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Development of a communication intervention to facilitate adherence to initial decontamination procedures during a mass casualty chemical incident

Symons, Charles Alexander

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**Development of a communication intervention to facilitate
adherence to initial decontamination procedures during a mass
casualty chemical incident**

Charles Alexander Symons

Submitted for the degree of Doctor of Philosophy

Department of Psychological Medicine
Institute of Psychiatry, Psychology and Neuroscience
King's College London

Abstract

Chemical contamination, whether from deliberate or accidental release of harmful chemicals, continues to pose a risk to public health. The 2018 Novichok release in Wiltshire, UK highlights the need to protect the UK civilian population from future chemical contamination incidents. Casualties of chemical contamination need to be decontaminated as soon as possible both to prevent or reduce the extent of adverse health outcomes for the casualties themselves and to reduce the risk that other people will be exposed to the chemical.

In the UK, the Initial Operational Response (IOR) protocol was implemented to address the need for fast, early decontamination. It is essentially first aid for chemical contamination. IOR involves casualties evacuating from the area in which the chemical was released, removing contaminated clothing (disrobing), then applying either water or dry, absorbent materials, depending on whether the chemical is known to be caustic.

IOR places a lot of responsibility on casualties. They are required to carry out their own decontamination within a short space of time. IOR also places a lot of responsibility on first responders who, in addition to all other aspects of the decontamination process, need to get casualties to adhere to this protocol. This is challenging for several reasons. First, people do not necessarily know that they are contaminated because not all hazardous chemicals result in immediate symptoms on contact. Second, even if people do know that they are contaminated, findings from this thesis and previous studies indicate that not all aspects of IOR are necessarily intuitive to casualties. Third, first responders are competing for casualties' attention with other, potentially more intuitive courses of action, such as presenting at a hospital, which may result in contamination of hospital staff and patients.

The aim of this PhD was to determine how first responders should communicate with casualties to ensure that casualties adhere to the IOR protocol, particularly when the risk of chemical exposure is ambiguous due to a delayed onset of symptoms.

I based the development of a preliminary communication strategy on: a review of the crisis communication literature; a systematic review of the effect of communication on casualty behaviour in mass casualty emergencies; a qualitative study on how first responders currently communicate with casualties during incidents that require decontamination; and an assessment of lay public perspectives on chemical contamination and decontamination. Findings from these studies indicated that, at a minimum, responders need to provide casualties with: practical instructions for undergoing IOR; contextual information about first responders' expertise in decontamination; and updates about actions responders are taking to treat casualties. I

drafted messages that contained this information but varied according to how the threat of contamination was conveyed and whether the effectiveness of IOR was made clear. Messages were tested in an experiment in which participants observed a chemical release scenario in the form of an immersive virtual reality video. The final communication intervention was based on the outcome of these studies.

The main academic contribution of this PhD was the finding that explicitly addressing the threat facing casualties made study participants more likely to expect themselves to remove contaminated clothing in a real incident, whilst explicitly addressing the efficacy of dry decontamination made participants more likely to expect themselves to perform dry decontamination. This outcome serves as a useful addition to the wider behaviour change literature on the processing of fear-arousing information.

In terms of practical impact, scripts based on the evidence gathered in this thesis will be finalised and disseminated to UK frontline responders and control room operators by the UK Home Office National Resilience Policy Team. The intention for the script is to serve as the basis for evidence-based communication training.

Based on the studies within this thesis, the key finding to include in this training is that people responding to a chemical incident should not shy away from telling the truth. If people need to take action, they first need to know that they are in danger and that decontamination is the means to resolving that danger. This evidence-based principle should support the ongoing cultural shift from control to engagement in the relationship between emergency responders and the community in which they work.

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At the risk of turning this into a public display of affection, I don't imagine for a second that I could have done this without my partner, mentor and best friend Dr Emma Jones.

Abbreviations

Abbreviation	Meaning
aIAT	Autobiographical Implicit Association Test
ANOVA	Analysis of variance
CBRN	Chemical, Biological, Radiological and Nuclear
CI	Confidence Interval
CO ₂	Carbon dioxide
CCTV	Closed-circuit television cameras
EFA	Exploratory factor analysis
EPPM	Extended Parallel Process Model
ERD	Emergency Response Department (Public Health England)
ESIM	Elaborated Social Identity Model
H ₀	Null hypothesis
H _a	Alternative hypothesis
IDEA	The Internalization, Distribution, Explanation, Action Model
IOR	Initial Operational Response
IQR	Interquartile range
ISRCTN	International Standard Randomised Controlled Trials Number
KCL	King's College London
M	Mean
MD	Mass Decontamination
NHS	National Health Service
PADM	Protective Action Decision Model
PHE	Public Health England
PMT	Protection Motivation Theory
PPE	Personal Protective Equipment
RCT	Randomised Controlled Trial
RQ	Research question
SIMCR	Social Identity Model of Collective Resilience
SMCC	Social-Mediated Crisis Communication Model
SME	Subject matter expert
SD	Standard deviation
SPSS	Statistical Package for Social Sciences (IBM)
UK	United Kingdom
ULS	Unweighted least squares
USA	United States of America

Statement of Contribution

I devised the original concept and preliminary project plan for this PhD. This PhD is one of seven work packages in a wider project entitled, “Laboratory Studies, Volunteer Trials, Exercises and Modelling of Emergency Mass Casualty Decontamination (The PHOENIX Project)”, funded by the Department of Health and Social Care Policy Research Programme (reference number: PR-ST-1015-10016). The principal investigator of the PHOENIX project and co-supervisor on this PhD took the lead on writing and submitting the funding application of the PHOENIX project. I wrote the sections of the funding application pertaining to my work package and the Project Approval Form submitted to King’s College London.

I developed the design for all studies reported in this thesis, with input from my supervisors and from members of the following panels attached to the PHOENIX project: public advisory panel, end user panel (consisting of emergency response practitioners), and technical advisory group (consisting of decontamination experts and UK government policy advisors). I wrote and submitted applications for ethical approval for all studies and I wrote and submitted the two protocols for the studies in Chapters 3 and 8, with input from supervisors. I recruited participants for all studies. My co-supervisor contributed to the identification of sources of recruitment for the interview study in Chapter 4. The immersive video used in the study in Chapter 8 was directed by Dependable Productions. I managed the logistics of recording, e.g. recruiting the cast and securing a filming location, and played an auxiliary role in directing on the day. Two of my supervisors and two police officers contributed to production on the day. Post-production of the videos was carried out by Dependable Productions with input from me.

I collected data for all studies and devised the randomisation and allocation concealment procedures for the study in Chapter 8. For this study, each of my supervisors contributed to randomisation and allocation concealment so that I remained blind to condition at the point of intervention and analysis. I carried out data analysis for all studies. For the quantitative studies (Chapters 7 and 8), I consulted with the Biostatistics and Health Informatics Advisory Service and Psychometric and Measurement Lab at King’s College London.

For the systematic review (Chapter 3), I consulted with the Public Health England library service at the Porton centre during the development of the search strategy.

I drafted each of the chapters and, sent them to my supervisors for their comments then revised the chapters based on their feedback.

Chapter 1 Communication during the Initial Operational Response (IOR) to mass casualty chemical incidents: Introduction

1.1 Introduction

Large-scale Chemical, Biological, Radiological and Nuclear (CBRN) attacks are identified in the UK's 2017 National Risk Register as a medium-low probability, but high impact risk to the UK civilian population (Cabinet Office, 2017, p. 10). Chemical incidents, defined as events involving exposure to chemicals with potentially adverse health effects (Clarke et al., 2008), pose a threat to public health that necessitates the development of effective countermeasures, in accordance with the *Prepare* strand of the UK government's counter-terrorism strategy (Home Office, 2011). A critical early intervention in the response to chemical incidents is decontamination; the process of removing hazardous substances from a contaminated person to reduce or prevent adverse health outcomes. The Initial Operational Response (IOR) programme, introduced in the UK in 2013, equips non-specialist first responders such as Police, Fire and Ambulance Services with protocols for pre-hospital decontamination. These steps are a precursor to specialist decontamination with purpose-built showering facilities and consist of ambulant casualties evacuating from the chemical release location (or 'hot zone'), removing outer clothing, and self-decontaminating with either absorbent materials such as blue roll or dressings, or with available clean water if the chemical is known to be caustic. Communication of instructions and advice from emergency responders to casualties is integral to the successful execution of these tasks in a mass casualty context.

Decontamination, particularly IOR, poses a challenge for affected casualties due to the active role they must take in these emergency response operations. IOR guidance stipulates that preliminary decontamination actions are to be carried out by the casualty, away from the source of contamination in an area nearby the hot zone, that is referred to as the 'warm zone' due to the presence of potentially contaminated casualties (National CBRN Centre, 2016). Given the unfamiliar nature of the actions required of casualties who do not necessarily know why the prescribed behaviours are necessary, an effective communication intervention is required to improve the efficiency with which casualties adhere to first responders' instructions. If casualties are unwilling or unable to engage in protective behaviours within a narrow timescale, even the most thoroughly researched and optimised decontamination protocol will be rendered ineffective from the outset. There is a tendency among authors of decontamination guidance documents to conceive of humans in crowds as inherently prone to panic by virtue of being in a crowd (Drury, Novelli, & Stott, 2013) or to

characterise non-compliance as a baseline position among a proportion of crowd members (Carter & Amlôt, 2016) with the implication that responders should “focus initial attention on compliant individuals” (Chilcott, Lerner, & Matar, 2019, p. 120). Such conceptions overlook the effect of incident management on compliance and the interplay between the behaviour of authorities at the scene and casualty behaviour. Findings from mass decontamination exercises indicate that if communication from first responders is perceived as poor, people are likely to be less willing to comply with decontamination instructions (Carter, Drury, Rubin, Williams, & Amlôt, 2012b, 2013). Communication in this thesis is defined, in accordance with previous conceptualisations (Bradley, McFarland, & Clarke, 2014), as the dissemination of information from authorities, in this case first responders at the scene of a chemical incident, to the affected population, in this case casualties who have been or are suspected by authorities to have been contaminated with hazardous chemicals.

Knowledge gaps pertaining to communication during an emergency and its effect on behaviour have been discussed in the literature. For example, previous systematic reviews and recent studies have concluded with recommendations for more: high-quality experimental assessments into what makes communication effective in the disaster response and recovery phase (Bradley et al., 2014); research on specific message components to improve the persuasiveness of medical countermeasure messages (Liu, Quinn, Egnoto, Freimuth, & Boonchaisri, 2017); and empirical studies that evaluate the effect of communication on behaviour during CBRN incidents (Rubin, Chowdhury, & Amlôt, 2012). Further investigation into the effectiveness of communication with casualties at the scene of decontamination has also been identified as a priority research need by experts from the Global Health Security Initiative’s Chemical and Radiological/Nuclear Working Groups (Cibulsky et al., 2015). This investigation has begun. Findings from recent research on decontamination in purpose-built showering facilities indicate that trust in first responders can be improved through communication consisting of: detailed practical instructions; health-focused information as to why decontamination is necessary; and regular updates about actions that responders are taking (e.g. Carter, Drury, Amlôt, Rubin, & Williams, 2014; Carter, Drury, Amlôt, Rubin, & Williams, 2015; Carter et al., 2013; Carter, Drury, Rubin, Williams, & Amlôt, 2015). This is important because trust in communicators is associated with message acceptance in the wider literature on risk communication in general (Glik, 2007a) and communication about CBRN risks in particular (Rubin et al., 2012). Findings also indicated that a lack of detailed instructions increased observed confusion and non-compliance with instructions among casualties in a mass decontamination field trial (Carter, Drury, Amlôt, et al., 2014).

Despite these initial findings, however, other questions remain unanswered. If health-focused information about why decontamination is necessary needs to be conveyed to casualties, then further investigation is required to determine the optimal content and presentation of this information. There is a need for research to identify how first responders should deliver potentially life-saving information so that it is understood, accepted, and acted on. For example, a review of guidance documents on mass casualty decontamination revealed variation in the level of detail provided about how to communicate with casualties (Carter & Amlôt, 2016). My interactions with members of emergency planning and response organisations at stakeholder workshops have indicated a need for more detailed guidance on the wording of information. The need for further research into the most effective communication channel to disseminate information to casualties during a chemical incident has also been identified as a priority (Carter & Amlôt, 2016). The aim of this PhD is to determine how first responders should deliver information to improve adherence to decontamination protocols by casualties in a chemical incident.

1.2 Overview of mass casualty chemical incidents

Despite international efforts to reduce the availability of Chemical Warfare Agents (CWA) (Chemical Weapons Convention, 1993), chemical weapons continue to be used in attacks on civilian populations. Recent high-profile cases include the sarin attacks in Syria in 2013 and 2017 (Arik Eisenkraft, Kassirer, & Kreiss, 2014; Blake & Mahmud, 2013; Zarocostas, 2017) and nerve agent releases in Wiltshire in 2018, after which official advice to wash clothes and clean personal effects was issued to potentially affected members of the public (Public Health England, 2018). Previous high-profile cases include: mustard gas attacks on civilians during the Iraq-Iran War (1980-1988) (Davis & Aspera, 2001; Ghasemi et al., 2008; Momeni & Aminjavaheri, 1994; Momeni, Enshaeih, Meghdadi, & Amindjavaheri, 1992); sarin attacks committed by the religious cult Aum Shinrikyo in Matsumoto City in 1994 and the Tokyo subway system in 1995 (Figure 1-1) that resulted in 12 recorded deaths (Levitin et al., 2003; Miyaki et al., 2005; Nakajima, Sato, Morita, & Yanagisawa, 1997; Nishiwaki et al., 2001; Okumura et al., 2005; Okumura et al., 1996; Yanagisawa, Morita, & Nakajima, 2006; Yanagisawa et al., 1995) and approximately 6,252 injuries (UPI, 2010); and VX attacks carried out in Osaka in 1994 (Tsuchihashi, Katagi, Nishikawa, & Tatsuno, 1998) and North Korea in 2017 (Hayes, 2017, p. 13). North Korea reportedly has a sizeable arsenal of the nerve agent, VX and Daesh reportedly have access to toxic industrial chemicals (TICs) and mustard gas (Gordon, 2018). Meanwhile it is not only terrorists and state actors who have access to chemical weapons. In London, there were 454 recorded grievous bodily harm offences involving corrosive substances (so-called “acid attacks”) in 2016 alone

(Metropolitan Police, 2017). Corrosive substance attacks involving multiple casualties were perpetrated in London In April and July of 2017 (BBC News, 2017a, 2017b).

In addition to deliberately orchestrated chemical incidents, civilian populations may also be exposed to Toxic Industrial Chemicals (TICs), such as chlorine and hydrogen sulphide, following accidental releases (Taxell et al., 2013). Such incidents include: the release of Methylisocyanate at a plant in Bhopal, India in 1984, which resulted in a reported death toll of over 3000 (Broughton, 2005; Chilcott, 2014; Dhara, 1992; Tomassoni, French, & Walter, 2015); chlorine gas release following a train derailment in South Carolina in 2005 that resulted in nine fatalities, eight of which occurred prior to hospitalisation (Gaskin et al., 2017; Van Sickle et al., 2009); and the 1976 Seveso chemical plant incident in Italy, which caused the evacuation of over 600 people and treatment of up to 2000 casualties (Cabinet Office, 2017; Pocchiari, Silano, & Zampieri, 1979).

[Permission to reuse figure not granted]

Figure 1-1 Casualties of the sarin attack on the Tokyo subway in March 1995.

1.3 Effects of hazardous chemicals

Hazardous chemical substances include: nerve agents, such as sarin and VX; pulmonary agents; cyanide; and blister agents, such as sulphur mustard and lewisite. Casualties can be exposed to hazardous chemicals in solid (e.g. powder), liquid, vapour and gas form (Geissmann, 2004; Levitin et al., 2003; Maynard, 2007b). Clinical effects of chemical incidents vary according to the chemical's properties and environmental factors, such as temperature, wind speed, and precipitation (Garcia, Rand, & Rinard, 2011; Gaskin et al., 2017; Vale, Marrs, & Rice, 2016). General symptoms of hazardous chemical exposure include: eye, nose and throat irritation; vomiting; dizziness; muscle weakness; headache; coughing; and shortness of breath (Chilcott, 2014; Kales & Christiani, 2004; Tomassoni et al., 2015). Hazardous chemical exposure can also result in long-term detrimental psychological and quality-of-life outcomes (Dworkin et al., 2008; E. Jones, Everitt, Ironside, Palmer, & Wessely, 2008; Razavi et al., 2014).

Whilst inhalation of chemical agents in gas or vapour form pose a considerable hazard (Gaskin et al., 2017), the majority of chemical agents outlined in Schedule 1 of the Chemical Weapons Convention are chemicals that affect casualties via the skin (Chilcott, 2007b). Chemical agents have toxic effects if they diffuse through the stratum corneum, a membrane at the uppermost layers of the epidermis (Chan, Zhai, Hui, & Maibach, 2013; Chilcott, 2007b; Phuong & Maibach, 2016; S. C. Wilkinson, 2008). Chemicals that affect casualties via penetration through the skin include nerve agents, which are particularly toxic to humans when absorbed via the skin (Vale et al., 2016) and blister agents, such as sulphur mustard. Sulphur mustard is one of the chemical agents of greatest concern due to the high number of casualties resulting from exposure to it throughout its use over the last century (Kales & Christiani, 2004; Wattana & Bey, 2009). Sulphur mustard (often referred to as "mustard gas") can affect the skin when it is in liquid or vapour form (Maynard, 2007a) and can result in death, conjunctivitis, pneumonia, bone marrow effects, gastrointestinal effects and renal effects, and painful skin burns that are susceptible to infection (Borak & Sidell, 1992; Davis & Aspera, 2001; Ghabili, Agutter, Ghanei, Ansarin, & Shoja, 2010; Wattana & Bey, 2009).

Casualties do not necessarily display symptoms at the scene of the incident. Latency, the interval between exposure to the agent and the onset of symptoms, is dependent on properties of the chemical agent, environmental variables, and route of exposure (Chilcott, 2014). Some chemical substances, such as nerve agents in vapour form and the blister agent phosgene oxime can cause immediate, painful and debilitating symptoms on exposure (Garcia et al., 2011; Tomassoni et al., 2015). However, other

chemical substances have a latency period that stretches over hours and days (Geissmann, 2004). For example, onset of symptoms following exposure to the nerve agent VX may occur up to 18 hours from exposure to the agent in liquid form (Clarke et al., 2008). Following exposure to sulphur mustard in liquid form, the latency period ranges from 30 minutes to 12 hours (Borak & Sidell, 1992; Clarke et al., 2008; Kales & Christiani, 2004; Spiandore et al., 2017; Wattana & Bey, 2009), the most frequently cited range being 4 to 12 hours (Borak & Sidell, 1992; Clarke et al., 2008; Kales & Christiani, 2004). During this latency period, casualties may be unaware that they are contaminated (Clarke et al., 2008; Kales & Christiani, 2004; Wattana & Bey, 2009) but if the chemical is not removed quickly, penetration of sulphur mustard through the skin can lead to irreversible cell and tissue damage within minutes of exposure (Borak & Sidell, 1992; Davis & Aspera, 2001; Garcia et al., 2011; Kales & Christiani, 2004). Lack of awareness of hazardous chemical exposure due to a long latency period could potentially prevent a casualty from immediately recognising the need to undergo decontamination even though unmitigated penetration of the agent may have detrimental health effects within minutes.

In addition to the effects on the casualty, chemical agents may result in clinical effects in people who come into contact with vapours released from contaminant remaining in the clothing, skin and hair of casualties who have not been decontaminated; a process termed, "secondary contamination" (Chilcott, 2007a; Clarke et al., 2008; Eckstein, 1999; Gaskin et al., 2017; Horton, Berkowitz, & Kaye, 2003; Nakajima et al., 1997; Nishiwaki et al., 2001; Okumura et al., 2005; Spiandore et al., 2017; Vale et al., 2016). In a chemical incident, the majority of contaminated casualties are likely to be able to walk and therefore self-present at a hospital (Kales & Christiani, 2004), which can lead to secondary contamination of other people, including healthcare staff. Chemicals in liquid form are more conducive than gaseous chemicals to secondary contamination because they are more likely to remain on the casualty (Clarke et al., 2008). The extent of vapour release from clothing is also dependent on the type of clothing worn by the casualty, with down outerwear leading to a longer duration of vapour release than jeans, as indicated by a study using the simulant chemical warfare agent, methyl salicylate (Feldman, 2010).

Medical staff have succumbed to secondary contamination following chemical poisoning and chemical suicides with hydrogen sulphide and phosphine (Gaskin et al., 2017). Between 1995 and 2001, there were six events in which United States Emergency Department staff experienced secondary exposure (Horton et al., 2003). Secondary contamination of rescue workers and staff at hospital facilities occurred following the Matsumoto and Tokyo sarin attacks (Clarke et al., 2008; Eckstein, 1999;

Nakajima et al., 1997; Nishiwaki et al., 2001; Okumura et al., 2005). In the absence of personal protective equipment (PPE) to provide protection from vapours released from casualties, rescue workers who responded within 270 minutes of the 1994 Matsumoto sarin attack experienced similar symptoms to the casualties (Nakajima et al., 1997). Following the 1995 Tokyo sarin attack, 23% of hospital staff at one of the receiving hospitals were subjected to secondary contamination due to a lack of PPE and on-site decontamination facilities (Okumura et al., 2005). Rescue workers who responded to the sarin attack were found to have chronic memory function impairment three years and nine months following secondary exposure to the contaminant (Nishiwaki et al., 2001). Such cases highlight the importance of containment of casualties prior to the arrival of decontamination facilities to protect emergency response staff, hospital staff, and other members of the public who lack the necessary PPE to mitigate against the risk of secondary contamination.

1.4 Decontamination

Decontamination is the process of removing or neutralising hazardous materials on external surfaces in order to reduce the risk of inhalation, reduce or limit skin absorption, and to protect others from secondary contamination (Chilcott, 2014; Cibulsky et al., 2015; Clarke et al., 2008; Levitin et al., 2003; Spiandore et al., 2017; US Department of Health and Human Services, 2014). Guidance documents on decontamination, published by Government departments and emergency response agencies in the UK and US, converge on the principle that following evacuation from the source of chemical release, the optimum method of decontamination is the removal of contaminated clothing (disrobing) and showering in a high volume of water (Biomedical Advanced Research and Development Authority, 2015; Home Office, 2013; Lake, Schulze, & Gougelet, 2013; National Ambulance Resilience Unit, 2014; US Army Chemical Biological Radiological and Nuclear School, 2011). Secondary contamination of healthcare staff can be reduced by deploying showering facilities to the scene of the incident (Kenar & Karayilanoglu, 2004), in an area referred to as the “warm zone”. A shower can be conducted in the warm zone in purpose-built mobile decontamination structures (Figure 1-2) and/or via the arrangement of fire appliances to produce a corridor with fire hoses positioned either side (the “ladder pipe” system). The latter is regarded as an interim step in the decontamination process, whereas the former is considered to be a more thorough form of decontamination (Biomedical Advanced Research and Development Authority, 2015).

Whilst the effectiveness of specialist decontamination showering facilities has been subjected to extensive testing in controlled studies (Amlôt et al., 2010; Hood, Fernandes-Flack, & Larrañaga, 2011; Leary et al., 2014), there may be a long delay to

the arrival of such resources (Amlôt, Carter, Riddle, Lerner, & Chilcott, 2017; Chilcott, 2014; Gaskin et al., 2017; Leary et al., 2014; Monteith & Pearce, 2015). For example, in a survey of European Union emergency response organisation staff, 20-30% of respondents indicated an estimated deployment time in excess of 10 hours (Chilcott, 2014; Gaskin et al., 2017). There may even be a delay in the arrival of resources for interim decontamination. In a recent survey of US Fire Department staff, the mean estimated dispatch time of a ladder pipe system was approximately 8 minutes during peak traffic with an additional mean time of approximately 5 minutes between arrival of fire tenders and establishment of a decontamination corridor (Power et al., 2016), notwithstanding time between detection of the hazardous chemical release and notification of emergency services. Any delay to the arrival of decontamination facilities is problematic given that time is critical to the effectiveness of decontamination showering (Borak & Sidell, 1992; Chan et al., 2013; Chilcott, 2014; Hewitt, Hotchkiss, & Caldwell, 1995; Hui, Domoradzki, & Maibach, 2012; Kales & Christiani, 2004; Leary et al., 2014; Levitin et al., 2003; Wester, Hui, Landry, & Maibach, 1999). The ideal decontamination protocol is one which can be implemented immediately following detection of hazardous chemical contamination.



