

Coping with uncertainty: police strategies for resilient decision-making and action implementation

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Abstract This study uses a hostage negotiation setting to demonstrate how a team of strategic police officers can utilize specific coping strategies to minimize uncertainty at different stages of their decision-making in order to foster resilient decision-making to effectively manage a high-risk critical incident. The presented model extends the existing research on coping with uncertainty by (1) applying the *RAWFS* heuristic (Lipshitz and Strauss in *Organ Behav Human Decis Process* 69:149–163, 1997) of individual decision-making under uncertainty to a *team* critical incident decision-making domain; (2) testing the use of various coping strategies during “in situ” team decision-making by using a live simulated hostage negotiation exercise; and (3) including an additional coping strategy (“reflection-in-action”; Schön in *The reflective practitioner: how professionals think in action*. Temple Smith, London, 1983) that aids naturalistic team decision-making. The data for this study were derived from a videoed strategic command meeting held within a simulated live hostage training event; these video data were coded along three themes: (1) decision phase; (2) uncertainty management strategy; and (3) decision implemented or omitted. Results illustrate that, when assessing dynamic and high-risk situations, teams of police officers cope with uncertainty by relying on “reduction” strategies to seek additional information and iteratively update these assessments using “reflection-in-action” (Schön 1983) based on previous experience. They subsequently progress to a plan formulation phase and use

“assumption-based reasoning” techniques in order to mentally simulate their intended courses of action (Klein et al. 2007), and identify a preferred formulated strategy through “weighing the pros and cons” of each option. In the unlikely event that uncertainty persists to the plan execution phase, it is managed by “reduction” in the form of relying on plans and standard operating procedures or by “forestalling” and intentionally deferring the decision while contingency planning for worst-case scenarios.

Keywords Uncertainty · Coping · Critical incidents · Naturalistic decision-making · Simulation-based training

1 Introduction

This paper explores the impact of uncertainty on decision-making in the high stake, irrevocable critical incident management environment police officers face during hostage negotiation incidents. It extends the *RAWFS* heuristic (Lipshitz and Strauss 1997), which presents five chronological and progressive coping strategies utilized to combat uncertainty during individual decision-making (reduction; assumption-based reasoning; weighing pros and cons; forestalling; suppression), to identify domain-specific coping tactics utilized by a hostage negotiation team. It will extend the original *RAWFS* model to (1) apply to an “in situ” team decision-making context (as opposed to individual retrospective accounts) (2) assess the progressive nature of the use of uncertainty coping tactics across the three phases of a decision process, and (3) include “reflection-in-action” as an additional coping strategies believed to be utilized by police officers in highly dynamic critical incidents. Specifically, we examine the distribution of uncertainty coping tactics used by teams of police

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officers to progress through the three stages of critical incident decision-making identified in the previous studies, namely from *situation assessment* (SA) to *plan formulation* (PF) to ultimate *plan execution* (PE) (van den Heuvel et al. 2011).

1.1 Uncertainty and heuristic biases

Definitions and theories of “coping with uncertainty” that exist within the decision-making literature are vague. *Uncertainty management theory* and *uncertainty reduction theory* (Berger and Calabrese 1975) focus on the subjective nature of uncertainty and argue that an individual’s perception of uncertainty is more important than the level of ambiguity in terms of situational characteristics (Bradac 2001). More recently, uncertainty has been explored as a response for wanting to control and predict the surrounding environment (Kobus et al. 2001) in order to feel safe and have sufficient resources to create meaningful and resonating plans and to implement goal-directed actions (Fiore et al. 2010). Despite a plethora of research, however, these types of general theories offer little coherent description of how decision-makers specifically manage highly emotive and uncertain situations (Goldsmith et al. 2005). They are therefore of little use to researchers attempting to explore strategies which aid the reduction in perceived uncertainty to overcome decision delay and enable strategic decision-making in highly consequential or risky environments.

In response to these criticisms, Lipshitz and Strauss (1997) defined uncertainty as a “*sense of doubt that blocks or delays action*”. Uncertainty is a crucial component in governing decision-making and can cause a deviation from strategic decision processes (van den Heuvel et al. 2011). The more uncertain a situation is to a decision-maker, the more high risk it is perceived (Bernstein 1998); therefore, the ability to manage uncertainty informs effective decision-making (Wickens and Hollands 2000). It has been highlighted in various naturalistic studies that heuristics are used as a cognitive method for reducing complex decision-making problems, and it has been found that when in ambiguous (Souchon et al. 2009), time-pressured (Kruglanski and Thompson 1999), highly novel (Crichton et al. 2007), cognitively overloading (Renkl et al. 2008) or uncertain (Cohen 2010) situations, people tend to rely on simple adaptable rules, or heuristic cues, to reduce the systematic processing of information (Reimer et al. 2004) and make decisions (Tversky and Kahneman 1974). Indeed, previous studies have found that in the majority of cases, police officers managed to implement strategic decisions, despite facing ill-structured problems and uncertain environments (van den Heuvel et al. 2011). However, heuristics can also lead to extremely poor, ill-informed, and biased decision-making (DiBonaventura and Chapman 2008).

Therefore, as critical incidents in police settings are often characterized by extreme uncertainty (van den Heuvel et al. 2011), limited and incomplete information (Camerer and Weber 1992), significant time pressure, and difficult decision problems (Nohrstedt 2000), it is extremely important to understand the cognitive coping strategies used to make such decisions within these types of environments.

1.2 RAWFS: a heuristic for coping with uncertainty

In order to more fully understand decision-making in the face of uncertainty, Lipshitz and Strauss (1997) examined retrospective real-world data and concluded that there were three basic types of uncertainty: inadequate understanding, incomplete information, and undifferentiated alternatives. It was suggested that in order to overcome such uncertainty, decision-makers followed a process known as the RQP heuristic: *reduce* uncertainty through information search, *quantify* uncertainty that cannot be reduced, and *plug the result* into a formula to select a preferred alternative (Lipshitz 1997). However, despite its potential, the RQP heuristic cannot be used without additional formulaic assistance, which is often both unavailable and impractical in real-world applied settings (Lipshitz et al. 2007).

The *RAWFS* heuristic was therefore developed, which proposed five heuristic coping strategies utilized chronologically by decision-makers in order to cope with uncertainty (Lipshitz and Strauss 1997). These five coping strategies are *reduction* of uncertainty through information search; *assumption-based reasoning* to fill in missing information; *weighing pros and cons* in order to derive subjective expected utility of options; *forestalling* to prepare for worst-case scenarios; and *suppressing* uncertainty in order to ignore doubts and/or conflicting information. In further analysis of the *RAWFS* heuristic, it was found that each of the above-mentioned coping *strategies* are underpinned by a number of coping *tactics* in order to deal with uncertainty during decision-making (Lipshitz et al. 2007). For example, *reduction* in uncertainty can be achieved through tactics such as delaying action, prioritising tasks, relying on standard operating procedures, and actively searching for information, and *assumption-based reasoning* can involve relying on previous plans, using mental rehearsal and simulating actions, and conjecturing an assumption to create situation awareness (Lipshitz, et al. 2007). These underlying coping tactics within each strategy can all serve to minimize perceived uncertainty and aid the decision-making process.

1.2.1 Extending RAWFS: reflection-in-action

Other research on expert decision-making has highlighted the importance of *reflection-in-action* to reduce uncertainty

(Schön 1983). In highly dynamic decision-making settings, decision-makers need to constantly reflect on, revise, and update their mental models or assessments of a situation in response to the adaptive and rapidly changing environment (Eraut 2000). *Reflection-in-action* is a reflective approach taken by decision-makers at a meta-cognitive level, where professionals reduce uncertainty by drawing on their previous experiences and continuously engaging with information and by critiquing, restructuring, and testing their understanding of a situation and their actions (Schön 1983). As such, the key distinction between *RAWFS* and *reflection-in-action* is the reactive nature of this strategy for reducing uncertainty and also its requirement for decision-makers to hold a certain level of expertise. Whereas *RAWFS* provides a set of incremental strategies utilized by decision-makers to reduce uncertainty, *reflection-in-action* relies on meta-cognitive expertise whereby the expert can reflect on the dynamic and changing decision-making environment in order to recognize effective tactics for reducing their uncertainty. This type of self-monitoring or intuitive reflection creates a psychological space in which uncertainty is more manageable, because it restructures one's understandings of a situation, framings of a problem, and, subsequently, strategies of intended action (Eraut 2000). Therefore, *reflection-in-action* can improve a decision-maker's ability to adapt his or her responses to the changing demands of an environment (Osman 2010) through revising the SA upon which plans are formulated and actions implemented. This study seeks to extend the existing *RAWFS* uncertainty model by exploring whether police officers in a highly dynamic hostage incident will also utilize strategies of *reflection-in-action* to minimize uncertainty and implement decisions (Schön 1983).

