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Modeling Psychosocial Decision Making in Emergency Operations Centres

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The researchers compared the effectiveness of two decision models for modeling decision making in Emergency Operations Centers (EOCs): Klein's Recognition Primed Decision (RPD) model and Gladwin's Ethnographic Decision Tree Model (EDTM). The focus was on decisions that affect the psychological and social well-being of responders and community members. Communities of EOC personnel participated in a simulated emergency event, followed by an interview and/or focus group. Analysis of the decision-making processes during the simulation revealed that most operational decisions were made intuitively, with expertise, and best modeled by RPD. When the decisions involved issues for which EOC personnel had less experience (e.g., psychosocial issues), the decision-making approach shifted from a fast intuitive style to a more deliberative style. In some cases, EOC staff requested additional information before making a decision. With no formalized feedback loops, decisions were delayed or not made at all, leaving community residents and EOC personnel without psychosocial services for unnecessary lengths of time. The researchers found the RPD model to be most useful in its potential for identifying areas where future training (i.e., simulated exercises) and education (i.e., knowledge transfer) could be offered to EOC personnel to improve the provision of psychosocial services.

Keywords: Emergency, Disaster, Decision making, Psychosocial, Emergency Operations Centre

Introduction

Modeling Decision Making in Emergency Operations Centres

How can communities increase their social, psychological and material resilience in the face of disaster? Given the risk of extreme weather, infectious disease, and chemical, biological, radiological, nuclear and explosive (CBRNE) events, adapting Emergency Operations Center (EOC) policy, protocol and training is essential. An EOC is a coordination and support centre to first responders at the incident site and is established during emergencies. EOC personnel make operational, strategic and "big picture" decisions in contexts characterized by high stakes, time-pressure and limited resources and time.

Researchers have worked to refine various aspects of EOCs (Botterell and Griss 2011). However, the psychosocial dimension of emergency response has been given little consideration (Lundin 2000). Those studies that have addressed it have found disasters to have a significant detrimental psychosocial effect (Lindell and Prater 2003). The term "psychosocial" refers to the physical, emotional, psychological and social well-being of individuals. Psychosocial well-being, during and after an emergency, is facilitated by self-care, community supports, and formal psychosocial services that can minimize stress and trauma, and ease the ability of affected parties to resume a "normal" life after an incident. Attending to the psychosocial dimension is necessary for effective emergency response (B. Elsner, former President of the BC Association of Emergency Managers, personal communication, December 5th, 2012).

This study is part of a larger research project called Simulation, Training and Exercise Collaboratory (SIMTEC). The goal of this project is to understand and enhance how decisions are made in EOCs, in particular, decisions that bear on the psychological and social well-being of responders and community members. Quarantelli (1997:47) notes the importance of attending to effective decision making in EOCs, rather than simply focusing on organizational control. The present research will be used to inform development of exercises and training material meant to encourage thoughtful engagement with the psychosocial dimension of disaster response. These exercises will be posted to the SIMTEC collaboratory and will be available to communities in Canada and internationally.

In this study, we analyze decisions made in a simulated EOC, using a qualitative paradigm in which extensive transcripts are analyzed for common themes. We ask two questions: (1) are decisions made in the EOC predominantly intuitive or deliberative? (2) is there a model that accurately reflects the observed decision making that could inform the development of training and education? In order to answer these questions, we compared the effectiveness of two models for analyzing the decision-making processes of EOC personnel during a simulated emergency event.

We first discuss two findings from decision theory that will help us understand what to expect from decision making in the EOC: (1) the dual process nature of decision making and (2) the importance of expertise in determining which of these cognitive mechanism is likely to be used. Then we compare two decision models that were developed in natural settings: Klein's (1993) Recognition-Primed Decision (RPD) model and Gladwin's (1989) Ethnographic Decision Tree Model (EDTM). The paper concludes with a summary of the findings and implications for current and future research.

Literature Review

Decision Theory

One finding to emerge from research spanning several decades is that decision making is "dual-stream:" there are parallel cognitive mechanisms involved in making decisions. One mechanism is fast, automatic, unconscious and associative (system 1 or intuitive); the other is slow, deliberate, conscious and rule-based (system 2 or deliberative) (Sloman 1996; Evans 2003). Generally the two systems operate together such that intuitive decisions are checked by deliberation.

Intuitive (system 1) decisions rely on computational processes such as schemas, heuristics and selective attention that allow decisions to be made without conscious deliberation. Such mechanisms favour speed and efficiency over accuracy. Researchers have identified biases and heuristics that people unknowingly rely on when they make intuitive decisions (Jacowitz and Kahneman 1995). These are essentially short cuts and in some cases lead to mistakes. Because experts rely on intuition, and we would expect experts' judgments to be more accurate, this effect has been called 'the paradox of expertise' (Dror 2011).

On the other hand, researchers studying decision making in natural settings emphasize the advantages of intuitive judgment. For example, Klein (1996) notes that intuitive decisions are much faster; an advantage in operational settings where there is often not time for deliberation. Further, researchers have found that in certain circumstances, intuitive judgment is highly accurate. Klein and colleagues found that in operational settings such as the fire-ground (Klein, Calderwood and Clinton-Cirocco 2010) and naval command-and-control (Kaempf, Klein, Thorsden, and Wolf 1996), effective decision making relies on intuition. Glick and Barbara (2013) found that experience and knowledge increased disaster responders' proficiency in making intuitive decisions in disaster situations.