Figure 1-2 Casualty actors (wearing orange capes) disrobing out of 'contaminated' clothing in a simulated chemical incident exercise; Fire Service Responders (wearing green protective suits) guide casualty actors through a structured mass decontamination shower in the tent structure (MD 1-3 structure) pictured in yellow (image reproduced with permission from Public Health England).

1.5 Initial Operational Response

In the UK, the need for efficient decontamination that can be achieved prior to the arrival of specialist decontamination resources and personnel has been addressed with the implementation of the Initial Operational Response (IOR) programme by Police, Ambulance, and Fire & Rescue Services. The IOR programme has been developed for use by first responders who do not necessarily have specialist training in CBRN or hazardous materials (HazMat) incident response (Home Office, 2015). IOR can be thought of as 'first aid for chemical incidents'. Its first steps consist of evacuation and disrobing. Following this, if the chemical is non-caustic, absorbent materials, such as paper towels, should be applied to skin (improvised dry decontamination). If the chemical is caustic, water from any available clean water source should be applied to skin (improvised wet decontamination). The process used to decide the choice of improvised decontamination method is illustrated in the flow chart in Figure 1-3.

The efficacy of evacuation as a preliminary form of decontamination is clear. Removing the casualty from the source of contamination lessens the contact between person and contaminant. Casualties should ideally evacuate upwind from the source of contamination (Kales & Christiani, 2004). Disrobing then removes a substantial proportion of the amount of contaminant remaining on the casualty following evacuation from the hot zone, and is an integral part of the decontamination process (Butler, 2014; Chilcott, 2014; Clarke et al., 2008; Kales & Christiani, 2004; Lake et al., 2013; Levitin et al., 2003; US Army Chemical Biological Radiological and Nuclear School, 2011; US Department of Health and Human Services, 2014). The effectiveness of removing contaminated clothing on reducing skin absorption of chemical agents decreases over time (Matar, Price, & Chilcott, 2010b), so disrobing should be carried out as soon as possible following evacuation. The optimum timescale for completion of evacuation and disrobing is within 15 minutes of exposure (Biomedical Advanced Research and Development Authority, 2015; Home Office, 2013, 2015; National Ambulance Resilience Unit, 2014; National CBRN Centre, 2016). The safest procedure for removing clothing is to cut the clothing off rather than lift clothing over the head. However, if cutting the clothing is not possible and the clothing can only be lifted over the head, casualties should be instructed to keep their mouth closed whilst lifting the clothing in such a way that it is kept away from their face in order to protect their mucous membranes (Figure 1-4) (Biomedical Advanced Research and Development Authority, 2015; Lake et al., 2013). For exposure to chemical agents in gas or vapour form, evacuation and disrobing are regarded as sufficient self-decontamination measures (Cibulsky et al., 2015; Levitin et al., 2003; US Department of Health and Human Services, 2014). When the agent is in liquid form, dry decontamination (Figure

1-5) is the default option for removing non-caustic agents from the skin once contaminated clothing has been removed. Studies have indicated that exposure to simulants of liquid chemical agents is reduced following the application of incontinence pads or blue roll, particularly when a blotting-followed-by-rubbing application method is used (Amlôt et al., 2017; Kassouf, Syed, Larner, Amlôt, & Chilcott, 2017).

As stated at the beginning of this chapter, the success of IOR decontamination as a countermeasure is contingent on casualties knowing, accepting, and engaging in the required behaviours. IOR decontamination can be conceptualised as a series of adaptive behaviours performed by the casualty, with communication from first responders serving as the external stimulus for action. Adaptive behaviours include: evacuation from the hot zone; disrobing in a safe manner as quickly as possible; application of absorbent materials to unprotected skin and hair; and remaining in the warm zone until specialist decontamination resources arrive (self-containment). These behaviours are adaptive in that they reduce the threat posed to the casualty by hazardous chemical materials and the wider threat of secondary contamination. In contrast, maladaptive actions may include: ignoring or resisting responders' instructions; self-evacuating from the treatment area without undergoing any form of decontamination; or presenting at a hospital and risking secondary contamination of hospital staff. The risk that maladaptive behaviours may occur is not merely hypothetical. For example, during a 'false positive' CBRN incident at the B'nai B'rith Headquarters, Washington D.C., casualties refused to disrobe when instructed (Vogt & Sorensen, 2002). Casualties self-presented at hospitals without undergoing pre-hospital decontamination during the Tokyo subway sarin attack of 1995, resulting in contamination of hospital staff (Okumura et al., 2005). Even if casualties are willing to engage in adaptive behaviours, the processes required to complete IOR actions are not necessarily intuitive to all casualties. The instruction, "remove your outer clothing", would not automatically prompt the casualty to adopt the safe disrobing procedure outlined in the *decontamination* section in this chapter. First responders therefore need to encourage casualties to undertake *specific* rather than general adaptive behaviours – all within a 15-minute timescale.

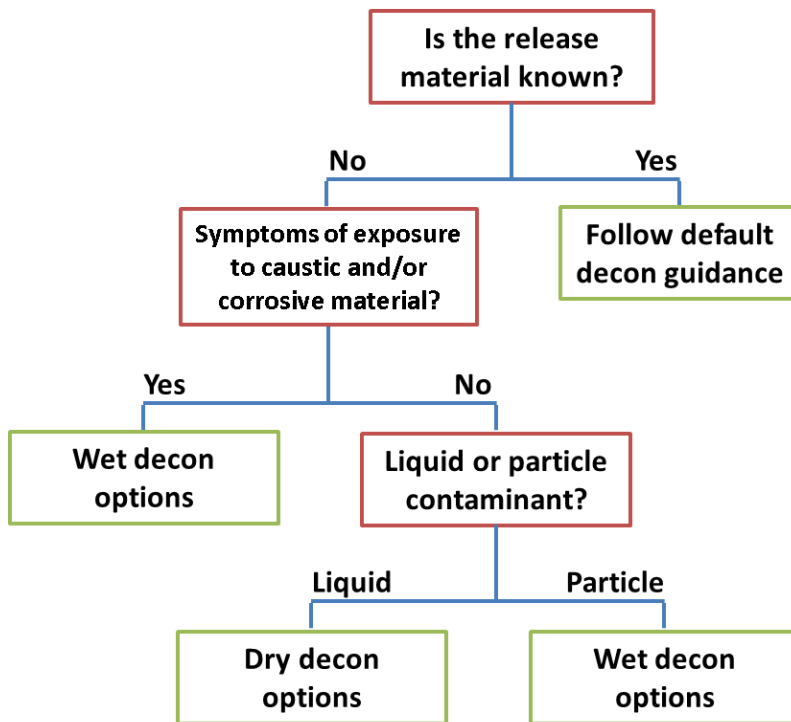


Figure 1-3 Flow chart to guide decision as to whether to implement dry or wet decontamination during IOR (Amlôt et al., 2017, S1, p. 2).

[Permission to reuse figure not granted]

Figure 1-4 Safe disrobing procedure, Figure 7-4 from Lake et al. (2013).

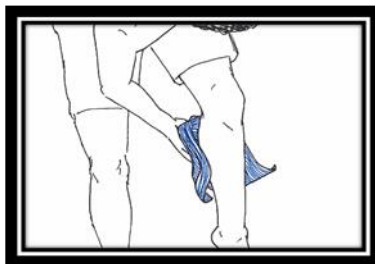
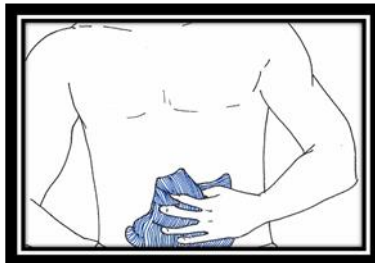
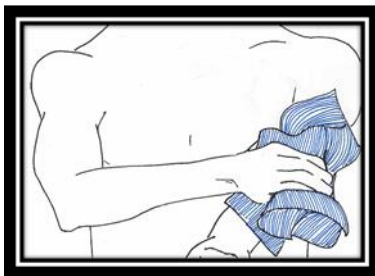
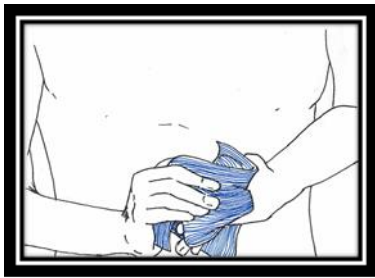


Figure 1-5 Dry decontamination procedure as illustrated in draft improvised dry decontamination guidance and instructions provided by Amlôt et al. (2017, S1, p. 3).

1.6 Aims and objectives

The aim of this PhD is to develop a communication strategy as an instrument to facilitate adaptive behaviour change within a narrow timescale to reduce skin absorption of hazardous substances in the acute phase of a chemical incident. The type of chemical incident for which the communication intervention developed during this PhD is primarily tailored towards is one in which the risk of contamination is ambiguous, with minimal signs and symptoms, but contamination is suspected to be likely by responding authorities. Such a scenario could occur, for example, following contamination by a chemical agent with a long latency, such as sulphur mustard in liquid form, as explained earlier.

Although there is a need to address the communication needs of a heterogeneous population that includes at-risk or vulnerable groups, such as children, older adults, people with physical or cognitive impairments and people who do not understand the language of the communicator (Edkins, Carter, Riddle, Harrison, & Amlôt, 2010), the initial development of a communication intervention may be easier with a relatively homogenous group. To test the initial principles developed over the course of this PhD, the target population for this investigation will be ambulant adults with no medical conditions that would render them unable to comprehend a communication intervention and who speak fluently the language of the communicator.

The primary end user group for the recommendations arising from the outcomes of this PhD is first responders tasked with carrying out decontamination during incidents involving potentially hazardous contamination of large numbers of casualties.

Chapter 2 Principles of effective communication in the acute response phase of an emergency: A literature review

2.1 Introduction

In the previous chapter, I explained why casualty behaviour is integral to the successful outcome of IOR decontamination and why an effective behaviour change intervention is required to promote IOR adherence. The development and testing of this intervention is the overall aim of my PhD. The UK Medical Research Council recommends basing the development of a behaviour change intervention on a theoretical framework prior to testing and implementing (Craig et al., 2008; Michie, West, Campbell, Brown, & Gainforth, 2014). In this chapter, I will synthesise relevant theories, models and findings from research in the ergonomics, health, social and cognitive psychology literatures to identify communication parameters that should be theoretically effective at promoting IOR adherence during a chemical incident.

The intervention of interest in this review is communication during the response phase of an emergency or crisis and the outcome of interest is observed or self-reported behaviour, particularly adherence to emergency directives. Using Grant and Booth's typology of reviews (2009), this chapter would be classified as a literature review rather than systematic review. Systematic reviews on the effect of crisis communication are already available (Bradley et al., 2014; Brandeau, Zaric, Freiesleben, Edwards, & Bravata, 2008; Glik, 2007a; World Health Organization, 2017). In terms of the methodology employed in this review, many of the studies on which it was based were obtained during the full text screening process for the systematic review reported in the following chapter (Appendix B), following the electronic database search reported in the systematic review (Chapter 3) and additional forwards and backwards citations searches that were carried out but not recorded in a systematic, comprehensive manner. My narrative synthesis approach was guided by an *a priori* framework based on the key components of crisis communication outlined below, rather than a systematic approach based on findings of included studies. This review also encompasses previous reviews in addition to original studies.

Crisis communication is the reactive process of transmitting information from authorities to the public during a situation in which public health and/or safety is threatened in order to motivate the uptake of protective actions to prevent or reduce the extent of adverse events (Barry, Sixsmith, & Infanti, 2013; Bradley et al., 2014; Glik, 2007a; Lindell & Perry, 2012; M. B. Rogers & Pearce, 2016). Whereas risk communication concerns the exchange of information about health risks over longer

timeframes, crisis communication occurs in a time-critical context when knowledge about the risks may be incomplete, when public outrage and/or anxiety are likely to be high, and when communicators need to motivate the public to take specific actions to prevent the situation from worsening (T. W. Cole & Fellows, 2008; Liu et al., 2017; Sandman, 2003; T. L. Sellnow & Sellnow, 2010).

Insufficient or ineffective crisis communication can have adverse consequences. Surveys and interview studies indicate that delayed evacuation during Hurricane Katrina was partially associated with inadequate communication, characterised as information sources not being deemed credible by the message audience; lack of information; lack of clarity regarding how to evacuate; and ambiguity regarding the necessity of taking action (Brodie, Weltzien, Altman, Blendon, & Benson, 2006; T. W. Cole & Fellows, 2008; Eisenman, Cordasco, Asch, Golden, & Glik, 2007; Glik, 2007b). In decontamination exercises, communication perceived as poor, for example due to lack of information, was perceived by role-playing “casualties” to be conducive to non-compliance and self-evacuation from the treatment area in a real incident (Carter, Drury, Rubin, Williams, & Amlôt, 2012a; Currie & Heslop, 2018). The large number of injuries resulting from the 2002 anhydrous ammonia release in Minot, North Dakota was partially attributed to the lack of information provided (Veil, 2007). If insufficient crisis communication is associated with adverse behavioural outcomes, further investigation is required into what features within crisis communication are required to elicit target, adaptive behaviour.

The utility of openly and honestly engaging with affected populations as a means of promoting mass uptake of adaptive behaviours during an emergency, crisis or disaster (terms used interchangeably henceforth) is predicted by the Social Identity Model of Collective Resilience (SIMCR) (Tajfel, Turner, Austin, & Worchel, 1979; Turner, Hogg, Oakes, Reicher, & Wetherell, 1987) and Elaborated Social Identity Model (ESIM) (Drury & Reicher, 1999, 2000). SIMCR suggests that people have both personal and social identities, and that social identities are based on group memberships. When people share a social identity, this affects the way they interact with members of their own social group (ingroup members) and members of other social groups (outgroup members). Ingroup members share norms and values based on their group identity and these norms determine the perceived acceptability of behaviours. In the ESIM, identification with other ingroup members, adherence to ingroup norms and the resulting adoption of behaviours is itself a product of the behaviour of a perceived “outgroup”, for example emergency responders. When the actions of the outgroup members are perceived by the ingroup members to be illegitimate, opposition and resistance to the outgroup, characterised as crowd conflict, is deemed normative and

acceptable by members of this psychological crowd (Drury & Reicher, 1999, 2000; Stott et al., 2018; Zeitz, Tan, Grief, Couns, & Zeitz, 2009). Conversely, when outgroup members are perceived to be behaving legitimately, for example when authorities are perceived to be transparent and honest, co-operative behaviour is deemed normative and acceptable by members of the psychological crowd. Open and honest engagement with affected populations is likely to be associated with the adaptive behavioural outcome of mass compliance with emergency services, based on the predictions of these social psychology theories and models of crowd behaviour. In this chapter, I will discuss the relevant research, from a range of psychology domains, that informs the most effective components of open, honest communication at promoting adherence.

The crisis communication literature broadly indicates that the effect of communication on compliance with directives is based on an interaction of: information source, e.g. government spokesperson or news broadcaster; information channel, e.g. television; message content, e.g. types of message; and audience factors, e.g. sociodemographic characteristics and risk perceptions among message recipients (Glik, 2007a; McGuire, 1981; McGuire, Rice, & Atkin, 2001). In the sections that follow, I will draw on theories and research that address the optimum source, channel, and content of communication and which audience factors moderate the effect of crisis communication on behaviour. These questions need to be addressed when developing a research agenda and communication intervention for use by first responders at the scene of a chemical incident in which casualties need to undergo IOR.

2.2 Message content

2.2.1. Types of information

The recommendation to provide specific guidance on actions message recipients should take to protect their health and/or safety is well supported by studies on communication in several types of emergency (Amlôt et al., 2017; Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015; Glik, 2007a; Mileti & Sorensen, 1990; D. D. Sellnow, Lane, Sellnow, & Littlefield, 2017; Sutton, Vos, Wood, & Turner, 2018; World Health Organization, 2017), including hypothetical or simulated chemical incidents (Amlôt et al., 2017; Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015). Studies on behaviour of role-playing bystanders during simulated vehicle accidents in virtual environments indicated that providing message recipients with a specific course of action reduced the likelihood of them moving the body of a virtual casualty – an action that would have adversely affected the casualty's health in a real incident (Bakker, Kerstholt, & Giebels, 2018; Stubbe, van Emmerik, & Kerstholt, 2017). But people do not automatically follow instructions in a warning message unless there is a justification for following instructions and the justification is understood (Sorensen,

2000). There are two recommended types of information pertaining to justification for action, predicted by well-supported theories and models of behaviour that are outlined below. These information categories are, broadly speaking, *Threat* and *Efficacy*. The rationale for this assertion is outlined in the remainder of this subsection.

In the context of non-emergency hygiene behaviour, which is separate from emergency behaviour but proximal to the subject area of decontamination, behaviour change interventions that consist of simply providing health education about handwashing had limited impact on handwashing behaviour (Biran et al., 2014; Biran et al., 2009; Curtis et al., 2011; Naikoba & Hayward, 2001). There is greater empirical support, based on a cluster RCT (Biran et al., 2014) and a review of studies from 11 countries (Curtis, Danquah, & Aunger, 2009), for the use of emotional drivers, such as appeals to disgust, in promoting handwashing with soap than there is for the use of knowledge promotion. In the context of an emergency, fear is likely to be a more accessible emotion than disgust. Stress and anxiety are frequently cited emotional responses to crisis situations (Covello, Peters, Wojtecki, & Hyde, 2001; Firestone & Everly, 2013; Glik, 2007a). In controlled intervention trials, physiological stress measured with salivary cortisol was elevated both immediately and 20 minutes after a simulated fire emergency (Robinson, Leach, Owen-Lynch, & Sünram-Lea, 2013) and 25 minutes after evacuation from a helicopter submerged underwater (Robinson, Sünram-Lea, Leach, & Owen-Lynch, 2008). Chemical incidents in particular are likely to provoke anxiety and stress, for example because of the direct effect that chemical agents can have on behaviour and cognition; participants exposed to nerve agents in human volunteer trials displayed increased anxiety, depressed mood and diminished performance in cognitive and psychomotor tasks (DiGiovanni, 2003; DiGiovanni Jr, 1999). Anxiety, stress, fear and confusion may also result from the psychological threat attributed to the rarity and unfamiliarity of CBRN materials (Krieger, Amlôt, & Rogers, 2014; Sheppard, Rubin, Wardman, & Wessely, 2006; Sullivan & Bongar, 2007).

Laboratory induced acute stress has been shown to have a detrimental effect on performance in working memory tasks (Jiang & Rau, 2017; Olver, Pinney, Maruff, & Norman, 2015) and in working memory related activity in the dorsolateral prefrontal cortex (Qin, Hermans, van Marle, Luo, & Fernández, 2009). Controlled intervention studies on cognitive performance indicated impairment in measures of executive function (Porter & Leach, 2010) and visual declarative and working memory (Robinson et al., 2013) in simulated emergencies. But there is also empirical support for the enhancing effect of acute physiological stress on working memory (Duncko, Johnson, Merikangas, & Grillon, 2009; Yuen et al., 2009; Yuen et al., 2011). A degree of stress can be adaptive but excessive stress can be maladaptive, a concept made explicit in

the Yerkes–Dodson law, whereby task performance improves with a certain level of arousal then decreases past this point in an inverted U-shape (Cohen, 2011). Restriction of information about the emergency is an approach that has been used by emergency response agencies to reduce or prevent expected public panic, as cited in a proportion of UK emergency planning guidance documents published between 1999 and 2011 (Drury et al., 2013). This approach is misguided for three reasons. Firstly, information deficiency itself can provoke anxiety in an emergency (Carter et al., 2012b; Sheppard et al., 2006). Secondly, reassuring information perceived as false or unsubstantiated can have a negative impact on trust in message sources (Maxwell, 2003; Rubin et al., 2012; Wiedemann & Schütz, 2005). Thirdly and most importantly, fear is not necessarily an impediment to adaptive behaviour in an emergency, in fact, fear is widely recognised in the literature as a key determinant of engagement in information about health threats (Peters, Ruiter, & Kok, 2013; Sutton, Vos, et al., 2018; Witte, 1992, 1994).

Behaviour change theories centred on the processing of fear appeals (messages designed to induce fear in the message recipient to elicit targeted behaviour change) have been subjected to empirical assessment for over 50 years (Maloney, Lapinski, & Witte, 2011; Ruiter, Kessels, Peters, & Kok, 2014; Witte & Allen, 2000). Several theories and models have developed to explain the effectiveness of fear appeals at eliciting target behaviour change, including Protection Motivation Theory (PMT; Figure 2-1) (R. W. Rogers, 1975, 1983), which is the most frequently used approach for assessing fear appeal effectiveness (Ruiter et al., 2014), and the Extended Parallel Process Model (EPPM; Figure 2-2) (Witte, 1992, 1994). I will first outline these theories and then the empirical support for including threat and efficacy information in crisis communication messages based on these theoretical approaches.

In PMT, motivation to adopt behaviours that are adaptive to health protection or to cease behaviours that are maladaptive is determined by the cognitive processes of threat and coping appraisal. During threat appraisal, maladaptive response probability is mediated by the perceived benefits associated with the maladaptive behaviour. Adaptive response is mediated by perceptions of the *severity* of the threat and the *susceptibility* of the message recipient to the threat or likelihood of being affected by the threat. During coping appraisal, maladaptive response is mediated by perceptions of the cost to the message recipient of engaging in the recommended behaviour (*response costs*) whilst adaptive response is increased by perceptions of *response efficacy* and *self-efficacy*. Response efficacy denotes the perception that the recommended action would be effective in negating the health threat whilst self-efficacy refers to the message recipient's perceived ability to adopt the prescribed action. Crisis

efficacy, a concept developed by Avery and Park (Avery & Park, 2016), specifically refers to perceived capability to adopt prescribed actions during a time-critical crisis. The researchers found that crisis efficacy predicted intended willingness to comply with official actions following hypothetical tornado, whooping cough and food-borne illness scenarios.

The EPPM, which is one of the prevailing theories of the effectiveness of threatening communication on health behaviour change (Peters et al., 2013) and has also informed successful interventions in previous studies on crisis communication (Sutton, Vos, et al., 2018; Verroen, Gutteling, & de Vries, 2013), expands on PMT by specifying how cognitive processes lead to either message rejection or acceptance on exposure to a fear appeal message (Witte, 1996). If the message recipient does not engage in threat appraisal then no response is elicited, irrespective of the salience of efficacy in the message. If the message recipient engages in threat appraisal but perceived threat is higher than perceived efficacy, or there is no perceived efficacy, then the recipient engages in the process of “fear control” to reduce their own perception of the threat. Fear control can consist of denial of the threat, unwillingness to think about the threat, or reactance: “threat to or loss of a freedom [which] motivates the individual to restore that freedom” (Brehm & Brehm, 2013, p. 4). When the message recipient’s perceptions of response efficacy and self-efficacy are high following threat appraisal, then a “danger control” process is initiated and the message recipient engages in the process of reducing the threat. In other words, the message is only accepted when both threat appraisal and efficacy appraisal are high.

The inclusion of information about threat and efficacy is also supported by the Protective Action Decision Model (PADM; Figure 2-3) (Lindell & Perry, 2012), a model for predicting behavioural responses to environmental hazards, which has been supported by findings from studies on behaviour and intentions in response to real or hypothetical cyclones (Ahsan, Takeuchi, Vink, & Warner, 2016), air pollution crises (P. Cheng, Wei, Marinova, & Guo, 2017), floods (Terpstra & Lindell, 2013), earthquakes (Lindell et al., 2015), wildfires (Strahan & Watson, 2018) and hurricanes (Huang, Lindell, & Prater, 2016). Similar to PMT and EPPM, the PADM accounts for the moderating role of perceptions about the threat, specifically the imminence of the threat and the susceptibility of the message recipient to the threat, and beliefs about protective actions in behavioural responses, such as searching for further information or taking protective action.