1.3 Coping strategies across phases of critical incident decision-making

Decision-making is the process of choosing an action which is most appropriate for dealing with the situation at hand (Hastie 2001). Despite the wide variety of decision-making models that exist, most follow the general theme of (1) generating available options; (2) deliberating the appropriateness of these options; and (3) implementing a chosen course of action. This has been outlined by Fellows (2004) as a three-stage model to decision-making consisting of: *options* (generating options and applying a stopping rule once an appropriate amount of options have been considered); *evaluation* (assign an associated value to each option); and *choice* (select an action based on associated value). Preceding this process, the decision-maker must also attempt to achieve situation awareness, that is, the holistic interpretation an individual holds regarding their environment resulting from the process of sense-making

(Schatz et al. 2011). Therefore, based on the previous police decision-making studies that have applied this phase approach to the observing and analysing the decision process (van den Heuvel et al. 2011), this paper will assess how uncertainty is managed across the holistic decision phases of (1) SA; (2) plan formation (options and evaluation); and (3) PE (choice).

1.4 Uncertainty during SA: *reduction* and *reflection-in-action*

1.4.1 *Reduction*

According to *RAWFS*, *reduction* plays an important role in the early stages of decision-making (Lipshitz, et al. 2007). Tactics within this strategy include active search for information; soliciting advice/opinions from colleagues/experts, and when no new information is available, extrapolating the information at hand, by, for example, using statistical methods or previous experiences to predict future events (Allaire and Firsirotu 1989; Klein 1993). *Reduction* has been proposed as a valuable strategy to improve overall decision-making through inducing improved mindfulness, novelty, and insight during the SA phase (Nonaka 1994). This is due to its tendency to widen available information and thus reduce the potential for “seizing and freezing”, whereby decision-makers narrow their attention, fixate on one interpretation of a problem, and filter out information that does not fit within that frame (Kruglanski and Webster 1996). It therefore allows for the “reframing” of a decision problem and the “switching of cognitive gears” (Friedman and Lipshitz 1992) to highlight differences, nuances, and discrepancies in the situation or problem (Weick and Sutcliffe 2001).

Therefore, strategic command officers attempting to create an initial understanding of a dynamic and high-risk hostage incident are predicted to primarily manage uncertainty through the use of the *reduction* strategy. Specifically, within the SA phase, this strategy is predicted to include the tactics of (1) active information search, (2) seeking advice from other strategic command officers, and (3) extrapolating meaning from the information at hand (see Fig. 1; Lipshitz and Strauss 1997).

1.4.2 *Reflection-in-action*

Reflection-in-action also serves to reduce uncertainty during SAs in terms of updating a decision-maker's mental model (Schön 1983). The critical function of *reflection-in-action*, which must occur rapidly and meta-cognitively due to the high levels of time pressure involved in dynamic events (hence “*in action*”), is to stimulate the questioning of assumptions and previous actions (“*on action*”) which

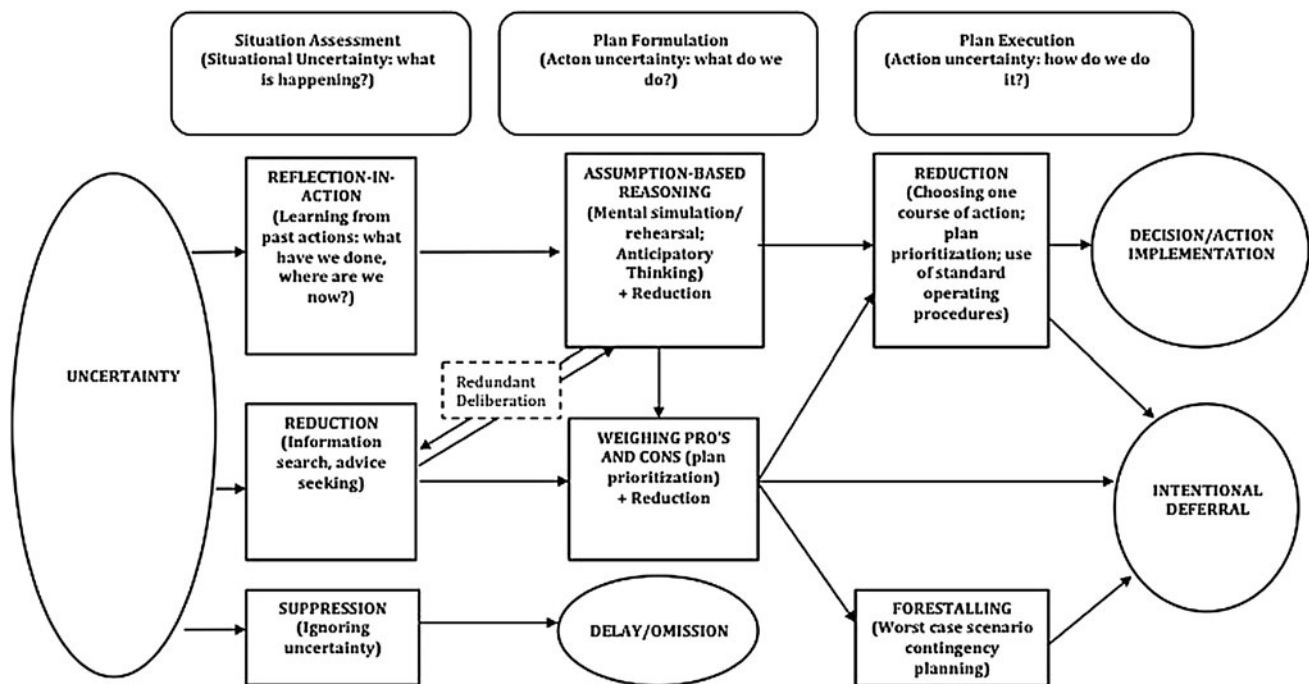


Fig. 1 Uncertainty management strategies used within situation assessments, plan formulations, and plan executions

are targeted at future actions (“for action”; Eraut 2000). This self-monitoring attitude and strategy has been found to aid dynamic decision-making in high-risk settings; for example, experienced surgeons who used a third-person perspective in order to reflect and critique their previous decisions were found to make better and more informed judgments in surgery (Wetzel et al. 2006). Due to the cyclical nature of the decision-making process in dynamic settings (such as critical incidents; van den Heuvel et al. 2011), police officers are expected to employ the *reflection-in-action* strategy during almost continuously throughout the incident management process. It is expected to specifically occur within the periods of self- and situational reflection, during *iterative* SA phases. Specifically, teams of police officers here are expected to reduce uncertainty through tactically examining the consequences of their previously chosen actions on the dynamic environment (i.e. the hostage situation; see Fig. 1).

1.5 Uncertainty during PF: *assumption-based reasoning* and *weighing pros and cons*

1.5.1 *Assumption-based reasoning*

An important element of the PF phase in high stake decisions is the process of generating options (Fellows 2004). *Assumption-based reasoning* is a mechanism that is frequently used by decision-makers to fill in gaps in the existing knowledge. *Assumption-based reasoning* is based

on a level of intuitive processing that is derived from the opportunity to learn within a predictable environment (Kahneman and Klein 2009) resulting in the development of appropriate strategies for efficient domain-specific expertise. In other words, decision-makers will base decisions on previously learnt assumptions in order to reduce uncertainty and formulate plans when faced with uncertainty. This is achieved by making assumptions that go beyond what is factually known and that are subject to retraction if/when they are found to conflict with stronger evidence (Cohen 1989). This strategy acts to reduce uncertainty and allows decision-makers to act quickly and decisively with very little information (Lipshitz and Strauss 1997). Tactics within this strategy include reverting to previously formulated plans, mental rehearsal (imagining potential plans prior to selecting a course of action), mental simulation (imagining implementation of action prior to executing), and conjecturing (Lipshitz et al. 2007). Due to the nature of this strategy, it is expected that the team of police officers will predominately rely on assumption-based reasoning during the PF stage of decision-making.

1.5.2 *Weighing pros and cons*

In order to comprehensively complete the PF phase, decision-makers in the strategic command of a hostage incident must not only formulate various potential strategies, but they must also evaluate which option will provide the best expected outcome (Fellows 2004). In instances where

decision-makers are faced with multiple undifferentiated options (following initial strategies of *reduction* and *reflection-in-action*), they have been found to opt to *weigh pros and cons* of potential courses of action in order to cope with uncertainty (Lipshitz and Strauss 1997; Wetzel et al. 2006; see Fig. 1). This is achieved by applying a rational choice model to estimate the attractiveness of each option in terms of its expected or perceived outcomes, along with the probability that a choice will result in these outcomes (Raiffa 1968). However, due to the deliberative and relatively time-consuming nature of this strategy, *weighing pros and cons* is predicted to occur less frequently than *assumption-based reasoning* during the PF phase of decision-making, where it will only be implemented for option evaluation of undifferentiated alternatives (Raiffa 1968) rather than option generation.