Intuitive judgments are more likely to be accurate if the decision maker has relevant expertise. Expertise is also the most significant determinant of which cognitive system (intuitive or deliberative) is employed; decisions made by experts are more likely to be intuitive (Salas, Rosen and DiazGranados 2010). Early work on expertise compared

novice with expert chess players, and found that while novice players consider separate pieces on the board and consciously evaluate alternative moves, experts recognize the overall pattern as a whole, and often the best move is obvious (Chase and Simon 1973). Research since then has found that when people first learn a task it is performed slowly and deliberately, but the more experience they gain, the more the task becomes automatic, which means conscious attention is not required, multiple tasks can be performed at once, and tasks are performed more quickly (Feltovich, Prietula, and Ericsson 2006), in other words, with system 1 type decisions rather than system 2. Another important finding is that expertise is domain-specific; expertise does not extend even to very similar tasks. For example, even expert chess players are no better than others at remembering the position of chess pieces on a board if the pieces are placed randomly rather than in a pattern that could be found in a game, in which case experts perform much better than others (Chase and Simon 1973).

Expertise is notoriously difficult to define. Experience alone is not enough to build expertise. Shanteau (1992) found a variety of features to be indicative of expertise: a grasp of domain knowledge (from theory as well as experience); psychological traits (e.g., confidence, communication skills, adaptability, sense of responsibility); cognitive skills (e.g., developed attention, sense of relevance, identification of anomalies, ability to work under stress); the use of formal and informal decision strategies (e.g., dynamic feedback, decision aids); and task characteristics (e.g., consistency of environment). Given the complexity of defining expertise, Shanteau suggests experts be identified by peers within their field: "in every field, there are some who are considered by their peers to be the best at what they do. In some domains this is reflected by official recognition or job titles. In others, it comes from "consensual acclamation" (Shanteau 1992:5).

Expertise is necessary but not sufficient for accurate system 1 decisions; Shanteau (1992) found that some experts' judgments (e.g., physicists) are more reliable than others (e.g., stock brokers). Two of the conditions under which experts are able to make reliable intuitive judgments are when the environment is relatively stable (contains statistical regularities), and when the decision maker has had sufficient opportunity to learn in that environment (Kahneman and Klein 2009).

Decision Models

Most decision theory was developed by studying naïve participants in the laboratory. For this reason, some have argued that decision theory is only marginally applicable to understanding decisions made in operational settings where people have expertise in the decisions they make and conditions are importantly different from those of a laboratory (Klein 2010). Therefore, for this study we relied on two models that were developed in natural settings: Gladwin's (1989) Ethnographic Decision Tree Model (EDTM) and Klein's (1993) Recognition-Primed Decision (RPD) model.

Gladwin's Ethnographic Decision Tree Model

Gladwin developed EDTM as an alternative to traditional quantitative models that make a priori assumptions regarding how decisions are made (Gladwin 1989). EDTM relies on ethnographic methods and the philosophical foundations of anthropology. As such, it treats individuals as experts regarding their own decision-making processes and uses ethnographic interviews, which allow interviews to unfold naturally with little structure and seek to understand the topic from the perspective of the subject. Rather than a scripted or semi-scripted interview, ethnographic interviews are generally mutually exploratory and may take place over an extended period of time (Heyl 2001). To apply EDTM, participants are interviewed to determine their decision-making criteria and then interview findings are checked by observing individuals within a specific context making the decision of interest in real-life situations. The model is built by finding common choice points (points at which the decision maker must choose one course of action over another) across participants. These points form the nodes on a decision tree. Thus, while individuals are interviewed for their decision-making criteria, the goal is to build a tree that reflects decision-making processes characteristic of a group. The validity of the model is then tested with a new sample of decision makers.

Gladwin, Gladwin and Peacock (2001) used this method to model South Florida residents' decisions to evacuate or not evacuate during hurricanes. They interviewed 100 participants in order to determine common decision-making criteria. The model was then tested with a separate sample of 954 participants. The decision point was {evacuate now; don't evacuate} (using Gladwin's 1989 notation for indicating dichotomous choice). Decision-making criteria included whether individuals lived in an evacuation zone, whether individuals felt safe in their homes and whether they had means of reducing risk (such as shuttering windows). The interviews revealed "decision-makers weighing two sides to hurricane risk, a process that also takes time" (Gladwin, Gladwin and Peacock 2001:138). In other words, decision-makers were found to consciously deliberate over criteria in order to determine whether or not to evacuate.

It should be noted that while Gladwin's aim is to avoid making assumptions about the decision-making process by asking individuals how they make decisions, she inadvertently makes a different set of assumptions: that decision making is a conscious process, and that individuals' verbal reports accurately reflect this process. Nevertheless, there are indeed advantages to this method as the tree is developed inductively over the course of in-depth interviews and the researcher's immersion in the individuals' culture means the EDTM may capture details and idiosyncrasies that would be absent from cognitive models.

Klein's Recognition Primed Decision model

Klein (1993) was interested in modeling decision making in operational settings. He notes that certain critical aspects of operational settings are not represented in traditional laboratory-based decision models. For example, decision makers are typically highly experienced. Other important characteristics of decisions made in operational settings include that they are typically high-stakes, time-sensitive, and made in contexts that are uncertain, ambiguous and ill defined (Klein and Klinger 1991).

In his work with fire ground commanders, Klein (1993) found that the decision-making process could not be modeled with decision trees because the "commanders argued that they were not 'making choices', 'considering alternatives,' or 'assessing probabilities'. They saw themselves as acting and reacting on the basis of prior experience" (Klein 1993:139). This kind of decision-making process would be impossible to model using a decision-tree model because each node in the tree is meant to capture an individual's reasons for going down one branch of the tree as opposed to the other. If the individual has no underlying reasons for making a decision, or at least is not aware of them, then there are no criteria from which to build a decision tree.

