Decision inertia: Deciding between least worst outcomes in emergency responses to disasters

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This study demonstrates how naturalistic decision-making (NDM) can be usefully applied to study 'decision inertia' – Namely the cognitive process associated with failures to execute action when a decision-maker struggles to choose between equally perceived aversive outcomes. Data assessed the response and recovery from a sudden impact disaster during a 2-day immersive simulated emergency response. Fourteen agencies (including police, fire, ambulance, and military) and 194 participants were involved in the exercise. By assessing the frequency, type, audience, and content of communications, and by reference to five subject matter experts' slow time analyses of critical turning points during the incident, three barriers were identified as reducing multiagency information sharing and the macrocognitive understanding of the incident. When the decision problem was non-time-bounded, involved multiple agencies, and identification of superordinate goals was lacking, the communication between agencies decreased and agencies focused on within-agency information sharing. These barriers distracted teams from timely and efficient discussions on decisions and action execution with seeking redundant information, which resulted in decision inertia. Our study illustrates how naturalistic environments are conducive to examining relatively understudied concepts of decision inertia, failures to act, and shared situational macrocognition in situations involving large distributed teams.

Practitioner points

- Researchers can use NDM to explore the cognitive processing associated with failures to act/decision inertia.
- Complexities in the decision-making environment of a multiteam system (e.g., non-time-bounded choice, large team size, and lack of strategic goals) are associated with decision-making failures.
- Barriers cause decision inertia as teams focus on redundant intra-agency information seeking rather than cooperative interagency communications.
- Strategic direction is especially important for shifting multiteam system communication towards interagency discussions on action execution.

If the behavioural implementation of making a decision is the execution of action (Lipshitz, Klein, Orasanu, & Salas, 2001; Yates, 2003), then failing to make a decision (e.g., making an executive choice) is when action execution fails. Traditional decision-making

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research has helped psychologists to understand the conditions under which decisions are likely to be actioned in a static, closed environment, where decision-makers have the opportunity to analyse the choice context and select an optimal course of action (e.g., expected utility theory; Von Neumann & Morgenstern, 1947). Yet in the 'real world', decision-makers rarely have the luxury of having unambiguous information or sufficient time to analyse choices, and thus, their rationality is bound by cognitive constraints (Simon, 1956). Whilst early research treated bounded rationality as maladaptive in causing cognitive biases and faulty heuristic processing (Kahneman & Tversky, 1979), 'naturalistic decision-making' (NDM) takes a more pragmatic perspective.

The NDM paradigm

NDM rejects the notion of 'right' or 'wrong' decisions and instead seeks to understand the cognitive processes associated with choice implementation by studying decision-making 'in the wild' (Gore, Banks, Millward, & Kyraikidou, 2006; McAndrew & Gore, 2013). NDM emphasizes the importance of real-world contexts, domain-specific expertise, and macrocognition in distributed and sociotechnical teams (Stanton, Wong, Gore, Sevdalis, & Strub, 2011). The aim of NDM is 'to understand how people make decisions in real-world contexts that are meaningful and familiar to them' (Lipshitz et al., 2001, p. 332). It juxtaposes earlier decision-making research that aimed to explore decision-making errors (Kahneman & Tversky, 1979) and instead takes a positive approach by focusing on the processes that enable individuals to make decisions (Gore et al., 2006). This is why NDM research is often grounded in the notion of 'expertise' as researchers seek to uncover the declarative knowledge that is implicitly stored in the cognition of experts (Klein, 1997). Expert 'macrocognition' goes beyond behavioural decision-making and encompasses a number of key cognitive elements that distinguish the expert from the novice, which include mental models, perceptual skills, sense of typicality, routines, and declarative knowledge (Klein & Militello, 2004).

In addition to furthering interest in positivist research, NDM has also developed naturalistic methods for data collection. For example, 'cognitive task analysis' is uniquely designed to unpack macrocognition and includes various, and largely qualitative, techniques such as the 'critical decision method' interview protocol (for more detail, see Crandall, Klein, & Hoffman, 2006). An overreliance on ecologically invalid laboratory-based settings is inappropriate (Schneider & Shanteau, 2003) as the real world is characterized by ill-structured problems, uncertainty, poorly defined goals, multiple feedback loops, time constraints, high stakes, multiple players, and conflict between personal ideals and contextual requirements (Orasanu & Connolly, 1993). Thus, this is the setting in which research should be conducted. Lipshitz (1993) recognized that although no unified NDM theory exists, they all have a common set of assumptions: Cognitive processing in the real world varies, situation assessment is critical, mental imagery is important, the decision-making context must be specified, decision-making is dynamic, and research should focus on how decision-makers actually function rather than how they ought to function.

An unparalleled advantage of NDM is the active encouragement for researchers to remain flexible and open minded when exploring large and naturalistic data sets. This facilitates the discovery of novel or previously missed psychological phenomena through coincidental observations. For example, the notion of expertise and 'recognition-primed decision-making' was a product of NDM research (Klein, 1997). A series of cognitive interviews conducted with expert firefighters revealed how skilled decision-makers were able to rapidly select a course of action by ‘pattern matching’ between the environment and the available responses they had cognitively stored. Crucially, Klein (2008) found that experts tend not to compare options to find the best response but instead evaluate each option in singular succession until they find one that is good enough. These conclusions on expert cognition have since been replicated in a wide range of domains and have had a significant impact on the understanding of expertise. For example, Jenkins, Stanton, Salmon, Walker, and Rafferty (2010) found that experts will ‘leap’ or ‘shunt’ between decision stages to facilitate rapid and intuitive action, whereas novice decision-makers are more analytical and linear in their decision-making. Experts are also able to ‘reflect in action’ during the decision-making process to reduce situation uncertainty and ensure that their actions remain consistent with the changing environment (Cristancho, Vanstone, Lingard, LeBel, & Ott, 2013; Schön, 1987; van den Heuvel, Alison, & Power, 2014).

Taking the above into account, the topic of interest for the current study was also a product of naturalistic observations. The authors, after having used NDM to research critical incident decision-making in the domain of emergency service workers for over 15 years, noticed that when faced with a challenging decision, even experienced decision-makers often fail to take any action at all. In other words, they appeared to rely on a cognitive heuristic that suggests when the solution to a problem is unclear, the safest option is to do nothing. Rather than commit to a choice, they actively (and with considerable cognitive effort) try and delay the implementation of a choice (Eyre, Alison, Crego, & McLean, 2008; van den Heuvel, Alison, & Crego, 2012). This is distinct from decision avoidance (Anderson, 2003) where decision-makers refuse to evaluate choice through passive inaction (e.g., ‘I choose not to decide for the time being’). Instead, we have observed how decision-makers fail to act through ‘decision inertia’, the cognitively active and redundant deliberation of choice despite there being a low (or no) chance of discovering any new information to inform the decision (e.g., ‘I am still thinking about whether I will commit to, refuse or avoid this choice’). This is important in dynamic crisis environments where often the ‘most-worst’ outcome is the failure to act as ‘more is missed by not doing than not knowing’ (Byrnes, 2011, p. 28). If a decision is optimal, then the team can perform well; if the decision is non-optimal, then the team can re-evaluate, revise, and respond, yet if the decision is not made, then the team drifts along a trajectory of uncertainty, inaction, and inertia. Not only will this study provide an in-depth analysis of this novel approach to failures to act, but we will also highlight how engagement with the NDM paradigm provided a contextualized, meaningful, and applicable methodology to research and discover the cognitive processes associated with inaction.

