefore, to combat the possibility of memory fragility in the recall of unverified retrospective armed confrontations, a follow up study is proposed to examine the decisional processes occurring during the completion of a recorded firearms training exercise.

It should be noted that analysis is based on only 23 participants, all recruited from a firearms department within the same British Police force. Although it is acknowledged that generalisability is a shortcoming, AFOs are a very specific group of decision makers and as such, generalisation to a larger population is not a major consideration, as findings are to be specifically applied to this particular group of decision makers (McAndrew & Gore, 2013; Roth et al., 2010). More relevantly, it is possible that these results represent force-specific novice AFO and expert SFO tactical decision making and a larger sample generated across UK wide forces could help decipher the generalisation of these findings to UK AFO tactical decision making more accurately (Smick et al., 2012). Nonetheless, given the limited time available and difficulties in gaining access to such a specialised group of officers, this was not possible. Future research may seek to clarify these issues through replication with officers across different forces to examine relationships and whether they exist in different policing areas.

**Conclusion**

Similar processes were reported across the two groups, whilst strategies used, tactical implementation, and confidence differed. Expert SFOs had a great deal of experiential knowledge. With this knowledge, expert SFOs were able to; (i) categorise incidents, (ii) recognise anomalies, (iii) have awareness of, and be able to quickly adapt to, the dynamic environment, (iv) use their training unconsciously and automatically, and (v) were confident in their abilities. Confidence in own ability enabled expert SFOs to utilise experiential strategies that freed cognitive resources, affording implementation of adaptive tactical decisions and actions assessed through mental modelling.Novice AFO comparison highlighted the gradual development of confidence in their own ability.These findings can be implemented into AFO training, highlighting the importance of these cognitive processes as a contributor to expert tactical decision making during firearms incidents.

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**Table 1. A summary of themes and sub-themes with supportive narratives from the transcripts.**

|  |  |  |
| --- | --- | --- |
| **Themes***Sub-themes* | ***N* of officers referring to (sub)theme** | **Example Data Extracts** |
|  | Expert SFOs | Novice AFOs |  |
| 1. **Experiential Knowledge**
2. *Assumptions*
3. *Prototypes & Analogues*
4. *Mental Modelling*
5. *Typicality*
6. *Intuition*
7. *Shared Situational Awareness*
 | 89 *(prototype)*1111108 | 46 *(analogue)*11950 | “we generally don’t run into fights with people who have various issues [mental health, alcohol or drugs] ‘cause they’re more volatile and more prone to doing something that’s unexpected” (SFO2)“try your best to, to stop anything like that [7/7, 9/11] happening, in your patch” (SFO10)"it took me back to the training course" (AFO3)“I always try and pre-empt the ‘what if’ factor […] in a position where it’s not a surprise” (SFO4)"try and cover any contingencies [...] I was told when I first come down, when a job is coming in, give yourself hypothetical scenarios, "what if, what if, what if”" (AFO11) “you’ll pick up, as a result of the experience on any, er, anything that’s missing” (SFO8)"Every job is not the same but there are certain aspects of it that you always look for" (AFO9) “you could tell straight away […] you get a bit of a feeling for a job” (SFO1) "a sixth sense " (AFO7)“everyone had the same mindset” (SFO7) |
| 1. **Strategies**
2. *Control*
3. *Training Mode*
 | 1111 | 15 | “hadn’t put my blue’s and two’s on because I didn’t want to alert the suspects […] didn’t want to give them any advantage on us, in preparing themselves to deal with armed police […] a game of chess” (SFO11)“you go into a training mode [...] just tends to come automatically as a result of your training” (SFO8) “I actually, sort of reverting to type if you like and reverting to training” (AFO2) |

**Table 1. continued**

|  |  |  |
| --- | --- | --- |
| **Themes***Subthemes* | ***N* of officers referring to (sub)theme** | **Example Data Extracts** |
|  | Expert SFOs | Novice AFOs |  |
| 1. *Chunking*
 | 6 | 0 | “you’re subconsciously prioritising […] that’s borne out of years of experience” (SFO5)“each stop was a separate little individual event […] you’re kind of ticking the boxes” (SFO11) |
| 1. **Adaptation**
2. *Flexibility*
3. *Confidence*
4. *Defensive Adaptation*
 | 1298 | 45 *(seeking verification)*1 | “the experience sort of made my decision making a lot quicker to say ‘well I’m now not doing this role, I’m doing that role”' (SFO3)“think on your feet and make a decision and look and be flexible […] because of your training and experience it just kicks in to think, ‘no-one’s there, I’ll go there and do my job there’' (SFO9)“I was very well trained […] definitely the experience helped without a doubt” (SFO11)"as opposed to training, this was difficult for me […] I didn't have the experience […] I was working out of my comfort zone " (AFO1)"sought the opinion of someone who was at the back with me who had more experience" (AFO6)"instead of, I suppose you could say asking permission I would probably say "I think I should go here because of this" [...] more confident in my own judgement" (AFO6)Its fight or flight isn’t it? […] its survival” (SFO2) “I thought, ‘Oh, \*\*\*\* me, I’m gonna’ die’ [...] what it boiled down to was me or him” (SFO11) |

**Table 2. Decision Requirements Table**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Phase** | **Decision Challenge** | **Cue/Information** | **Expert Strategy/Practice**  | **Novice Traps** |
| Pre-Arrival | Spontaneous deployment; Uncertainty; Environmental challenges | Visual cues; Audio intelligence feeds; Suspect’s previous offences or emotional/mental health/intoxication; Previous knowledge of suspect/case | Situational awareness and assessment; Instinct; Assumptions and expectations based on prototypes; Predictive mental modelling and contingency planning | Lack of previous knowledge to inform mental modelling, assumptions and expectations |
| Arrival and/or Contact | Ascertaining control over the situationDynamic Situational limitations Threat to life; Contact; (No) ShootTime Pressure; Responsibility | Visual assessment of the suspect (attitude/demeanour/likelihood of compliance)Fast paced changes in environmental cues, suspect assessment, and/or intelligenceLack of resources, equipment and/or trainingVisual assessment of suspect aggression; Presentation of a weapon; Knowledge of suspect intent/capability; Increased physiological arousal and perceptual changesHigh speed; Potential suspect escape | Maintaining covert tactics for an advantage on the suspect; Initial dominance/aggression; Typicality and anomaly recognitionTactical action based on training mode; Adaptation and flexibility aided by mental modelling and preparationAdaptation; Tactical dominance; Shared situational awarenessSlowed perception – time to react; Controlled adrenaline – faster reactions and stronger disposition; Narrowed focus on hands (location of threat); Cover; Safety in numbersBest fit (fast response over optimal but timely decisions); Chunking; Predictive consequence mental modelling | Rushing in – lack of situational reassessmentDefied expectations; Reluctance to adaptSeeking verification; Lack of confidenceUncontrolled adrenaline response; Speeded time – rushed and time pressured decisionsTactics not yet conducted automatically – active analogue recall needed to guide action. |
| Post-Incident | Scene preservation; Handover  | Lack of pressure | SOPs; Hindsight/ hypotheticals |  |

1. Corresponding Author [↑](#footnote-ref-1)