The converging prediction of PMT, the EPPM and the PADM is that adherence to official directives can be facilitated by making salient: the severity of the threat facing

message recipients; their susceptibility to the threat; the efficacy of adhering to recommended actions; and recipients' self-efficacy at adopting said actions. For the remainder of this subsection I will discuss the evidence to support this assertion.

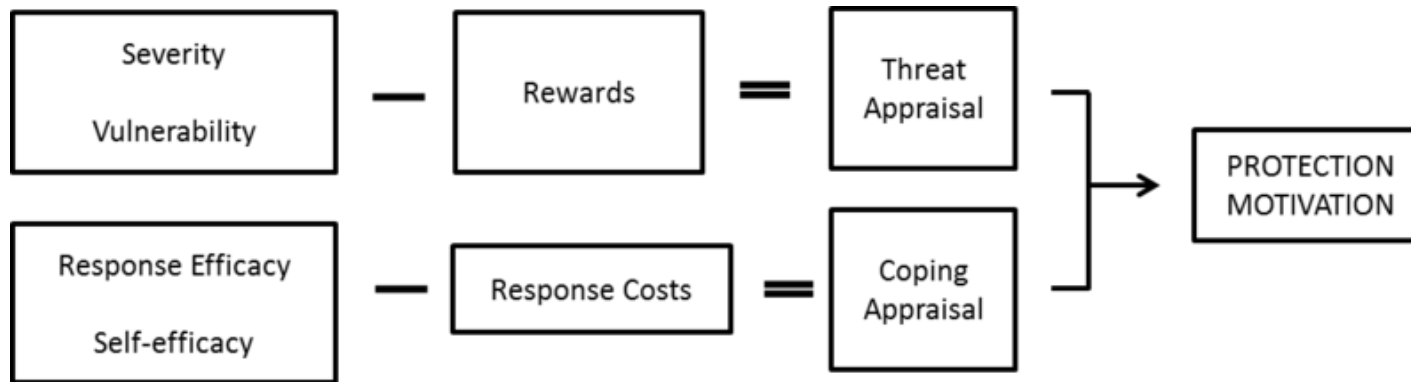


Figure 2-1 Diagram depicting components of Threat and Coping Appraisal in Protection Motivation Theory (R. W. Rogers, 1975, 1983), image provided by Suminshin00, distributed under a CC BY-SA 3.0 license (<https://creativecommons.org/licenses/by-sa/3.0/deed.en>).

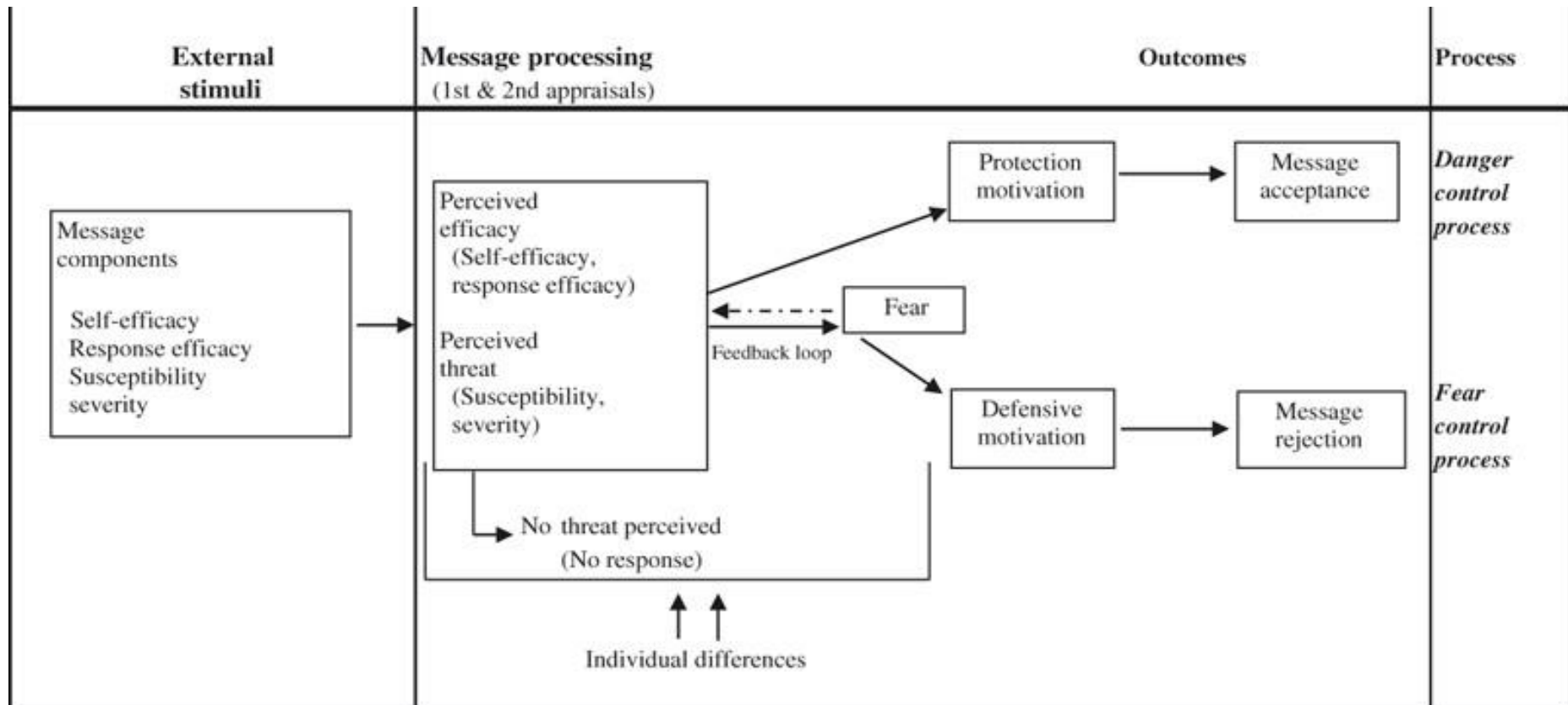


Figure 2-2 Diagram depicting the Extended Parallel Process Model (reproduced with permission from Kim Witte); in the fear control process, perceived threat leads to message rejection via fear and defensive motivation whereas in the danger control process, perceived threat results in message acceptance via protection motivation when efficacy is perceived.

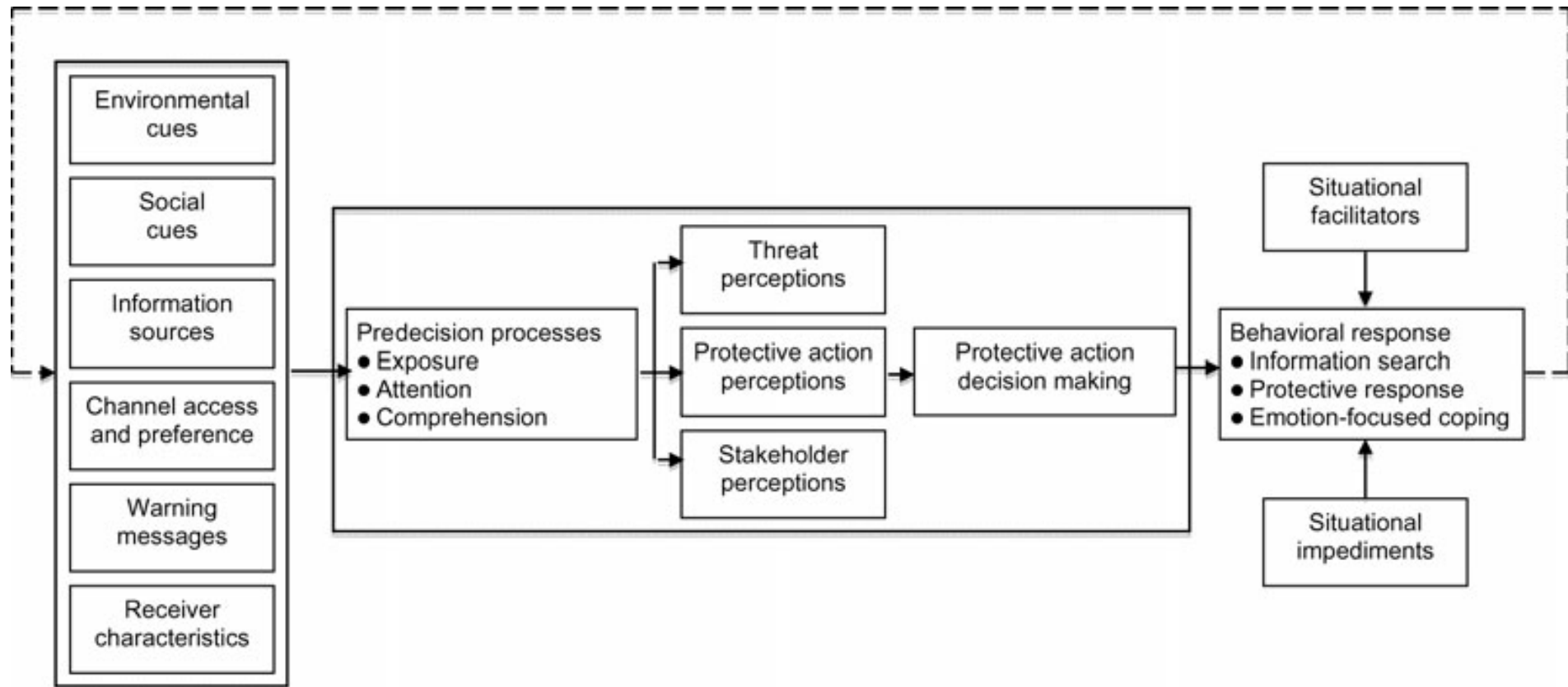


Figure 2-3 Sequences in the Protective Action Decision Model, Figure 1 from Lindell and Perry (2012); the left section depicts external components, such as social cues and information sources, the right section depicts behavioural outcomes and the middle section depicts interim cognitive processes.

Meta-analyses have indicated that the most effective interventions at promoting behaviour change, based on measures of attitudes, intentions or real behaviour are high in both threat and efficacy information (Peters et al., 2013; Sheeran, Harris, & Epton, 2014; Witte & Allen, 2000). Whilst only six studies met the inclusion criteria in the meta-analysis carried out by Peters et al. (2013), in all included studies, both threat (severity and/or susceptibility) and efficacy (response efficacy and/or self-efficacy) information was manipulated in a minimum 2x2 factorial design. Further, only studies with measures of observed behaviour, as opposed to proximal measures such as intention, were included. The meta-analysis indicated that threat information only affected behaviour when efficacy information was high whilst efficacy information only affected behaviour when threat information was high (Peters et al., 2013). Fear appeals that promote one-time behaviours, such as getting vaccinated, were found to be more effective than fear appeals that promote repeated behaviours, such as exercising regularly, in a meta-analysis of 248 independent samples (Tannenbaum et al., 2015). These meta-analyses are all based on studies of behaviour change in response to long-term health risks, such as smoking and alcohol-related risks, rather than behaviours in response to acute, emerging health risks.

During this review, I was unable to locate any meta-analyses, systematic reviews, or intervention studies on the effects of and/or interaction between manipulated threat and efficacy constructs in crisis communication messages on behaviour. Qualitative findings from a systematic review of studies on communication with the public about hypothetical or real CBRN emergencies (Rubin et al., 2012) revealed that people would want to receive information about incident severity, likelihood of being affected, the efficacy of recommended protective actions, and potential risks associated with taking recommended actions. Low self-efficacy was a reported barrier to seeking further information. Threat and efficacy message constructs have been assessed in terms of their effect on information circulation among social media users in the response phase of actual disasters but the number of studies is low. Analysis of Tweets transmitted during the Waldo Canyon wildfire (Sutton et al., 2014) and 2013 Boston Marathon Bombing (Sutton et al., 2015) indicated that messages with information that described the hazard and its impact, for example information about damaged areas, were associated with higher message re-transmission among Twitter users. Analysis of Tweets published in the United States during the 2016 Zika outbreak (Vos et al., 2018) showed that inclusion of severity (e.g. "Zika can cause birth defects") or response efficacy (e.g. "To prevent the spread of Zika is to prevent mosquito bites"), but not susceptibility information, was associated with message retransmission. Interestingly, the inclusion of both severity and response efficacy information in the same message

was associated with reduced retransmission, relative to messages that incorporated one of these components.

Previous studies on behavioural intention in response to crisis communication have tested the effectiveness of either threat or efficacy message constructs at improving self-reported adherence likelihood. For example, Pearce, Rubin, Amlôt, Wessely, and Rogers (2013) found no difference in intended compliance with official recommendations during a hypothetical chemical release incident between a message in which severity was made salient or a message in which the threat was understated to reassure recipients. But intended compliance was associated with higher perceptions of response efficacy and self-efficacy whilst non-compliance was associated with higher threat perceptions. Based on the findings pertaining to perception variables and the predictions of PMT and the EPPM, the inclusion of information about the efficacy of following official recommendations would have most likely increased the effectiveness of the “worst case scenario” message relative to the reassuring message. Verroen et al. (2013) tested the combined effect of efficacy information (“...The following self-protective actions have proven to be very effective”) and peer feedback on intended compliance with official recommendations following a hypothetical hazardous chemical release. Peer feedback was conveyed through mock social media messages that either supported or opposed the advice recommended in the message intervention. All participants were primed with the same threat-based information pertaining to the hazardous substance risks associated with the area surrounding their postal code. Whilst there was no effect of efficacy on intended compliance, there was a significant interaction between efficacy and peer feedback whereby peer feedback had no effect on intended compliance when efficacy information was provided, but did affect intended compliance when no efficacy information was provided.

The implication of theories and studies outlined above is that in addition to providing recipients with information on protective actions that they should take and information pertaining to the source of the message, communicators should address rather than negate fear by explicitly acknowledging the severity of the hazard and the likelihood that recipients will be affected. This information should also be accompanied by information about the efficacy of protective actions to promote adherence.

2.2.2. Communicating uncertainty

Communicators may not have access to all the information outlined above at the time when information would need to be disseminated. But based on the importance of timely communication, as outlined in Section 2.4.1, communication cannot be delayed

until all specific details are known. Scholars of risk communication advise that uncertainty is addressed early on in a crisis (Liu et al., 2017; Sandman, 1993) and systematic review findings pertaining to a range of crises, predominantly infectious disease outbreaks, indicate that communicators should state when information is currently unknown in order to facilitate trust (World Health Organization, 2017). There is a low number of studies on crisis-specific uncertainty communication (Liu et al., 2017) and a systematic review (Sopory et al., 2019) on how to communicate uncertainty in public health emergencies found only one study in which a comparison group was used in the assessment of uncertainty communication. The review covered a range of methodological approaches, sample nationalities, and types of public health emergency, such as infectious disease and flooding. The key finding from the review in terms of message content guidance was to include information about uncertainties as this was associated with positive outcomes, such as a reduction in the influence of misinformation from other sources, although acknowledgement of uncertainty was associated with reduced trust in authorities and decision-making inertia among message recipients from vulnerable groups (Sopory et al., 2019).

Given the potential for low threat perception or “wishful thinking” in response to stated uncertainties, as observed in climate change risk communication (Markowitz & Shariff, 2012), communicators should balance acknowledgement of uncertainty with the need for people to take action. When the extent or impact of a hazard is ambiguous to the communicator but recipients still need to be motivated to take action, possible approaches include stressing that taking action is more important than clarifying the risk (Sandman, 1993) or using a combination of verbal (e.g. “very likely”) and numerical (e.g. “90%”) indicators to frame the probability of impact (Bostrom, Böhm, & O’Connor, 2018).

2.2.3. Ordering of message content

There is limited evidence to inform the order in which information should be presented. One study on communication of smoking risks indicated no difference in effect on intended smoking cessation between an intervention in which threat was presented before efficacy information and an intervention in which efficacy was presented before threat information (Hall, Bishop, & Marteau, 2006). However, the EPPM would suggest that information about the threat should precede information about efficacy because threat appraisal is a necessary precursor to efficacy appraisal. Based on a review of studies on response to emergencies to inform the design of emergency warning systems in buildings (Omori, Kuligowski, Gwynne, & Butler, 2017), the recommended order of content for long messages is as follows: statement about message source, statement about hazard, location, guidance on action to take, and when people need to

act (Omori et al., 2017, p. 1656) though this recommendation was based on only one study that could not be retrieved. Based on the available evidence, the order in which information to inform and justify action is presented is not important so long as threat information precedes efficacy information and the source of the message is stated at or near the beginning of the message.

2.2.4. Wording of message content

As stated earlier, cognitive function may be impaired under stressful conditions based on findings from laboratory studies (Jiang & Rau, 2017; Olver et al., 2015; Qin et al., 2009) and studies in which stressors were applied in naturalistic settings (Porter & Leach, 2010; Robinson et al., 2013). The Mental Noise Model predicts that information processing is impaired in situations involving high stress and arousal, as would be expected in an emergency (Covello et al., 2001; Firestone & Everly, 2013; Glik, 2007a). One of the recommendations emanating from the Mental Noise Model is that no more than three messages are presented at one time (Firestone & Everly, 2013). I was unable to find a study from the crisis and emergency response domain in which comprehension under stress was tested as a function of the number of messages presented. One tangentially pertinent experiment from the marketing domain showed that appraisal of a cereal product was higher when four rather than three positive statements were presented to participants experiencing higher cognitive load whereas three messages were more effective than four in the lower cognitive load condition (Shu & Carlson, 2014) but this finding pertains to message persuasiveness rather than comprehension. Previous studies on intended behavioural responses to nuclear device explosion (Wood et al., 2017) and tsunami (Sutton, Vos, et al., 2018) warnings have indicated that condensed warning messages may result in increased intended milling (Wood et al., 2017), reduced ratings of fear (Sutton, Vos, et al., 2018), and reduced perceived ability to decide what to do in response to the warning message (Sutton, Vos, et al., 2018; Wood et al., 2017), relative to more comprehensive messages, which indicates the need to provide sufficient information.

A better approach than message reduction for reducing cognitive demand in an emergency is to tailor language to be easily understandable by most lay audiences. Words frequently used by risk managers, such as “non-significant” may not necessarily be readily understood by all audiences (McComas, 2006). A review of studies on the effectiveness of public health messaging during hazardous smoke events indicated that messages constructed in non-technical language, such as ‘stay indoors’ and ‘reduce outdoor physical activity’ were more likely than scientifically-worded messages to be recalled, understood, and acted on by the message audience (Fish et al., 2017). It is recommended that information be tailored to the US 6th-grade reading level or lower (R.

C. Chandler, 2010; Omori et al., 2017), which corresponds to the Year 7 or Key Stage 3 reading level in the UK. Given the potential for casualties' working memory to be compromised, it is also recommended that all messages are repeated throughout the process so that casualties are not required to recall all information. Repetition of messages is also an effective means of conveying urgency, which is in turn a determinant of message compliance (Bean et al., 2015).

2.3 Source

One of the key determinants of whether official advice in an emergency is accepted and acted on is the message recipient's trust in the information source (Bass et al., 2015; Glik, 2007a; Liu et al., 2017; Maxwell, 2003; McComas, 2006; Pearce et al., 2013; Reynolds & Seeger, 2005; Rubin, Amlôt, Page, & Wessely, 2009; Sherman-Morris & Lea, 2016). This has been specifically observed in emergencies involving CBRN material (Rubin et al., 2012), including hazardous chemicals (Pearce et al., 2013). Trust in the context of crisis communication is defined as the "impersonal" trust the public attributes to persons working in (public) institutions" (Chryssochoidis, Strada, & Krystallis, 2009, p. 137). There is evidence to support the likelihood that certain baseline communicator characteristics would be more likely to promote trust. For example, local sources and emergency responders are more likely to be trusted than communicators at a more abstract level, such as national government (Aldoory & Van Dyke, 2006; Wray, Rivers, Jupka, & Clements, 2006). I was unable to locate any study in which variability in public trust between the emergency services was assessed. Sources perceived as competent (Cordasco, Eisenman, Glik, Golden, & Asch, 2007; Latré, Perko, & Thijssen, 2017) and caring or benevolent (Latre et al., 2017; McCroskey & Teven, 1999) are likely to be trusted. In one study on expected adherence to preparatory actions for a hypothetical nuclear incident, perceived trustworthiness and credibility varied according to the type of communicator, but expected adherence did not (Latre et al., 2017).

The specific effect of message source has been assessed in the field of social media crisis communication. The Social-Mediated Crisis Communication Model (SMCC; Figure 2-4) is used to explain the transmission of information from "influential social media creators" either directly to "followers" of influential creators or indirectly to "social media inactives" who receive information from personal acquaintances or traditional media organisations who follow influential social media creators (Austin, Liu, & Jin, 2012). Early research on the SMCC and crisis communication in social media has highlighted the impact of the source of the social media message on the message audience's intended information seeking (Austin et al., 2012), information

retransmission (Rasmussen & Ihlen, 2017; Snoeijers, Poels, & Nicolay, 2014), and compliance with recommendations or instructions within the message (Freberg, 2012; Liu, Fraustino, & Jin, 2016). Austin et al. (2012) found that when the initial information was presented to participants as having originated from a university, further information seeking was reportedly less likely to occur than when the source of the message was a third party, such as a journalist or friend. Freberg (2012) found that a social media message generated by the Centers for Disease Control and Prevention was more likely to affect intended compliance with a food recall message than a message generated by a non-expert social media user. A social media message originating from a government official was associated with high perceived evacuation likelihood in response to crisis information (Liu et al., 2016). In an experimental study on social media crisis message retransmission among university students, a message presented as having originated from the dean of a university resulted in greater intended message retransmission compared to a message originating from the university (Snoeijers et al., 2014). The number of followers of a Twitter account is a peripheral factor associated with the source of a Tweet. During the 2013 Boston Marathon Bombing, the number of followers was strongly associated with retransmission of Twitter messages (retweeting) (Sutton et al., 2015). The implication from these findings is that indicators of expertise and authority are associated with increased adaptive crisis behaviours, including compliance with recommended actions.

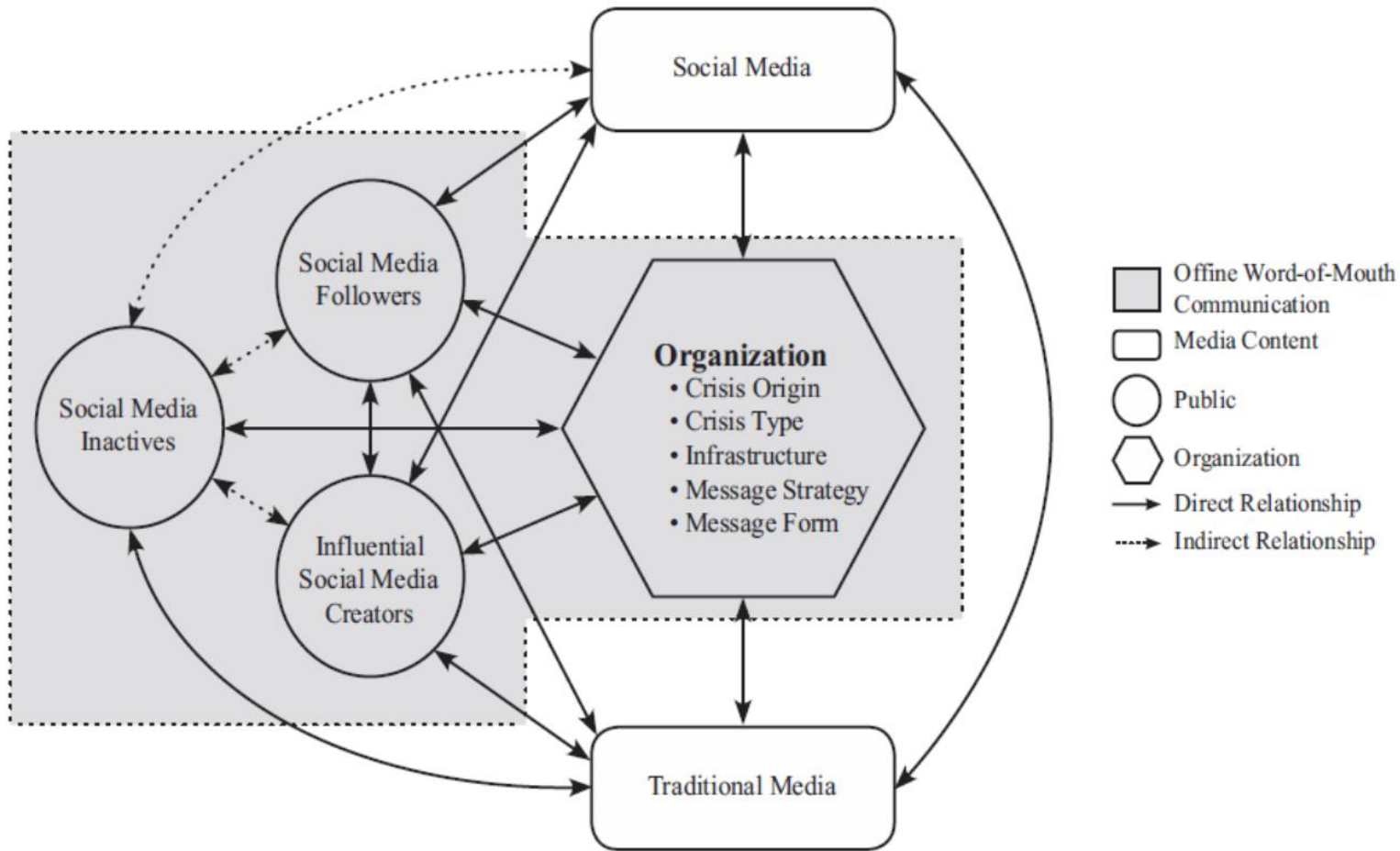


Figure 2-4 Social-Mediated Crisis Communication Model (SMCC), Figure 1 from Austin et al. (2012); the diagram depicts how information is disseminated via social media during a crisis.