Using NDM to research macrocognition in a multiagency emergency team responding to a simulated sudden impact major disaster

Emergency service workers must operate in highly dynamic, uncertain, and complex decision-making environments where interoperable team coordination is essential to facilitate action (House, Power, & Alison, 2014). These decision-making environments are highly unstable, rapid-changing, and unpredictable (van den Heuvel et al., 2014), and thus, effective team processing requires that ‘members’ interdependent acts convert inputs to outcomes through cognitive, verbal, and behavioural activities directed towards organizing task work to achieve collective goals’ (Marks, Mathieu, & Zaccaro, 2001, p. 357). To clarify, macrocognition is the study of ‘how teams move between internalisation and externalisation of cognition to build knowledge in service of problem solving' (Fiore et al., 2010, p. 203). It considers both social and technical influences on team cognition during the decision process (Schubert, Denmark, Crandall, Grome, & Pappas, 2012) to increase understanding of collective group cognition during sense making (Stanton et al., 2011). Teams are not only made up of a collection of individuals, but also consist of 'subteams' (or 'agencies'). In multiteam systems, individuals will share and utilize information to assist both individual (intra-agency) decision-making goals and more strategic joint (interagency) decisions and actions (Ancona & Chong, 1996). They need to shift attention between within-group, intrateam processing, and between-group, interteam coordination (Marks et al., 2001). For example, police officers operate with their 'intra-agency' police colleagues along with their 'interagency' emergency response colleagues (e.g., fire and ambulance services), who have both cohesive and conflicting goals depending on the incident and required outcome.

Teams struggle to make decisions due to poor communication, inconsistent situation awareness, and conflict of interests (Chen, Sharman, Rao, & Upadhyaya, 2008). Rusman, van Bruggen, Sloep, and Koper (2010) examined virtually distributed teams and found that 'trust' between team members was based upon judgements of communality, ability, benevolence, internalized norms, and accountability. Not only does this show the importance of placing objective trust in another's ability during teamwork (Mayer, Davis, & Schoorman, 1995), but it also highlights the importance of subjective ratings of benevolence, norms, and communality that will be derived from past experience with one another. Keyton and Beck (2010) highlighted how the type and meaning of communications in teams is based upon an ever-evolving context derived from past interactions within the team. Past experiences of operating within a specific team influences an individual's understanding of their role and team culture (Bearman, Paletz, Orasanu, & Thomas, 2010) which can influence their decision-making behaviour at both an individual and collective levels (Marks et al., 2001). Thus, research needs to be sensitive to social dynamics and embrace subjective and personal experiences. NDM methods are ideal for enabling a deeper exploration of both intra- and intergroup processing at both cognitive and socially constructed levels.

Exploring how time pressure, team size, and strategic direction interact with decision-making in emergency service decision-making teams

Emergency incident contexts provide a unique domain in which to apply NDM to study multiteam systems, cognitive processing, and failures to act. Over the last decade, a considerable number of natural and man-made major emergencies have occurred, which include flooding, tsunamis, nuclear accidents, and toxic chemical spills. The effects of these emergency incidents are widespread, affecting a large population, disrupting infrastructure, and incurring huge costs (emotional, physical, and commercial) in both the short and long term. Although society recovers, post-incident criticisms of such major disasters often suggest that there was inadequate pre-planning and delayed responding. For example, Japan's Nuclear Accident Independent Investigation Commission emphasized how delays in taking action contributed to the inappropriate response that occurred during the Fukushima nuclear disaster, which lead to confusing and conflicting messages at both a response and civilian level (Kurokawa, 2012). As a result, the magnitude of the initial damage was greater, and the amount of time taken to recover was longer, due to the inherent ambiguity and complexity associated with the challenging environment (van den Heuvel et al., 2014).

We selected three barriers that, with reference to the literature and anecdotal evidence, were anticipated to reduce action implementation and instead cause time-delayed inertia decision-making processes. We predicted that interagency communications would decrease when choices were non-time-bounded, involved multiple agencies, and lacked clear strategic direction. These 'barriers' were relevant to the decision-making context of emergency incidents as they typically involve multiteam systems who often hold competing goals and must operate under variable time pressures. Although it is recognized that conducting NDM research at simulated training events offers the potential to explore a vast array of other variables (e.g., expertise, decision strategies, behavioural patterns), we chose to focus on three specific barriers in order to reduce and control the data set, and to aid our understanding of the cognitive and social processes associated with failures to act.

Time-bounded choice

A choice can be either time pressured to meet a deadline or non-time-bounded and thus amenable to deliberation. When an individual is exposed to time-pressured deadlines, they will try and adapt to time constraints by reducing their generation of potential options (Alison, Doran, Long, Power, & Humphrey, 2013). Time pressure makes individuals more risk-seeking and increases the likelihood of choice implementation (Young, Goodie, Hall, & Wu, 2012), but this does not always lead to increased decision accuracy. NDM research has described how skilled decision-makers can adapt well to time pressure using efficient and intuitive pattern matching (Alison, van den Heuvel et al., 2013; Klein, 1997), whereas less skilled decision-makers will utilize faulty and biased cognitive and heuristic shortcuts to speed up and bypass the decision-making process (Ask & Granhag, 2007). Yet there has been relatively little research on how the absence of time pressure influences choice, specifically with regard to how it influences the likelihood and timeliness of action execution. This may be due to the traditional use of experimental paradigms whereby choices are made salient to the decision-maker in order to prompt a response, thereby artificially inducing a pressure to respond.

When a decision is not constrained to deadlines, this means that decision-makers have the opportunity to avoid or redundantly deliberate on their choice. When decisions are perceived to be difficult, then individuals will try to avoid committing to a course of action (van den Heuvel et al., 2012) in order to avoid anticipated negative consequences such as negative emotions (Anderson, 2003), and when operating within organizational settings, the potential for criticism is due to accountability (Waring, Alison, Cunningham, & Whitfield, 2013). When someone expects to receive feedback on their actions in team-based settings, they will tend to avoid choice (Zeelenberg & van Dijk, 1997) due to the potential for anticipated loss (Crotty & Thompson, 2009), the anticipation of blame (Eyre et al., 2008), or the perceived inability to personally justify their choice (Brooks, 2011). A lack of deadlines means that individuals are more likely to use deliberative and alternative-based processing of choice to establish whether any of their available options are available/acceptable (Parker & Schrift, 2011), in place of more time-efficient cognitive search strategies, such as satisficing (Simon, 1956), which establishes which of the available options is the 'least worst' or 'acceptable'. Thus, a complex decision problem that is 'non-time-bounded' has high potential for inertia, and we predicted that this will principally manifest through reduced action execution and increased redundant deliberation over already established intra-agency information.

Team size

Communication and coordination are essential for facilitating a team's macrocognitive functioning (Keyton & Beck, 2010). We hypothesized that as the number of responding agencies involved in the decision task increased, the ability to coordinate action would diminish. This is because although 'interdependent' tasks require the coordination of information and resources from multiple players (van de Ven, Delbecq, & Koenig, 1976), the increase in the number of people involved makes the decision environment more complex (LePine, Piccolo, Jackson, Mathieu, & Saul, 2008). Team decision-making is facilitated by shared mental models, where all players hold a common understanding of the situation and associated actions (Mathieu, Marks, & Zaccaro, 2001). The key macrocognitive function of a multiteam system is to reduce uncertainty and risk by establishing and maintaining common ground and shared mental models (Schubert et al., 2012). In multiteam systems, shared mental models not only inform how players should coordinate within their own team but also help a collective awareness of interagency goals and actions (Mathieu et al., 2001). Multiteam systems must monitor both inter- and intrateam processes to provide relevant feedback and instruction to one another (Dickinson & McIntyre, 1997). Team monitoring and coordination behaviours that help facilitate action should occur continually to ensure that actions within the multiagency network are consistent (Brannick, Prince, Prince, & Salas, 1992; Marks et al., 2001).