1.6 Uncertainty during PE: *reduction* and *forestalling*

1.6.1 *Reduction: the use of standard operating procedures*

In deviation from the original sequential RAWFS heuristic, this paper argues that uncertainty during PE can be minimized by use of the *reduction* tactic. However, in this final decision phase, reduction occurs in the form of relying on policy, existing plans, or standard operating procedures. This has been found to aid prioritization of strategies and focus a decision-maker's attention on higher order objectives when executing decisions (Lipshitz and Strauss 1997). Specifically, although no national policy exists on crisis negotiation, the execution of various strategies and actions are always guided by a set of predefined plans; using a standardized format, the strategic command team creates a set of plans at the start of any event in anticipation of every potential contingency, which are subsequently followed when the time to implement that decision occurs (Vecchi et al. 2005). For example, the "casualty evacuation" plans depicts, in a step-by-step manner, how either hostile (offenders) or friendly (victims) casualties must be removed from the stronghold. Relying on these predefined and prepared steps reduces uncertainty with regard to how the team should execute high-risk actions (during PE) in a volatile and dynamic incident (Crego and Alison 2004; see Fig. 1).

1.6.2 *Forestalling: deferring a choice to prepare for a worst-case scenario*

According to Lipshitz and Strauss (1997), if decision-makers fail to identify a "good enough" option using the previously mentioned strategies, they may manage uncertainty by *forestalling* a choice. This is the strategy of preparing various strategies or courses of action to counter

potential negative outcomes or worst-case scenarios, due to persistent uncertainty about the potential occurrence of that scenario (Lipshitz, et al. 2007).

Forestalling is often accompanied by the intentional temporary deferral of a choice, while the team prepares for all possible outcomes and thus become more passive in the decision-making process (Mckenzie et al. 2009). Intentional deferral in this phase is a tactic whereby individuals actively postpone closure on a decision and seek more conclusive information in the hope that a better assessment of the effectiveness of each strategic option will become available to them (Hansson 1996; see Fig. 1). This intentional choice to defer a decision or "calculated procrastination" (George 1980) constitutes an adaptive form of decision delay to overcome uncertainty. Evidence suggests that when decision-makers are able to temporarily tolerate uncertainty and its associated emotional discomfort, it can lead to better outcomes (Orlitzky and Hirokawa 2001), although this will only occur if the time gained by deferral is spent *intentionally* and *vigilantly* (Osman 2010). However, due to the high-risk and time-pressured nature of such incidents, *forestalling* via decision deferral is expected to occur in a minority of cases (see Fig. 1; Mann et al. 1997).

1.7 Maladaptive strategies for persistent uncertainty: *suppression* during SA and *redundant deliberation* during PF

1.7.1 *SA and suppression*

Lipshitz and Strauss (1997) found that, as an ultimate last resort, decision-makers sometimes choose to *suppress* their experience of uncertainty, which involves both tactics of denial (ignoring uncertainty) and rationalization (symbolically going through the motions of acknowledging uncertainty but not actually reducing it). In other words, while *suppression* may temporarily alleviate the negative effect associated with uncertainty, it does not remove the actual source of uncertainty and is therefore ultimately not an adaptive strategy (Fiore et al. 2010). *Suppressing* information is a maladaptive response to uncertainty that can detrimentally derail the strategic decision process and further block an individual's ability to develop strong and fully informed rationales for selecting a course of action later in a later decision-making phase. This can lead to potential decision errors (Lipshitz et al. 2007). This is particularly true of hostage incidents, which involve "dead-end" scenarios (van den Heuvel et al. 2011) that do not end unless they are resolved (either successfully or unsuccessfully) by active police interference (Denning et al. 2009). Due to the fact that police officers who respond to hostage operations are high ranking and highly experienced, the *suppression* strategy is only expected to occur

very minimally. However, in those few instances where police officers do suppress uncertainty, this is expected to occur during the initial SA phase of decision-making, where the extremely high levels of uncertainty will overwhelm their ability to systematically search for information (Lipshitz et al. 2007), thereby co-occurring with (temporary) omissions of a decision (see Fig. 1).

1.7.2 PF and redundant deliberation

Finally, one potential derailment from an effective decision process occurs if decision-makers fail to prioritize and formulate a plan and instead resort to seeking more information on options (thereby returning to the use of *reduction* and SA; van den Heuvel et al. 2011). This additional information is more often than not unavailable or inaccessible (Nohrstedt 2000). Seeking more information therefore digresses decision-makers and results in *redundant deliberation*, that is, pointlessly deliberating between options without actively reducing uncertainty. This strategy may be especially maladaptive in high-risk hostage negotiation settings as it prevents closure on a decision (Hansson 1996), causes decision delays (Lipshitz and Strauss 1997; van den Heuvel et al. 2011), increases uncertainty, and may induce negative effect within team dynamics (Anderson 2003). Thus, *redundant deliberation* is a maladaptive coping tactic of the *reduction* strategy, which may ultimately delay the effective resolution of a high-risk hostage incident (see Fig. 1; Lipshitz et al. 2007).

In sum, in line with the previous theories and models of uncertainty in dynamic decision-making (Lipshitz and Strauss 1997; Schön 1983; Klein et al. 2007), this study aims to present exploratory analysis of the strategies utilized by police officers to cope with uncertainty. It will specifically examine the progressive nature of the RAWFS heuristic within a critical incident domain and as applied across a three-staged decision model (SA, PF, PE), identify the potential maladaptive strategies that lead to (temporary) decision omissions and lack of progression, and introduce and additional strategy—*reflection-in-action*—as a prevalent and useful coping tactic utilized by police officers to minimize uncertainty when managing a hostage incident.

2 Method

2.1 Participants

2.1.1 Trainees

Participants ($n = 16$) consisted of police officers who would be required to work during a real-world hostage negotiation situation and were completing required

training. They were split across four roles: first responders ($n = 3$), hostage negotiators ($n = 8$), negotiator coordinators ($n = 3$), and incident commanders ($n = 2$). First responders were required to attend the scene of the hostage taking initially and relay information to their superiors. The hostage negotiation team were then deployed to the scene. This team consisted of a “negotiator’s cell”, which included four negotiators who were responsible for engaging and establishing rapport with the offenders; one incident commander (IC), who was required to make the ultimate strategic decisions to resolve the incident with input from his advisors; and one negotiator coordinator (NC) who provided strategic advice to the IC and acted as an intermediary between the hostage negotiators at the scene and the IC. During real events, this team may expand to include any other advisor the IC might require; for example, a “Tactical Advisor” is often present to instruct the IC on any options for tactical intervention to resolve the incident (see Fig. 2). Data collection in this study focussed on the roles of the NC’s and IC’s because they hold primary (shared) responsibility for, and accountability over, decision-making to peacefully and effectively resolve the hostage negotiation situation. Thus, although they were members of a wider team who made tactical decisions in response to their advice and recommendations, the focus of the present study was on the strategic decision-making of the NC and the IC as key advisors in the team decision-making process.

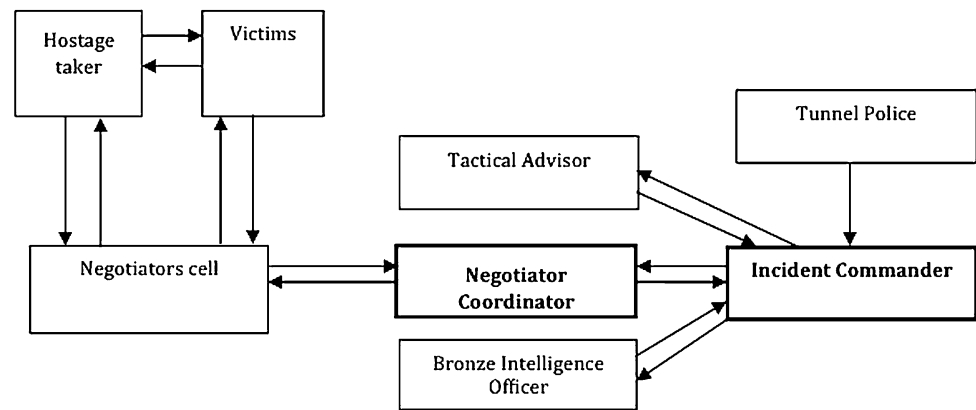
2.1.2 Role players

Fourteen individuals (one police officer and 13 civilians) volunteered to play the roles of hostage takers (three in each exercise) and hostages (four in each exercise) across the study that ran twice over two nights. The main hostage taker was played by one police officer who had substantial previous experience enacting this role and two civilian volunteers. The four “hostages” in each exercise were civilian volunteers who were briefed on their roles by the police prior to the exercise to enhance realism and immersion of the simulated incident. Figure 2 illustrates the set-up of the exercise participants and the chain of interaction among them, with the key participants emphasized in bold.