Klein found that rather than search for the optimal solution (a potentially slow process since every option has to be evaluated), the fire ground commanders used a "satisficing" strategy (Simon 1972); they chose the first option that wasn't rejected (Klein 2008). Their extensive experience with similar situations allowed them to rapidly recognize and categorize a situation according to cognitive schemas (or scripts), each of which corresponds with a typical course of action. This occurs automatically (unconsciously) and thus is experienced as intuition. Mental simulation is used to imagine and evaluate the potential course of action. Thus, the intuitive decision is checked by imagining its outcome and anticipating any problems. If there are no flaws, the action is pursued; if there are potential flaws, another option is considered until a feasible course of action is determined (Klein and Klinger 1991).

Once a given situation is recognized and the appropriate mental schema is activated, there are three possibilities: (1) the schema contains the typical action; this action is carried out, (2) mental simulation is used to consciously evaluate the action proposed by the schema; no flaws are discovered; the action is carried out, (3) mental simulation reveals some problems with the proposed action (perhaps the situation was not recognized properly to begin with) and the process begins again (Klein 1993). "A purely intuitive strategy relying only on pattern matching would be too risky because sometimes the pattern matching generates flawed options. A completely deliberative and analytical strategy would be too slow; the fires would be out of control by the time the commanders finished deliberating" (Klein 2008:458).

A criticism of this model is that it conflates experience with expertise (Bond and Cooper 2006). As discussed above, experience alone is not equivalent to expertise. Expertise requires a combination of factors, only one of which is experience (Feltovich,

Prietula and Ericsson 2006). Therefore, care should be taken so that this model is applied to those with expertise (not just experience) in the domain of interest.

Comparison of RPD and EDTM

Common to both models is their emphasis on decision making in natural settings as opposed to a laboratory. However, there are also significant differences, two that are relevant in this study. The first is methodological. Gladwin (1989) employs ethnographic methods that require in-depth interviews and extensive immersion in the participants' culture. In contrast, while Klein (1993) avoids the laboratory, he nevertheless uses the methods of cognitive psychology, which involve carefully controlled experiments and rely on a computational model of the human mind. While our study involves observation of decision making as well as interviews, we use a mixed-methods approach that does not involve immersion in the participants' culture. We nevertheless employ EDTM to capture deliberative decisions that do not fit the intuitive decision making identified by Klein (1993) and to determine if decision trees might be useful for understanding EOC-based decision-making processes.

The second difference is that Gladwin's (1989) model requires decision-makers to be aware of why they make decisions, whereas Klein's (1993) model is based on decisions that are made unconsciously (intuitively). The dual-process model of decision making clarifies this difference between RPD and EDTM, namely that RPD applies to intuitive (system 1) decisions (with a secondary role for system 2) and EDTM applies to conscious (system 2) decisions. It is impossible for Gladwin's model to capture system 1 decisions. EDTM requires that individuals report on how their decisions are made, but system 1 decisions are made without conscious awareness, i.e., people do not necessarily know how their own system 1 decisions are made and therefore cannot (reliably) report on them. Any reasons that *are* given for how a system 1 decision is made are confabulated; thus even if reasons are given, they are not reliable indicators of how the decisions are actually made. On the other hand, Klein's model cannot capture system 2 (conscious) decisions since RPD applies primarily to intuitive (system 1) decisions – if conscious processes *are* involved, they occur after the initial decision, in order to verify the decision.

The Present Study

Given the research discussed, we expected that decisions made in the EOC for which the decision maker has expertise would rely on system 1, whereas decisions for which the decision maker does not have expertise would rely on system 2. The participants in the present study are highly experienced in their positions, in the upper ranks of their organizations, and most (but not all) have experience working in EOCs. Therefore, we

assumed that they would have the relevant expertise, at least for the decisions they encounter regularly, although we will readdress this issue in the discussion.

Most EOC personnel have little expertise when it comes to psychosocial decisions (Lundin 2000), therefore, we expected participants to use deliberation for psychosocial decisions. We expected most decisions to fit Klein's RPD model; however, we thought that EDTM would be useful when it came to modeling psychosocial decisions if they turned out to be deliberative.

Method

Participants

Thirty-seven participants (24 males, 13 females) were recruited from a number of communities involved in emergency management in the Lower Mainland of British Columbia. These participants included agencies such as police, fire, engineering and planning. Most participants (20) were between the ages of 46-55 (9 were between the ages of 36-45, 5 were over 55 and 2 were between19- 36). Participants had an average of 15 years of experience in their current position (range: 1 to 35 years), and most were in the executive or higher management levels of their organization, such as chiefs, managers and sergeants (depending on the size of the community, in Canada (other than Quebec), a police sergeant or staff sergeant will often be the highest rank below Inspector). The average number of times each participant had worked in an EOC was 4 (range: from no experience in an EOC to 21 years).

In February and March 2012 we sent invitations to participate in the study to every local emergency management director in Metro Vancouver and in the Fraser Valley (26 communities), as well as to the BC Provincial Ambulance Services. The directors of these organizations (e.g., police, fire, ambulance, public works) were asked to recruit senior decision makers with active roles in their EOC. We followed up on the invitations we sent and five communities agreed to participate, sending enough participants for 7 "pods" (two communities sent enough participants for two pods each). A pod consisted of four to six participants occupying a simulated EOC.

Procedure

Participants from the same community were allocated to the same pod for the simulation. EOC personnel usually have pre-existing working relationships. Therefore, by placing community members in the same pod, this study could take advantage of the working relationships and group dynamics of existing EOCs in order to more accurately simulate an EOC. The participants within a pod were to act as if they were an EOC unit, with each participant playing a role according to his or her expertise.

Prior to the exercise, participants were briefed on the fictional city of Denton in which the simulation was based. In order to make the simulation as realistic as possible, participants were not told anything of what the scenario would involve other than it would involve a winter-related incident. The simulation was held at the Justice Institute of British Columbia (JIBC) Dr. Donald B. Rix Public Safety Simulation Centre.