Establishing a shared mental model is more difficult in large teams. Being a member of a large team reduces an individual's psychological 'ownership' of a problem as responsibility is diffused throughout the wider team network (Kroon, 't Hart, & van Kreveld, 1991). An individual's sense of ownership of a problem influences how personally responsible they feel for the potential consequences of a choice (Pierce, Kostova, & Dirks, 2001). Holding someone individually accountable for collective outcomes makes them work harder at a team level (Kroon et al., 1991), and thus, psychological ownership facilitates team work. In large teams, individuals have less 'ownership', feel less accountable, and thus reduce their efforts as lines of communication become exponentially larger rather than additive (Kroon et al., 1991). When support from other team members is lacking, individuals are less likely to process decision tasks at an individual level (Mueller, 2012). In addition, when operating in hierarchical teams involving command structures (such as the emergency services), these process losses associated with increased team size are often underestimated by those in charge (Staats, Milkman, & Fox, 2012). This could induce erroneous expectations of decision-making capabilities from those higher up the decision-making command chain. Therefore, we hypothesized that as team size increased, the likelihood of action would reduce due to associated reductions in psychological ownership of the decision problem, feelings of responsibility, and diluted communications.

Superordinate goals

'Superordinate (strategic) goals' help guide decision-makers to generate and evaluate different courses of action (Cannon-Bowers, Tannenbaum, Salas, & Volpe, 1995; Dickinson & McIntyre, 1997). They are 'goals that are urgent and compelling for all groups involved but whose attainment requires the resources and efforts of more than one group' (Sherif, 1962, p. 19). Strategic direction helps to guide the planning of actions to achieve goals. It can facilitate deliberate planning, wherein principal courses of action for mission accomplishment are formulated, contingency planning, where alternative plans are developed to adapt to any anticipated potential events, and reactive planning which is in response to unanticipated changes during the incident (Cannon-Bowers et al., 1995; Marks et al., 2001). In multiteam systems, common goals are critical for interteam cooperation as it transforms individual units into a powerful collective (Katzenbach & Smith, 1993). Individuals often hold competing individual and team-based goals that can make decision-making difficult (Wittenbaum, Hollingshead, & Botero, 2004). Clear strategic direction can reduce cognitive conflict by placing boundaries on decision-making and making collective aims salient. The setting of superordinate goals can also help teams to adopt a collective identity, which can reduce the potential for diluted efforts as a product of large teams and facilitate intergroup cooperation (Driskell, Salas, & Johnston, 1999).

To establish and reach common strategic goals, a team must exchange reciprocal information across the network. Individuals need to understand the network as a whole in terms of available resources and expertise, and also be made aware of any potential constraints in the decision environment (Stout, Cannon-Bowers, Salas, & Milanovich, 1999). Effective macrocognition in teams is thus dependent upon 'action processes', the acts taken by members that contribute directly to goal accomplishment (Marks et al., 2001) and help synchronize both individual and collective activities within complex, dynamic, and unpredictable environments (Tesluk, Mathieu, Zaccaro, & Marks, 1997). Action processes help with sense making across the team network (Alberts & Hayes, 2006) as they involve team monitoring and the implementation of synchronized and coordinated actions (Marks et al., 2001). In addition, the communication of strategic direction must be communicated with explicit meaning and intent across the multiteam network to achieve a shared awareness (Beck & Keyton, 2009; Keyton & Beck, 2010). Taking the above into account, we predicted that a lack of clear strategic direction would reduce the ability to coordinate and communicate decisions and actions.

Method

Data were collected from a large-scale multiagency (n = 14 agencies) simulation-based training exercise of an aeroplane crash over a major city. It explored the macrocognitive processing of a multiagency, emergency response team who would be expected to respond to this type of incident. The training event was conducted using the 'hydra' system, an immersive simulated learning platform that can assist organizational training whilst facilitating research. As discussed at length by Alison, van den Heuvel et al. (2013), simulations provide a useful platform for studying decision-making in multiteam systems (such as the emergency services) as they provide vast amounts of varied data to explore the social, organizational, cultural, and political factors that are inherent in such organizational environments, whilst importantly facilitating their primary purpose in training decision-makers by exposing them to challenging incidents. Hydra replicates a traditional 'tabletop' simulation exercise by placing trainees (or participants) into small teams split across separate 'syndicate rooms'. Those who are running the exercise, in our case a mixture of trainers and researchers, control the simulation from the central 'control room' by feeding relevant information into each syndicate room. As with a traditional tabletop exercise, participants are split into teams and placed into syndicate rooms according to the purpose of the simulation. Each syndicate room is equipped with a laptop computer, a large TV screen to project the computer image, a printer, and a video/sound recorder.

During the exercise, syndicate rooms are fed information. Information feeds or ‘injects’ may include videos, audio clips, paper print out messages, or even role players. Syndicate rooms can also request and receive additional information through the ‘communicator’, a chat box that links each syndicate room to the central control room. Facilitators in the control room can respond to information requests from each syndicate room through this system, monitor decision logs, and pass information between syndicate rooms at the request of participants. This allows simulations to be fluid, dynamic, and responsive to the actions of the participants in the syndicate rooms, enabling an in-depth analysis of immersive and NDM whilst maintaining a level of experimental control.

Participants

Participants (n = 194) took part in a two-day simulated exercise of an aeroplane crash over a major city. Participants came from 14 different agencies, including the police (n = 20), fire (n = 10), ambulance (n = 8), military (n = 3), local authority (n = 12), government offices (n = 15), media (n = 19), health services (n = 15), environment agency (n = 6), utilities (n = 6), science and technical advice (n = 13), and transport (n = 31), along with a multiagency gold group (n = 36). All participants were experienced real-life responders who could be required to respond to a real-life major incident of this nature (London Emergency Services Liaison Panel, 2007). They were a mixture of strategic (‘gold’) decision-makers (who were placed in one syndicate room and were tasked with making strategic decisions about the incident) and tactical decision-makers from each agency (who were split into separate syndicate rooms during the exercise, one for each agency team).

In addition to the participants in the syndicate rooms, 10 trainers and 19 subject matter advisors were located in the control room. Advisors were experienced emergency responders from the local resilience forum who helped design the scenario and were able to respond to agency-specific information requests. The exercise control team was responsible for feeding information feeds to each syndicate room and responding to communicator messages.

Procedure

Strategic ‘gold’ commanders from each agency were placed into one syndicate room, and supporting staff from each agency were split into separate agency-specific ‘syndicate rooms’ (Figure 1). This set-up was designed to replicate the command structure that would be in operation during a real-life major incident in the United Kingdom. Each syndicate room received information that reflected what they would receive in a real-life event. For example, support staff in the ambulance syndicate room received information regarding casualties, whereas the police support staff received information on cordoning and evacuation procedures. Agencies communicated to one another by sending logged messages through the communicator (via the control room). They were also able to communicate with other members of their own agency not in the syndicate room (e.g., those from their agency on the simulated incident ground) also via a message to the control room.