Although it is important for adherence outcomes that information is delivered by communicators who are trusted, perceptions of trust can themselves be improved by the content of communication. Message content characteristics that have been observed as being conducive to trust were discussed in Section 2.2. An additional type of information that promotes trust is information about actions taken by the communicating authorities to protect message recipients. For example, in studies on observed crowd behaviour during decontamination or expected behaviour in a hypothetical decontamination scenario, updating casualties on actions being taken by first responders at the scene improved ratings of perceived legitimacy of, and identification with, responders and these perceptions were associated with ratings of intended compliance with decontamination instructions (Carter, Drury, & Amlôt, 2018; Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015). But information about why decontamination is beneficial was provided concurrently in the same messaging framework, so it is unclear what effect information about actions responders are taking would have in isolation. The Internalization, Distribution, Explanation, Action (IDEA) model (D. D. Sellnow et al., 2017) of instructional risk and crisis communication predicts that effective compliance-promoting messages include information about what actions are being taken by authorities. But the model also includes information about the degree to which the message recipient and their loved ones would be affected by the crisis and what actions the message recipient should take within the same messaging framework. Further, at the time of writing there is little empirical support for the model beyond one study in which a messaging intervention based on the model improved adaptive behavioural intentions in a hypothetical *E. coli* outbreak, relative to an intervention modelled on traditional news coverage (D. D. Sellnow et al., 2017).

There is tentative support in the literature (Mallett, Vaught, & Brnich, 1999; Omori et al., 2017) for beginning a message with a statement pertaining to the source of the message, although one publication (Mallett et al., 1999) cited no empirical support for the recommendation and the other publication (Omori et al., 2017) cited only one source which was not retrievable during the course of the present review. But based on the previously discussed effect of source characteristics, specifically ones that denote expertise and authority, on behavioural outcomes including message compliance, it is a reasonable assumption that message recipients would need to know who the messenger is so that the potential moderating effect of baseline trust in the source is activated. Information about who the communicator is (or which organisation they represent) and what actions they are taking in support of message recipients are theoretically effective source-based message components to augment the message content outlined in Section 2.2.1.

2.4 Channel

Communication channels, modalities or media fall into three broad categories: “push technologies”, such as public address systems, that do not necessitate information recipients actively searching for information; “pull technologies”, such as websites, that rely on active information searching on the part of the audience; and combination push-pull technologies, such as social media notifications or mobile text alerts, that require pre-incident registration and peri-incident access to technologies by the message audience (Omori et al., 2017). There is limited empirical support for the relative effectiveness of different communication channels, e.g. audio announcements via public address versus written instructions via signage, at promoting target behaviour change during a crisis. In laboratory studies, written instructions were less conducive to compliance with safety instructions (Wogalter & Young, 1991) or compliance with a novel task under time pressure (Pacilio Jr, 1977) than audio instructions or a combination of audio and written instructions. The only available study in which communication channels were compared in the recovery phase of a real emergency was a survey of survivors of the 2010 Haiti earthquake (Contzen & Mosler, 2013). Change in reported handwashing frequency was associated with the type of channel used to promote hygiene, with channels such as radio associated with increased food-related handwashing. Other channels had no effect or, in some cases, were even associated with decreased food-related handwashing, as was the case with home visits and community workshops. These findings pertain to sustained, long-term behaviour rather than acute, responsive behaviour however. One study (Edworthy, Hellier, Newbold, & Titchener, 2015), consisting of three experiments, was found that directly compared different communication channels in terms of their effect on warning message retention following retransmission of messages from person to person during a simulated crisis. Whilst written communication resulted in more accurate message recall than verbal information, the difference between communication channels became less pronounced as information was disseminated further down the “grapevine”.

2.4.1. Multiple channels

Whilst there is no strong evidence for using one particular source or channel to disseminate information, the use of multiple sources disseminating one consistent message has been suggested to be an effective approach to promoting trust and adherence to recommended protective actions (Glik, 2007a, 2007b; Mileti & Sorensen, 1990; Omori et al., 2017; Rubin et al., 2012; Sorensen, 2000; World Health Organization, 2017). Inconsistency between information disseminated by the media and official information provided by authorities was found to be associated with reduced intention to adhere to protective behaviours in a systematic review of

uncertainty communication in public health emergencies (Sopory et al., 2019). Pragmatically, the most effective communication channel is one that guarantees that information reaches the target audience. A combination of push and pull technologies increases the likelihood that initial information reaches the target audience and that the audience is able to retrieve further information (R. C. Chandler, 2010; Omori et al., 2017). For example, official leaflets containing protective measures for safe water consumption that were distributed to Gloucestershire residents affected by the 2007 flood were not used by the majority of residents in one survey, particularly older adults in the sample, with local media and family and friends necessary as additional communication channels to extend the reach of the information to the intended audience (Rundblad, Knapton, & Hunter, 2010). Compliance with emergency directives was positively associated with receiving directives via multiple channels during the 2007 San Diego wildfire (Strawderman, Salehi, Babski-Reeves, Thornton-Neaves, & Cosby, 2012) and an acute haemorrhagic conjunctivitis outbreak in Taipei City (Yen et al., 2009).

Findings from previous crisis and emergency communication reviews indicate that communication should be implemented as soon as possible in order to promote trust in the communicator and compliance with official advice during a hazardous event (Carter & Amlôt, 2016; Omori et al., 2017; Reynolds & Seeger, 2005; World Health Organization, 2017). In a survey of cyclone evacuation in Bangladesh, a greater proportion of households that evacuated received early warnings, compared to households that did not evacuate (Ahsan et al., 2016). Residents of an area in which drinking water was contaminated were more likely to adhere to official recommended behaviours, such as drinking bottled water or flushing taps prior to ingesting water, if they received information on the day of the emergency rather than subsequently (Galarce & Viswanath, 2012; Savoia, Stoto, Gupta, Wright, & Viswanath, 2015). Delayed provision of information was associated with anxiety and rumour circulation in an open-ended questionnaire study of attitudes of Year 12 students during a meningococcal disease outbreak (Taylor-Robinson, Elders, Milton, & Thurston, 2009). In the absence of accurate and sufficient information, members of the target audience are likely to seek out further information (a process referred to as “milling”) and thereby delay taking protective action (Omori et al., 2017; Sutton et al., 2014; Wood et al., 2017). Swift communication from authorities can itself be a facilitator of trust during an emergency (Sharp, Thwaites, Curtis, & Millar, 2013). The effectiveness of a communication channel at promoting adherence to emergency directives is inversely proportional to the speed at which it can be employed.

In previous disasters, communication infrastructure itself has been disrupted as a result of the hazard. This occurred in the wake of Hurricane Katrina when communication systems reliant on electricity ceased to be operational and health communicators relied on face-to-face means of message dissemination (Vanderford, Nastoff, Telfer, & Bonzo, 2007). The implication is that the most reliable intervention would be a combination of channels both reliant and non-reliant on functioning infrastructure, such as face-to-face communication or vocal communication via battery-operated public address systems.

2.4.2. Communication via mobile phone

Social media have been used increasingly by emergency response authorities as part of disaster information dissemination campaigns (Leykin, Aharonson-Daniel, & Lahad, 2016; Ma & Yates, 2014) due in part to the speed at which information can be transmitted (Finch et al., 2016) and also because information can be transmitted more widely. Social media, particularly Facebook and Twitter, have received increased attention in the literature on crisis communication and there is recognition of the need to combine social and traditional media when disseminating information to affected populations (Y. Cheng, 2018; Rasmussen & Ihlen, 2017; World Health Organization, 2017). In a large-scale pan-European public perceptions survey, the peri-emergency phase, as opposed to pre- or post-emergency phase, was the phase at which social media was found to be least impactful on behaviour and information exchange (Knuth, Szymczak, Kuectiekbalaban, & Schmidt, 2016). During Hurricane Sandy and the 2013 Boston Marathon Bombings, the majority of Twitter users who had been misinformed on Twitter proceeded to circulate the misinformation (Wang & Zhuang, 2018), indicating that extensive, rapid information retransmission would not necessarily entail the adoption of target, adaptive behaviours. In terms of message format, the use of capital letters to precede a declarative statement about evacuation was not associated with retransmission during the Waldo Canyon wildfire (Sutton et al., 2014) but was a strong predictor of retransmission during the Boston Marathon Bombing (Sutton et al., 2015).

Location-based mobile alerting systems enable emergency response organisations to transmit text messages, via short messaging service (SMS) or cell broadcast, to all mobile phones within a defined geographic area (Bean et al., 2015; Cabinet Office, 2014; Wong, Jones, & Rubin, 2018). Consultation with UK emergency response organisations suggests that messages can be delivered within a maximum timeframe of 15 minutes (Cabinet Office, 2014). The majority of respondents in a UK survey indicated high intended compliance with messages received via mobile alerting (Cabinet Office, 2014). Survey respondents who received a warning via Reverse 911,

an automated landline telephone call issued by emergency services, reported significantly higher evacuation rates during the 2007 San Diego wildfire than respondents who received alerts via other channels (Strawderman et al., 2012). Participants in a qualitative study on public perceptions of text message alerts about a hypothetical nuclear detonation expected that they would experience fear and confusion due to limited information about the emergency and vague information as to what the recipient can do to alleviate the threat (Bean et al., 2016). Trust in, and compliance with, messages received via this channel is affected by factors such as: pre-existing awareness of the mobile alerting system among message recipients, which can be achieved via a public information campaign about the system or by recipients opting in to the system (Bean et al., 2016; Cabinet Office, 2014; Wong et al., 2018); perceived social pressure to comply (Gutteling, Terpstra, & Kerstholt, 2017; Han, Ada, Sharman, & Rao, 2015); perceived information quality (Gutteling et al., 2017; Han et al., 2015); affective response to message (Gutteling et al., 2017); perceived safety threat; perceived finance threat; and past experience with emergencies (Han et al., 2015). Previous studies have indicated that additional information would be sought by message recipients via other channels, such as the internet, prior to following directives in location-based text messages (Bean et al., 2016; Cabinet Office, 2014; Wong et al., 2018), which indicates that the use of location-based text messaging does not necessarily prevent milling (information-seeking).

There are two theoretically effective approaches to overcoming limitations regarding the amount of text that can be included in one message delivered via location-based text or social media message: inclusion of a hyperlink to a webpage with further information or staggering information across a sequence of messages. Whilst the perceived need for information in an emergency situation may motivate recipients to click on the hyperlink (Sutton, Woods, & Vos, 2018), the inclusion of a hyperlink had no effect on message retransmission of evacuation-related Tweets during the Waldo Canyon fire (Sutton et al., 2014) and was a barrier to message retransmission among social media users during the Boston Marathon Bombing (Sutton et al., 2015). In a study on responses to a hypothetical impending tsunami message, condensing all information so that it can be transmitted in one message resulted in reduced ratings of fear and reduced perceived decision-making ability, whereas staggering the information over a sequence of messages did not (Sutton, Vos, et al., 2018). The implication is that a sequence of messages containing all necessary information would be more conducive to message compliance than one condensed message but the evidence for this assertion is based solely on one study.

2.4.3. Signage

Emergency communication can also be factored into the architecture of public spaces. When a crisis or emergency requires evacuation from a location, evacuation speed can be increased by updating emergency exit signage in preparation for the emergency. Manipulation of visual parameters of signage affects wayfinding during simulated emergency evacuations (Andrée, Nilsson, & Eriksson, 2016; Galea, Xie, Cooney, & Filippidis, 2015; Galea, Xie, Deere, Cooney, & Filippidis, 2017a, 2017b; Galea, Xie, & Lawrence, 2014; Glover & Wogalter, 1997; Künzer, Hofinger, & Zinke, 2016; Kwee-Meier, Mertens, & Schlick, 2017; Nilsson, Frantzich, & Saunders, 2005, 2008; Vilar, Rebelo, Noriega, Duarte, & Mayhorn, 2014). The use of an Active Dynamic Signage System (ADSS), which consists of flashing lights to highlight the existence of the escape route sign or a red cross to indicate that the exit route is no longer viable, improves on static signage in terms of noticeability (Galea et al., 2014) and guiding evacuees towards a particular exit (Galea et al., 2015; Galea et al., 2017b). When a red cross was used to indicate that an exit route is not viable and adjacent signs were positioned to indicate an available route more participants evacuated via appropriate exits (Galea et al., 2017a). Findings from this programme of research support previous studies in which green flashing lights influenced route choices during simulated fire evacuations (Andrée et al., 2016; Nilsson et al., 2005, 2008) most likely due to the salience of flashing lights and the cognitive affordance of the colour green; green being commonly associated with the concept of “safe to proceed” (Künzer et al., 2016). During tunnel evacuation experiments in which smoke was present (Fridolf, Ronchi, Nilsson, & Frantzich, 2013; Ronchi et al., 2017), the addition of a loudspeaker with a voice message that informed participants to use a particular exit improved participants’ motivation to select the exit route.

2.4.4. Acoustic factors

The use of the voice to transmit information from authorities to casualties is a potentially useful modality given that it does not require access to pre-developed materials. More importantly, live, as opposed to pre-recorded vocal communication allows for updated information (Omori et al., 2017) which is useful in a crisis situation as available information is subject to change during an incident. Voice amplification technology, such as vehicle-mounted or handheld public address systems, would increase the volume and hence the reach of communication. Acoustic factors of vocal communication can affect response time (Arrabito, 2009; Simpson & Williams, 1980) and self-reported attitudinal responses (Barzegar & Wogalter, 1998; Hollander & Wogalter, 2000; Taylor, 2014) to warning information. For example, enunciation by a recorded female, rather than male speaker has been associated with reduced accuracy and slower response times among listeners in a word identification task (Arrabito,

2009) and lower ratings of perceived acceptability of voiced fire evacuation warnings (Taylor, 2014) but has also been associated with improved ratings of intended carefulness (Barzegar & Wogalter, 1998; Hollander & Wogalter, 2000). Words recorded with a “whisper voice” style resulted in reduced response time in a word identification task, relative to urgent or monotone voice styles (Arrabito, 2009), whilst words recorded with an urgent or “emotional” vocal tone (characterised as a voice style that would be used by the speaker when alerting a loved one to an imminent threat (Barzegar & Wogalter, 1998)) resulted in higher ratings of intended carefulness (Barzegar & Wogalter, 1998), faster response times (Ljungberg & Parmentier, 2012), and increased distraction from engagement in a cognitive task (Ljungberg, Parmentier, Hughes, Macken, & Jones, 2012) in laboratory studies. Warning words presented quickly (50% faster than recorded speed of word) improved ratings of intended carefulness compared to warning words presented at 50% slower than recorded speed (Hollander & Wogalter, 2000).

2.5 Moderating effect of audience characteristics

The ability to access, process and act on warning messages is influenced by sociodemographic factors relating to the recipients of crisis communication, such as age, gender and socioeconomic position (Galarce & Viswanath, 2012; Glik, 2007a; Saha & James, 2017; Taylor-Clark, Viswanath, & Blendon, 2010). For example, whether people heard, understood or acted on Hurricane Katrina evacuation orders was associated with employment status, having family or friends, home ownership, gender, and age (Taylor-Clark et al., 2010). Participants from ethnic minority groups in England, Scotland and Wales were more likely than white participants to have engaged in recommended health behaviours during a swine flu outbreak (Rubin et al., 2009). During a contaminated drinking water incident, compliance with official recommendations varied among different demographic groups within a surveyed sample (Galarce & Viswanath, 2012). For example, self-reported compliance with official advice to flush warm water taps for at least 15 minutes was higher for women than men and higher for Black respondents than for Hispanic or White respondents. Female participants reported higher ratings than male participants of risk perceptions and intention to change their behaviour in response to information about hypothetical terrorism, food safety and bed bug infestation events (Spence et al., 2017). Full compliance with recommended protective behaviours following a hypothetical chemical spill was higher among women than among men and higher among UK than among Polish participants (Pearce et al., 2013). Frisby, Sellnow, Lane, Veil, and Sellnow (2013) found that there was a significant interaction between participants’ stated learning preferences and the type of information they received on their perceived

efficacy to take protective action during a crisis. Younger participants indicated greater intended compliance than older participants with a food recall message disseminated in a social media message generated by a non-expert social media user (Freberg, 2012).

Behavioural response to signage can also differ depending on audience characteristics. In a laboratory study of simulated wayfinding in a tilted passenger ship, evacuation decision-making of younger participants was influenced more by signage containing a green flashing frame on the perimeter of the sign, whereas decision-making of older adult participants was influenced more by signage containing information on when the sign was last updated (Kwee-Meier et al., 2017).

A range of factors affect perceptions of trust in the communicator, including sociodemographic characteristics of the audience (Chryssochoidis et al., 2009) and the communicator's pre-existing reputation for trustworthiness among the audience (Cairns, de Andrade, & MacDonald, 2013). Historical and contemporary unjust treatment of the message audience by authorities due to sociodemographic factors such as ethnic and socio-economic group was a reported factor in non-adherence to evacuation warnings during Hurricane Katrina (Cordasco et al., 2007).

In the field of non-emergency hygiene which is proximal to decontamination though unrelated to emergency behaviour, a covert observational study of soap use in a natural setting revealed gender differences, with women responding more than men to the promotion of hand hygiene education and men responding more than women to an appeal to the emotion of disgust (Judah et al., 2009). In a meta-analysis of the effect of fear appeals on attitudes, intentions, and behaviour in a wide range of behavioural contexts such as dental hygiene, fear appeals were found to be more effective when the percentage of female participants exceeded the percentage of male participants in the sample (Tannenbaum et al., 2015).

2.6 Discussion

The aim of this review was to draw from the literature and from health and social psychology theories more broadly, to identify guidelines for communication from authorities to improve casualty adherence to IOR protocols during the initial stage of the response to a chemical incident. Outcomes from this review include initial guidelines on communication during IOR and an agenda for future research. It may not be feasible to translate all review outcomes to IOR practice. I will now outline each recommendation, based on the findings of the present review reported in earlier sections, and explain both the feasibility of applying the recommendation to practice and the need to conduct further empirical assessment prior to practical application. The

communication principles derived from this review are based on unidirectional communication from authorities to recipients. It is anticipated that when casualties contact communicators, e.g. by dialling 999, it is not necessary, for example, to explicitly address competence and expertise of the communicator because this would already be acknowledged by message recipients in advance of the interaction. As stated in Chapter 1, the primary scenario of interest is one in which the threat of contamination is ambiguous to casualties but deemed highly likely by responders.

Recommendation 1. Information should be disseminated to affected casualties as soon as responders know that IOR needs to be implemented

Previous research indicates that faster communication is effective in promoting behaviour change. With IOR there is no real choice but to communicate quickly, rendering further empirical assessment of this recommendation redundant. Actions need to be taken as soon as possible therefore actions need to be communicated as soon as possible. As stated in Chapter 1, the optimum timescale for completion of evacuation and disrobing is within 15 minutes of exposure (Biomedical Advanced Research and Development Authority, 2015; Home Office, 2013, 2015; Joint Emergency Services Interoperability Programme, 2013; National Ambulance Resilience Unit, 2014; National CBRN Centre, 2016) therefore casualties need to be informed about the actions required of them as soon as possible. The most important consideration regarding communication channels in a chemical incident is that information is received by casualties quickly and that information is received by as many casualties as possible. Fast communication from responders to casualties serves not just the practical requirement of ensuring that evacuation and disrobing occur within the optimum 5-minute timeframe; it is also likely to improve perceptions of trust in the source of the message. It is anticipated that the channel most conducive to swift information dissemination to affected casualties would be the use of amplified vocal communication by responders at the scene, for example via a handheld or vehicle-mounted loudhailer. Whilst acoustic factors of vocal communication have been shown to affect outcomes in laboratory studies, responders would have to use the voice that they have. The fundamental recommendation regarding the acoustic parameters of vocal communication in the IOR context is to eliminate background noise if possible and practical and to ensure that the voice of the responder is of sufficient volume to be heard over the sound of background noise, such as fire engines and running water.

Recommendation 2. Multiple sources and channels should be used to disseminate one consistent message to casualties

The source of communication during IOR is likely to be determined either by current IOR guidelines which specify that the first responders on scene would be the first communicators (Joint Emergency Services Interoperability Programme, 2013; National CBRN Centre, 2016) or by the need to communicate rapidly to ensure rapid decontamination, in which case the first communicator may be a civilian at the scene with training in decontamination, for example attendance at the first aid course. The choice of platforms, channels or media used to disseminate information to casualties is likely to be constrained by what is available to the first responder at the point when they arrive on the scene. Therefore, there is little practical utility to testing the effectiveness of different communicators.

Whilst it would be useful to run a study to test whether the use of multiple sources and channels is more effective at promoting IOR adherence, the more pragmatic approach is to determine which communication channels are likely to be available to responders then focus on finetuning message content that can be applied to available channels. Findings from this review indicate that location-based text messaging and carefully managed social media communication could be used to augment messages delivered by responders at the scene. But further investigation is required to test whether terse messaging would be effective at promoting adherence when applied to recipients at the treatment area of a mass casualty emergency.

Recommendation 3. Casualties need to be provided with the following information: who the responder(s) is/are (including information to denote their competence and actions they are taking); information about the likelihood and severity of contamination; practical instructions on actions casualties should take to protect one another; the efficacy of these actions at reducing the threat of contamination; and casualties' self-efficacy

During certain types of emergency, justification to take action may be apparent in the absence of communication from authorities, for example due to the presence of fire. However, as explained in Chapter 1, skin exposure to hazardous chemicals does not necessarily result in immediate symptoms (Borak & Sidell, 1992; Chilcott, 2014; Clarke et al., 2008; Davis & Aspera, 2001; Garcia et al., 2011; Geissmann, 2004; Kales &

Christiani, 2004; Spiandore et al., 2017; Vale et al., 2016; Wattana & Bey, 2009) and casualties may not know that they are contaminated and that decontamination is required. The threat posed to casualties would therefore need to be explained to them.

Based on the outcomes of this review and relevant theories, the application of information about the severity of and casualties' susceptibility to chemical contamination; the efficacy of IOR decontamination; specific instructions about actions casualties should take; and a statement as to the expertise/competence of and actions taken by the communicator would constitute a theoretically effective approach to promoting the uptake of protective behaviours in the initial minutes of a chemical incident. It is anticipated that information about the efficacy of decontamination and casualties' self-efficacy as agents of their own protection would serve to alleviate excessive fear by orienting attention to the fact that whilst the situation is threatening, the casualty has the means to resolve the threat. This theoretically allows first responders to maintain trust by avoiding unsubstantiated reassurance about the threat whilst also preventing threat appraisal from exceeding efficacy appraisal. If the source or cause of the chemical release is unknown to authorities, the uncertainty could be acknowledged by stating that responders are investigating the cause of the chemical release, but the chemical is known to be harmful so action needs to be taken immediately.