The scenario, a severe winter storm, was developed from case analyses, literature reviews, and expert interviews in order to reflect a realistic disaster. Significant participant feedback from the pilot exercise was used to refine the scenario, with particular emphasis on making it as realistic as possible. Various audio (e.g., radio dispatches, phones calls), audio-visual and paper injects were introduced into the pods in order to simulate the atmosphere in a real EOC.

Psychosocial cues were introduced throughout the scenario. For example, an arena roof collapsed under the weight of waterlogged snow in the midst of an international peewee hockey tournament. This incident created stress, as there were demands in excess of existing resources as well as the psychological impact of witnessing children undergo trauma and injury. In addition, there were multiple decision points that would impact the community and vulnerable populations. For example, a structural fire at a transitional housing unit forced residents out of the building. Participants needed to decide how to strategically manage this incident along with the many other events taking place in the community.

After the simulation, participants were interviewed individually and in focus groups. Interviews were semi-structured: interviewers asked open-ended questions about how decisions were made in the simulation. Focus groups were approximately one hour. The interviews were between 20 and 40 minutes. The interviews and focus groups were recorded and analyzed the same way the simulation transcripts were analyzed.

Analysis

Video and audio recordings were made of each pod during the simulation and the interviews and focus groups. The recordings were then transcribed and coded using NVivo qualitative analysis software. Researchers viewed the video recording of the pods while analyzing the transcript, to ensure that visual information such as gestures and body language was captured. Coding involves selecting relevant sections of text and grouping them into themes, some of which were determined prior to collecting data, some of which emerged through the process of analysis.

Three researchers coded the transcripts, using both inductive and deductive methods, analyzing the coding to the point of saturation, where no new themes presented themselves. Researchers kept an audit trail, a journal of notes, surrounding their thought processes while coding. These notes allowed the researchers to consult with each other in detail regarding emerging themes, their logic in coding, and any issues or thoughts that

arose through the process. This methodology also allowed for an audit, meaning a different researcher reviewed the journals and coding for a particular transcript, making the coding process transparent. Thematic analysis was used to determine trends and themes in the data, which is the grouping together of thoughts and ideas in the data to fall under categories that can be discussed meaningfully (Boyatzis 1998).

The coding process included open coding, which allows the researchers to capture any emergent themes, axial coding, which aims at examining conceptual categories, and selective coding which creates core categories based on the data (Bowen 2008). The research questions were developed into a codebook, informed by decision theory, which helped guide the axial and selective coding phases. The use of both coding practices is a mixed methods approach and a form of analytical triangulation (Jick 1979; Fereday and Muir-Cochrane 2006), strengthening the trustworthiness of the study.

Inter-rater reliability (where transcripts were separately coded by more than one researcher) was conducted for a limited number of transcripts; reliability for identifying key concepts was high (97 per cent). On-going reliability was achieved through regular research meetings and joint coding sessions where the researchers reviewed their inductively developed themes to ensure they were observing similar themes and using language in a parallel fashion.

The themes that emerged through the analysis were then analyzed with reference to the two decision models discussed above. The analysis focused specifically on decision points where two or more courses of action were possible. The researchers aimed to classify the data within the two decision models. Decision trees were built for decisions that occurred across all pods, and where there was vocal deliberation.

Results

In the interviews, participants were asked how they made decisions in the EOC simulation. The single most common decision-making strategy reported was that decisions were based on past experience and training, that people "just knew" what to do. Not once did anyone cite particular reasons for the decisions that were made or report comparing options. Several examples made by participants are listed below.

> B2EP01: From all our life experiences and work experiences. The more experience you have the more… you have to pull from to make those decisions….The more experience you have and then wisdom, the more things … become second nature.
>
> B3EP05: Everybody there I think had limited true EOC experience but they all had a lot of site experience. And so their decisions were made based on stuff that they're used to making out, decisions they'd make out in the field.

B4EP03: I would think just probably his experience and his past history with stuff. To be honest, most people that I've met that work in ambulance service have that. They don't fluster, they're very calm, they're very you know, serious and professional and they just sort of you know, work it all through.

B1EP06: The beginning stuff was just day to day routine stuff that was easy to deal with. It wasn't an emergency. I mean it was normal stuff, right. We do it every day. Again that's only through experience.

B4EP06: I think paramount was his [EOC Director] training…He had completed his I think EOC [higher level courses]… he didn't just walk off the street and have that skill set. He's practiced it and knew his role.

B4EP04: I think everyone just kind of knew what needed to be done and got to task on it. I don't know if there was, there wasn't any debate I don't think over, or disagreement I should say over what the next course of action should be. I think everyone took it in stride and had a pretty good understanding of what needed to be done and just got to task.

Another indication of the importance of experience was that several participants noted the common practice of deferring to individuals with the most experience or expertise.

B3EP03: Normally the EOC director may or may not have any background in emergency management so they have to defer to the person or people who are in charge of those sections for the expertise.

B1EP04: I think we came to consensus based on strengths. So it was not an individual that came to every decision every time …. So it was… not just our areas of responsibility but our strengths. So if, when we have an electrical issue we just happen to have our own electrical guy and that happens in a local EOC. It doesn't matter what rank that person is, we're going to go to that person as our subject matter expert. So the decision choices – I should say the options – is what that subject matter expert now brings forward.

Without any prompting (i.e., participants were not specifically asked about anticipating outcomes), several participants described imagining the outcome of their decision in order to anticipate any problems as an important part of the decision-making process.