The training event took place over 2 days. Day one of the training event simulated the multiagency ‘response’ phase, which ran in real time from 8 AM until 10 PM and represented two simulated days (e.g., ‘day 1 response’ and ‘day 2 response’). The second exercise day simulated the multiagency ‘recovery’ phase, which ran in real time from 8 AM

Figure 1. A typical syndicate room used during a ‘Hydra’ simulation.

until 12 midday and simulated the transition to ‘day 3 recovery’ (London Emergency Services Liaison Panel, 2007). During the simulation, participants within separate syndicate rooms were responsible for sharing and coordinating the information they had received to relevant internal and external bodies through the communicator.

The scenario: Aeroplane collision over a major city

A general timeline was followed by the exercise control room. The control team fed information about the overall unfolding scenario to all agencies; however, specific timelines and information feeds were adapted during the simulation based upon the learning requirements of the exercise and recommendations from advisors. The initial information feed (that went to all agencies) stated that two aeroplanes had crashed above a local city airport: One crashed into a residential tower and the other crashed into a power station (causing a large section of the city to lose power). Subsequent feeds involved updates on traffic congestion, the failure of specific metro lines, information on toxic plumes and reduced air quality over large and populated areas of the city, updates on number of victims and casualties involved, and information regarding hospital generators failing and running out of fuel. Agency-specific information feeds involved, for example, an intelligence update that terrorism could not be ruled out (police) and that the number of available resources were being stretched due to the severity of the incident (fire and ambulance).

Data collection

Data were collated from the electronic communication logs that were passed between the syndicates and control room. Participants used communication logs to request additional information about the incident from their own or other responding agencies and also to provide information when requested. They used the communicator to coordinate decisions and actions and request information from their own agency (e.g., advisors) or other agencies. Participants marked their communications as follows: (1) information seeking, (2) a decision, or (3) an action. Communications were coded according to whether they were ‘intra-agency’ (e.g., fire requesting confirmation of available resources from control) or ‘interagency’ (e.g., police coordinating triage locations with ambulance). Communications were coded as intra- or interagency only when they explicitly mentioned either their own or another agency. Note that ‘intra-agency’ communications does not refer to verbal communications made within syndicate rooms, but relates to messages concerning their agency that were sent to the control room.

Data analysis

Social network analysis

Social network analysis (SNA) usefully provides an overarching picture of the social dynamics of team-based settings and can further be used to focus qualitative analysis. We conducted a SNA of the communication logs to produce an overview of the social interaction and relationships between the different agencies involved in the exercise (Knoke & Yang, 2008). Relational SNA shows how central a group is within the network, where they are positioned within the network (which is defined by their relationship or ties to all others), and how dense the ties are between the groups or people that make up that network (Mizruchi, 1994).

The initial step in analysis involved inputting frequency data into the network analysis package, UCINET (Borgatti, Everett, & Freeman, 1992). To analyse the density, centralization, and hierarchy of the social network, two communication matrices were produced: One that reflected the presence or absence of communication between agencies, and another to indicate the total sum of messages between agencies (Table 1). These matrices coded communications across the entire incident, as well as specifically within the ‘response’ (e.g., days 1 and 2) and ‘recovery’ (e.g., day 3) phases of the simulation. In addition, a multidimensional-scale technique was used to create a visual representation of networked communications for both the response and recovery phases (Figures 2 and 3). This visual representation involves plotting all agencies relative to one another so that their position within the space reflects how strongly they are socially connected to others. Agencies that are closely located have more relative association with each other and represent the key members of that network, whilst agencies on the fringes or periphery of the network are those agencies who communicated less with all others (Heinz & Manikas, 1992).

Identifying the ‘critical issues’ that required interagency communication

One of the challenges of NDM research is establishing how to judge decision-making quality (Gore et al., 2006). The SNA provided top-level frequency findings on communications between agencies, but this does not provide us with information about communication quality. For example, some decisions may require more internal than external collaboration and thus decentralized networks may counter-intuitively reflect better quality coordination. To address this, we approached five subject matter experts (SMEs; three high ranking police officers, one ex-military, and one chief fire officer) who highlighted six ‘critical issues’ during this scenario that, according to their expertise and experience, required a high frequency of interagency liaison (Table 2). These SMEs were external to the exercise and were approached post-exercise (via email). They were provided with a timeline and information feeds from the exercise in slow time and were asked to identify the ‘critical issues’, where interagency communication was required for

Table 1. Frequency of communications between (and within) agencies

	Police 1	Police 2	Police 3	Amb	Fire	Media	Military	Trans	STAC	LA	Govt Off	Health	Utilities	Environ	Gold	Control	Ex	Total
Fire	8	5	5	7	86	3	2	2	2	2	2	2	2	3	5	21	10	167
Trans	10	7	6	3	4	5	9	54	2	2	2	2	16	2	1	10	23	158
Health	7	4	5	9	2	3	2	2	9	6	3	40	6	2	17	14	22	153
Police 1	73	5	5	5	6	6	1	7	1	5	1	1	3	1	6	4	20	150
LA	12	6	6	4	4	6	4	4	4	53	6	6	7	5	2	7	6	142
Amb	8	6	6	91	1	0	2	4	0	0	0	2	0	0	3	3	8	134
Utilities	7	2	2	1	2	1	5	2	1	1	1	1	63	1	6	4	7	107
Environ	6	0	0	0	1	0	0	5	2	1	0	0	4	26	2	5	27	79
Govt Off	4	1	1	1	1	1	1	9	3	8	2	1	3	1	2	8	24	71
Media	8	3	3	3	4	2	2	2	2	3	2	2	4	2	1	3	0	46
Police 3	5	3	14	0	3	0	0	1	1	1	0	0	1	1	2	2	6	40
Police 2	4	20	5	1	0	0	0	5	0	0	0	0	0	0	2	0	1	38
STAC	2	2	2	2	5	2	1	1	3	2	1	2	2	1	1	2	4	35
Military	0	0	0	0	0	0	25	0	0	0	0	0	0	0	1	1	5	32
Gold	6	5	3	4	5	0	1	1	0	2	1	0	0	0	0	1	2	31
Total	160	69	63	131	124	29	55	99	30	86	21	59	111	45	15	85	165	1347

Note. Amb, ambulance service; Trans, transport; STAC, science and technical advice cell; LA, local authority; Govt off, government office; Util, utilities; Environ, environment agency; Gold, gold group; Cont, control; Ext, external.

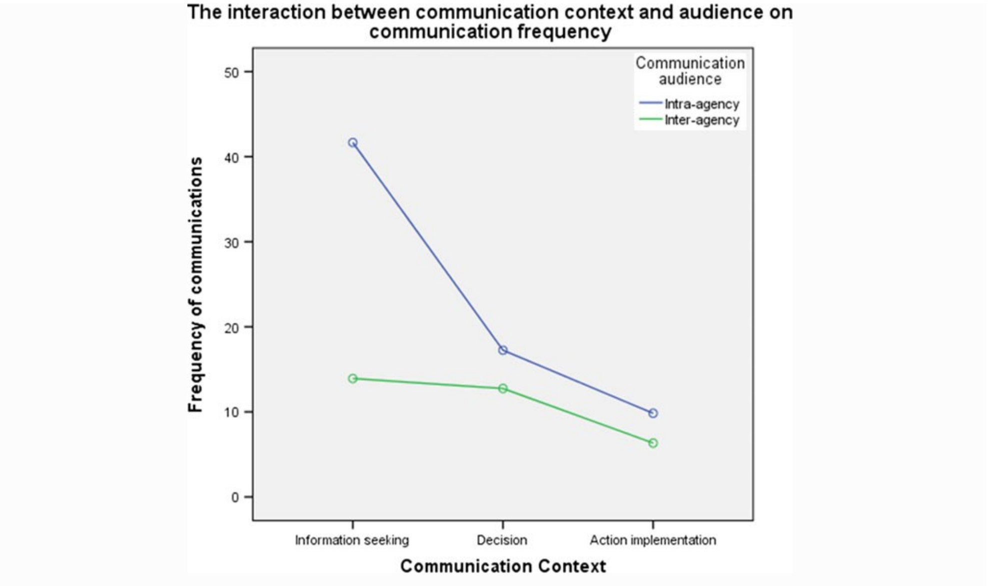

Figure 2. The interaction between communication content and audience on communication frequency.