In the context of communication during the initial phase of decontamination, it is anticipated that threat framing would consist of highlighting the fact that the message recipient has been contaminated with a hazardous chemical and that failure to respond to the threat will result in adverse health consequences for themselves and people with whom they come into contact. In a chemical incident, susceptibility would be conveyed by highlighting the location of the source of exposure. Efficacy framing would consist of explaining the benefit of recommended actions (removal of outer clothing and application of absorbent materials to skin) and by explaining the ease with which the message recipient can engage in these actions. At present, these are assumptions but further qualitative investigation into how lay people conceptualise chemical skin contamination would allow for more rigorous guidance on how to convey threat and efficacy constructs (see Chapter 5). It is anticipated that self-efficacy is a harder construct to address via communication as only the message recipient can be truly aware of their own self-efficacy.

Studies included in previous reviews and meta-analyses on the effect of threat and efficacy information on behavioural outcomes have only assessed behaviour change pertaining to long-term risks, for example smoking cessation, vaccination, diet,

exercise, sun protection, disease prevention, safe driving, and earthquake preparation (Peters et al., 2013; Sheeran et al., 2014; Tannenbaum et al., 2015), as opposed to behaviour in the acute response phase of an emergency. Whilst previous studies have supported PMT in the context of emergency *preparedness* behaviour (Mulilis & Lipka, 1990; Poussin, Botzen, & Aerts, 2014), no empirical support was found in the present review for the effect of threat and efficacy information on behaviour change within a narrow timeframe, such as would be available in an incident that necessitates IOR.

It is expected that, pending further empirical assessment outlined above, this recommendation would be easy to apply in practice. In subsequent chapters, I will explore potential impediments to the practical application of theoretically effective guidelines pertaining to message content.

Recommendation 4. Information should be staggered rather than condensed and repeated throughout the IOR process

Based on the anticipated stress and anxiety that would occur during a mass chemical incident and the predictions of the Mental Noise Model, processing of all the information outlined in the previous recommendation is likely to be impaired. The most effective approach to addressing this processing impairment is to stagger and repeat information, rather than condense and hence provide insufficient information. There is evidence to support this recommendation from one study on decision-making responses to a hypothetical impending tsunami social media message (Sutton, Vos, et al., 2018). It would be useful to repeat this experiment in the IOR context using channels that would be available to first responders.

Recommendation 5. Language used to construct messages should be simple and nontechnical

Messages cannot be accepted and acted on if they are not understood. The tailoring of crisis and risk communication to audiences with different information processing abilities is receiving attention, for example through a programme of research (Bass, Gordon, Gordon, & Parvanta, 2016; Bass, Gordon, Maurer, et al., 2016) on improving communication with low-literacy adults about radiological terror events. The most pragmatic approach to take in a chemical incident, based on findings from this review, is to frame information in simple, non-technical language, using the US 6th-grade reading proficiency level (R. C. Chandler, 2010; Omori et al., 2017) as a guide for pre-recorded or scripted messages.

2.6.1. Limitations

This review was carried out whilst the response to the 2018 Wiltshire Novichok incident was still unfolding. While lessons from the incident are likely to be relevant to this work, at the time of writing no assessment of public responses to communication issued by authorities during this incident was available.

As explained in the introduction, this review included a proportion of studies found following a systematic search, the method for which is reported in the following chapter. Due to the breadth of theories and studies, I did not use a systematic, replicable method to identify and synthesis findings from the entirety of literature relating to crisis communication, but I included findings from previous systematic reviews.

To further develop guiding principles for communication during IOR that can be empirically tested, I carried out a systematic review with more stringent inclusion criteria, limited to studies of behaviour in response to communication with casualties at the scene of a mass casualty emergency. This review is reported in the next chapter.

Chapter 3 The impact of communication on casualty behaviour during mass casualty emergencies: A systematic review

3.1 Introduction

In the event of a mass casualty emergency involving the release of a hazardous chemical, UK first responders are trained to implement Initial Operational Response (IOR) as a preliminary countermeasure, prior to the arrival of specialist decontamination facilities. During IOR, casualties are required to adopt a series of behaviours, including evacuation; improvised dry decontamination (removal of a contaminant from the skin using any available absorbent materials) or improvised wet decontamination (removal of a contaminant from the skin using any available water source). The success of these steps as a countermeasure against exposure to a harmful chemical will be determined by casualties' willingness to carry out recommended behaviours. If casualties are unwilling to engage in the required behaviours, then the countermeasure will be ineffective.

In the previous chapter, I outlined recommendations for communication techniques that are likely to be conducive to public adherence to protective actions during an emergency. These are based on well supported theories of behaviour change, previous reviews and studies on research areas tangential to IOR decontamination, including crisis and emergency risk communication, wayfinding signage, and non-emergency hygiene behaviours. Based on the outcomes of the review, it is expected that adherence to IOR can be improved via: swift communication (Carter & Amlôt, 2016; Omori et al., 2017; Reynolds & Seeger, 2005; World Health Organization, 2017); multiple sources disseminating one consistent message (Glik, 2007a, 2007b; Mileti & Sorensen, 1990; Omori et al., 2017; Rubin et al., 2012; Sorensen, 2000; World Health Organization, 2017); simple, non-technical language (Fish et al., 2017); and the provision of information about who the first responders are (Mallett et al., 1999; Omori et al., 2017) and what actions they are taking to protect casualties (Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015), what protective actions casualties need to take (Amlôt et al., 2017; Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015; Glik, 2007a; Mileti & Sorensen, 1990; D. D. Sellnow et al., 2017; Sutton, Vos, et al., 2018; World Health Organization, 2017), and information about the emergency itself, such as cause and impact (Firestone & Everly, 2013; Omori et al., 2017; Sorensen, 2000; Sutton et al., 2015; Sutton et al., 2014; Sutton, Vos, et al., 2018). Based on converging predictions of Protection Motivation Theory (PMT) (R. W. Rogers, 1975, 1983), the Extended Parallel Process Model (EPPM) (Witte, 1992, 1994), the Protective Action Decision Model (PADM) (Lindell & Perry,

2012), and the IDEA Model of instructional risk and crisis communication (D. D. Sellnow et al., 2017), information about the severity of the threat, casualties' susceptibility to hazardous chemical exposure, the efficacy of IOR at reducing the threat of contamination; and casualties' self-efficacy at performing IOR, should improve the effectiveness of messages designed to promote adherence.

Whilst previous literature reviews have assessed communication-related factors that may affect emergency preparedness (Savoia, Lin, & Viswanath, 2013) or public behaviour in the response phase of disasters (Bean et al., 2015; Bradley et al., 2014; Glik, 2007a), including CBRN disasters (Rubin et al., 2012), there has yet to be a systematic review directly relevant to mass casualty IOR decontamination, a communication context with a particular set of constraints. Firstly, the audience consists of people confined to the particular location of the emergency, such as a car park or train station, and who are, or are strongly suspected to be, casualties of the incident. Secondly, the timeframe of interest is the acute phase of the incident when behaviour change is required immediately to protect life or prevent serious negative health effects. This contrasts with communicating preparedness messages before an incident or risk communication in the medium to long-term following an emergency. Third, the communicators would be responders present at the scene, such as police, ambulance staff or firefighters, who are engaging directly with casualties, rather than government or media spokespersons disseminating information via social or traditional media.

In this review, I explored the existing literature on communication with casualties at the scene or treatment area of a mass casualty emergency, defined as an event where the number of patients poses a substantial demand on first responders and first receiving hospital staff and resources (Floyd, 2017; Glarum, Birou, & Cetaruk, 2009), reducing the capacity to concurrently treat all patients (Lynn, 2016). Mass casualty emergencies differ from disasters in that patients, "can be managed within the resources of the affected organisation or health facility" (Aitken & Leggat, 2012, p. 144). The category, "mass casualty emergency" (MCE) encompasses chemical incidents in addition to other types of emergency, such as a fire. The terms "mass casualty incident" or "mass casualty event" describe a similar set of parameters and in this chapter the terms are used interchangeably.

The aim of the review was to identify communication interventions that have been assessed in terms of their effect on: a) the observed or self-reported behaviour of casualties at the treatment area of an emergency (including incidents that later transpire to have been false alarms); b) the observed or self-reported behaviour or self-

reported behavioural intentions of participants during a simulated emergency; or c) the behavioural intentions and expectations of participants in a hypothetical emergency situation or vignette. The purpose of this review is to identify communication factors that are likely to be directly relevant to communication during IOR and to identify unanswered research questions that need to be addressed when developing a communication intervention for this type of emergency.

3.2 Method

3.2.1. Electronic database searches

I used search terms (Appendix A) pertaining to the population/context, intervention and outcome of the research question to search the following electronic databases:

- Ovid®SP MEDLINE® In-Process & Other Non-Indexed Citations;
- Ovid®SP MEDLINE® 1946 to Present;
- OvidSP PsycINFO® 1806 to March Week 1 2018;
- Web of Science™ v5.27.2 (Thomson Reuters, New York, New York, USA).

Searches were first conducted on 12th August 2016, with preliminary results used to inform the scope of investigation in the PhD, then replicated in March 2018. In this chapter, I describe the method and results of searches carried out on 14th March 2018.

Database-specific controlled vocabulary was used where available (MEDLINE® and PsycINFO® searches). Free text terms were consistent, save for database-specific truncation and wildcard options, across all three databases. Free text terms were searched within titles and abstracts on MEDLINE® and PsycINFO® and within title, abstract, author keywords, and Keywords Plus® in all Web of Science™ v5.22.1 databases, excluding MEDLINE® (Web of Science™ Core Collection, BIOSIS Citation IndexSM, BIOSIS Citation IndexSM, KCI-Korean Journal Database, Russian Science Citation Index, and SciELO Citation Index). MEDLINE® results were excluded from the Web of Science database results because MEDLINE® had already been searched via Ovid®SP.

A proportion of the population/context free text search terms were derived from previous reviews on the subject of disasters (Brooks et al., 2015) and communication regarding CBRN incidents (Rubin et al., 2012). In line with recommendations by Egan, MacLean, Sweeting, and Hunt (2012), both generic (e.g. *disaster*) and specific (e.g. *chemical spill, hurricane, landslide*) search terms were used.

Search terms pertaining to each concept of the research question were combined via the Boolean operator “OR.” The combined searches for each concept were

subsequently combined using the Boolean operator, “AND.” Resulting citations were exported to EndNote® X8.0.1(Thomson Reuters, New York, USA) and duplicates were removed.

3.2.2. Grey literature searches

I searched the following grey literature sources on 20th March 2018: British Library directory of online doctoral theses (EThOS); International Standard Randomised Controlled Trials Number (ISRCTN) registry; the Cabinet Office Civil Contingencies Secretariat Emergency Planning College Document Hub; Fire Brigades Union (FBU) Publications; Fire Safety Engineering Group publications; Defense Technical Information Center (DTIC); and The National Institute for Occupational Safety and Health (NIOSH-2) bibliographic database. Exercise reports written by Public Health England (formerly Health Protection Agency staff) were not included in the grey literature search as these had already been subjected to secondary analysis by Carter et al. (2012b, 2013). Based on the outcomes of the secondary analysis and consultation with the lead author, there was no information in these materials on the relationship between decontamination compliance and specific characteristics of communication. These reports would therefore not have met the intervention criteria for this review. The main finding of this literature was that information perceived by roleplaying exercise casualties as poor was associated with expectations of non-compliance in a real incident. Whilst this finding contributed to the rationale for the project, the reports themselves did not meet my inclusion criteria.

The terms “communication,” “emergency” and “behaviour” were entered into the abstract, title, and subject keyword search fields in EThOS, combined with the Boolean operator, “AND”. The terms “communication” and “emergency” were entered, with the Boolean combination operator “AND,” into the text search field of the ISRCTN registry and ‘All Fields’ search field of the NIOSH-2 database. The term “Communication” was entered as a keyword search in the FBU publications database. All Fire Safety Engineering Group and Cabinet Office Civil Contingency Secretariat Emergency Planning College publications were screened for relevance. The following search terms for were used to search for DTIC technical reports:

("mass casualty emergency" OR "mass casualty incident") AND (communicat OR instruct* OR messag* OR signage)*

3.2.3. Citation checking

Following the screening of full texts found in electronic database and grey literature searches, I reviewed the citations of included papers, relevant review papers found in electronic database searches, and references of potentially relevant abstracts for which

full texts could not be accessed. I also used Google Scholar to screen papers which had cited included papers.

3.2.4. Study selection, quality appraisal, data extraction and data synthesis

I conducted an initial screening of all the titles and abstracts of electronic database search results against the inclusion and exclusion criteria outlined in Table 3-1 to identify potentially relevant papers. Electronic database searches were not restricted by language so I was able to identify potentially relevant non-English language papers by screening abstracts that had been translated into English. The full texts of potentially relevant papers were examined further to ensure that all criteria were met. Full texts for which the applicability of inclusion criteria was uncertain were reviewed by the supervisory team and discussions were held until consensus was reached.

I used the 2011 version of the Mixed Methods Appraisal Tool (MMAT) (Pluye et al., 2011) to appraise the quality of included studies based on information provided in the publications and, where available, supplementary information. The tool was developed specifically for appraising the quality of studies in systematic reviews in which there are quantitative, qualitative and mixed methods studies (Pluye, 2013; Pluye & Hong, 2014). Whilst the tool's content validity and reliability have been assessed, work is ongoing to further develop the tool (Hong, Gonzalez-Reyes, & Pluye, 2018; Pluye et al., 2011; Souto et al., 2015).

I extracted and tabulated the following data from included studies. First author, year of publication, study type (e.g. randomised trial, cross-sectional survey, focus group); setting (country in which study took place); sample size; sampling method and study population (e.g. students); type of emergency (e.g. hurricane); and nature of emergency (e.g. real, simulated or hypothetical) were collated for display in one table (Table 3-2). Communication intervention(s) or predictor(s) assessed; behavioural measure(s); key findings (effect or lack of effect of communication interventions/predictors on behavioural outcomes); and quality appraisal score were collated and displayed in another table (Table 3-3).

Data extracted from each study were submitted to each corresponding author, when correspondence was possible, to check for accuracy of data extraction.

Narrative synthesis is an established method of using text to collate study findings in mixed systematic reviews for which meta-analysis is not appropriate due to methodological and statistical variability (Campbell, Katikireddi, Sowden, McKenzie, & Thomson, 2018). Following the method of narrative analysis established by Popay et al. (2006) and cited as an available narrative synthesis method in PRISMA-P

guidelines (Shamseer et al., 2015), I grouped communication interventions and predictors across studies into categories and reported whether and how each communication category affected behaviour during an incident. Preliminary synthesis was developed by tabulating effects and direction of effects of each study (Table 3-3). Qualitative case descriptions about interventions and/or predictors that had similar directions of effect across studies were used to identify factors that explain the effect that communication can have on casualty behaviour in an MCE, based on the available literature.

3.2.5. Protocol registration

The protocol for this review was published on PROSPERO (2016:CRD42016047719) on 19th September 2016. The protocol was amended on 11th January 2017 to include “written in English” as a criterion for type of study to be included in the review.

I stated in the protocol that I anticipated using the Cochrane Collaboration’s tool for assessing risk of bias but given that the tool was developed for the appraisal of randomised trials and that studies found in this review covered a wider range of study types, including qualitative studies, in practice I used the Mixed Methods Appraisal Tool (Pluye et al., 2011) because it is tailored to mixed systematic reviews (Pluye, 2013; Pluye & Hong, 2014).

Rather than separate qualitative from quantitative studies and randomised controlled trials (RCTs) from other quantitative studies and carry out separate narrative syntheses (as stated in the protocol), I applied narrative synthesis to all included studies. This was due to the low number of included studies. In the protocol, I specified that I would synthesise the relative impact of “behaviour change predictors” in observational studies but because the research question centred on the impact of communication on behaviour, I only synthesised behaviour change predictors pertaining to communication.

Table 3-1 Inclusion and exclusion criteria for study selection.

Category	Inclusion Criteria	Exclusion Criteria
Type of study	<ul style="list-style-type: none"> • Contains original data; • Human participants; • Written in English. 	<ul style="list-style-type: none"> • Review papers and meta-analyses
Population/ Context	<ul style="list-style-type: none"> • Casualties in a mass casualty emergency (hypothetical, simulated or real-life); • Civilians who have not completed training in response to emergency situations as part of their profession. 	<ul style="list-style-type: none"> • Participants and populations drawn from military organisations; • Participants and populations drawn from emergency response organisations; such as paramedics and firefighters, who are trained to adopt target behaviours in response to emergency situations; • Studies on communication with the wider public (i.e. people who are not directly affected by the incident).
Intervention(s), exposure(s)	<ul style="list-style-type: none"> • Studies where there is an explicit qualitative or quantitative evaluation of the effect of emergency responders' communication on casualty behaviour; • Studies of mass casualty emergencies in which responders are deployed to the scene of the emergency and are required to communicate with casualties; • Communication interventions include, but are not limited to, one-to-one interaction between responders and casualties without the aid of technology; interaction between responders and casualties involving technology (e.g. public address systems); pre-recorded audio, visual, and audio-visual message(s); information sheets; siren systems; provision of equipment, such as first aid kits, with instructions to casualties. 	<ul style="list-style-type: none"> • Studies on long-term communication campaigns; • Studies on communication between responders or communication between responder agencies during emergencies.
Outcome(s)	<ul style="list-style-type: none"> • Objective measures, observations or self-reports of behaviour or behavioural intentions among casualties or participants 	

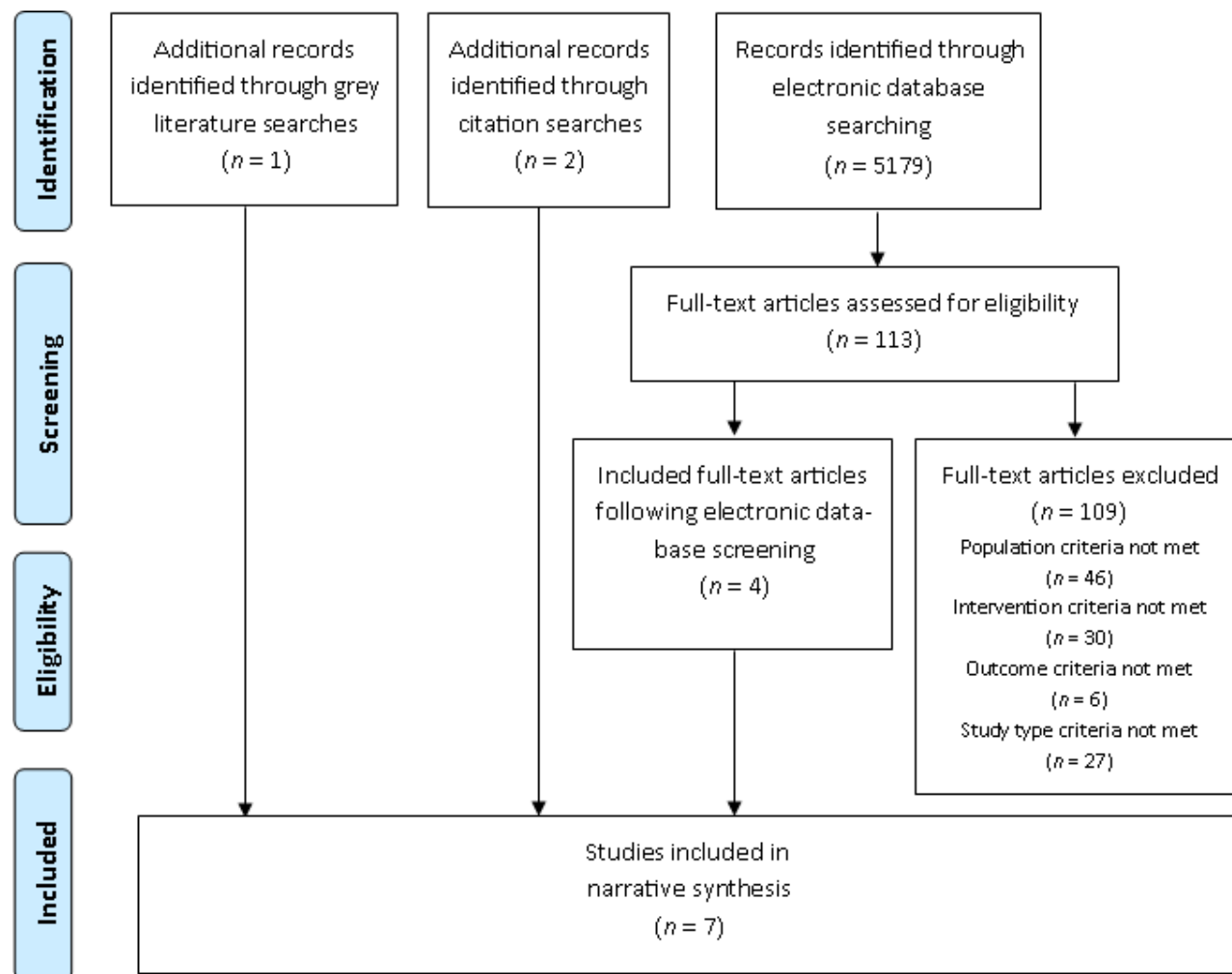


Figure 3-1 Preferred Reporting Items of Systematic Reviews and Meta-Analyses (PRISMA) (Mother, Liberati, & Tetzlaff, 2009) flow diagram of the literature search and screening.

3.3 Results

3.3.1. Study selection and summary

5179 search results, excluding duplicates, were extracted from electronic databases. The abstracts of two theses (Abdelhamid, 2018; Fraustino, 2017) were deemed potentially relevant but after exhausting all means of accessing full texts (including contacting corresponding authors), I had no option but to exclude studies contained in these theses. References were available –and searched -for one of the abstracts (Fraustino, 2017). One paper (Baek, Baek, Shin, Song, & Kook, 2011) with an abstract that indicated potential relevance was excluded because the full text was not available in English. Following title and abstract screening, 113 full texts were screened and four studies met all inclusion criteria. The list of papers excluded on full text screening and the justifications for exclusion are outlined in Appendix B. One study found in grey literature searches was included and two studies were included following citation searches. The total number of included studies was seven (flow diagram displayed in Figure 3-1).

Six studies (Duarte, Rebelo, Teles, & Wogalter, 2014; Fridolf et al., 2013; Galea et al., 2017a, 2017b; Kwee-Meier et al., 2017; Vilar et al., 2014) for which full texts were screened were excluded from the review because the tested interventions were emergency exit designs inherent in the structural design of the environment in which participants underwent emergency wayfinding, rather than interventions administered in response to an MCE. Although not meeting the inclusion criteria for this review, the outcomes of these studies and related studies found via backwards and forwards citation searching (Andrée et al., 2016; Bode, Wagoum, & Codling, 2014; Galea et al., 2014; Glover & Wogalter, 1997; Nilsson et al., 2005, 2008) are outlined in the previous chapter.

Data extracted from the included studies (Amlôt et al., 2017; Boyce, McConnell, & Shields, 2017; Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015; Mallett, Vaught, & Brnich Jr, 1993; Proulx & Sime, 1991; Purser, 2010) are displayed in Tables 3-2 and 3-3. The types of emergency in included studies were: mass casualty exposure to an unknown substance (Amlôt et al., 2017; Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015), emergency fire evacuation (Boyce et al., 2017; Mallett et al., 1993; Proulx & Sime, 1991), and evacuation for unknown reason (Purser, 2010). Behavioural measures concerned either evacuation (Boyce et al., 2017; Mallett et al., 1993; Proulx & Sime, 1991; Purser, 2010) or compliance with decontamination instructions (Amlôt et al., 2017; Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015). Aside from one hypothetical scenario presented to participants via vignette (Carter, Drury, Amlôt, et al., 2015), one real incident recounted

by participants in a qualitative case study (Mallett et al., 1993) and one observational study without comparison group (Boyce et al., 2017), the remaining studies were emergency simulations conducted as randomised (Amlôt et al., 2017; Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015; Purser, 2010) or non-randomised (Proulx & Sime, 1991) controlled trials in a natural (Carter, Drury, Amlôt, et al., 2014; Proulx & Sime, 1991; Purser, 2010) or laboratory (Amlôt et al., 2017) setting for which participants were briefed (Amlôt et al., 2017; Carter, Drury, Amlôt, et al., 2014) or not briefed (Proulx & Sime, 1991; Purser, 2010) in advance. The studies in which participants were not briefed in advance about the emergency simulation differed from the studies in which participants knowingly took part in emergency simulations, in terms of the type of emergency studied. These 'covert' emergency simulations were all studies of mass evacuation behaviour, whereas overt studies centred on behaviour during mass casualty decontamination.