B3EP01: in this circumstance here with the arena thing, we couldn't and didn't anticipate that we were going to have an ammonia leak as a result of this roof collapse so we put a reception center right next to the arena. Well of course now that's going to be contaminated by this ammonia leak so we didn't know

that. We didn't foresee that, maybe some people would argue you could have foreseen that and I guess we could have, but at the same time we made that decision based on that risk at the time. So now a lot of it too, doing risk management and risk assessment is trying to think of contingencies right? What if, if this happens what are we going to do, if this happens what are we going to do and that's a lot of, a lot of things you have to think of as, as any type of supervisor whether you're in the EOC or not, you know trying to deal with on a constant basis so. So I think a lot of it has to do with contingency planning and trying to think of all possible scenarios.

B3EP02: the motor vehicle incident, um we had a structure fire, we had a structural collapse, we had a HAZMAT incident, I've been to all type, every one of those types of those incidents multiple times so you feel really confident when that kind of stuff gets thrown at you. And you feel like you can, it's no problem you know making those decisions, but you're not the one, you're not the one making the decisions cause you're not the one on, in the field right? It's that IC. But you can sort of picture what's going on in your head and get a really good picture in your mind even before you get there of what that guy's going through and what he needs or what he may need as far as support goes.

As well as looking at what participants said they did, we also looked at the transcripts from the simulations to see what was said during the decision-making process. It is impossible to determine from the simulations alone whether people were consciously evaluating options, or whether they were making decisions intuitively. However, because decisions were made in groups, if decisions were made through conscious deliberation, it is likely that at least a portion of the deliberation was vocalized. Lack of vocalization could indicate either that the decisions were made intuitively, or they were made individually without consulting others. Most decisions were made quickly, authoritatively and without vocal deliberation. For example, note the following:

B4EP01: And you can be the planning section chief as well. And so we need reps. and we need to get situational awareness obviously.

B4EP01: Engineering, we've got to find out if you've got staff. Mechanical issues for the snowplow. If you've got enough salt.

B4EP04: So I'm going to get DB to come secure the rec centre with me so we have a place. We still don't have a place.

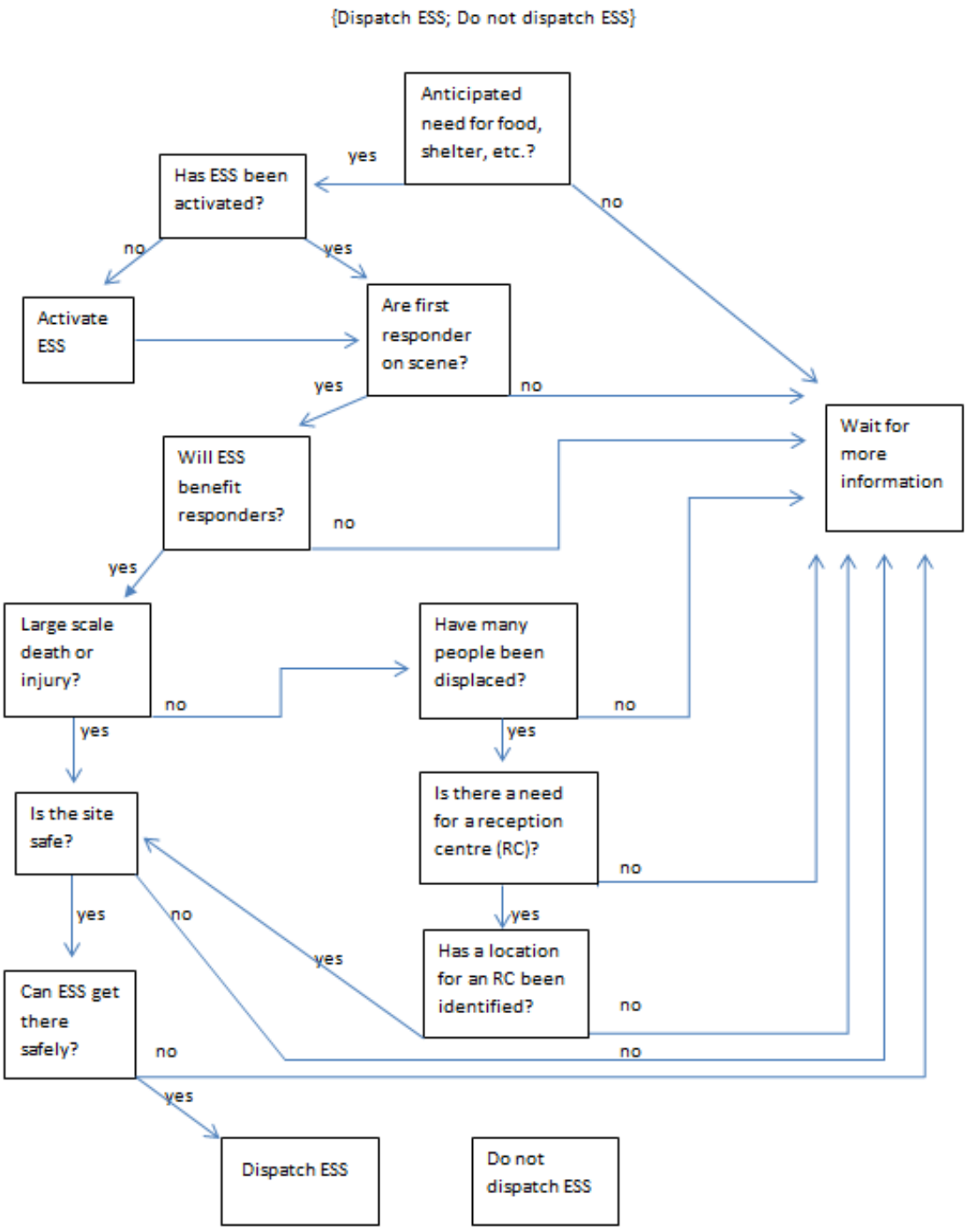
However, *some* decisions did involve deliberation. In the following example, participants discuss what would be involved in using a church as a reception center.