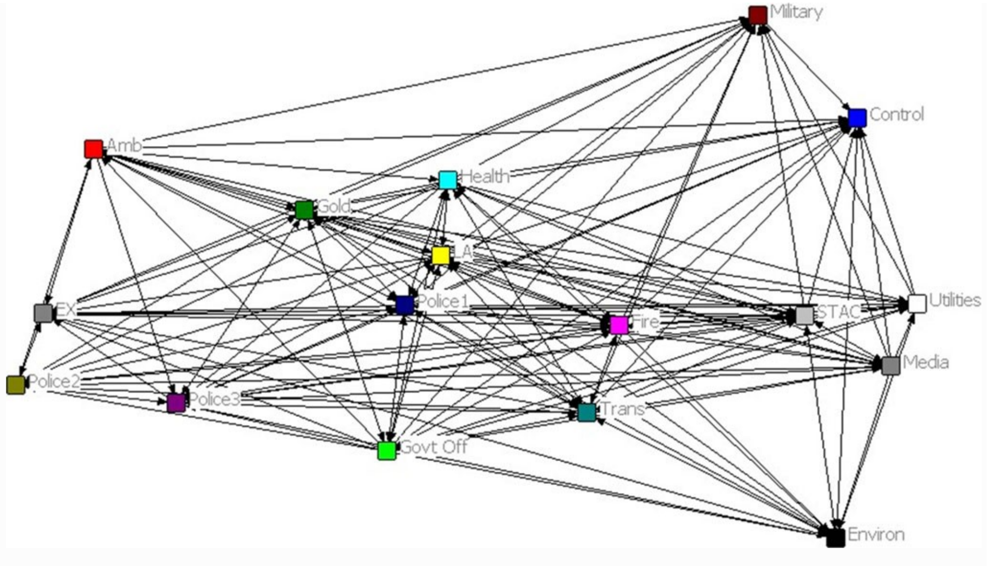

Figure 3. MA network during the response phase of incident management.

success (or 'good' decision-making). An issue was highlighted as 'critical' if four of the five SMEs identified and agreed that it was. SMEs also identified which agencies should be involved; only five of 14 agencies were identified as requiring involvement with these critical issues (police, fire and rescue, ambulance, military, and local authority) which the authors suspect is due to their need to be involved in the dynamic response phase of the incident. Each 'critical issue' was also coded for the prevalence of our three barriers: (1) non-time-bounded problem, (2) large number of agencies involved, (3) and/or lacked

Table 2. The six critical issues identified by the subject matter experts

Critical issue (agencies involved)	Definition	Optimal response
Resource coordination (police, fire, ambulance, local authority, military)	The timely resolution of any major incident requires agencies to continually monitor and implement intra-agency resources whilst sharing this information and receiving information from other agencies	Sharing of resource information should occur continually, but it is especially important during the initial response phase
Casualty triage (police, fire, ambulance)	Participants had to consider how to coordinate the recovery of casualties and bodies during the response phase	A significant amount of coordination regarding the issue should occur at the tactical (bronze) level on scene. Strategic decisions and actions with regard to the distribution of resources by police, fire, and ambulance at 'gold' level is also required
Communication channels (police, fire, ambulance, local authority)	During the initial response phase, the communication ('airwave') channels were disrupted. The police received a direct request from a tactical officer on whether or not they should implement the 'Mobile Telecommunication Privileged Access Scheme (MTPAS)' – A UK procedure for prioritizing mobile telephone networks for emergency services	Collaboratively decide to invoke the scheme and provide interagency rationale for the decision
Reception centre location (police, local authority)	This is essential for ensuring the welfare of those civilians affected by the incident	There needs to be ongoing review of the needs of civilians. This should be primarily led by the local authority as it feeds into the later recovery phase when attempting to restore normality
Emergency evacuation (police, fire, ambulance, local authority)	All agencies received information that a smoke plume caused by the aeroplane crash might potentially be toxic and thus hazardous to responders and civilians in affected area	There needs to be discussion amongst blue light responders and the local authority, with advice from science and technical advisors (STAC) or the airline investigation branch. A joint decision must then be made on whether or not to evacuate both responders and civilians from the affected areas
Handover of primacy (police, local authority)	At some point, the police must hand over the primary management of the incident to the local authority	This indicates that the response phase is over the recovery phase has begun. Thus, the timing of this decision is crucial

clear strategic direction. Qualitative analyses of communications about these critical issues explored how 'barriers' and interagency discussions interacted. Quantitative analyses of to whom these communications were made was also conducted to establish whether the response was ‘interoperable’. It was classed as ‘interoperable’ if more than 50% (i.e., the majority) of logged communications about this issue were ‘interagency’.

Results

Descriptive analyses of inter- and intra-agency communication frequency

A repeated measures ANOVA found that across the incident as a whole agencies made significantly more intra-agency communications (M = 68.42, SD = 41.52) than interagency communications (M = 33.00, SD = 20.13), $F(1, 11) = 13.581$, $p = .004$. There was a significant difference in the number of communications made depending upon their content, $F(2, 22) = 6.246$, $p = .007$. Significantly more messages discussed information seeking (M = 55.58, SD = 35.82) than decisions (M = 30.00, SD = 22.68) or actions (M = 16.17, SD = 28.229). There was a significant interaction between communication content, audience, and frequency, $F(1.23, 13.58) = 6.871$, $p = .016$, as information-seeking communications were especially intra-agency (Figure 2).

Social network analysis

UNICET was used to calculate ‘network density’ and how embedded or isolated each ‘node’ (e.g., agency) was within the wider network (Hanneman & Riddle, 2005). The average density value was 3.45, which represented an average density tie of 59.5%. This meant that, across the entire incident, 59.5% of all possible reciprocal communications between agencies occurred with an average number of messages between agency pairs of 3.5 messages. This indicated that 40.5% of possible communications between agencies were not made. Low density occurred because agencies focused on contacting individuals within their own organizations instead of the network (Table 1). The highest number of interagency communications (n = 16; transport and utilities) was less than a quarter of the number of intra-agency communications (n = 86; fire and rescue). Network density was significantly higher during the response phase of the incident (density = 2.95) compared to the recovery phase (density = 0.49), $t(0.61) = 2.61$, $p < .05$, as 75.4% of all possible communications were made during response compared to only 27.1% during recovery (Table 3). This pattern was also illustrated in the visual representations of the network, as the response phase had more (strong) ties between pairs of agencies (Figure 3) than the recovery phase (Figure 4).