In studies on evacuation, target behaviour change consisted of exiting the emergency location within the shortest possible time (Boyce et al., 2017; Mallett et al., 1993; Proulx & Sime, 1991; Purser, 2010) whilst using the safest exit routes (Mallett et al., 1993; Proulx & Sime, 1991). In studies on mass casualty decontamination, target behaviour was characterised as adherence to emergency responders' instructions (Amlôt et al., 2017; Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015) with maximum efficiency (Carter, Drury, Amlôt, et al., 2014).

3.3.2. Quality Appraisal

The one included qualitative study met all criteria in the MMAT aside from demonstration of appropriate consideration for how the influence of researchers may have affected findings. Overall quality of included quantitative studies was low with most studies meeting one MMAT criterion at most. Limitations applicable to all included RCTs were lack of clear description of the randomisation, with authors frequently stating that participants were randomised rather than describing the randomisation procedure in sufficient detail, and lack of information about the size of the withdrawal or drop-out rate. Only one RCT provided a description of allocation concealment by stating that participants were assigned to an intervention condition via a computer programme when they clicked on the link to the online experiment (Carter, Drury, Amlôt, et al., 2015), thus ensuring that researchers would be blind to condition at allocation stage. However, authors either reported that researchers were not blind or provided no indication as to whether researchers were blind to condition at the analysis stage.

Table 3-2 Characteristics of included studies.

First author (year of publication)	Study type	Setting	Sample size	Sampling method and study population	Type of emergency	Nature of emergency
Amlôt (2017) [Study 2]	Quantitative: randomised controlled trial	UK	21	Not stated	Mass casualty exposure to unknown substance	Overt simulation (laboratory experiment)
Boyce (2017)	Quantitative: descriptive incidence study without comparison group	UK	239	Occupants present at the study location	Fire alarm	Covert simulation (participants unaware that incident was not real)
Carter (2014)	Quantitative: randomised controlled trial	UK	111	Self-selected convenience sample of university students	Mass casualty exposure to unknown substance	Overt simulation (field experiment)
Carter (2015)	Quantitative: randomised controlled trial	UK	129	Self-selected convenience sample of university psychology students	Mass casualty exposure to unknown substance	Hypothetical scenario
Mallett (1993)	Qualitative: case study	USA	21	Purposive sampling of survivors of mine fire	Underground fire	Real incident
Proulx (1991)	Quantitative: Non-randomised controlled trial	UK	Not stated	Occupants present at the study location	Fire alarm	Covert simulation (participants unaware that incident was not real)
Purser (2010) [Laboratory experiment]	Quantitative: randomised controlled trial	UK	59	Self-selected convenience sample of university students and staff	Ambiguous incident resulting in emergency evacuation	Covert simulation (participants unaware that incident was not real)

Table 3-3 Interventions/predictors, behavioural measures, key findings, and quality appraisal of included studies.

First author (year of publication)	Communication intervention(s) or predictor(s) assessed	Behavioural measure(s)	Key findings	Quality appraisal score
Amlôt (2017) [Study 2]	Two messaging interventions administered in a between-subjects design with one trial per condition: Condition 1. Control intervention (no instructions or explanation); Condition 2. Provision of instructions on how to undergo dry decontamination and an explanation as to the purpose of dry decontamination.	<ul style="list-style-type: none"> • Observation of participants undergoing dry decontamination; • 7-point Likert scale item pertaining to self-reported intention to undergo dry decontamination and intention to seek further treatment in a real incident. 	<ul style="list-style-type: none"> • Significantly more participants in the intervention group applied absorbent materials to all parts of their body and adopted the correct procedure and used sufficient absorbent material to avoid cross-contamination; • No statistically significant effect of intervention on self-reported behavioural intentions. 	0%
Boyce (2017)	All occupants received: alarm siren (fire alarm); live voice announcements administered via public address system after alarm sounding; and cases of staff requesting that patrons evacuate after alarm sounding. Two separate rooms within the same building were analysed separately. In Room 1, the alarm was followed by one main announcement from the bar manager. In Room 2, the alarm was followed by repeated announcements from the DJ.	Observation of recognition time (time taken for occupants to realise that an emergency is occurring) and response time (time taken for occupants to make first move indicative of evacuation from building after realising that emergency is occurring).	No inferential statistical analysis was carried out on difference between communication conditions but there were descriptive observations in both rooms of increase in evacuation activity following voice announcements made after the sounding of the alarm siren.	50%

First author (year of publication)	Communication intervention(s) or predictor(s) assessed	Behavioural measure(s)	Key findings	Quality appraisal score
Carter (2014)	<p>Three messaging interventions administered in a between-subjects design with one trial per condition:</p> <p>Condition 1. Sufficient practical information about steps casualties should take; health-focused explanations about why actions are necessary; and updates about actions that responders are taking;</p> <p>Condition 2. Sufficient practical information about actions casualties should take;</p> <p>Condition 3. Insufficient practical information about actions casualties should take.</p>	<ul style="list-style-type: none"> • Observation of time taken for total number of participants per condition to proceed through decontamination shower (descriptive statistics); • Observation of frequency of non-compliance, confusion, and helping behaviours; • Ordinal questionnaire items pertaining to self-reported willingness to help others during a real incident (1 item) and expectations of compliance during a real incident (3 items); • Open-ended questionnaire items pertaining to participants' self-reported experiences of field experiment. 	<ul style="list-style-type: none"> • No inferential statistical analysis was carried out on time taken to proceed through decontamination shower. Descriptive statistics indicated that participants in Condition 1 took the least amount of time and participants in Condition 2 took the most amount of time to complete the shower. • There was no significant effect of messaging intervention on observed helping behaviour. • Observational analysis indicated significantly more instances of behaviour coded as non-compliance and confusion when practical information was insufficient (Condition 3) than when practical information was sufficient (Conditions 1 and 2). Significantly less confusion was observed when health-focused information about why actions are necessary and updates about actions that responders are taking were provided (Condition 1). • There was no significant effect of messaging intervention on self-report ordinal measures of expectations of compliance or willingness to help others during a real incident. • Path analysis indicated no indirect effect of communication on expected compliance in a real incident but, following removal of non-significant paths, path analysis did indicate that being in Condition 1, rather than Conditions 2 and 3, was a significant predictor of responder legitimacy, which in turn was a significant predictor of collective agency, which in turn was a significant predictor of willingness to help others during a real incident. • Content analysis of open-ended questionnaire items resulted in no themes pertaining to self-reported behaviour or behavioural intention in a real incident. 	0%

First author (year of publication)	Communication intervention(s) or predictor(s) assessed	Behavioural measure(s)	Key findings	Quality appraisal score
Carter (2015)	Three messaging interventions administered in a between-subjects design: Condition 1. Sufficient practical information about steps casualties should take; health-focused explanations about why actions are necessary; and updates about actions that responders are taking; Condition 1. Sufficient practical information about actions casualties should take; Condition 2. Insufficient practical information about actions casualties should take.	Ordinal questionnaire items pertaining to self-reported expectations of compliance with the decontamination process (3 items) and helping and orderly behaviour (3 items) were the scenario to occur in real life.	<ul style="list-style-type: none"> • There were no statistically significant differences between messaging intervention on expectations of compliance or helping and orderly behaviour in a real incident. • Following removal of non-significant paths, path analysis indicated that being in Condition 1, rather than Conditions 2 and 3, was a significant predictor of perceptions of responder legitimacy. Perceived responder legitimacy was a significant predictor of perceived identification with responders, which in turn was a significant predictor of expected compliance. Perceived responder legitimacy was also a significant predictor of perceived collective agency, which in turn was a significant predictor of expected helping and orderly behaviour. 	25%
Mallett (1993)	All respondents potentially received face-to-face communication between mine staff; page phone system; dial phone system; and wayfinding signage.	Self-reported retrospective accounts of behaviour.	<ul style="list-style-type: none"> • Evacuation was reportedly delayed by lack of detailed information (e.g. size and location) about the fire; insufficient instructions as to how to evacuate; obscured wayfinding signage; lack of trust due to previous difficulties with following wayfinding signage; the malfunctioning of the page phone system; and inability to hear the dial phone ringing. • Participants reported following other mine staff who were perceived as experienced in wayfinding, for example miners with fire bossing or mine rescue experience. 	75%

First author (year of publication)	Communication intervention(s) or predictor(s) assessed	Behavioural measure(s)	Key findings	Quality appraisal score
Proulx (1991)	Five communication interventions administered in a between-subjects design: Condition 1. Alarm siren; Condition 2. Instruction to evacuate administered by station staff; Condition 3. Repeated instruction to evacuate administered via public address system; Condition 4. Instructions on which evacuation routes to take and directive instructions aimed at specific occupants, administered by public address system and train station staff; Condition 5. Instructions on which evacuation routes to take, directive instructions aimed at specific occupants, and information about the reason for evacuation (fire) and the location of the fire, administered via public address system.	Observation of time taken for occupants to start to move, time taken for occupants to evacuate from the station, and whether occupants took safest evacuation route from their starting location.	No inferential statistical analysis was applied to test the difference between conditions on behavioural measures. Descriptive statistics indicated that the alarm siren (condition 1) resulted in the greatest delay to time taken to start to evacuate and time taken to evacuate from the station. The intervention administered in condition 5 resulted in the most efficient time to start to move and to evacuate the station.	25%

First author (year of publication)	Communication intervention(s) or predictor(s) assessed	Behavioural measure(s)	Key findings	Quality appraisal score
Purser (2010) [Laboratory experiment]	<p>Three communication interventions administered in a between-subjects design with two trials per condition:</p> <p>Condition 1. Alarm siren;</p> <p>Condition 2. 9-second recorded female voice message: "Attention please! Attention please! This is an emergency. Please leave the building by your nearest exit";</p> <p>Condition 3. 4-second recorded female message: "This is an emergency! Please leave the building".</p>	<ul style="list-style-type: none"> • Observation of recognition time (time taken for each participant to stop engaging in pre-intervention activity and respond to intervention), response time (interval between first response to alarm and first movement to evacuate); • Additional observations of behaviour (no coding scheme); • Ordinal questionnaire items pertaining to the extent to which participants were motivated to leave the room, were motivated by the alarm, and attempted to finish their activity before evacuating. 	<ul style="list-style-type: none"> • Participants in the voice message conditions displayed shorter recognition times than participants in the alarm condition. • Participants in the 4-second message condition displayed shorter recognition times than participants in the 9-second message condition. • There was no effect of intervention on response time. • Data from one 4-second message trial were excluded (and a replacement trial carried out) because occupants did not evacuate at any point during the trial. • There were observed evacuation delays in the voice message conditions due to participants staying to listen to the full message and its first repeat but no descriptive or inferential statistics of this observation were reported. • Group interactions were observed as having an effect on time taken to evacuate. • Questionnaire items indicated that participants were significantly more motivated to leave the room in the 9-second than in the 4-second message condition and that the intervention reportedly had a significant effect on whether participants attempted to finish pre-intervention activity before evacuating but there was no explicit statement as to the direction of effect. 	25%

3.3.3. Synthesis

3.3.3.1 Provision of instructions improved uptake of target behaviours

For both categories of target behaviour, the provision of instructional information, delivered either in person or via a speaker system, as to what actions were required of the audience was found to be more conducive to changing the target behaviour when compared to minimal or no information about required actions. Live or pre-recorded voice message instructions to evacuate resulted in reduced time taken by casualties to respond to an unanticipated evacuation (Proulx & Sime, 1991; Purser, 2010) and greater disengagement from pre-alarm activities (Boyce et al., 2017), relative to the sounding of an alarm, though inferential statistical tests were only carried out in one (Purser, 2010) of these three studies.

Greater detail in instructional information improved outcomes relative to instructions that lacked detail. In one study (Proulx & Sime, 1991), more specific instructions on how to evacuate, "Passengers on all platforms should board the first available train. Passengers at Concourse level should leave by the nearest exit. Do not use the lift." appeared to reduce time taken for the message audience to clear the area when compared to the less detailed instruction to "evacuate the station immediately". Instructions on how to evacuate that were perceived by participants to be insufficient were associated with delayed evacuation in an underground fire (Mallett et al., 1993). Similarly, participants subjected to a communication intervention in which they were guided through the entire process of dry decontamination with instructions such as, "use some of the blue roll to blot and rub hands until they are clean" were significantly more likely to apply absorbent materials to all parts of their body and to apply absorbent materials in a manner that would not incur cross-contamination (Amlôt et al., 2017). Participants in a mass decontamination field experiment (Carter, Drury, Amlôt, et al., 2014) displayed behaviours coded as confusion, such as asking other participants or emergency responders to explain what actions should be taken, or non-compliance, such as leaving the trial area, significantly more frequently when practical information about what actions they should take were limited to, "We would like you to undergo a decontamination shower. Please take off your outer layers of clothes, down to your swimwear. Please then change into the orange ponchos provided" and when first responders at the scene were briefed in advance not to help participants undergo actions.

3.3.3.2 Provision of justification for instructions improved uptake of target behaviours

When provided with either specific information about the emergency or information as to why it was necessary to take protective action, participants were observed or self-

reported to be more likely to engage in target behaviours. Respondents who had evacuated from a real-life underground fire reported that their decision to evacuate was delayed by lack of detailed information about the fire, for example the size of the fire and where the fire was located (Mallett et al., 1993). When informed in an unannounced train station evacuation that there was a suspected fire and when informed of the specific location of the fire, passengers evacuated from a train station more quickly than when they were not informed of the type and location of the emergency (Proulx & Sime, 1991). Participants in a decontamination laboratory trial (Amlôt et al., 2017) adopted the correct, safe dry decontamination procedure more frequently when informed that, “using the blue roll to remove the contaminant is an effective way to make sure that as much of the contaminant as possible is removed from your skin...to reduce any adverse health effects from the contaminant...[and] prevent spread of the contaminant to other people and places”. It is not possible to determine whether it was justification in the form of information about the threat or information about the efficacy of protective action that resulted in improved behavioural outcomes or whether it was provision of direct instructions on how to engage in protective actions that improved outcomes as both types of information were provided concomitantly in both studies.

There were significantly fewer instances of confusion, and descriptive data indicated that passage through a decontamination shower was more efficient, when responders were briefed to be as helpful as possible and when health-focused information as to why decontamination is necessary was provided in the form of the following message delivered via public address system: “Undergoing a decontamination shower will then remove any remaining contaminant from your skin. This will help to prevent you suffering any adverse effects from the contaminant” (Carter, Drury, Amlôt, et al., 2014). There was also an indirect effect on expected helping behaviour in a real incident, that was mediated by increased perceptions of responder legitimacy and collective agency (the perception that participants would be able to work together to resolve the situation). It is not possible to determine whether these outcomes can be attributed to: the health-based justification message that participants heard; the unrecorded information they will have received from responders; or the information about actions responders were taking that was also present in this communication condition. In an online RCT, the provision of a similar justification for following instructions (“it is important that you undergo decontamination, as this will protect you, and others around you who may become contaminated”) had an indirectly positive association with expected compliance in a real incident, after taking into account perceptions of responder legitimacy and perceived identification with responders. However, it is not

possible to separate the effect of this justification from the effect of stating actions that responders are taking (“you are informed that responders are setting up the decontamination tent, and as soon as this has been completed, the decontamination process will begin”) as this information was also present exclusively in the same condition.

3.3.3.3 Provision of regular updates about actions responders are taking improved uptake of target behaviours

In an online RCT to test messaging interventions in a mass decontamination scenario (Carter, Drury, Amlôt, et al., 2015), regular updates from responders about actions they are taking, such as “responders are setting up the decontamination tent, and as soon as this has been completed, the decontamination process will begin” (p. 188) had an indirectly positive association with expected compliance in a real incident. Inclusion of similar information in a messaging intervention administered in a field experiment in another included study (Carter, Drury, Amlôt, et al., 2014), e.g. “We are now finishing the set up of the decontamination tent, and the decontamination process will begin in about 5 minutes time”: increased the efficiency with which participants proceeded through the decontamination shower, though inferential statistical analysis of this difference was not possible; resulted in fewer observed instances of confusion; and indirectly increased self-reported ratings of likelihood of helping other casualties in a real incident. But it is not possible to separate the effect of this type of message from the effect of providing health-based justification for undergoing decontamination as neither type of message was tested in isolation in either study.

3.4 Discussion

The aim of this systematic review was to assess the effect of communication on the behaviour of casualties at the scene or treatment area of an MCE as an initial step in developing a communication intervention for use by first responders tasked with promoting casualty engagement in IOR at the scene of a chemical incident. My synthesis of included studies indicated that uptake of target behaviours among casualties in an MCE can be improved by providing: information about actions casualties should take; justification for taking such actions in the form of information about the emergency, specifically the type of emergency and the location or source of the incident, and information about the efficacy of taking protective action; and regular updates from responders about actions they are taking.

Findings from this review are supported by findings from other reviews and studies on crisis communication with the wider public during a hazardous event, which indicate that specifying the type of hazard that is facing message recipients as well as its

source and impact (Firestone & Everly, 2013; Omori et al., 2017; Sorensen, 2000; Sutton et al., 2015; Sutton et al., 2014; Sutton, Vos, et al., 2018) and providing information on specific actions that message recipients should take to protect themselves (Glik, 2007a; Mileti & Sorensen, 1990; D. D. Sellnow et al., 2017; Sutton, Vos, et al., 2018; World Health Organization, 2017) would improve public adherence to adaptive behaviours during a hazardous event. Threat perceptions are predicted to influence likelihood of taking protective action in Protection Motivation Theory (PMT) (R. W. Rogers, 1975, 1983), the Extended Parallel Process Model (EPPM) (Witte, 1992, 1994), and the Protective Action Decision Model (PADM) (Lindell & Perry, 2012), while the IDEA Model of instructional risk and crisis communication (D. D. Sellnow et al., 2017) predicts that increased specificity of recommended actions promotes greater likelihood of adherence to target behaviours. The present review provides evidence, albeit limited, that provision of both types of information promote adaptive behaviour at the scene or treatment area of an MCE.

The present review also provides tentative evidence that information about the response efficacy of protective action improves adherence to recommended response protocols. However, studies in which response efficacy was tested also included other types of messaging within the same intervention. In other words, it was unclear whether it was response efficacy information or more specific practical instructions (Amlôt et al., 2017) or updates about actions responders are taking (Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015) that had the observed impact on behavioural outcomes. But there is evidence in the wider literature that explaining the benefit of taking protective action improves adherence to adaptive, target behaviours during a chemical incident (Rubin et al., 2012; Verroen et al., 2013) and the effectiveness of appeals to response efficacy at promoting target behaviour change is supported by theories of fear appeal effectiveness, such as PMT (R. W. Rogers, 1975, 1983) and the EPPM (Witte, 1992, 1994).

There is also theoretical support for the finding from this review that updating casualties on actions responders are taking would have an impact on casualty behaviour. In the previous chapter, I reported that trust is a potential determinant of compliance (Bass et al., 2015; Glik, 2007a; Liu et al., 2017; Maxwell, 2003; McComas, 2006; Pearce et al., 2013; Reynolds & Seeger, 2005; Rubin et al., 2009; Sherman-Morris & Lea, 2016). Further, the Elaborated Social Identity Model (ESIM) (Drury & Reicher, 1999, 2000) predicts that co-operation with the out-group (in this case, emergency responders) is likely to occur when the behaviour of out-group members is perceived as legitimate by members of the in-group (in this case, casualties). Making salient that responders are working to protect casualties is a theoretically effective approach to demonstrating

legitimacy and projecting goodwill, which is associated with trust (Latre et al., 2017; McCroskey & Teven, 1999). In the two included studies that included such statements in the messaging intervention, perceived legitimacy of responders and identification with responders was increased (Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015). As far as I am aware, there is no empirical test to confirm whether information about actions authorities and responders are taking would have a positive effect on perceived trust, legitimacy, or outcomes relating to compliance in the absence of any other information. But there is sufficient evidence from included studies in this review to predict that inclusion of information about actions responders are taking would improve the likelihood of casualty adherence.

This review has highlighted the limited number of studies on communication with people at the scene of an MCE. This reflects the finding by Rubin et al. (2012) about the absence of studies on the information needs in the immediate hours or days following a real-life Chemical, Biological, Radiological or Nuclear (CBRN) incident, “during the chaos of the early stages of a real incident” (p. 11). The few studies that have been done in this area are largely poor quality. The evidence from included studies indicates that communication affects behaviour at the treatment area of a mass casualty emergency, but further research is warranted to provide more detailed guidance on how responders should communicate with casualties. Some findings from this review may be interpreted as axiomatic and leave many unanswered questions. For example, included studies provide no evidence to support recommendations on which channel to use to disseminate information to casualties.

Based on the common components in PMT, EPPM and PADM and the support for these theories in the disaster communication literature, the combination of information about the severity and susceptibility of the threat with information about the efficacy of protective action and message recipients’ self-efficacy is likely to improve adherence to target behaviours. Previous meta-analyses have supported this assertion when it comes to health and safety behaviours in other, non-emergency response contexts (Peters et al., 2013; Sheeran et al., 2014; Witte & Allen, 2000), even when outcomes of studies were limited to real behaviour (Peters et al., 2013). But this combination of message components has yet to be tested in a messaging framework tested in the MCE context.

3.4.1. Limitations of included studies

By far the biggest limitation within this review was the small number of studies that I identified. It appears that very little research has considered the impact of different

communication styles on behaviour during an MCE. All conclusions drawn from this body of work must therefore be treated with caution.

“Immersion” in emergency exercises refers to “the subjective experience of being in one place or environment when one is physically situated in another,” with high immersion improving the external validity and generalisability of findings from emergency simulation studies (Alison et al., 2013, p. 4). A common limitation of studies included in the present review was the lack of realism in overt emergency simulations or visualisations of hypothetical emergency scenarios. The stress inherent in an emergency (Leach, 2004, 2005; Porter & Leach, 2010; Robinson et al., 2013; Robinson et al., 2008), particularly when CBRN materials are involved (Krieger et al., 2014; Sheppard et al., 2006; Sullivan & Bongar, 2007), has the potential to cause diminished cognitive functioning (Jiang & Rau, 2017; Olver et al., 2015) and impaired information processing (Covello et al., 2001; Firestone & Everly, 2013; Glik, 2007a).

The apex of immersion in a decontamination study would be to convince participants that real contamination has occurred. The subject of making study participants or exercise casualty role-players truly believe that they have been contaminated has been raised during discussions with stakeholders but disregarded for two important ethical reasons. First, to successfully convince someone that their health is in real danger constitutes a form of psychological harm, a tactic used by those who would post innocuous white powder to provoke distress in the recipient. Second, there is the concern that the act of undertaking a scientific study in which participants are deceived into thinking they have been exposed to a noxious substance would likely undermine public trust in a subsequent official, genuine message that a hazardous chemical has been released.

In future studies on the effectiveness of communication on behaviour in simulated emergencies, an acute laboratory stressor, such as CO₂-enriched air inhalation (Ehlers, Margraf, & Roth, 1986; Ree, French, MacLeod, & Locke, 2008; Van Den Bergh, Kempynck, Van De Woestijne, Baeyens, & Eelen, 1995), could be applied to induce physiological stress prior to the communication intervention to more realistically assess the impact of communication on behaviour in an emergency. The limitation inherent in this approach is that, in the absence of method development work, it is unclear whether laboratory stressors would be a valid proxy for the stress experienced at the scene of an emergency. Observational analysis of real emergencies, for example via footage extracted from body cameras worn by first responders, would be a useful approach to assessing the effect of communication variables on casualty behaviour under real-life emergency conditions.