2.2 Procedure

Data were collected at a live hostage negotiation simulation exercise that was conducted twice (across two consecutive nights) with 16 police officers from various north-west UK forces. The live simulation was designed to fulfil the officer’s annual negotiator training requirements. Informed consent was obtained from all of the participating officers

Fig. 2 Participants in the simulated hostage event



for the use of observations of their behaviours and other materials collected during the exercise for research purposes.

The exercises involved a scenario in which the police officers were required to negotiate with a group of hostage takers holding several hostages on a bus within a tunnel. A detailed exercise plan was adhered to across the two exercises. This was to ensure that key elements of the scenario (i.e. escalation in the offender's levels of frustration) and injects of information (i.e. intelligence on the offender's background) were consistently introduced to the participants across the two independent exercises. However, in order to maintain fidelity and allow for the officers' decisions to take effect and for them to experience consequentiality of their choices, some flexibility in the development of the scenario was permitted.

3 Data collection and analysis

3.1 Videos of strategic command meetings

All of the strategic command meetings held between the IC and NC were videoed, transcribed, and subjected to analysis. In order to ease analysis, these transcribed statements were grouped into discussion "segments", according to which of the identified critical decisions were being addressed by the team, and further organized according to who was speaking and which exercise ("Night one" or "Night Two") the participants were from. It is worth noting that teams were not evaluated in terms of how well or poorly they performed as the focus of the study was the prevalence of uncertainty coping strategies and not standardized performance. Further, due to the qualitative nature of the data and small sample sizes, data from the two separate simulations were collapsed between simulations, and the prevalence of each of the uncertainty coping strategies used was explored descriptively in terms of prevalence of uncertainty coping strategy used.

3.1.1 Coding process

A frame-by-frame coding and script analysis process was used to identify (see "Appendix 1"):

1. *The phase of the decision process teams were in.* In line with the previous research adopting the SAFE-T coding classification, these strategic *decision phases* were coded as SA, PF, or PE (van den Heuvel et al. 2011).
2. *The uncertainty management strategies that were being applied by decision-makers in that frame.* Coping or management strategies were coded based on the classification in accordance with the RAWFS heuristic (Lipshitz and Strauss 1997; Lipshitz, et al. 2007) and therefore included *reduction, assumption-based reasoning, weighing pros and cons, forestalling, and suppression*. An additional code, *reflection-in-action* was also included in the coding process (Schön 1983).
3. *Whether or not the relevant decision was implemented or reached at the end of each discussion.* This *decision* code was used to indicate whether the team had sufficiently reduced uncertainty and decision implementation and was therefore coded as *made* (M) or *omitted* (O). A decision code was only assigned to a certain segment or discussion if a decision was clearly and explicitly stated (e.g. "we will now deliver food to the hostages") before the discussion progressed to other issues or the meeting ended.

An inter-rater reliability analysis for this coding system was performed using the Kappa statistic to determine consistency among two independent raters who were blind to the purpose of the study. The independent raters were given thorough instructions on how to code for the study's 3 main measures (decision phase, coping strategy, and decision made or omitted) and were asked to code 30 % of the data (see "Appendix 1"). A substantial level of agreement was reached among the individuals, $\kappa = .696$

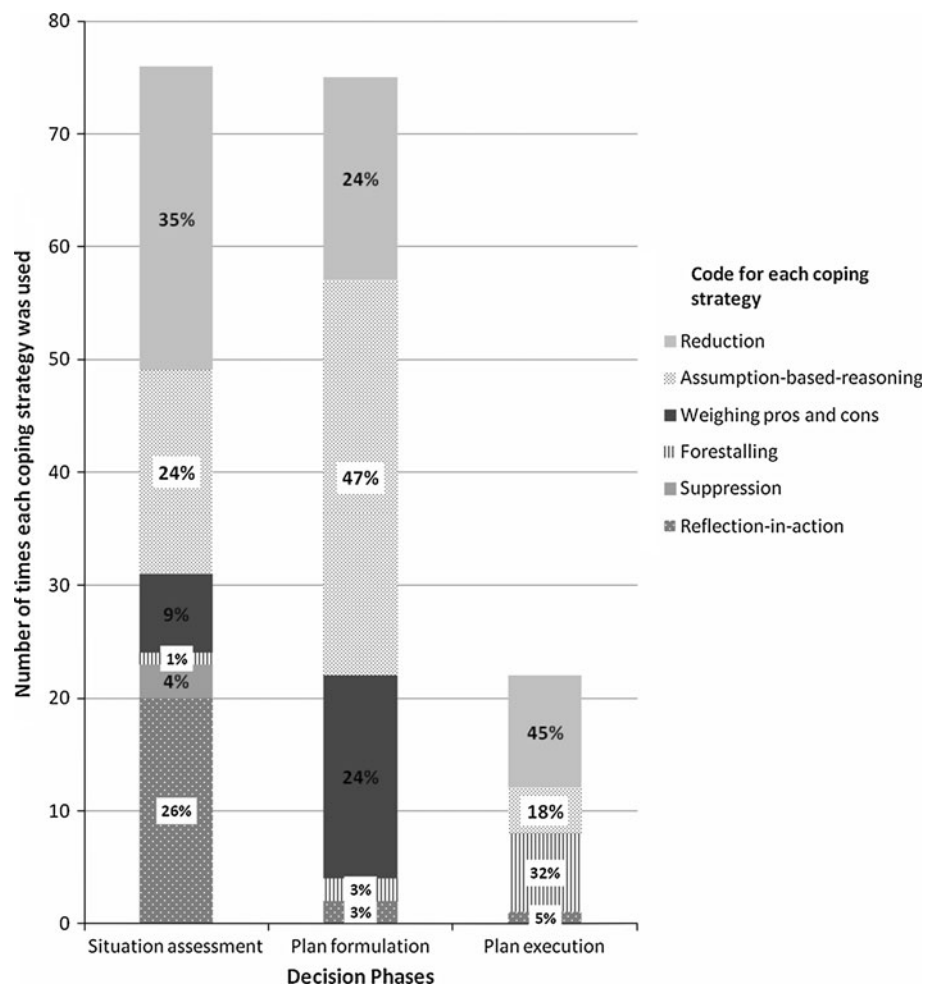
($p = .000$). Those instances where raters disagreed were discussed until an agreement was reached and adapted accordingly.

4 Results

4.1 Overall results

Figure 1 depicts the relationship between coping strategies that were found to be used within and between decision-making phases that resulted in both decisions being made and those being omitted. This paper will explore each of these decision-making phases in turn with a breakdown of overall coping strategies utilized within each decision phase in Fig. 3. Figure 4 indicates how each individual coping strategy was used overall across decision phases. Although the effectiveness of decision-making with regard to dealing with the situation was not measured, both decision-making teams managed to resolve the incident peacefully and successfully within the 4-h time frame they were given to so within the training exercise.

Fig. 3 Stacked columns bar graph to indicate each individual decision phase's use of coping strategies. Column height indicates the number of times each strategy was used within each phase, with the percentages indicating proportion of strategy used within each phase



4.2 Coping strategies to reduce uncertainty during the SA phase

The two main strategies that were found to be employed by decision-makers within the initial SA phase were *reduction* ($n = 27$ of all statements in the SA phase; 35 % of coping strategies used in SA phase) and *reflection-in-action* ($n = 20$; 26 %). *Assumption-based reasoning* was also found to occur frequently during this decision phase ($n = 18$; 24 % see Fig. 3).

4.2.1 SA was managed by reduction and reflection-in-action

Initial SA was predominantly managed by *reduction* ($n = 27$; 35 %). *Reduction* was mostly found in the form of “active information search” and was therefore reflective of sense-making. For example, both the IC and NC often sought intelligence, information, and advice from each other in order to inform their understanding of the dynamic situation, and this was found during the initial meeting and early SA phase of subsequent discussions (see “Appendix 2”). When

looking at how *reduction* was utilized overall across all decision phases, it was used mainly during SA (i.e. 49 % of total *reduction* use was during SA) followed by PF and PE (see Fig. 4).

When SA was revisited in later decision discussions, *reflection-in-action* ($n = 20$; 26 %) was also found to be used. Furthermore, when looking at how *reflection-in-action* was utilized overall across decision phases, it was used mainly during SA (87 %; see Fig. 4). This strategy involved officers “stepping back” and explicitly reflecting on the previous actions (by both the police and offenders) that had led up to the current situation. This then informed the implementation of future decisions and plans (see “Appendix 2”).