Centralization measures how well connected a node is with the rest of the network. In-degree centrality reflects the number of communications leading into that node, whereas out-degree centrality reflects the number of communications going out from that node (Hanneman & Riddle, 2005). High in-degree centralization indicates that a small number of agencies are being consulted by all others, whereas high out-degree centralization indicates that a small group of agencies are sending information out (Scott, 2001). The

Table 3. Average density values and percentage of present ties across network for entire incident and per incident phase

	Density	Density: % of ties
Entire incident	3.45	59.5
Response phase	2.95	75.4
Recovery phase	0.49	27.1

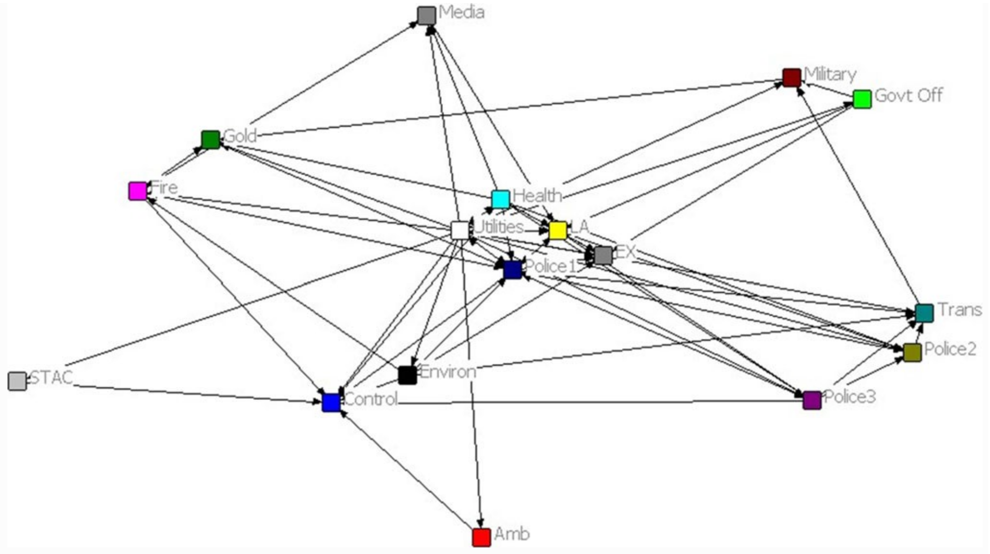

Figure 4. MA network during the recovery phase of incident management.

multiagency network was found to be decentralized as there were relatively low levels of in- and out-degree centralization, although in-degree asymmetry was almost twice as high as out-degree (28.5% and 15.7%, respectively, see Table 4). The network was more centralized during the initial response phase (in-degree = 25.49% and out-degree = 17.12%) than the recovery phase (in-degree = 10.82% and out-degree = 6.25%). Table 5 presents each agency's itemized centrality for both phases of the incident and across the entire incident. In addition, the SNA found no evidence of a hierarchy within the network at any phase of the incident or overall (Table 4). This meant that no single agency commanded the incident as a key player (albeit this finding would be expected as a product of the UK Gold Command structure).

Interoperability during six 'critical issues'

Critical issues were coded for the presence or absence of our three hypothesized 'barriers' to multiagency decision-making, namely whether the issue was ongoing in duration (e.g., lacked a deadline), involved three or more agencies, and/or lacked a clear superordinate goal (e.g., lacked strategic direction from gold; Table 6). Although there was no significant correlation between the number of barriers present and the frequency of interagency communications, there was an interesting trend in the data. It was found that barrier frequency was negatively correlated to interagency communication frequency ($r =$ .542, $p = .266$); as the number of barriers increased, communication with external agencies decreased. Likewise, a nonsignificant positive correlation was found between

Table 4. Hierarchy and centralization degrees for the entire incident and per incident phase

	Hierarchy	Centralization – In-degree (%)	Centralization – Out-degree (%)
Entire incident	0	28.57	15.78
Response phase	0	25.49	17.12
Recovery phase	0	10.82	6.25

Table 5. Itemized in-degree and out-degree centrality for each agency for the entire incident and per incident phase

	Entire incident		Response		Recovery	
	Incoming	Outgoing	Incoming	Outgoing	Incoming	Outgoing
Police 1	10.60	8.82	5.29	6.53	2.40	2.29
Local Authority	5.73	8.29	1.79	6.88	1.60	1.47
Police 2	4.60	2.24	2.86	2.12	0.67	0.12
Police 3	4.20	2.35	3.00	1.82	0.67	0.53
Fire	8.27	9.82	2.43	9.06	0.73	0.77
Ambulance	8.73	7.88	2.50	7.88	0.06	0.06
Transport	6.60	9.29	2.86	9.00	0.47	0.29
Health	3.93	9.00	1.29	6.88	0.87	1.88
Utilities	7.40	6.29	2.86	4.53	1.07	1.77
Environment	3.00	4.65	1.29	2.82	0.53	1.71
Government Office	1.40	4.18	1.29	3.82	0.13	0.41
Military	3.67	1.88	1.93	1.77	0.33	0.12
Science and Technical	2.00	2.06	1.86	2.00	0.07	0.06
Media Advice Cell	1.93	2.71	1.71	2.59	0.20	0.12
Gold Group (Strategic Coordinating Group - SCG)	3.40	1.82	3.21	1.71	0.40	0.12
External	11.00	N/A	8.67	N/A	2.20	N/A
Control	5.67	N/A	4.87	N/A	0.87	N/A

barrier frequency and intra-agency communication (r = .691, p = .128); as the number of barriers increased, the number of within-agency communication also increased. This suggests that when decision-making is more complex (e.g., increased barriers), communication with other agencies decreases and internal-agency communication increases. It is possible that the lack of statistical significance in this trend was due to the lack of power generated by our single (albeit large) naturalistic data set. Further research in more experimental and repeatable settings may help to clarify these effects.

Qualitative analyses of critical issues characterized by where the intra-agency communications: Resource coordination and casualty triage

Table 6 shows how the two 'critical issues' that had all three barriers present were the only two critical issues were communications were predominantly intra-agency focussed (i.e., not intereoperable). Both 'resource coordination' and 'casualty triage' critical issues had ongoing duration (e.g., lacked a deadline for a final decision and action), involved more than two agencies, and, following analysis of the communications sent from the 'gold' strategic syndicate, had no superordinate goals. The only reference made to 'resources' in the gold syndicate was unclear: 'Police gold: Scene management and resourcing at scene', and communications on 'casualty triage' focused on information seeking rather than setting necessary direction: 'Fatalities. What is the scale of the incident we are dealing with?'; 'Bodies left on scene at present? Those at hospital being dealt with'. Thus, both issues were considered by the SMEs to lack strategic direction.

Analyses of communication content at the tactical level supported our earlier finding that agencies focused on intra-agency matters and that these communications were

Table 6. The number of barriers and frequency of communications for each critical issue

	Non-time-bounded (Y/N)?	More than 2 agencies (Y/N)?	Poor strategic direction (Y/N)?	Total number of barriers	Frequency of communications		Did interoperability occur (% of interagency communications)?
					Intra-agency	Interagency	
Resource coordination	Y	Y	Y	3	34	8	No (19)
Casualty triage	Y	Y	Y	3	14	10	No (42)
Communication channel failure	N	Y	Y	2	4	4	Yes (50)
Reception centre location	Y	N	N	1	9	13	Yes (59)
Emergency evacuation	N	Y	Y	2	8	12	Yes (60)
Primacy handover	Y	N	N	1	4	14	Yes (78)

predominantly concerned with information seeking (Figure 5). For example, the ambulance service focused on information seeking about their own resources: 'How is ambulance coping with core business? i.e. availability of resources?'; as did the fire and rescue service: 'All bulk foam units are currently in use. What reserve stocks of foam do we have and do we need to order more?' For the casualty triage issue, it was also found that agencies were primarily concerned with information about internal resources: 'Request information from ICR regarding our casualty figures from all sites'. Despite this, the SMEs recommended that communication between agencies should be interagency focused to reach a successful resolution. As was found, an intra-agency focus on internal resources reduced the ability of agencies to coordinate resources on scene. Likewise, agencies discussed casualty triage by gathering information from one another, yet failed to coordinate their efforts on scene to facilitate action. Both issues were characterized by the three identified barriers, and both issues induced a failure to communicate between agencies and execute action.