Another limitation that applied to all quantitative studies in this review was the use of group participation (Amlôt et al., 2017; Boyce et al., 2017; Carter, Drury, Amlôt, et al., 2014; Proulx & Sime, 1991; Purser, 2010), whereby participants were allocated to or observed in groups rather than in single study sessions. Whilst observing participants in groups improves the generalisability of findings to the *mass casualty* context, it means that only one (Amlôt et al., 2017; Boyce et al., 2017; Carter, Drury, Amlôt, et al., 2014; Proulx & Sime, 1991) or two (Purser, 2010) trials were carried out to test each communication intervention, raising the risk of bias due to baseline characteristics, for example number of participants, and any pre-existing social relationships within each group.

There are three viable approaches to resolving this issue whilst ensuring that participant behaviour is assessed in a crowd context to achieve ecological validity. The first is to use multiple trials per condition. The second is to allocate participants to communication conditions in single study sessions using confederates to play the role of the other casualties to ensure consistency between conditions. Both approaches are costly in terms of time and money. The third approach is to use an immersive virtual environment to simulate being in an MCE. A proportion of the excluded studies on wayfinding behaviour in response to different emergency exit signage (Duarte et al., 2014; Vilar et al., 2014) or pre-incident instructions (Carattin, Meneghetti, Tatano, & Pazzaglia, 2016) and an excluded study on peri-emergency bystander behaviour were carried out in an immersive virtual environment (IVE) where participants operated virtual bodies from a first-person perspective to simulate being in an emergency. The use of an IVE in an RCT on communication during IOR decontamination would allow for accurate simulation of a large-scale chemical incident (complete with multiple other casualties) whilst ensuring that participants can complete the study in a single session to avoid the confounds associated with group participation.

All quantitative studies were carried out in the UK and only one included study was carried out outside of the UK. Caution should be taken when extrapolating findings from this review to non-UK populations.

Studies were predominantly low quality, particularly in the case of RCTs. It is possible that some aspects of these studies that would meet the quality appraisal criteria were present but not reported. The need for more high-quality randomised controlled trials in the field of crisis communication has been raised in a previous systematic review (Bradley et al., 2014). The quality of future MCE communication RCTs can be improved by: explicitly stating the percentage of participants who completed all outcome measures and the percentage of participants who withdrew or were withdrawn

from the study; reporting in detail the approach to randomisation; and where possible, developing a procedure for blinding researchers to study condition at both the allocation and analysis stages of the research process.

3.4.2. Limitations of review

Grey literature searches were carried out to circumvent the risk of publication bias but there is no guarantee that every study that meets the inclusion criteria was found during the search process. Studies which found no effect of communication interventions on casualty behaviour in an MCE may have been harder to locate, resulting in a bias in the review's findings.

Only one potentially relevant non-English language paper (Baek et al., 2011) was excluded from the review due to the English language exclusion criterion. Based on the abstract, it is highly unlikely that review outcomes would have changed had this study been included so the English language restriction was not a limiting factor.

Whilst the MMAT is an appropriate tool for a mixed systematic review, the MMAT has been criticised on the basis that some criteria, such as <20% withdrawal rate, may have been met but not reported and so study quality may be assessed as low purely on the strength of reporting rather than methodology (Hong et al., 2018). In the present review I cannot rule out the possibility that studies were appraised inaccurately as low quality due to reporting rather than methodology.

Whilst I consulted with my supervisors when unsure about the applicability of studies to this review, screening of both titles/abstract and full texts was carried out by me only. It is possible that the use of single-screening increased the risk of missing studies that would have met the inclusion criteria at each step of the search process but the recommendation to use double-screening to improve accuracy of study identification is based on limited evidence comprising a low number of case studies (Waffenschmidt et al., 2018).

Chapter 4 Qualitative investigation into the standard practices of first responder communication in a hazardous chemical release incident: A guidance document review and interview study

4.1 Introduction

Findings from the literature reviews reported in Chapters 2 and 3 provide initial guidelines for developing a communication intervention for use by first responders to improve the likelihood of casualty adherence to IOR in a chemical incident, particularly when signs and symptoms of exposure are not salient. Swift communication, using simple, non-technical language, and having multiple sources and channels disseminating one consistent message to affected casualties are likely to be effective approaches to promote adherence. In terms of message content, it is likely that an effective communication intervention would need to include information about: the severity of the contamination threat posed to casualties; the likelihood of exposure; practical information about actions casualties should take to protect themselves; the efficacy of these actions in reducing the threat; information about casualties' self-efficacy in performing these actions; and information about who the communicators are and what actions they are currently taking. In this chapter, I will investigate whether these theoretically effective approaches are used in current standard practice.

Official guidance documents on the management of casualties during mass casualty decontamination have been published by many government departments, particularly in the UK (HM Government, 2008; NHS, 2010; NHS Scotland, 2012) and USA (Governor's Office of Emergency Services, 2006; Lake et al., 2013; US Army Chemical Biological Radiological and Nuclear School, 2011; US Department of Health and Human Services, 2014). The target audiences of these documents include incident commanders, trainers for emergency response organisations (US Department of Health and Human Services, 2014) and first responder agencies, such as the Fire and Rescue, Police and Ambulance services. In a previous review in this area, 15 of the 19 guidance documents published before 2016 that were identified were found to provide information about communication during an incident, but the level of detail varied between documents (Carter & Amlôt, 2016). It is also unknown whether the guidance on communication in these documents is reflected in the training and conduct of first responders who communicate with casualties when responding to an incident involving a hazardous chemical release.

The aim of the present study was to ascertain current first responder communication practices during mass casualty decontamination, particularly at the initial stage, via a

review of guidance documents and interviews with first responders. My objective was to assess whether current practice corresponds to the theoretically effective guidelines suggested by the reviews reported in preceding chapters.

4.2 Method

4.2.1. Design

The investigation consisted of a) a review of decontamination guidance documents to collate specific examples of communication approaches recommended for use by responders and b) semi-structured open-ended one-on-one interviews with responders in UK Police, Ambulance, and Fire & Rescue Services in order to gather information on strategies used by responders when communicating with casualties during decontamination procedures.

4.2.2. Review of guidance documents

4.2.2.1 Search strategy and screening

Guidance documents ($n = 19$) containing information about the management of casualties during mass casualty decontamination were identified as part of a review carried out by Carter and Amlôt (2016), who searched for reports published up to 2014. I repeated the search strategy reported in their review in October 2016 with the date refined to only include documents published since the previous review was conducted. The search strategy consisted of screening the first 200 results of advanced Google searches with the search terms: “mass decontamination” AND “guidance”; “mass decontamination” AND “procedure”; “mass casualty decontamination”; and “decontamination public emergency” (Carter & Amlôt, 2016).

I identified additional guidance documents following consultation with subject matter experts at Public Health England. I screened guidance documents found via all searches against the following inclusion criteria. Documents had to contain references to channels or modalities that could be used to communicate information to casualties and/or refer to examples of specific messages that could be communicated to casualties by responders during mass casualty decontamination operations. Where I identified two or more versions of a document, only the latest version was included.

4.2.2.2 Data extraction and analysis

I extracted data from guidance documents that related to communication recommendations. I carried out thematic analysis on recommended messages (specific statements for responders to communicate with casualties that were extracted from guidance documents) using NVIVO 11.2.1.616 (QSR International). Recommended messages were allocated to semantic categories using the data-derived approach to

thematic analysis outlined by Braun and Clarke (2013) to “reflect the semantic content of the data” (p. 207). Types of messages and communication channels were not reported if they were only included in one guidance document in order to avoid basing a theme on the position of one particular set of document authors. Theme titles were italicised in the results section.

4.2.3. Interviews with first responders

4.2.3.1 Participants

I used purposive sampling, identifying participants by consulting with members of an end user panel for the wider programme of research in which this study was conducted and by colleagues of panel members. The panel consisted of emergency response professionals. I recruited additional participants from my research team’s database of contacts who had consented to be contacted about participation in studies. I recruited interview participants from Police (n=2), Ambulance (n=4), and Fire & Rescue (n=6) organisations to cover the range of first responder organisations that are likely to be communicating at the scene during IOR. The letter used to recruit participants is displayed in Appendix C.

4.2.3.2 Materials

I used an interview schedule (Appendix D) to ensure consistency in the data collection method. I pilot tested the schedule via a practice interview with a subject matter expert (Fire & Rescue Service Capability Advisor). In brief, the interview schedule contained questions on the following main topics:

- The interviewee’s experience and training in communication with casualties during incidents where decontamination is required;
- Available channels (equipment or technology) for communicating with casualties;
- What the interviewee would say to casualties when they arrive on the scene;
- Examples of what the interviewee has said (in training or in practice) or would say in order to get casualties to:
 - Disrobe;
 - Implement improvised dry and wet decontamination;
 - Remain in place;
- Summary and clarification on how the interviewee approaches communication with casualties in incidents where decontamination is required;
- Any other information that the interviewee deemed relevant.

4.2.3.3 Procedure

I carried out semi-structured open-ended one-on-one interviews via telephone or Skype in March and April 2017. Ethical approval for this study was granted by the King's College London Psychiatry, Nursing & Midwifery Research Ethics Panel (reference: LRS-15/16-3406; Appendix E). Prior to the interview, interviewees read an information sheet (Appendix F) and submitted a completed consent form (Appendix G). All interviews were audio recorded and transcribed either by me or by an external transcription agency (with a non-disclosure agreement in place to ensure data confidentiality).

4.2.3.4 Analysis

I analysed anonymized interview transcripts in NVIVO 11.2.1.616 (QSR International), using the same approach to thematic analysis that I used to code recommended messages from guidance documents to message content themes. The minimum number of sources required to constitute a theme was two to avoid basing a theme on one participant's particular attitudes and experiences. Theme titles were italicised in the results report.

4.2.3.5 Participant feedback

Following completion of the study, I sent a summary of results of the interview study to everyone who had participated. Participants were asked whether the findings reflected their experience of communication in chemical incidents. Where participants elaborated on their communication technique or suggested changes to the results, consideration was then given to adjusting the results summary to take these points into account.

4.3 Results

4.3.1. Review of guidance documents

4.3.1.1 Document selection

Of the 19 decontamination guidance documents included in the previous review on psychosocial aspects of mass casualty decontamination (Carter & Amlôt, 2016), 12 were included in the present review (Department for Communities and Local Government [DCLG], 2012; Fire and Rescue Service [FRS], 2003; Governor's Office of Emergency Services [GOES], 2006; Harvard School of Public Health [HSPH], 2013; Home Office, 2004, 2013; Lake et al., 2013; Metropolitan Medical Response System [MMRS], 2003; National Ambulance Resilience Unit [NARU], 2014; State Government of Victoria [SGV], 2007; US Army Chemical Biological Radiological and Nuclear School [USACBRNS], 2011; US Department of Health and Human Services [HHS], 2014). Six documents were excluded because they did not contain recommendations about communication channels or communication messages (Health Protection Agency,

2008; HM Government, 2008; International Atomic Energy Agency, 2013; NHS, 2010; NHS Scotland, 2012; U.S. Army Soldier and Biological Chemical Command, 2003) and one (Lake, Schulze, & Gougelet, 2009) was excluded because a more recent version of the same document was already included in the review. No additional guidance documents were found by updating the search, although five additional documents were identified by subject matter experts at Public Health England (Biomedical Advanced Research and Development Authority [BARDA], 2015; Home Office, 2015; Joint Emergency Services Interoperability Programme [JESIP], 2013; National Ambulance Resilience Unit [NARU], 2016; National CBRN Centre [NCC], 2016).

In total 17 guidance documents were included in the review. One source was a training video on IOR (NCC, 2016) which contained scenes of responders communicating to actors who were role-playing casualties. This was included as a guidance “document” because whilst the format differed from a text document, the information contained in the video served the same function as a text document. Nine documents were published in the UK (DCLG, 2012; FRS, 2003; Home Office, 2004, 2013, 2015; JESIP, 2013; NARU, 2014; NARU, 2016; NCC, 2016), seven in the US (BARDA, 2015; GOES2006; HSPH, 2013; Lake et al., 2013; MMRS, 2003; USACBRNS, 2011; HHS, 2014), and one in Australia (SGV, 2007). Documents were published between 2003 and 2016.

4.3.1.2 Communication channel

Fourteen of the 17 included documents contained one or more recommendations about channels, media, or modalities that could be used to communicate information to casualties during mass casualty decontamination. One recommended communication channel was *voice amplification* equipment, such as loudhailers and public address (PA) systems on emergency vehicles, to facilitate verbal communication with multiple casualties. It was recommended that a PA system should be “on one of the first arriving emergency vehicles” (USACBRNS, 2011) and that responders should use a “calm but authoritative voice” when broadcasting via a PA system (HHS, 2014). Another recommended channel was *pictorial instructions* (e.g. Figure 4-1), such as those included in the instructions in ‘disrobe packs’ (Figure 4-2), which are supply kits containing provisions for decontamination. It was recommended that pictograms should be large and brightly coloured (HSPH, 2013). Other recommended communication channels were: *posters or signage; pre-recorded, looped audio and/or video messages to provide instructions to casualties; flyers or instruction sheets* (e.g. Figures 4-3 and 4-4); and *practical demonstration of decontamination actions*.

[Permission to reuse figure not granted]

Figure 4-1 Decontamination instructional images developed by Cambridge Public Health Alliance (Harvard School of Public Health, 2013, p. 23).

[Permission to reuse figure not granted]

Figure 4-2 Pictogram included in disrobe pack (Home Office, 2013, p. 47; 2015, p. 20).

[Permission to reuse figure not granted]

Figure 4-3 Example instruction sheet (Governor's Office of Emergency Services, 2006, p. 39).

[Permission to reuse figure not granted]

Figure 4-4 Example instruction sheet (Metropolitan Medical Response System, 2003, p. 35).

4.3.1.3 Message content

Eight of the 17 included documents (BARDA, 2015; GOES, 2006; JESIP, 2013; MMRS, 2003; NARU, 2014; NARU, 2016; NCC, 2016; USACBRNS, 2011) contained recommendations for specific messages that responders could provide to casualties. Four main themes were identified in these recommendations.

Instructional messages featured in all documents in which specific messages were recommended. Recommended instructional messages addressed: general adherence to instructions; evacuation; remaining in place following evacuation; disrobing; dry decontamination; wet decontamination; and helping other casualties.

You must be thoroughly cleaned before you can be treated (MMRS, 2003).

If you can hear me, follow me (BARDA, 2015).

Wait for the emergency services to arrive and act upon their instruction (NARU, 2014).

Remove outer clothing – do not pull clothing over head unless absolutely necessary (JESIP, 2013).

Please use this material...to remove the substance from your skin (NARU, 2016).

We are going to wash you off. Walk towards the water spray (USACBRNS, 2011).

Assist others who are less able or injured to carry out tasks - if you can (NARU, 2014).

Response efficacy messages included statements that alluded to the effectiveness of adherence to instructions as well as statements that provided more elaborate explanation as to the health protective benefits of adherence to specific forms of decontamination, such as disrobing and dry decontamination.

In order to help you and to protect your health and safety, and the safety of others, please follow our directions (MMRS, 2003).

Removing the outer layer of clothing is sufficient response to removing the hazard from you, and no further on-scene cleansing or decontamination is necessary (GOES, 2006).

Using this absorbent material to remove the substance from your skin will ensure that as much as possible is removed. Which will help to prevent you suffering any adverse effects, and will also prevent the spread of the substance to other people and places (NARU, 2016).

Messages coded to the theme of *informing casualties that they may have been contaminated* all contained qualifying words and phrases such as “may”, “might” or “we

do suspect". And, in some cases, messages explicitly *understated the threat of contamination*.

You may have been exposed to a hazardous substance (MMRS, 2003).

We have a reasonably strong belief that a substance, no matter how slight, has come into contact with you (GOES, 2006).

It is highly unlikely that any harm has come to you (GOES, 2006).

4.3.2. Interviews with first responders

4.3.2.1 Sample characteristics

All participants had experience in responding to real chemical incidents and/or in participating as responders in decontamination exercises with role-playing casualty actors. Sample characteristics are displayed in Table 4-1.

Table 4-1 Sample characteristics of interview study participants.

Emergency Service	Experience in responding to real chemical incidents (including false positive incidents)	Experience in live decontamination exercises
Ambulance	Yes	Yes
Ambulance	Yes	Yes
Ambulance	Yes	Yes
Ambulance	No	Yes
Fire & Rescue	Yes	Yes
Fire & Rescue	Yes	Yes
Fire & Rescue	No	Yes
Fire & Rescue	No	Yes
Fire & Rescue	No	Yes
Fire & Rescue	No	Yes
Police	Yes	No
Police	No	Yes

4.3.2.2 Communication channel

First responders discussed the range of communication channels available to them when responding to a chemical incident. Reported communication channels included the use of *voice amplification* equipment to facilitate the verbal delivery of messages to casualties. Discussion around voice amplification technology was primarily focused on handheld loudhailers and vehicle-mounted PA systems. The use of PA systems already installed in buildings or venues, for example in a football stadium, and the use

of helicopter PA systems were discussed but the participants had not themselves used these particular forms of voice amplification. When discussing voice amplification, participants described how they would provide casualties with a *two-way radio* and thereby communicate from a distance.

It'll be a case of somebody, whether they've got to stand on the fire engine or whether they've got a loud speaker or whatever (P3).

you might be in an area that has actually got some sort of security, or enclosed like a football ground where you can control the public and you can communicate with the PA systems ... we rely a lot on loudhailers (P5).

within our service the things that we teach them to do is the PA system on your fire engines, I don't know if you're aware of that, so basically the button that controls the sirens you flick it over and it turns into a PA system. And all our fire engines carry that. (P6).

we've also developed a method within the service where we teach them to throw a hand-held radio forward into the risk area (P6).

The ambulance vehicles rather than our rapid response vehicles, have loud hailers as part of the setup. So, what they can do is have someone sat in the cab actually then communicating over a loud hailer to everyone. (P7).

We have started carrying a loud hailer on one of our vehicles just to try and assist with the volume over a distance, just to try and keep that barrier (P10).

I have observed the operational crew are using loud hailers on front line appliances (P11).

Participants pointed out that voice amplification was not available in all response vehicles and, in one case, the participant reflected on the utility and cost-effectiveness of making voice amplification equipment more widely available to first responders.

Certainly megaphones, I think is just generally, if we're expected to go to any sort of large-scale public incident, being able to gain attention and communicate across a large group, which is gonna be noisy because people are gonna be talking and all the other stuff that goes with that would be hugely useful for this, to the point where I think it's very unlikely being able to do it without it. And they're not expensive or large. I just Googled one, I said to my boss can we have some, I Googled it and it was like, you know, a tenner for one, they fold down and it's quite a small thing. (P1).

We have got loud hailers and they do... there are some police vehicles that carry the loud hailers, but not all of them. And if it was really... if you're really, kind of, faced with... And if we've got time yes, we can call upon a loud hailer, or a police vehicle with a loud hailer on it (P12).

Pictorial instructions, such as pictograms in disrobe packs, were discussed when participants described the ways in which they would guide casualties through the decontamination process. Participants also discussed the use of *physical demonstration* (e.g. miming disrobing and dry decontamination) as a means of

conveying required actions to casualties. One participant reported that they used physical demonstration to convey instructions when casualties were non-anglophone. The use of *gestures or cues*, for example placing blue roll in front of casualties, was cited as an approach used to encourage self-decontamination.

We have done this with, potentially, non-English speakers so what we've had to do then is we have had to basically do the best we can, even to the point of we've... so the emergency services themselves, we've actually tried to show them, so we've basically mimicked, we've done something and tried to do a bit of hand signal ... so they've followed what we actually did. (P3).

We're sort of, miming, we're sort of gesturing with our hands what they need to do ... we sort of, would get a handful of blue roll and sort of, try and show them what we're expecting. Brushing it off of them, brushing it downwards, brushing it away from them. ... And sort of, imitating what we want them to do so they can try and copy us. (P4).

If a casualty is basically right, you don't know whether you've got contaminant on you or not, we'll then issue a disrobe pack and let them read it and then actually get them to go through the pictographs themselves, we won't touch them, nothing. Make no touching nor movement towards them. ... Our only method at the minute is to hold up a pictogram and say, this is what you've got to do. (P5).

You need to keep it short and you need to keep it direct because people can tend to work things out, you start pointing at buckets and pretending to wash your face. People pick up on that quite quickly, as opposed to trying to explain it saying: well, you're going to do this first, you're going to rinse this and then you're going to wipe this or you're going to take this blue roll. You know, quite often it's easier just to grab a piece of the blue roll and physically rub it across your arms or your face, as opposed to trying to explain it. And it tends to get a lot more direct results quicker. (P6).

Depending on whether it's going to be a wet decon or a dry decon, by putting something in front of them quite quickly, whether it's blue roll or buckets depending on which direction we're going in, again, focusses their mind and they all tend to huddle around that equipment (P6).

They're told to have a look at the cover that shows the pictorial diagram, open them up, and if they can follow the guidance (P11).

Participants discussed the use of *lights and sirens* on emergency response vehicles as a means to capturing casualties' attention in the first instance.

Put the blue lights on give a blast of the sirens just so it focuses everybody. ... We will blast the horns on the appliances, put the blue lights on just so everybody looks at us (P3).

Communication in the absence of equipment or technology was discussed when participants reflected on the use of *verbal communication without voice amplification technology*.

We don't have anything really, we don't have any megaphones or anything like that, it's simply about shouting (P1).

So I sort of parked it [the car] up with the passenger side toward where the group was assembled and shouted out from sort of only 20-25 metres away (P10).

Casualties themselves were discussed as a potential channel of communication from responder to casualties. Participants discussed how, in exercises, they would *nominate a casualty as a spokesperson to relay instructions from responders to other casualties*. The stated advantage of the approach was that it reduces the size of the audience to whom the responder would need to disseminate information. Spokespeople would be selected from the crowd of casualties based on whether they were known to having a military, medical, or emergency response background or based on whether they demonstrated signs of being an “obvious” or “natural” leader. One participant stressed that they had only used the approach under exercise conditions and were unsure as to whether the nominating of a casualty spokesperson would be an effective and practical means of communication in a real incident.

One of the things that I did find quite useful from a mass decon point of view during exercises was using a stooge. ... If you're communicating with one person, rather than communicating with dozens of people, you can get one person to shout out, you know, "I want you to follow what I'm doing". So we found that to be quite useful but that's very much in a staged environment, I don't know how it would work in the general population. From a mass casualty point of view, certainly in the staged environment, that seemed to work reasonably well. It was something we didn't start using until the latter exercises. And it was because I witnessed it somewhere else, to be honest, that I actually started using it, where you've got a natural leader, who's like, "Right guys, listen in, do this". It was like, I actioned that. It's much easier communicating with one person rather than trying to communicate with dozens of people at one people. ... there's always one obvious leader amongst them –the noisy one in there. And if you can get them on your side, I found that was quite useful. (P2).

I think you would look for the most coherent and engaged person, and try and develop an initial rapport, and then ask them if they are willing to be your spokesperson. ... If I put fire gear on and a face mask, that's a big barrier to good communications. So if there's someone who is already, or who is possibly, affected; then they could be good. And obviously, you could ask people if they're military, emergency service, doctors, nurses; someone who has a degree of responsibility or seems willing to do so. So if you found out if there are people within that group who are from an emergency sort of responsible background, then maybe they can be used as an asset to pass the message around. (P11).

4.3.2.3 Message content

All participants reported that they did not have access to a script for communication during mass casualty decontamination and arguments were made about the *impracticality of standardising or scripting communication* due to the need to be able to

adapt communication to different situations and different casualty populations. When prompted for specific examples of things said by responders, responses tended to focus on the approach to communication that they would take.

Training was very much focused on the fact that you have to adapt how you communicate with people depending on the circumstances (P2).

You see it, you can't have a specific set way of talking to somebody. ... You can't have almost like [have] a script because you don't know what it is you could be doing (P3).

We don't have a script as such, and I think that would be hard to do purely from the dynamics and the demographics of where we're based. Obviously, being the brigade that I'm in we can go into quite large Asian communities, we could be going to quite a large Somali community and we've got quite a large Eastern European community as well, so it's quite difficult to have a scripted approach, it's got to be more dynamic than that. (P6).

You take every incident as you see it, so you... I think you are allowed to assume some things and you have to pre-script and pre-load as you respond to any incident, really. But when you get there, things certainly change and you have to adapt what your initial thoughts were before you arrived. (P11).

There's nothing scripted because that, again, under pressure it would be difficult for officers to remember (P12).