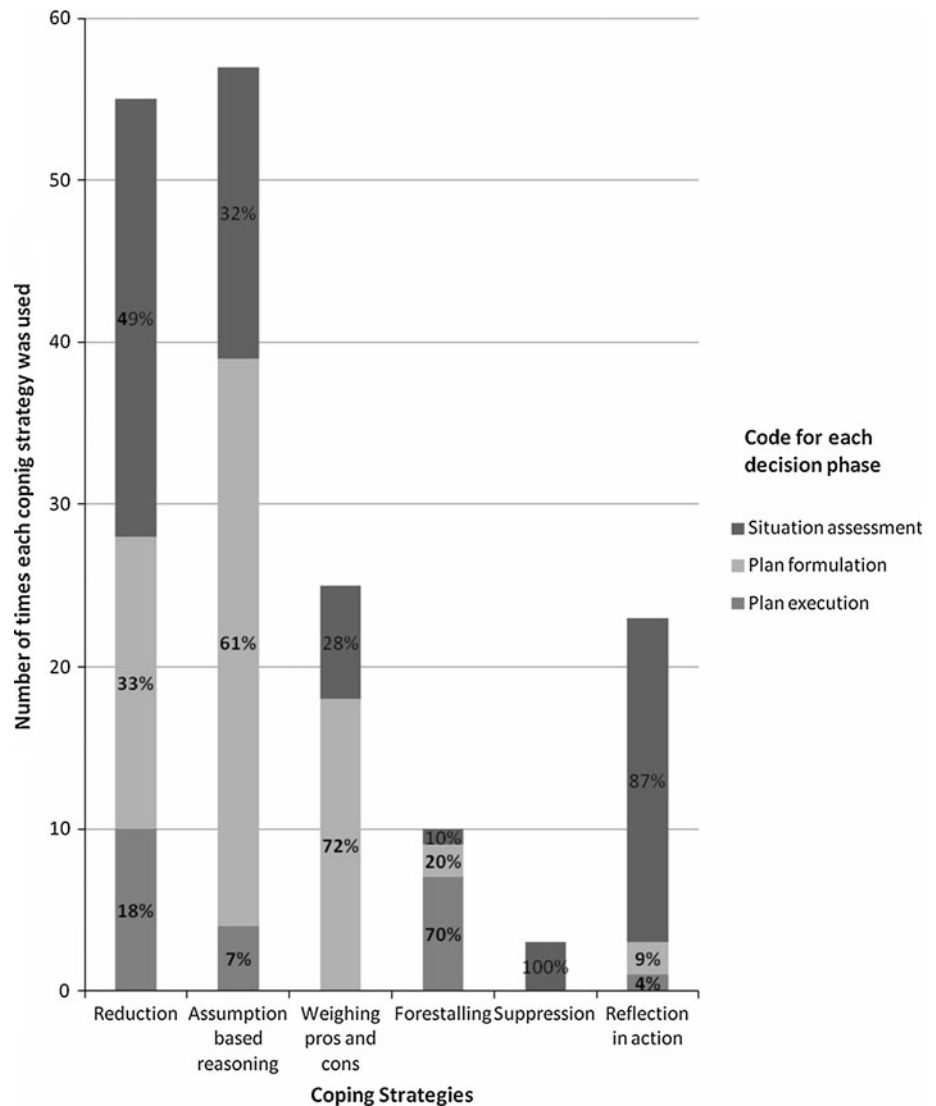
Although *assumption-based reasoning* strategies were used less frequently in during SA phase than *reduction* or *reflection-in-action*, the *assumption-based reasoning* tactics of anticipatory thinking and conjecturing were

employed by officers engaged in sense-making procedures; for example, conjecturing involved making assumptions about the situation to create a working understanding of the incident that would inform the formulation of their subsequent strategies (see “Appendix 2”). Thus, although this was not expected, *assumption-based reasoning* was also utilized frequently during the SA phase ($n = 18$; 24 %).

4.2.2 Maladaptive coping with uncertainty during SA was manifested by suppression

Finally, in a small minority of cases during SA, decision-makers were found to *suppress* uncertainty about a decision ($n = 3$; 4 %) leading to (temporary) omissions of that choice. As decisions were omitted, this was classed as maladaptive coping. For example, discussion over whether officers should introduce a “reality check” to the offenders (by making clear to offenders what the consequences of

Fig. 4 Stacked columns bar graph to indicate how often each individual coping strategy was used within each decision phase. Column height indicates number of times each strategy was used, with percentages indicating where each strategy was proportionally used across decision phases



their actions were), was omitted at the SA phase as the NC attempted to *suppress* high levels of uncertainty about this choice (see “[Appendix 2](#)”). Furthermore, when assessing how *suppression* was utilized overall across all decision phases, it was used exclusively during SA (see Fig. 4).

4.3 Coping strategies to reduce uncertainty during PF phase

Both *assumption-based reasoning* ($n = 35$; 47 %), via the tactics of mental simulation, rehearsal, and anticipatory thinking, and *weighing pros and cons* ($n = 18$; 24 %) were used to formulate, prioritize, and choose a course of action (see Fig. 3). Collectively, these RAWFS heuristics allowed for the assessment of both the potential positive and negative consequences of possible decisions in order to progress to the final implementation and PE phase.

4.3.1 Uncertainty during PF was managed by assumption-based reasoning

When progressing from SA to PF, decision-makers were found to rely predominantly on *assumption-based reasoning* ($n = 35$; 47 %). *assumption-based reasoning* involved decision-makers mentally rehearsing or simulating the potential processes and strategies they were considering to implement, and the effects or consequences those actions would have on the offenders and hostages. They were therefore using anticipatory thinking to imagine consequences to “hit the ground running” once a decision was made (Lipshitz et al. 2007; see Fig. 1). For example, mental simulation was used by an IC in planning potential processes, mental rehearsal was used by the tactical advisor when imagining potential scenarios before choosing one, and anticipatory thinking was found to be predominantly used by one IC, who would visualize the consequences of his actions on later investigation and post-incident situations (see “[Appendix 2.1](#)”). Overall, a dominant 61 % of total *assumption-based reasoning* use was during PF (see Fig. 4).

4.3.2 Uncertainty during PF was managed by weighing pros and cons

In addition, officers were also found to reduce uncertainty by *weighing pros and cons* ($n = 18$; 24 %). This strategy was used to assess potential formulated plans, reduce uncertainty, and allow for plan prioritization (see Fig. 1; Lipshitz and Strauss 1997). This strategy is illustrated in the discussion regarding whether or not to provide the hostage takers with a “getaway” car (see “[Appendix 2.1](#)”). Furthermore, when assessing how *weighing pros and cons* was used across all decision phases, it was used the most (72 %) during the PF phase (see Fig. 4).

4.3.3 Maladaptive coping with uncertainty during PF involved re-engagement with the reduction strategy creating redundant deliberation

It was found that some decisions led to (temporary) omissions of choice via re-engagement with *reduction* strategies during PF, where officers tried to search for additional information about the situation after formulating optional plans ($n = 18$; 24 %). Specifically, this tactic involved decision-makers highlighting “known unknowns” about the potential plans and engaging in redundant deliberation (continually seeking and reassessing additional information when planning various strategies); blocking the team decision process from reaching PE and instead directing them back to SA (see “[Appendix 2.1](#)”).

Indeed, an unexpected finding was the way in which redundant deliberation was utilized. In discussions that resulted in temporary *omissions* of decisions during PF, it was found that decision-makers engaged in redundant deliberation through continual SA “loops” between SA strategies of *reduction* and PF strategies of *assumption-based reasoning*. This *reduction* (SA)-*assumption-based reasoning* (PF) loop prevented progression to formulated concrete plan and was illustrated when the IC and NC discussed whether to request the release of hostages (see “[Appendix 2.1](#)”). Thus, redundant deliberation caused maladaptive coping for managing uncertainty during PF. However, these “loops” only occurred in a minority of cases.

4.4 Coping strategies to reduce uncertainty during PE phase

Uncertainty during PE resulted from confusion regarding how to choose between and best implement the potential strategy derived during the PF phase (i.e. which optimal steps or plans to follow). This was resolved predominantly by officers using *reduction* strategies ($n = 10$; 45 %) in the form of relying on the existing standard operating procedures or plans or by *forestalling* ($n = 7$; 32 %) the decision (see Fig. 3).

4.4.1 Uncertainty was reduced during PE via reduction (implementing standard operating procedures)

The strategy most frequently adopted within this phase was *reduction* ($n = 10$; 45 %) by relying on standard operating procedures to prioritize how plans should be executed. For example, the IC used standard operating procedures for crises negotiation to implement decisions when deciding on the issue of implementing a communication device (see “[Appendix 2.2](#)”).

4.4.2 Reducing uncertainty during PE through forestalling

Forestalling was also found to occur when officers remained uncertain about difficult decision problems during PE and thus prepared contingencies for worst-case scenarios ($n = 7$; 32 %). Interestingly, the employment of the *forestalling* strategy occurred both in instances where decisions were made, as well as when they were (temporarily) omitted. For example, during the decision on whether to provide the offenders with a vehicle, the IC explicitly chose to prepare an option, but not yet implement the choice; making it an available option if, in the “worst-case scenario”, they would have to implement it (see “Appendix 2.2”). Overall, 70 % of total use of *forestalling* was found to be during PE phase indicating that it was during this decision phase that it was used the most (see Fig. 4).