B1EP02: We need a temporary shelter set up. Well we could set up in the church. The church was still open according to the news.
B1EP01: The church was still open. Okay so …
B1EP02: We should confirm from the site really, 'cause this is the news. They're talking …
B1EP01: Ya once we get confirmation.
B1EP02: Should we be – should we be calling, should we be getting all those ESS volunteers on stand-by?
B1EP01: Ya okay good.
B1EP02: So we want to use the church as a reception centre at this point then?
B1EP01: Ya.
B1EP02: Okay so we need to find out if we can do that.
B1EP01: And the question is, we need a reception centre but can they also serve as a group lodging facility if required?
B1EP02: Okay
B1EP01: Let's call Engineering. See if we can send somebody from Engineering out to the Manor, Golden Manor to check as to the condition of the generator. Can we fix, can we replace it so that we can keep the residents there? That's the most ideal situation as we are limited, have limited lodging?
B1EP04: And let's talk to City Works and see if they've got a generator on wheels that we could drag out there.
B1EP01: And a call to City Works to see if they have a spare generator on wheels that we could send out in the interim for them. Right now shelter in place as we are looking at possible alternate generators. And then …
B1EP04: generators.
B1EP03: How about heaters as well?
B1EP04: Heaters ya. Can we also look into the community to the large stores?
B1EP04: We'll also send a note to PREOC [Provincial Regional Emergency Operations Centre].
B1EP01: Note to the PREOC, okay.
B1EP04: So in that stay-communiqué, we'll just back that communiqué with a PREOC notification that we're looking for power supply assistance?
B1EP01: Okay so I'm Liaison so I'm going to contact the PREOC.
B1EP02: So this is a high priority.

If the decision is {open reception center at church; open reception center somewhere else} we can infer from the dialogue that certain criteria are considered: is there confirmation the church is open; can the church also be used for lodging; can the generator be fixed or replaced; is there access to heaters? This decision was unique to this

particular pod. Since decision trees are meant to represent decisions across groups (Gladwin 1989), a decision tree was not built for this decision.

Figure 1. Decision to Deploy or Not Deploy Emergency Social Services



One decision that all pods deliberated, and for which the researchers constructed a decision tree, was the decision of whether or not to deploy Emergency Social Services (ESS). ESS is a component of the British Columbia emergency program that provides services such as food, clothing, lodging, family reunification, emotional support and psychological first aid. The decision tree (figure 1) indicates that ESS was deployed only after much consideration, and only after most other aspects of the situation had been dealt with. There appear to be no clear rules around when ESS should be activated. All pods waited until they had significant information about the situation before activating ESS. In this sense, when it came to ESS, pods erred on the side of false negatives over false alarms (they preferred to risk not having ESS present when ESS was needed rather than prematurely deploy ESS).

Discussion

Decision Making in the EOC

The results indicate that most decisions made in the EOC simulation were intuitive rather than deliberative. Given that the participants had significant expertise, and that previous research indicates expertise to be the most significant determinant of whether decisions are made intuitively, this is not surprising.

In the interviews, participants did not report a single instance of choosing between options. They claimed decisions were made according to experience and that people "just knew" what to do. In other words, according to participants' reports, decisions were made intuitively, not deliberatively. Most decisions made during the simulation exercise were made quickly and with little vocal deliberation, providing further support for the claim that most decisions in the EOC were intuitive.

Despite that participants did not report deliberating, according to the transcripts of decision making during the simulation, in some cases participants did deliberate, suggesting either that participants weren't aware of deliberating in these instances, or avoided mentioning it—perhaps because they know that intuitive decisions are the ideal in disaster situations. Most instances of deliberation occurred around psychosocial decisions. If participants were not aware of deliberating in these instances, it may relate to the lack of training and support regarding psychosocial issues. There is little awareness of psychosocial factors in general, and therefore a lack of awareness surrounding the decision-making processes regarding these issues is to be expected. It will be interesting to observe whether awareness surrounding decision-making processes for psychosocial issues increases with the training that will be delivered in future simulations.

One decision that involved deliberation was the decision regarding whether or not to activate ESS. Is there a reason that this decision in particular was made differently than other decisions in the EOC? The simplest explanation is that EOC personnel are less

likely to have expertise in this area. This is not surprising given that psychosocial aspects of emergencies have not been given much importance in emergency response training and protocols (Lundin 2000) and therefore it is unlikely that EOC personnel will have developed sufficient expertise for such decisions to be made intuitively.

Despite that the researchers found some practical problems with EDTM (which will be discussed below), some interesting findings relevant to decision making can be gleaned from examining the ESS decision tree (figure 1). In particular, note that the pods never chose *not* to deploy ESS (note that no arrows point to the decision {do not deploy ESS}). Not deploying ESS was the default action that resulted from delaying the decision until further information arrived. However, the result was that in all cases pods kept deferring the decision so that no decision was actually made. This is an instance of "analysis paralysis" (Gasaway 2010), the inability to make decisions as a result of relying on deliberative processes where faster, intuitive decision making would be more appropriate. One possible reason the pods delayed the decision to deploy ESS is that EOC personnel are aware that there are limited resources, and fear that if they deploy ESS unnecessarily, then they may be depriving others of this resource. Other reasons may include lack of awareness regarding the psychosocial impact of disaster and uncertainty regarding what resources to deploy or how to deploy them. Future iterations of the simulation will help determine the reason for the delayed response: if after training, a response is made, this will indicate that the issue was one of awareness and training.