Qualitative analyses of critical issues characterized by interagency communication: Communication channel failure, reception centre location, emergency evacuation, and primacy handover

Discussions about the 'communication channel failure', 'reception centre location', 'emergency evacuation', and 'primacy handover' were predominantly interagency (i.e., >50% of communications were interagency) and tended to focus less on information seeking and more on action execution (Figure 5). The only exception was the 'communication channel failure' issue (Table 6), as this issue was minimally discussed (n = 8) and only just reached the 50% interagency communication margin. In terms of the barriers that were present for these issues, there were mixed findings. As mentioned, the frequency of interagency communications was negatively, albeit non-significantly, associated with the number of barriers. It is likely that this non-significant trend was in part due to the mixed findings when the number of barriers dropped below 3.

Both team size and duration of issue are barriers to interoperability that are difficult to influence from a solutions perspective. As such, we focused on the setting of

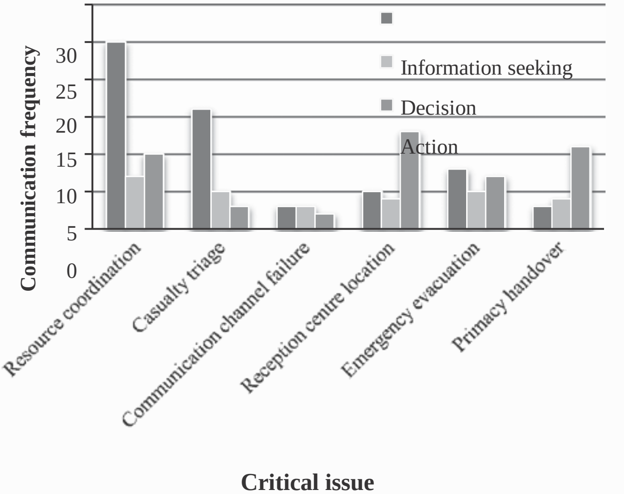

Figure 5. The frequency of communications made for each critical issue broken down by communication content.

superordinate goals from ‘gold’ decision-makers for our analysis. Although gold acknowledged communication channel failures as an issue that needed to be resolved: ‘Mobile phone network may not be working. Not sure how to communicate to community’, they did not outline a strategic goal. Likewise, the emergency evacuation issue lacked clear strategic direction as commanders focused on information seeking over setting goals: ‘Need to have update re smoke/direction and intensity etc’. This lack of superordinate strategy further impacted tactical discussions as responders focused on reacting to the impact of the issue rather than generating tactics for resolution or to prevent further escalation or harm: ‘boroughs need to be mindful of the lack of communication methods due to the loss of power’; ‘Contact AAIB for specialist advice regarding hazards contained within smoke plume’. Thus, although there was a high proportion of interagency communication, they did not induce action. As indicated in Figure 5, the content of communications for these two issues was fairly evenly dispersed between information seeking, decision-making, and action execution. Although they were not dominated by information seeking as was found for the two intra-agency issues, the proportion of communications was less focused on action execution than their interagency counterpart issues (e.g., reception centre location, primacy handover). Fundamentally, a lack of strategic direction diluted the focus of discussions on action execution.

In contrast, the ‘reception centre location’ and ‘primacy handover’ issues did have clear strategic direction. For the reception centre location issue, gold communicated a clear goal: ‘Agree to active humanitarian centre’ and further specified who should take charge: ‘LA [local authority] to organise humanitarian centre’. This meant that the local authority was able to take charge of the tactical response and coordinate action with other agencies: ‘LA understands police have been posed question about flowers and other tributes and are identifying suitable areas. Expect contact soon on this’. This was similar for the primacy handover issue: ‘LA have the lead. Key messages, major tragedy. All agencies have worked together; now return to normality’. Interestingly, although this message was not communicated until the very end of the response phase of the incident, the LA (in accordance with their role) had already begun contingency planning for taking primacy: ‘Recovery group meeting convened at 13.00. Rationale: To initiate process and an impact assessment in the early stages and to horizon scan for the next 48 hours’. Communications predominantly focused on action execution rather than redundant information seeking (Figure 5). Thus, issues that were guided by strategy from gold were dealt with through increased interagency communications (as recommended by the SMEs) that specifically focused on the useful execution of actions.

Discussion

NDM can be used in a novel way to explore the intricate cognitive and social processes to understand failures to act. Data were collected from an immersive simulated training exercise of the emergency response to a major disaster. The network as a whole was decentralized and communications tended to be intra-agency-focused and dominated by information seeking. SMEs identified six critical issues that required interagency communication for a successful resolution (e.g., decisions needed to be coordinated jointly between agencies). If critical issues were non-time-bounded, involved more than two agencies, and lacked clear strategic direction, then communications predominantly involved redundant intra-agency information seeking, as opposed to the useful interagency coordination of decisions and actions (as recommended by the SMEs). The decision-making process was delayed due to decision inertia. However, when one or more of these barriers was missing, interagency communications increased and discussions were more focused on decisions and actions. Specifically, when issues had clear strategic direction, they were associated with action execution. We argue that the relatively under explored notion of 'decision inertia' and the contexts that provoke it warrant further attention, as it is a salient problem in real-world decision-making. Given the repeated criticism of the emergency services for failures to act rather than for errors of judgment, we suggest that specific attention be directed at this interesting phenomenon of what Anderson (2003) more broadly describes as 'The Psychology of Doing Nothing'.

Limitations

It is difficult to dispute the academic integrity of the NDM movement in extending our understanding of real-world choice, yet there is an inherent methodological problem in deriving conclusions from such uncontrolled, complex, and dynamic contexts. By researching 'natural' environments where the researcher cannot manipulate rigorously defined independent variables, nor quantify objective dependent outcomes, the objectivity of research conclusions is reduced. There is a risk that researchers' interests could bias the interpretation of the data, creating the potential for unreliable or invalid findings (Lipshitz et al., 2001; McAndrew & Gore, 2013), as researchers continually return to and attempt to explain the data, thereby risking post-hoc rationalization and assumed significance. Likewise, it is possible that the ability to immerse oneself in the data, with the freedom for methodological flexibility, is a strength for NDM research that primarily desires pragmatic solutions derived from the data to help practitioners.

It has been suggested that a useful way to improve objectivity may be through the use of simulations, whereby researchers can maintain a level of control over the scenario and data recordings (Alison, van den Heuvel et al., 2013). Yet this may come at the cost of reduced stress and cognitive demand on the decision-maker compared to real life. The behaviour of participants may also be influenced by the simulated environment as, for example, participants focus more on information seeking over action implementation as this is perceived as the main purpose of the communicator. Alternatively, the traditional laboratory-based decision-making environments may improve objectivity of conclusions, but this comes at the cost of artificially clean decision-making environments that assume pure rationality of thought (Thwaites & Williams, 2006). It is noteworthy that research on emergency decision-making is notoriously complex and might involve many variables, such as strategic group-level presentation (Van Leeuwen, 2007), intricate power relations (Nadler & Halabi, 2006), perceived dangerousness of emergencies (Fischer et al., 2011), and a whole spectrum of non-verbal factors, such as the body language and facial expression of decision-makers, and a number of serious ethical considerations would also arise (Binik, Mah, & Kiesler, 1999). Furthermore, we should bear in mind that even the currently available virtual reality systems offer only crude approximations of natural experiences and only half-credible computer-generated responses (Rovira, Swapp, Spanlang, & Slater, 2009). To deal with (but not to completely overcome) this challenge, we adopted a complementary qualitative method that could bring other kinds of subtle insights, which are sometimes out of scope for experimental methods (Bryman, 2007), to light.