5 Discussion

This study assessed the coping strategies used by a team of strategic command police officers to manage uncertainty in a high-risk hostage negotiation incident. It extended the *RAWFS* heuristic (Lipshitz and Strauss 1997) by assessing (1) an “in situ” team decision-making context (as opposed to individual retrospective accounts), (2) the progressive nature of the use of uncertainty coping tactics across the three decision-making phases, and (3) the use of “reflection-in-action” as an additional coping strategy by police officers when responding to a highly dynamic critical incident. Overall, the results illustrated that decision-makers actively employed adaptive strategies to minimize the detrimental effect of uncertainty on the decision process leading to decision implementation. The use of specified uncertainty-reducing strategies were broadly consistent with the chronological order identified in previous studies (Lipshitz and Strauss 1997; Lipshitz et al. 2007) and aided progression of the decision process in an adaptive manner (i.e. from SA to PF and PE; see Fig. 1). However, the frequency with which each of these coping strategies was utilized differed greatly per decision phase, indicating that different strategies were required to adaptively manage uncertainty depending on the nature of that decision-making stage. It is important to acknowledge that the domain specificity of the present study to a hostage negotiation scenario and its limited sample in terms of number of participants and their high level of experience may limit the application of the study’s findings. However, due to the rich qualitative data obtained and strict methodological coding principles utilized (see “Appendix 1”), such limitations are deemed minimal in terms of impact on result application.

Uncertainty during the initial SA phase of decision-making stemmed from a lack of understanding regarding the dynamic, unfolding situation. Results of the present paper were found to be broadly consistent with the proposed chronological *RAWFS* model of Lipshitz and Strauss (1997), with SA being predominantly governed by *reduction* and *assumption-based reasoning I* tactics. Specifically, it was found that *reduction* involved responders seeking factual information about the situation (i.e. who were the offenders, how did they end up in this hostage situation, how many victims were being held, etc.) or advice from others on effective resolution tactics. This supports previous literature, which found that when individuals are motivated to avoid the negative effect (Anderson 2003) and cognitive dissonance arising from uncertainty (Festinger 1957) during sense-making procedures, they seek advice from external sources (Pornpitakpan 2006). Seeking advice will have reduced uncertainty for the police officers by forcing them to view problems in alternative frames and providing them with information they had previously ignored (Heath and Gonzalez 1995). The high levels of advice seeking found within the *reduction* strategy may be an artefact of the inherent team setting examined in the current study, where advice seeking may have been utilized more readily due to the availability of alternative opinion in the immediate environment. Future studies may seek to examine whether *reduction* arises through advice-seeking tactics if the availability of alternative opinion through team members is not viable.

Although not expected, it was also found that *assumption-based reasoning* played an important role in the initial SA phase of decision-making. This occurred when decision-makers made assumptions about “unknowns” in the hostage stronghold in order to create a working understanding of the incident. It is possible that in order to deal with missing information, decision-makers relied on experience through *assumption-based reasoning* to create a primed recognition of a likely SA (Lipshitz, et al. 2001). This recognition-primed decision-making has been found to aid rapid response and strategy formulation in crisis management (Ross et al. 2004). The decision-makers’ high levels of expertise may be one reason for their ability to rely on past experience and thus utilize *assumption-based reasoning* to estimate “unknowns” during the earlier SA phase (Klein 1993). Moreover, within iterative SA phases, a reliance on past experiences within the same event might have formed a basis for certain assumptions about the situation within the stronghold. It would be useful to carry out further research to extrapolate the use of *assumption-based reasoning* during initial SA by testing to see whether, for example, inexperienced officers utilized this strategy during early SA. Further, as inexperience has been associated with filling in missing information with biased heuristic

processing (Tversky and Kahneman 1974), it would also be of interest to explore how efficiently *assumption-based reasoning* is used by inexperienced officers.

Reflection-in-action was found to play a role during latter, iterative SA phases of the dynamic decision process (i.e. when the situation had to be reassessed due to evolving circumstances). This tactic was used to make sense of the situation by assessing previously implemented actions, the reactions it had caused from the offenders, and the associated consequences of those actions on shaping the dynamic environment (see Fig. 1). The self-monitoring attitude may have been consistently running along the overall process; however, evidence of it corresponded to the reflective, iterative SA phases of the decision process. These iterative SA phases allowed for reflection and the verbal generation of testable predictions about the effect the team's decisions may have on the volatile situation (Osman 2010). This type of reflective attitudes and behaviours have been found to be especially useful in dynamic, reactive environments such as those found in hostage incidents, whereby the effect of previous police actions on an offender's behaviour can be used to create an iterative understanding of the personality, characteristics, and potential future behaviour of that offender (Rake and Njå 2009).

As *reflection-in-action* was an additional coping strategy not addressed in the original RAWFS model, it is important to explore the possible reasons for the use of *reflection-in-action* in the current study. For example, perhaps *reflection-in-action* is specific to dynamic and adaptive decision-making situations, such as the real-life, dynamic, team-based “in situ” testing environment created in the present study. Further, the exploration of uncertainty-reducing strategies in *team*-based settings may have fostered an environment whereby reflective behaviour was required in order to generate consensus on the dynamic situation. It has been found that accountability-related decision factors (Alison et al. 2010), such as fear of the long-term consequences, can impact upon team processes associated with trust and conflict; thus, *reflection-in-action* may act as a strategy to overcome accountability-related fears. It is important to carry out further research to examine whether the prevalence of *reflection-in-action* strategies is consistent in other decision-making settings, as well as assess its uniqueness to team-based decision scenarios.

Not all coping strategies employed by the strategic command team during SA were adaptive. Specifically, some results found that officers chose to *suppress* high levels of perceived uncertainty in this initial decision phase. *Suppression* tactics involved either ignoring uncertainty entirely or acknowledging and identifying the source of uncertainty without actively seeking to manage or cope with it in any way (see Fig. 1; Lipshitz and Strauss 1997).

Results showed that *suppression* was coupled with instances in which decisions were temporarily omitted; therefore, suppression of uncertainty “blocked” the team's ability to identify and resolve crucial problems (Lipshitz and Strauss 1997) or led to a “seizing and freezing” of responses (Kruglanski and Webster 1996), albeit for a short matter of time. However, the evidence of *suppression* tactics was minimal, and its use was often challenged by team members through further reduction or reflection strategies. Thus, the low levels of omissions found may be attributable to the team-based setting used in hostage negotiation incidents, where *suppression* was not possible as other team members would highlight this form of maladaptive coping and attempt to overcome it collectively. This unique application of RAWFS to a team-based hostage negotiation setting has therefore revealed a possible deviation from the original chronological nature of uncertainty coping strategies originally proposed by Lipshitz and Strauss (1997); this provides grounds for further exploration on uncertainty coping strategies in other team-based settings.

Uncertainty management within the PF phase was primarily achieved through a combination of the more intuitive *assumption-based reasoning* and the analytical *weighing pros and cons* strategies (Lipshitz and Strauss 1997). This is in line with the proposition that cognition is neither purely intuitive nor purely analytical (Hamm 1988) and reflective of a variety of existing decision-making models that follow this intuitive-analytic pattern, such as the dual-process model (Kahneman and Frederick 2002), the implicit–explicit processing model (Engle 2007), and global impression-focal search model (Krupinsky et al. 2006). Therefore, the current study provides additional theoretical evidence to support the notion that PF is governed by a combination of cognitive processes that are both intuitive and analytic in nature.

Specifically, intuitive *assumption-based reasoning* allowed officers to formulate a set of working strategies, by engaging in the specific tactics of mental simulation and rehearsal of the implementation of various potential strategies (Lipshitz and Strauss 1997), in order to anticipate the potential consequences each of those strategies may produce (Klein et al. 2007). This result is in accordance with past studies, which found that experts build on previous experience in order to deal with the unknown, and at times *unknowable*, future of the event they are facing (Cohen 2010) and that this kind of *anticipatory thinking* is especially beneficial in dynamic decision environments (Wetzel et al. 2006). The strategy of *assumption-based reasoning* in this study served to reduce uncertainty by informing the team's understanding of what plan might potentially work well, as well as what potential factors or problems might deter their success (Dreyfus and Dreyfus 1986). However, as NDM research has found intuitive processing to be

dependent on a certain level of domain-specific expertise (Reyna and Lloyd, 2006), it is important for future studies to explore the direct relation between expertise and the ability to engage in effective assumption-based reasoning to manage uncertainty. Further, it has been found that in certain settings relying on predefined plans or heuristic biases can hinder a decision, thereby leading to inappropriate or drastic outcomes (Pennington and Hastie 1988; Reimer et al. 2004); therefore, research should assess when the use of analytic processing is more appropriate than intuitive judgment.