The ESS decision tree (figure 1) indicates that, in this case, deliberation was problematic. All the pods waited for significant information prior to activating ESS. The consequences of this strategy are potentially serious: in the simulation, people (including children and others who may require special assistance) were left outside in a severe storm with no place to go, and no assistance while pods waited for more information. If this had been an actual emergency rather than a simulation, a material disaster (winter storm) potentially could have led to severe and preventable physical and psychosocial consequences. It is clear that an alternative decision-making strategy is required.

Comparison of Decision Models

For understanding how decisions were made during the EOC simulations, and for informing future research, training and protocol, we found RPD to be a more useful model than EDTM for the following reasons: 1) RPD is an accurate model of how most decisions were made in the EOC simulation, 2) EDTM proved problematic as a model for the few decisions that could not be modeled according to RPD because the decisions were too complicated 3) RPD describes how most decisions *should* be made in the EOC (thus informing training), and 4) when RPD is *not* a good model, i.e., when decision making shifts from the intuitive to deliberative mode, it points to decisions that should be more carefully examined, in order to determine *why* the decision-making strategy shifted

from intuitive to deliberative, and how training or education could assist the decision makers. In other words, even in the cases where RPD fails to apply, it is informative. The failure indicates a decision of interest, one that should be examined further, and where training may be appropriate. We will discuss these points in order.

As discussed above, most of the decisions made in the simulation were made without vocal deliberation, suggesting these decisions were intuitive. Self-reports of intuitive decision making confirm this conclusion. Some participants reported simulating (imagining) the outcome of possible decisions in order to determine whether they would encounter problems. Intuition and simulation are both features of the RPD model, whereas they are not part of EDTM, suggesting that RPD is a better model with which to analyze decision making in the EOC.

It is not surprising that RPD proved to be a better fit in most cases than EDTM given that decision making in the EOC requires rapid decision making by experts; time-sensitivity and expertise are two conditions that Klein et al. (2010) deemed to be essential to RPD. Decision-making strategies in which options are consciously compared are much slower, and decisions made by experts rarely involve conscious deliberation (Klein and Klinger 1991).

One of the decisions for which the transcripts indicated deliberation was the decision regarding whether or not to activate ESS. The researchers used EDTM to model this decision. While the decision tree was helpful in visualizing the decision-making process and allowed the researchers to look at the decisions from a different perspective, there were some practical problems. It was impossible to create decision trees that could be generalized across groups. The EOC context is highly complex. Many factors are relevant in the EOC (e.g., safety, timing, politics, and coordination amongst agencies) and these factors change depending on the situation. This means there may be many possible outcomes of any decision, and there are not always only two options. It also means that, because different factors are relevant in each case, the criteria each group considers to arrive at a final decision are different. It is impossible to create a decision tree that applies to all cases since each case is so different. The extent of the uniqueness of each case is itself an interesting observation, important to the study of decision making in EOCs.

One of the strengths of the RPD model is that it is descriptive as well as normative; it reflects how most decisions are actually made in operational settings, but it also indicates the most effective decision-making strategy in time-sensitive contexts since choosing the first workable option is a much quicker process than choosing among two or more options (Klein and Klinger 1991; Glick and Barbara 2013). While in some cases analytic strategies are effective for novices (Klein 1998), in natural settings, subjects perform better if they rely on unsystematic rather than analytical approaches (Johnson, Driskell, and Salas 1997). In the laboratory or with a well-defined problem, an analytical approach may be effective, but in natural settings, including the simulated environment used in the current study, there are so many factors that to consciously weigh them all may be too

cognitively demanding; relying on experience is much more effective. Decisions that rely on intuition are also automatic, thus freeing up attention for other tasks (Sloman 1996).

When decision making shifts from intuitive to deliberative, and therefore cannot be modeled with RPD, this is an indication that these decisions should be carefully examined. Given that intuition is more efficient in operational settings, one should ask, "why are deliberative methods beings used?" This is not to say that deliberation is in all cases problematic, or should be avoided at all costs. Indeed, deliberation is essential if the relevant expertise is lacking, if a novel situation is faced, or if solving a problem demands teamwork. However, in other cases deliberation may indicate that training in a particular area is lacking. In these cases the shift from the intuitive to deliberative mode indicates where a training intervention would be appropriate (see section below on Training and Education).

Our primary interest is practical rather than theoretical. We are interested in a model that will be most helpful in informing future research and facilitating the development of education and training to encourage engagement with the psychosocial dimension of emergency response. Since RPD helps identify where training is lacking (the decisions that do not fit RPD), and suggests methods for inducing changes in behavior (training to move decision making toward RPD), it is a useful model for decision making in the EOC.

Training and Education

There are two training factors that can assist novices to make decisions like experts: the first is to enhance deliberate practice with immediate, accurate and diagnostic feedback (Shanteau 1992) and the second is to support reflective practice (Klein 1998). Klein notes that exercises and simulations are ideal methods of training in that they provide individuals with experiences similar to those they would gain in the field, with the opportunity for direct feedback, "A good simulation can sometimes provide more training value than direct experience. A good simulation lets you stop the action, back up to see what went on, and cram many trials together so a person can develop a sense of typicality" (Klein 1998: 43).

The second important characteristic of operational training is that participants have the opportunity to reflect on their experiences (Klein 1998). Klein uses the example of a chess master who reviews a game after it has been played to learn from it. In the field, incidents can be reviewed in a similar manner (1998). In our study, focus groups and interviews served as a space for reflection.

Since the current project involves multiple simulations, we are able to analyze decision making from one simulation to inform training prior to the next. Following exercises held in February and March 2012, a training video was developed based on this analysis of decision making in the simulations. Through the analysis, five themes emerged, which were developed into the following training points: (1) taking breaks; (2) respecting gender and diversity; (3) demonstrating strong leadership; (4) providing psychosocial support to EOC personnel and

frontline responders; and (5) proactively deploying emergency social services volunteers and disaster psychosocial volunteers (a network of trained clinicians in British Columbia available during emergencies).