Thus, we suggest that rather than judge research according to how ecologically 'valid' or 'objective' it is, it should be judged according to the 'credibility' and 'transferability' of the conclusions drawn from the context-rich environment (Mischler, 1990). Kuhn (1962) highlights how the definition of ‘science’ is a culturally defined phenomenon according to the benchmarks set by the scientists of the day; thus, NDM may reflect a paradigm shift from a top-down experimental focus to a more bottom-up focus on contextualized enquiry. Overall, although we acknowledge that there are methodological concerns for NDM and simulation-based research, we argue that the unique advantage of context and grounded meaning to conclusions is an unparalleled advantage of this research domain.

Three barriers to macrocognition in multiteam systems: Non-time-bounded choice, large team size, and a lack of superordinate direction

We found that when a decision task was non-time-bounded, involved multiple agencies, and lacked clear strategic direction, then interagency action execution failed and decision inertia occurred through the redundant deliberation of intra-agency information. Interestingly, the only two issues where the majority of communications were intra-agency and focused on information seeking were also the only two issues that were characterized by all three decision barriers. It is acknowledged that whilst intra-agency resource monitoring is useful during a major incident response (National Police Improvement Agency, 2009), interagency coordination and information sharing is equally critical, and further that communications on decisions and actions will inevitably be less than those on information seeking; as the latter informs the former. To minimize these effects, we focussed on the six ‘critical issues’ that SMEs identified as requiring interagency communication.

The effectiveness of a multiteam system is dependent upon the sharing of task interdependence across the team network (De Dreu, 2007), and thus, an overt focus on intra-agency information can distract decision-makers from collective goals and behaviours (Comfort, 2007; De Dreu, 2007). By solely communicating agency-specific information, there is the risk of an ‘information starvation’ effect within the multiteam system, where important information is not shared with the wider team, a prevalent problem during emergency response (Netten, Bruinsma, van Someren, & de Hoog, 2006). Although a decentralized approach to multiteam systems may usefully allow experts to focus on their own specialisms (House et al., 2014), if this occurs in the absence of interagency coordination of efforts, then this means that key decisions and actions may be missed or redundantly duplicated (Brannick et al., 1992). Interagency communication is essential to facilitate a shared understanding of the requirements of the dynamic decision environment.

One barrier that we predicted would reduce decisions and actions was a lack of deadlines or specific time demands. Individuals avoid difficult choices when possible (van den Heuvel et al., 2012) and so when critical issues were non-time-bounded, we found that teams failed to communicate interagency decisions and actions. We acknowledge, as with most NDM research, that we cannot conclude a causal relationship between time demands and decision outcomes, but existing literature may help explain it. It is possible that a lack of deadlines induced inaction as teams tried to avoid potential anticipated negative emotions, such as anticipated regret (Anderson, 2003). Individuals may have utilized more selective search strategies when evaluating options because they felt they had the time to do so. Indeed, when decision-makers are placed under time pressure, then they tend to use time-saving processes such as satisficing to reach a choice (Simon, 1956); yet when deadlines are absent, individuals use more selective alternative-based processing to continually deliberate on potential courses of action to find the ‘best’ option (Parker & Schrift, 2011). We suggest that when a critical issue was non-time-bounded, teams redundantly sought further information about the choice from within their own agency, rather than committing to a joint choice with other agencies.

The involvement of more than two agencies also reduced communication on decisions and actions. It is possible that an increase in team size reduced the ‘psychological ownership’ over decision outcomes due to diluted feelings of responsibility and accountability (Kroon et al., 1991; Pierce et al., 2001). Agencies must keep one another informed of their actions in multiteam systems to orchestrate the smooth sequencing of activity (Healey, Hodgkinson, & Teo, 2009), yet when responsibility is diluted, roles and responsibilities are confused (Bearman et al., 2010). Role confusion can permeate both intra- and interagency action to reduce the overall effectiveness of the multiagency team (Quarantelli, 1985). An increase in team size may further decrease the level of trust throughout the team network. Trust is reflected by a willingness of the trustor to take risks based upon advice received from the trustee (Mayer et al., 1995) and within multiteam networks the building of trust is based upon reciprocity (Rusman et al., 2010). When team size was larger, agencies may have focused on information concerning their own team due to poor trust within the wider multiteam network. Fundamentally, any increase in interagency team size means that individuals can ‘hide in the crowd’ and avoid taking responsibility for action (Kroon et al., 1991).

A further barrier associated with reduced interagency action was when there was a lack of clear superordinate direction (LePine et al., 2008). Interestingly, not only was a lack of strategic direction associated with intra-agency information seeking, but when strategic direction was present, this appeared to increase interagency communications on ‘actions’, suggesting a bidirectional relationship. In other words, a lack of strategy reduced action, whilst strategic direction facilitated action. Unclear goals at a strategic level may have reduced cooperation as decision-makers were distracted by their own intra-agency goals (de Bruijn, 2006). Intra- and interagency goals tend to compete (Sonnenwald & Pierce, 2000) and so if strategic goals are unclear, then intra-agency goals are more salient. It was found that when strategic goals were set, discussions became focused on facilitating action, which was judged by the SMEs as necessary. Effective communications are essential for facilitating action in multiteam systems where different backgrounds and cultures must work together towards an effective resolution (Bearman et al., 2010) and so strategic goals must be set with clear meaning and intent (Keyton & Beck, 2010). This is achieved by establishing reciprocal relationships to develop a shared understanding and team cognition (Cooke, Gorman, & Rowe, 2009). Thus, when strategic direction is lacking either completely or due to implicit assumptions, then teamwork failed to be interdependent and goal-focused (Salas, Cook, & Rosen, 2008); yet when strategy is clear, it can facilitate the implementation of action in multiteam networks.

Conclusion and Implications

Our research has both methodological and applied implications. Firstly, we demonstrated how NDM can be used to research failures to make decisions. Whereas traditional laboratory-based decision experiments treat the absence of choice as a null effect, NDM’s emphasis on context and real-world choice allows us to explore the dynamic and interrelating processing associated with decision inertia. In addition, our research provides a worked example of how NDM allows for both practitioners and academics can combine training and research to derive mutually beneficial conclusions. Secondly, we found that the barriers of non-time-bounded choice, large team size, and a failure to set clear strategic direction can inhibit multiteam system decision-making, a finding that requires further investigation. For example, experts can adapt to time pressure efficiently using satisficing strategies (Klein, 2008), and so it would be interesting to explore whether experts are more willing to take action despite the absence of deadlines or whether they will continue to avoid choice if the opportunity arises. It may also be possible to conduct cognitive task analysis (CTA) style interviews in order to unpack how these variables influence the cognitive processing of emergency workers in real life (Crandall et al., 2006) or to compare differences in decision-making styles between 'critical' decisions and those that are less 'high-stake'. As strategic goals facilitated interagency communications of decisions and actions, this highlights the importance of superordinate goals during emergency response command and control, creating clear implications for effective training of practitioners.

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