Indeed, results showed that this intuitive approach did not always produce a preferred “good enough” strategy or reduce uncertainty to a comfortable level for the decision process to progress; in these cases, officers were found to occasionally resort to the more analytic strategy, *weighing pros and cons* (Lipshitz and Strauss 1997). This strategy was slow and deliberate, whereby the team would collectively discuss the positive and negative attributes and consequences of each potential choice in order to select an informed course of action. This may be considered a maladaptive strategy for the hostage negotiation scenario presented in the present study due to the need for rapid processing and timely action to gain control over a potentially dangerous environment (Porter and Millar 1985). On the other hand, *weighing pros and cons* may have acted as a legitimate and useful uncertainty management strategy, as it has been found to act as a useful social management strategy within team decision settings when a lack of consensus arises between decision-makers (Fiore et al. 2010), one which may reduce the accountability fears associated with team decision-making (Alison et al. 2010). Indeed, the strategic command team was found to actively engage in a discussion on the potential consequences and utility of each advisor’s preferred strategy with a final choice made based on the option that was associated with the least amount of negative attributes. Therefore, although this technique is more time-consuming than its intuitive counterpart, when it was employed, it served to reduce uncertainty during PF (see Fig. 1), which, ultimately, enabled greater informed action implementation in the final PE phase (Fiore et al. 2010).

Maladaptive coping with uncertainty was also found during the PF stage of the present study, with an over-reliance on intuitive approaches obstructing the team’s progression towards the final PE phase. Specifically, in cases of extreme uncertainty (Dhar 1997), the team found it difficult to appropriately utilize *assumption-based reasoning* to formulate a set of plans or strategies (Arai 1997) and chose to re-engage with *reduction* strategies by searching for additional information. However, as additional information was unavailable, this resulted in a process of redundant deliberation (Nohrstedt 2000), where the team

would address a decision subject, debate the various potential strategies that may be used in response to it, and re-assess the situation to inform each of those strategies (but not come to a conclusion or implement a choice; see Fig. 1). While seeking additional information may have reduced the team’s negative effective uncertainty (Anderson 2003), avoiding the decision through redundant deliberation may have actually *increased* action uncertainty by raising scaremongering questions around the potential courses of action left for the team to choose from. It also prevented the team from reaching closure on that decision (Hansson 1996), by ignoring the actual source of uncertainty such as a lack of understanding, and focusing on a continuous search for alternative options (Fiore et al. 2010). Thus, although decisions may have been resolved at a later stage in the decision scenario, the observed choice to re-engage in *reduction* and seek more information constituted a maladaptive response to uncertainty, which was detrimental to the progression of decision-making and caused considerable delay in the management of the incident (Lipshitz and Strauss 1997; van den Heuvel et al. 2011).

Within the final phase of PE, uncertainty stemmed predominantly from a lack of understanding on how best to implement a chosen course of action. Results showed that action uncertainty was, once more, actively managed through the use of *reduction*; however, *reduction* in this final phase involved a specific tactic of relying on standard operating procedures and pre-defined plans (Vecchi et al. 2005). The reliance on policy, standard operating procedures, and plans drafted during the periods of less-impending time pressure reduced uncertainty because it created a situation in which the team had greater control over the environment and could readily identify the steps needed to efficiently and safely execute an action (i.e. the removal of the hostages from the stronghold; Romano and McMann 1997). This supports military research that found that recognition planning models are useful for increasing operating tempo whereby experienced commanders provide intuitively driven plans of action prior to operation, whose staff then monitor and implement if deemed appropriate (Ross, et al. 2004; Thunholm 2003). Further, when dealing with chemical, biological, radiological and nuclear attacks, it has been found that pre-planned procedures for emergency response can increase willingness to work (Becker and Middleton 2008), leading to more effective decision-making. Thus, the findings of the present study highlight the importance of pre-planned responses and awareness of standard operating procedures when dealing with high stake, critical situations.

However, results also illustrated that when high levels of action uncertainty persisted during the final PE phase, police officers actively and intentionally opted to postpone

action execution by *forestalling* (i.e. preparing contingencies for a potential worst-case scenario; Lipshitz et al. 2007) in a minority of cases. One interesting example of the use of this strategy occurred in response to the decision on whether or not to provide the offenders with a vehicle; here the decision-makers prepared contingencies based on the dynamic risk of the situation (i.e. offenders could escape and harm the general public), while remaining aware that the risk would only escalate to an extreme enough level to necessitate the implementation of that tactic in a “worst-case scenario” (Froot et al. 1994). Therefore, the choice to *intentionally* and *temporarily* defer a decision at the final stage of the decision process (while preparing tactics in accordance with a range of strategies) may have ultimately produced better decision outcomes (Orlitzky and Hirokawa 2001). The relationship between *forestalling* and the *temporary deferral* of a decision is in line with the previous studies that found that the active recognition of a lack of information did not lead to overt action but to decision deferral (Krikelas 1983). Here, decision-makers chose to temporarily tolerate high levels of effective uncertainty and focus away from the proximal goal of removing that unease, in order to focus on the distal goal of preparing a range of strategic plans and tactics (Mckenzie et al. 2009). These active and intentional deferrals constituted a strategic and calculated approach to managing uncertainty because they encouraged decision-makers to remain open to new possibilities and allowed for a switching of courses of action avoiding the foreclosure of rushed decisions (French, et al. 2001). Nevertheless, the choice to delay a decision within a hostage incident remains inherently controversial, as it allows time and space for the potential escalation of risk to the victims within the stronghold, an aspect the police officers have no control over (Rake and Njå 2009). Therefore, *forestalling* was only found to be used minimally, in the face of extreme high-risk and ambiguous decisions of which the outcomes were unknown, and, more often than not, unknowable (Cohen 2010).

6 Conclusion

This study assessed the coping strategies used by a team of strategic command police officers to manage uncertainty in a high-risk hostage negotiation incident. It has illustrated that in order to foster adaptive decision-making, teams must progress through three phases of decision-making, SA, PF, and PE, by cumulatively managing the inherent uncertainty associated with each of those phases. Results showed that uncertainty management occurred through the use of specific strategies within each of these phases that fostered decision progression. Specifically, uncertainty

during SA was initially aided by *reduction* and *assumption-based reasoning* and iteratively by *reflection-in-action*; PF was managed through *assumption-based reasoning* and *weighing pros and cons*; and uncertainty during PE was overcome via *reduction* (through the use of standard operating procedures) and *forestalling*. In a minority of cases, maladaptive uncertainty management was also observed with the use of *suppression* during SA and a return to *reduction* (leading to redundant deliberation) during PF. The limitations of the present study include domain specificity to a hostage negotiation scenario and its limited sample in terms of number of participants and their high level of experience. However, as the study was found to provide rich, qualitative data and followed strict methodological coding principles involving inter-rater reliability, such limitations are deemed minimal in terms of impact on results. Thus, overall, this paper has contributed to the theoretical understandings of the uncertainty coping strategies utilized “in action” within team-based critical incident decision-making in high-risk naturalistic settings.

Appendix 1: Coding guidelines

Coders were presented with a transcript of the discussions between decision-makers during the hostage negotiation simulation. They were also given the following guidelines with regard to coding the discourse taking place during the situation. There were three forms of coding: (1) coding the decision phase; (2) coding the uncertainty coping strategy used; and (3) coding the decision as “made” or “omitted”.

Decision phase coding

Decision phase (code)	Description
Situation assessment (SA)	Participants are creating a <i>storyboard</i> or an image of what is going on at that moment in time (e.g. what is going on? What do I perceive?)
Plan formulation (PF)	Participants discuss <i>strategies</i> for dealing with the dynamic event They formulate <i>options/hypotheses</i> on how to deal with situation They <i>define</i> the roles/responsibilities required to carry out strategy
Plan execution (PE)	Participants create <i>tactics</i> for carrying out a previously defined plan They discuss the physical <i>actions</i> required to execute previously formulated plans They <i>assign</i> the roles/responsibilities to carry out tactical action

Coping with uncertainty strategy codes

Uncertainty coping strategy (code):	Description of how each strategy and tactics to achieve this:
Reduction (R)	<p>Seeking further information to reduce uncertainty via the tactics of</p> <ul style="list-style-type: none"> Advice seeking (from external sources and each other) Extrapolating meaning from information at hand—for example, “if the offender is saying X, it means he might be inclined to do Y” Discussing standard operating procedures, policy, and plans Redundant deliberation—asking repeated questions, not making any progress in their thinking, planning, or decision-making
Assumption-based reasoning (AbR)	<p>Constructing assumption-based hypotheses to reduce uncertainty via the tactics of</p> <ul style="list-style-type: none"> Mental simulation (create hypothetical mental models and simulating the steps of their plans if they were to implement them) Mental rehearsal (testing hypothetical mental model by imagining possible consequences if they were to implement a plan or strategy) Anticipatory thinking (focusing on the potential outcome of their actions in both short term and long term)
Weighing pros and cons (WPC)	<p>Listing and trading off the pros and cons of possible courses of actions to overcome uncertainty</p>
Forestalling (F)	<p>Remove uncertainty by avoiding non-reversible actions through</p> <ul style="list-style-type: none"> Preparing for worst-case scenario: identifying various contingency plans that may be used in case offender does something extreme (e.g. becomes violent to the victims, tries to escape) Intentional deferral: an active choice to not make a decision yet, with explicit intention to revisit this decision at a later point in time
Suppression (S)	<p>Taking a carelessly calculated gamble to reduce uncertainty via the tactics of</p> <ul style="list-style-type: none"> Denial of uncertainty (either knowingly or unknowingly) Acknowledging uncertainty but not doing anything about it
Reflection-in-action (RIA)	<p>Process of continually critiquing and revising assumptions via</p> <ul style="list-style-type: none"> Reflecting on previously chosen actions; for example, “before when the offender said X, we said/did Y. That resulted in Z” Reframing their mental models; for example, “I thought the offender was X but this indicates he might be Y” An incremental and deliberate monologue describing the dynamic environment; for example, “I think what the offender is now feeling/doing is...”