Preliminary findings from a simulation in October 2012 in which participants viewed the training video prior to participating in the simulation revealed that this strategy was somewhat successful. Briefly, behavior between the pods that did and did not receive psychosocial training was quite different. Pods that received the training were more likely to take into account psychosocial factors, made better psychosocial decisions, and were less likely to use deliberation in making such decisions. However, in a number of cases, the single training opportunity was not sufficient to lead to sustained changes over time as the stress levels in the exercise increased. Detailed results will be reported in a subsequent paper.

Considerations and Limitations of the Current Research

In the qualitative paradigm, reliability and validity (common standards from quantitative research) are addressed through quality, trustworthiness, and rigor (Golafshani 2003). Though debated and defined widely by social scientists, good working definitions of these terms include quality as how "good" the research is by the standard of the disciplines in which they are entrenched (Flick 2007), trustworthiness as the accuracy or credibility of the analysis provided (Krefting 1991), and rigor as both the choice of sound theoretical methods as well as transparency and explicitness in how data collection was conducted (Kitto, Chesters, and Grbich 2008).

Adherence to these standards was addressed through triangulation and use of an audit trail and inquiry. Triangulation is the use of multiple methodologies to strengthen against the inevitable biases of any single approach (Blaikie 1991), and was achieved in data collection by using both interviews as well as simulations, and in data analysis by using both inductive and deductive processes, and by having multiple researchers engaged in the process and continually discussing observations. Use of an audit trail, or journal of notes around thematic analysis, addressed trustworthiness and rigor as the researcher's logic is easily open to examination by another member of the team (Carcary 2009). The inquiry audit is the process of examining the audit trail along with the data and findings to determine whether the researcher's conclusions are valid (Lincoln and Guba 1985), speaking to both the quality and rigor of the findings.

One limitation to the current study is that the sample size was relatively small (n= 37), and because of this, we were not able to include participants acting in all roles that would typically be found in an EOC (e.g., public works was not represented in all of the EOC pods). There were not sufficient participants to test the decision trees according to Gladwin's (1989) method which requires that the trees are built from one sample (of approximately 25), then tested on another (approximately 25). Note that in this context, each pod would count as a single unit since it is a pod rather than an individual that

makes each decision. This means that the sample size for the decision tree method was actually 7.

While the sample size was small for the use of EDTM, in other respects, such as in the use of RPD and in the qualitative analysis of decision making, the sample size was not a problem. Quality was achieved in other ways, not through sheer quantity, but through depth of analysis, triangulation, and use of an audit trail.

Participants varied widely in their level of experience; some individuals had never worked in an actual EOC before, whereas others had worked in an EOC many times. While this is typical of what occurs in a real situation, it makes it difficult to identify the effects of expertise on decision making. This was not a central question of the present study, but would be interesting to examine in future research.

We made the assumption that decisions that were not vocally deliberated were intuitive and informed by expertise. However, it is possible that deliberated decisions were in some cases simply not vocalized. It is also possible the person making the decision may have had higher status, or a more dominant personality within the group and, therefore, did not consult the group. Future research could investigate further the reasons behind how decisions are made in EOCs.

For practical reasons such time limitations and availability of participants, we did not engage in ethnographic interviews, nor in immersion in the EOC culture. While this decision was intentional, nevertheless it made evaluating EDTM problematic. It is possible that, to some extent, EDTM was not a good fit because we did not follow Gladwin's (1989) method closely enough. An ethnographic study looking at EOCs would be interesting; however it was not part of this study.

Future Research and Conclusion

As discussed in the introduction, the connection between intuition and expertise is complicated, and will require more research in order to better understand the issues. To what degree are intuitive decisions in the EOC accurate? Our results suggest that errors were more likely to occur when deliberation was used (which resulted in some cases in "analysis paralysis," i.e., important decisions were not made as participants were waiting for more information). Klein's (1996) work also suggests that in a high stress, command and control environment such as an EOC, where decisions must be made rapidly, intuitive expertise is a more effective method of decision making. However, as Dror's (2011) work on the paradox of expertise shows, in some cases expertise can lead to errors since expertise relies on processing shortcuts such as biases and heuristics that may ignore important information. Given the importance of the decisions made in an EOC, future research should investigate in more detail the extent to which expert intuitive decisions in the EOC are accurate.

Methods must be in place for managing decisions for which personnel do not have sufficient expertise. No matter how much experience and training persons have, they will nevertheless face novel cases with which they have little direct experience. It is important that novel cases are recognized, and the appropriate decision-making strategy is employed.

Future research should also examine other factors that may influence decision making, such as stress (is intuition more effective when there is greater time-pressure?), and group dynamics (are EOC personnel more likely to use intuitive decision-making processes if they have working relationships with one another?). Researchers have found that focus tends to narrow as stress increases (Cohen 1980); this is also true for groups so that as stress increases, the focus shifts from the group to the individual (Johnston, Driskell and Salas 1999), implying that people may look internally for solutions rather than seeking outside help from those with expertise. This is especially relevant given our finding that EOC personnel do not always take into account psychosocial factors, an area for which they are unlikely to have expertise, but for which there are plenty of experts on hand, such as Emergency Social Service workers and Disaster Psychosocial Service workers. It is essential that EOC personnel extend outward, seeking help from outside the EOC when they do not internally have the expertise required to solve a particular problem.

Our hope is that this research encourages responsible and accurate decision making in EOCs with respect to psychosocial decisions; that EOC personnel engage experts when faced with decisions for which they do not have expertise, and that training in psychosocial decision making results in greater expertise in this area. An emergency response that expertly manages the psychosocial as well as material effects of disaster will lead to stronger, more resilient communities.

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Notes

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