Decision made versus omitted

Every discussion should be given one decision “Made” or “Omitted” code at the end of that discussion. The discussion

will only be coded for a decision “made” if the team has explicitly identified a decision and tasked someone with implementing that choice; for example, “Great, on your advice then, the decision is to provide the offender with food”.

Appendix 2: Example quotes of coping strategies coded during the SA phase

Coping strategy	Tactic within strategy	Description of strategy in HN context	Quote
Reduction (initial SA)	Active information search	The IC and NC often sought intelligence, information, and advice from each other in order to inform their understanding of the dynamic situation	OK, run me through, where are we going to take this to? Stage 1: if I said to you, "I'm putting negotiators in there (if I am explaining this to someone else) what do I expect to get in the next half hour?"
Assumption-based reasoning (initial SA)	Conjecturing	Officers made assumptions about what was occurring inside the stronghold (when insufficient information was available) to create a working understanding of the incident	"I don't think it is reality that they would give up all the hostages because if they do give up all the hostages then they've given up bargaining chips. My view on these people is that the reason why they have the hostages is to buy them time, to mentally think about where they are and to escape. To give up all the hostages is like giving themselves up, so I don't think that as a criminal I would be releasing hostages on that."
Reflection-in-action (iterative SA)	Stepping back and reflecting	The NC and IC discussed previous actions in order to make an informed decision	IC: "right, what have we done for them?" NC: "we've swapped over negotiators when they asked us to. We haven't told them any lies, we have been engaging with them [...] we have engaged with them, been nice to them [...] haven't gone crashing in, haven't told them any lies..." IC: "well, can't we use all that and say 'right we have done all that, what are you now going to do for us?'"
Suppression (maladaptive SA)	Decision omission	Discussion over whether to introduce a "reality check" to the offenders (by making consequences clear to the offenders), was omitted as the NC attempted to <i>suppress</i> high levels of uncertainty.	IC: "so why are you, if it is 50–50, why are you advising to go with the reality check, or you just saying that's an option?" NC: "I'm just saying that's an option (shrugs)"

Appendix 2.1: Example quotes of coping strategies coded during the PF phase

Coping strategy	Tactic within strategy	Description of strategy in HN context	Quote
Assumption-based reasoning	Mental simulation	The IC used mental simulation to plan the potential processes of action	“I don’t want to get into choosing, if they start giving me names and saying “you choose” I’m not going to do that. They’ve [...] given me an opening bid, and I sort of want it to be known that I am interested in that opening bid. I don’t know what words you’re going to use as a negotiator but I am interested... but here is my counter bid, let the 3 go and the car will get to you”
	Mental rehearsal	Tactical advisor used mental rehearsal by imagining potential scenarios before choosing one when advising over the provision of a car	“Depending on the time and on the fuel switch, we could actually have the strike down within the cartilage of the tunnel area. Which gives us some control as they come out of the tunnel”
	Anticipatory thinking	The IC visualized the consequences of their actions in terms of later stages of investigation, as well as post-incident procedures or examination of their decision-making and rationales	IC: So we are going to coroner’s court, and when we get to coroner’s court I need to be able to say that I got some advice and I was able to make a decision IC: [...] what I really need is some options so that I can start making choices. Because at the moment, she dies, other people die, I’m at coroner’s court or public enquiry and I am trying to explain some decisions I have made, and at the moment, I can’t make any. Because I’m not being given any options by my Tac Advisor, by my intelligence people, or by you
Weighing pros and cons	Plan prioritization	The IC and NC discussed whether or not to provide the hostage takers with a car	IC: In relation to the car, my gut instinct is to say no. However what this now presents us with is a tactical option. If we have more than one hostage on the bus, and we can present them with a car which means they take no hostages, I’ve saved a load of lives. And therefore presenting a car might actually give me some tactics NC: So let the three go and then the car will be put in. What about... I appreciate what you were saying about not wanting to get into it, but are we possibly not letting them leave with two hostages? IC: sorry, by all means give me another solution to save three lives. Because I can’t get into it, we can sit here forever and make them starve to death, or we can sit here forever and see if they just give people up. I mean, that is an option, but I have got to say, I’ve got no information on the identity of the hostages, I don’t know what illnesses they’ve got, I know that one has allegedly had her thumb cut off, so they are being physically assaulted now, so I actually have an imperative to do something. I can’t have a tactical imperative on that for all the reasons I have given you. So, that’s all I can come up with at the moment

Appendix 2.1 continued

Coping strategy	Tactic within strategy	Description of strategy in HN context	Quote
Reduction (maladaptive PF)	Redundant deliberation	The IC sought advice on “known unknowns”; blocking the team decision process from reaching PE and instead directing them back to SA	“To that end, I don’t know if you’ve got there yet, or if they’ve asked what’s going to happen, it doesn’t sound like they’ve got any kind of conception that this is going to end any other way than the way they want it to. When it comes to reality, if they asked “what would happen if we gave ourselves up?” what would you say?”
Reduction-assumption-based reasoning loop (maladaptive PF)	Redundant deliberation	The IC and NC engaged in a reduction-assumption-based reasoning loop when redundantly deliberating whether to request the release of hostages	<p>IC: “Now, your advice please on this—do we ask for all the hostages to be released or do we ask for one of the hostages to be released?” (reduction)</p> <p>NC: “I don’t think it is reality that they would give up all the hostages because if they do give up all the hostages then they’ve given up bargaining chips. My view on these people is that the reason why they have the hostages is to buy them time, to mentally think about where they are and to escape.” (assumption-based reasoning)</p> <p>IC: “How do the other hostages feel if we say “oh give up A hostage” [...] that is the bit I need your advice on is—what is the best way to approach this? I want to save someone.” (reduction)</p> <p>NC: “My advice to you is that I don’t think in the reality here that anybody will get seriously injured, if we play this strong.” (assumption-based reasoning)</p>

Appendix 2.2: Example quotes of coping strategies coded during the PE phase

Coping strategy	Tactic used within strategy	Description of strategy in HN context	Example
Reduction	Using standard operating procedures	The IC, when deciding on the issue of implementing a communication device, sought advice from the technical support unit (TSU) officer and then implemented the decision based on the standard operating procedures for crisis negotiation	<p>TSU: “AT the INK you’re only speaking on demand, whereas the field phone will have the dynamic footage coming in”</p> <p>IC: “Perfect, on your advice that’s what we should do. Alright, I’m happier with that and I’ll tell you why I’m happier with that. Because it means that I now know that you are negotiating towards the planned objective, rather than endless “we’re just trying to chat” and that’s what we are meant to do. [...] Ok. Decision—you can go and tell them, they are going to negotiate a field phone in and then give them a reality check”</p>

Appendix 2.2 continued

Coping strategy	Tactic used within strategy	Description of strategy in HN context	Example
Assumption-based reasoning	Mental simulation	Officers would mentally simulate the exact procedures by which they would execute their actions and “play out” the anticipated consequences of that action	IC: “Right, ok, in order to help you get towards that option, I would like you (to NC) to get your team to negotiate in something, yeah? Because when I think the phone went in and we haven’t actually had any data back from that as to where he is and those other two are still on the bus. As soon as they are off the bus, I don’t care what it is, food or medicine, say let’s take food down there, yeah? Unconditional, he hasn’t asked for it, we’re worried about all of you, we’ve got some comfort for you.[...] we approach the bus with one, with a food parcel, leave it down for them, then we get an intelligence gain don’t we. Can you do me a favour, have a word with the TSU, explain what we are going to do, and whoever is going to take the food forward, we want them to have a camera on them and a recording device so that they can just talk through what they are seeing and what’s there and they can just give us a situation”
Forestalling	Preparing for worst-case scenario	The IC explicitly chose to prepare an option, but omit decision implementation; making it an available option if, in the “worst-case scenario”, they would have to implement it	“OK, right. Can you after this meeting go and do some work on that for me? and at least then I have got that as an option but at the moment I haven’t got any vehicle so I haven’t really got any tactical options at all. NC—what have you got for me?”

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