Participants reflected on specific, discrete statements that they had made when speaking to casualties either in real incidents or in exercises. All participants recalled the use of *instructions*. Actions for which instructions were targeted included general adherence to instructions; evacuation; remaining in place following evacuation; disrobing; dry decontamination; wet decontamination; helping other casualties; and refraining from eating, drinking or smoking.

"This is what I want you to do. I want you to move away from the hazard" (P1).

"Right, there's the shower, it's in the front garden. Go and get washed off" (P2).

"What I want you to do now is to put your arms into that water there" (P3).

"Come towards the sound of my voice" (P4).

"I am telling you, you will remove the clothing and you will go into the shower" (P6).

"Okay, everybody, you all need to take your outer clothes off" (P8).

"Please come towards me, walk towards me now, and as you're doing so take off your top layer of clothing" (P12).

Messages coded to the theme of *threat severity* included statements about the personal adverse health consequences for the casualty if they do not adhere to responders' instructions as well as statements about the consequences for other

people, including loved ones, who may be contaminated by coming into contact with the casualty if they self-evacuate without undergoing decontamination. References were also made to *stating the likelihood that casualties are contaminated*.

“As far as we’re concerned you’re all contaminated” (P3).

“If you leave here and you go home there’s a chance that you can put your loved ones at risk” (P3).

“Look, you know, the belief is you have been contaminated in something” (P6).

“What you’re wearing at the moment is covered in a chemical, it will slowly but surely soak through your clothing and it will start to, potentially, damage your skin and cause you problems” (P7).

“If you go home without any level of assessment carried out on you, and possible decontamination, would you want to go home and spread something that we don’t know that’s on you on to your loved ones” (P11).

When recalling severity-based messages that they had used, participants discussed the rationale for this type of messaging and reflected on how describing the risks to casualties and their loved ones would motivate casualties to adhere to instructions.

So we kind of... it’s almost like giving them a bit of a guilt complex (P3).

Fear might be the most effective way of containment (P10).

Whilst severity-based statements had reportedly been used in communication by half of the sample, all participants recalled using messages that were coded to the theme of *reassurance*, for example to reduce anxiety or distress. Reassurance comprised a range of message types. In most cases, reassurance consisted of highlighting that *medical assistance will be provided* or highlighting the *response efficacy* of adhering to responders’ instructions. Messages coded to the theme of response efficacy were specifically discussed by participants with reference to motivating casualties to adhere to instructions. Reassuring messages also included *stating that casualties’ privacy and modesty will be protected*.

“Medical care is on the way” (P1).

Try and explain to them that the best thing for them is to get that clothing off of them, I know it’ll take up to 80% of the contaminant off of them but telling them that it’s the best thing for the (P4).

Normally if we’re telling them that is the safest thing, taking your clothing off reduces the decontaminants, or trying to get that message across, they normally do it (P5).

“By removing that clothing, you’re going to remove the majority of that contaminant” (P7).

Try and calm them down and just make them aware that, you know, they are

going to be put into something to maintain their dignity (P9).

“If you remove your outer layers of clothing, that's going to give you the most... be the most help for you. It's going to remove most contaminant. ... Look, we know what we're doing and that's the best thing you can do is to release that outer layer and wipe away from your face and stuff; and that's scientifically what's the best for you”. (P10).

“Help is on its way, medical attention is on its way, please come towards me now” (P12).

In some cases, participants discussed how they would *understate the threat of contamination* to reassure casualties.

“You're gonna be alright” (P1).

“What we're doing here is belt, braces and a bit of string”. ... It was trying to just reassure them that “we are going through this process but I'm 95% certain that it's not necessary” because they weren't displaying any symptoms by the time I got there. (P2).

We try and tell them that it's going to be okay, and they're going to be fine even though at that point we probably haven't got a clue what it is that they're contaminated with or the problem is. But mainly it will be: “don't worry, calm down; you're going to be fine”. (P8).

Participants recalled explicitly *acknowledging that aspects of the decontamination process may be difficult for casualties.*

“This may take some time, we need your patience, we will get these things sorted out as soon as we can but it may take some time” (P8).

We always warn them that they are going to get wet; but that the water is obviously warm, not freezing cold, and they would be fairly, you know, decontaminated in detail, shall we say (P9).

“It's going to be cold, but, sorry it's a necessary evil” (P12).

Despite the fact that the interview schedule was tailored towards unidirectional communication from responders to casualties, a minority of participants recalled *asking casualties for information.*

“Is anybody injured? Is anybody in need of first aid?” (P3).

...asked them if any injuries have occurred, have they got any burn sensations, have they got any hearing problems (P5).

Mainly it's: are you all okay, is everything okay? (P8).

4.3.2.4 Communicator

Participants reflected on who should communicate with casualties. Whilst there was recognition that the first person on scene would need to be the communicator,

participants primarily reported that there was an ideal type of communicator, specifically a person with authority, such as an Incident Commander or Watch Commander.

If you just passed it to a generic firefighter and say: that's now your job it will start to fall apart quite quickly. You want people that are naturally quite disciplined and, you know... I come from a military background so I find it very easy to - not being horrible - shout at people and organise them in that form. Whereas if you give it to a part-time firefighter or a relatively new recruit, they haven't got the confidence to be quite bossy, does that make sense? You know, so it needs to be... you need to make sure that the... whether it's the watch commander or the crew commander that's in charge of the fire engine or whether it's someone on the watch that are quite a strong character to do it, because you need to relay that in your voice as well. So, if for example you're just shouting it across the car park because you know, they're not... you haven't got to that stage where you're in protective suits or anything again, you need that voice to carry, you need to be quite direct to what you need to do. (P6).

I would think they would be told by a senior officer who would be suited, you know, he would make himself heard that they were going to be X, Y and Z done to them (P9).

It could be a random rapid response paramedic who's first on scene, or a police officer or, you know, just... for its [IOR's] impact to be there it's got to be easily implemented by all levels, I guess (P10).

There were conflicting perspectives on which of the main emergency services would be most suited to communicating with casualties in a decontamination incident. Each of the three main emergency services were cited as the most suitable communicating organisation. In most cases, a member of an emergency service cited their type of service as the most suitable but, in one case, the participant cited their service as less suitable than either of the other main services.

We [fire service] don't have maybe the same experience and understanding of how people behave that maybe the police will have cos everything they do is with people. The ambulance, again, all with people. Ours is much more often to do with, sort of, how do you put it – buildings, natural sort of phenomena, fire, water, whatever it might be. The people are usually either incapacitated and needing rescuing or put outside a cordon and dealt with, again, by the police or, if they're injured, ambulance. So suddenly coming across mass decon which requires us to engage with people or mass casualty events where we become part of the health administering medical care, I think would be quite unusual for us and I don't think we'd have the same awareness and ability as the police and the ambulance would naturally have. ... If we go to a house on fire, we don't, in the crudest way, we don't talk to the fire. We just get on with what we need to do. We communicate between ourselves as a team. (P1).

The fire service does achieve being quite direct, literally in the fire service we do that quite well. You know, certain police officers do that quite well in terms of how they deal with someone you know, kicking off in a pub and things like that. The ambulance service tend to struggle with that, because it's not in their, sort of... they don't really need to do it on a regular basis (P6).

having a police officer telling you that you're not allowed to move and you've got to stay there and basically kettling you probably isn't going to come across as well as when you've got someone through ambulance service in green who is there to help you (P10).

Participants discussed the role of the sight of the communicator's full-face personal protective equipment (PPE) and the sound of a "forceful" vocal tone in capturing casualties' attention and encouraging adherence to instructions.

It's not barking orders to them, but I need them to understand. So, I'm not quiet but I'm quite... how shall I say? I'm not like a dictator shouting orders to them, I'm quite forceful in what I'm saying because I want them to look at me and listen to what I'm saying because there's going to be a lot of other stuff going on as well. ... You've got to have that initial forceful voice and then when everybody turns and looks at you then you bring your tone down (P3).

They'll look at you like you're mad, telling them to get undressed. And then I think when they realise and they start seeing people with breathing apparatus getting put on and stuff like that I think they realise they may have something nasty on them and we're serious, and then they'll slowly but surely comply ... I think they realise the seriousness of it when we've come crashing through their door dressed in full-face respirators. (P4).

4.3.2.5 Communication barriers

Participants reported that due to the risk of responders becoming contaminated by exposure to contaminated casualties, it is necessary to either maintain a safe distance from casualties or approach casualties wearing PPE (Figure 4-5), such as self-contained breathing apparatus that covers the whole face. These measures were reported to make communication between responders and casualties more difficult.

I think the greater level of PPE... it becomes harder to communicate because you get more and more difficult actually seeing, people seeing your face, hearing your voice (P1).

The problem is that the PPE that these forward personnel are wearing, that restricts the communication (P5).

But you've got to look after yourself as well...it's distance, which can bring in, introduce problems in terms of communication (P12).

The other communication barriers that participants either expected or experienced were casualties not understanding English or having difficulty hearing the responders and responders having difficulty communicating face-to-face with a large number of casualties.

You've also got foreign casualties as well; that's when the communication problems becomes a lot more difficult and we rely heavily on the pictographs (P5).

Depending on the community that you're working in, English might not be their first language (P6).

Now that was easier to a nurse who sort of, understood the concept and there's one individual, but if you had that as 10, 15 perhaps 20 people; it would be incredibly difficult to try and explain that because you'd probably end up explaining it about five-ten times over. ... It was just a case of you know, because it was a one-to-one I could have that conversation with her. You know, she stood at the face shield of my gas tight suit and I could explain to her what I wanted her to do. But like I say, if it was a larger group you would really struggle to do that. (P6).

It's a difficult one depending on both how... not just the communicating, the reason for doing it, but being able to communicate in the first place; whether people can actually communicate in English, if they've got an understanding of the language. And that's a whole new ball game. (P7).

That's where the real challenge is going to come in, where you've got massive numbers of people (P10).



Figure 4-5 An illustration of the communication challenges posed by full-face Personal Protective Equipment worn by first responders (image reproduced with permission from Public Health England).

4.3.2.6 Coercion

Although it was never prompted, the subject of using force to decontaminate casualties was raised by a small minority of participants. When the coercive approach was discussed, it was typically alluded to then disregarded but in two cases, the perceived advantages of coercion were discussed. In one case, the participant even discussed the use of coercion in a decontamination exercise.

Ultimately what we're going to do, we're going to arrest them, we're going to lay them down, we're going to cuff them and then we're going to drag them through. Put them on stretchers and actually forcibly decontaminate them. You know, that's the ultimate we've got to do; because, you know, we've got to clean them, we can't leave them contaminated out in the field for the next day and a half until they change their mind. ... We've run a couple of exercises, for example, where we've got... we've had a female that wouldn't go through because she had issues around obviously stripping off, removing her clothing, modesty etc. And then we had another individual that wouldn't go through for religious reasons; you know, they wouldn't take their headwear off and things like that. So again, although they were staged it proposed problems to the crews. And again, the ultimate one was, one of them we managed to convince to go through, but the guy that we had has played the part that wasn't going to remove any headwear. ... It was a case of we got the police to basically arrest him, take him to the ground and then we basically cuffed him, removed his headgear and then took him through the showers (P6).

So if an individual or a group of individuals don't want to comply, you'd ask them politely to please comply; but if not there's not a lot you can do. You can't ask the police to go and shoot them. It would be easier, because then there would be shoot one, save a thousand. I think people who weren't ready to comply as soon as they saw guns they would be, oh, it's best I can comply now, because that could hurt (P11).

4.3.2.7 Expectations regarding casualties' psychological state and behaviour

Although the interview schedule was focused on responders' recollection of their approach to communication, almost all participants volunteered unprompted reflections on casualty behaviour and the psychological basis of casualty behaviour during the course of discussion. Participants reported that casualties would be *stressed and impatient* though this was predominantly raised as an expectation or assumption rather than as a recollection from a real incident. Participants reflected on how stress would make it difficult for casualties to follow instructions and make it more likely that they would self-evacuate to their home or to a hospital.

I mean, even, going back to the IOR packs, they're not straightforward to use... Now if that person's panicked or in some way is riled up because of what's just happened, that presumably in a hostile environment is going to become even harder (P1).

For a casualty, you know, it can become very scary, a very... panic situations. And there, I think most people would try to get out (P5).

I think we would have a lot more panicky patients, a lot more you know, grumpy, upset, 'for God's sake do something'; you know, especially if people would be suffering ill health and pain from being exposed to anything they would be a lot more anxious (P8).

Conflicting attitudes were raised about the use of commanding or controlling casualty management approaches in response to anticipated stress.

I'm not... convinced command and control is the best way to, sort of, don't know, if you start trying to push people into lines to go through a shower, people are already wound up, are you just going to make it worse? I don't know (P1).

You need to get physical with them, you need to literally almost line... treat them like recruits, line them up physically and then point to what you want them to do because if you try talking to them, if they're in distress they don't really listen (P6).

Participants stated that the *provision of information and treatment would facilitate casualties' trust and improve compliance* and that providing explanation about the benefits of decontamination would improve compliance with instructions, including the instruction to disrobe.

I think you want to be open and honest as much as possible. You want to give information. I think, the more information- I don't think it matters- in some ways I think it's about whether people trust you so I think if you're giving plenty of information, I don't think people necessarily compute that information or know what you do with it cos they're in a pretty unusual situation so I don't think it's got anything to do with necessarily, them actually weighing up and computing this information in sort of a rational logical manner. But I do think that they have information, if you're willing and forthcoming with it, explaining what's happening, why you're doing what you're doing, and almost trying to build a rapport with the crowd. You're trying to build trust with the crowd, with the group, whoever it might be so that you are –they view you as there to help them and being legitimately there for that reason without any other, sort of, issues going on. And you sort of bring them into a part of the solution maybe. I think then people will be more likely to be compliant. (P1).

It's trying to just talk to them to let them know exactly what's happening; because a lot of the people, and we've certainly seen it with a lot of people, the lack of information sometimes is worse than anything else because they can see things happening, but they don't understand why they're happening. ... I think once people are then informed, they can then make the decisions to remove stuff. And I don't think you'll have a problem with anyone following instructions if they are informed of the reasons behind why they're doing it, why we're doing it, and benefits to them of them complying (P7).

I think for me if someone just came up to me and told me to take off my clothes or even take off all my clothes... I don't think I'll be too happy, but I think if you try and contextualise it, and try and give someone a reason for it; yes, I think that helps (P10).

Compliance with instructions was believed to be influenced by factors beyond communication. For example, participants believed that *casualties would find it difficult to disrobe in view of other people and cameras* and that *casualties would be unlikely to disrobe unless they feel the physical symptoms of chemical contamination*.

I know the initial thing wasn't to take everything off but that's not a real life thing, it's not going to happen, you're not going to get people to do that unless they're absolutely covered and absolutely plastered in the stuff and they're really in some sort of stress (P3).

Initially they do look at you like you're talking rubbish, and there's no way they're going to strip off in front... because there may be a crowd even if the crowd's 100 metres back it's just a sea of camera phones pointing at them, and you're telling them to strip off down to their pants and that (P4).

If they were suffering in terms of got irritation or a burning sensation or they were struggling to breathe, I don't think you would struggle to get people to strip off and go into a shower, if I'm perfectly honest (P6).

Certainly from what I've seen, most people have been quite happy with how the process has gone. I think it's just the same problem over and over again, is that sudden realization that people are having to take off their clothing in view of a lot of people; and I certainly wouldn't be happy doing that (P7).

Participants stated that there would be *differences between different casualty populations in terms of their perception of and interaction with authorities*, particularly police officers.

I think the police see that most clearly, if you go to certain demographics as a police officer, you're gonna be received, probably again to do with trust, you're gonna be received much more kindly than in other demographic areas and I think, same with the fire service is that, depending on who's been contaminated and depending on their relationship with the state, authority, fire service, it's gonna influence how they then react to it (P1).

People can start to get angsty, there's some people who aren't on terms with the police and they then spread unrest through the group and stuff, it then leads to a scene, I guess (P10).

4.3.2.8 Communication training

Participants reflected on the training they had received in communication during decontamination and in some cases the training was regarded by the participant as insufficient.

So I think part of the problem is that that's not really laid out but it's a really crucial element cos IOR is really quite basic because it's effectively getting people to take off their clothes, dab themselves off, and then move away from a hazard. So it's almost entirely based around actually communicating, getting people to co-operate but all of our processes and procedures are based around the process part. And so I think you'd see very differently between each crew that turned up exactly what they would do, probably based on their own perceptions of what they're likely to encounter. (P1).

Not a lot of that [training], no. The IOR, when it first came out, we had like, an e-learning package and a video to watch and that was basically it (P3).

Yes, I've been involved initially with IOR when that started rolling out, and I had one input up at the National Centre on how people react and public reaction and communication and who they trust and who they don't trust within a position of authority in a CBRN event (P4).

Okay, so part of that, sort of, initial roll out and ongoing is how we explain to the crews and the firefighters how they're going to try and communicate the instructions to the members of the public. Whether it be through IOR or through

mass decontamination and the best methods for processing those individuals through the systems that we need to put in place to get them decontaminated. (P6).

Many participants reported having participated in live decontamination field exercises with role-playing casualty actors and participants specifically discussed the *limitation of exercises as tests of the effect of communication* on adherence in a real incident due to the artificiality of role-playing casualties' behaviour. Role-playing casualties reportedly either went through the motions of the exercise or portrayed the 'character' of 'non-compliant casualty'.

If you tell them to do something they basically do it because that's what they're there for (P1).

We have exercises where people are just told to go with what happens and then there's exercises where people are told to just hang back and panic a bit and say they can't hear and this, that and the other (P3).

A lot of people's exercises I was going to it was always going to be 10 or 20 off duty squaddies or students that when you say to them strip off, they'll strip off (P6).

Usually when we do live casualty play, we use actors from various backgrounds and they are usually instructed to be as difficult as possible. So if you do not tell them exactly what to do, then they'll carry on their own script (P7).

And it's role playing, so it's hard to gauge how at a real incident people would behave and react to good communication (P11).

4.3.2.9 Feedback from participants following the submission of summary report

Aside from statements of agreement with the summary of themes reported above, feedback included reference to an exercise in which scripted signage, specifically an enlarged version of the pictogram included in the disrobe pack (Figure 4-2), was used. The participant stated that "discussion moved on to disabilities, learning difficulties, foreign language". One participant reiterated that the tone of the responder was important and explained that, when responding to incidents, a "direct assertive voice" gets results from the public whereas, in their experience, a softer tone "does not get the results especially from scared and stressed individuals who are looking for that guidance".

4.4 Discussion

The aim of this study was to ascertain the current standard practice of communication during the Initial Operational Response to mass casualty chemical incidents by synthesising recommendations across guidance documents and by identifying trends in first responders' experiences in communication with casualties during decontamination. Several key findings were identified with regards to the communication methods and

types of messaging both recommended to, and reportedly used by, first responders during decontamination.

4.4.1. Communication channels

Guidance documents and interviewees cited a wide range of available communication channels. The literature reviews reported in Chapters 2 and 3 provided no empirical support to justify the use of one channel over another. Using multiple channels to communicate consistent information could be effective at promoting trust and adherence based on findings from the broader review (Chapter 2). The use of voice amplification, for example via a handheld loudhailer or vehicle-mounted PA system was the only cited communication channel that allowed for both verbal communication and the capability to adapt the message during the course of an incident. Speaking with voice amplification, as opposed to pre-recorded messages in the form of signage, pictograms and recordings, allows the communicator to adapt messaging as more information becomes available about: the contaminant; the actions responders are taking; the actions casualties are required to take; and any other events that occur.

Interview participants made reference to communication barriers including the need to communicate with multiple casualties and the need to either maintain distance from casualties or only approach casualties whilst wearing PPE, making communication more difficult. Voice amplification technology enables a responder to communicate with multiple casualties from a safe distance. Consideration would need to be taken to ensure that voice amplification systems can be heard above extraneous noise, such as the sound of fire engines running water for an interim decontamination shower. However, as a pragmatic step to ensure that messages are heard, emergency response organisations that respond to chemical incidents should ensure that responders have access to voice amplification technology.

4.4.2. Communicator

Whilst interview participants expressed views about messenger characteristics, including reflections on which emergency services would be best suited to communicating, in practice the issue may be a moot point. Findings from the review reported in Chapter 2 indicate that, to promote trust and adherence, information needs to be communicated as soon as it is known by the authorities. Moreover, as reported in Chapter 1, delaying decontamination undermines its effectiveness. Delaying communication until someone from the 'correct' service or someone with the 'correct' personality is available is therefore not possible during IOR. Instead, communication training for mass casualty decontamination, particularly at the IOR stage, should be applied as extensively as possible across the emergency services. Given that several

participants discussed perceived advantages and disadvantages of different emergency services or post-holders taking charge of communication, it may be that training should be adapted to emphasise the importance of the 'person on the spot' as being the best communicator, and that waiting for someone else to arrive is not an option. If the first person on scene is the person who needs to communicate with casualties, then any responder who could be deployed to the scene of a chemical incident needs to have high perceived self-efficacy in communication. Findings from studies on the effectiveness of training courses in patient communication for healthcare professionals (Hsu, Huang, & Hsieh, 2014; Nørgaard, Ammentorp, Ohm Kyvik, & Kofoed, 2012; S. Wilkinson, Linsell, Perry, & Blanchard, 2008; S. Wilkinson, Perry, Blanchard, & Linsell, 2008) indicate that training in communication with casualties would be an effective approach to improving responders' self-efficacy in this proficiency.

4.4.3. Coercion

Decontamination via physical force, or threat of physical force, was discussed by responders in the interview study. Coerced evacuation and confinement may have legal precedent. Under the terms of the Civil Contingencies Act 2004, a senior Minister of the Crown, such as the Prime Minister, "may make emergency regulations" if urgent provisions are warranted to prevent, control, or mitigate "an aspect or effect" of an emergency that "has occurred, is occurring or is about to occur". Emergency regulations include the authority to "prohibit, or enable the prohibition of, movement to or from a specified place" and to "require, or enable the requirement of, movement to or from a specified place" (Civil Contingencies Act, 2004, pp. 15-17). In the context of IOR, this authority would only apply to evacuation and containment. Clearly however, this a legally complicated issue. Proper interpretation of the Civil Contingencies Act 2004 would require input from a legal expert.

Discussions of the Civil Contingencies Act may also be moot. Forced decontamination of those who have the capacity to consent to undergoing decontamination but choose not to, is likely to be unethical and impractical. In terms of ethics, the use of physical coercion runs counter to the principle of patient autonomy, discussed by scholars of healthcare ethics (Trotter, 2007). Regarding practicality, in a mass casualty incident there are unlikely to be the requisite resources and personnel to forcibly disrobe and decontaminate every casualty. The likely media presence and video recording capabilities of members of the public with smartphones would publicise cases of responders forcibly decontaminating people and this would potentially have an adverse effect on the reputation of the responding agency. As discussed in Chapter 2, the Elaborated Social Identity Model predicts that crowd behaviour would be influenced by

the actions of responders. If the behaviour of responders is perceived to be illegitimate, this can lead crowd members to unite to challenge emergency responders; conversely, where responders' actions are perceived to be legitimate, this promotes compliance and cooperation from crowd members (Drury & Reicher, 2000; Drury, Stott, & Farsides, 2003). In the case of IOR, if responders were to attempt to force casualties to decontaminate, there is a risk that this behaviour would prompt reactance and hostility among the casualty group, which would have detrimental effects on the efficiency and effectiveness of decontamination. Rather than attempting to physically force casualties to undergo decontamination, it is therefore both morally and logistically more appropriate for responders to communicate about the importance of decontamination.

4.4.4. Message content

In terms of the actual messages delivered to casualties, instructional messaging about actions casualties should take was cited in all guidance documents in which recommended messages featured and was reportedly used by all interview participants. This is a promising finding given the empirical support from the previous two chapters for the positive effect of providing information about protective actions that should be taken on adaptive behaviour change during an emergency (Amlôt et al., 2017; Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015; Glik, 2007a; Mileti & Sorensen, 1990; D. D. Sellnow et al., 2017; Sutton, Vos, et al., 2018; World Health Organization, 2017). Instructional messages cited in this study typically took casualties through each step of the process, with varying degrees of detail. Synthesis of findings from included studies in the systematic review reported in the previous chapter highlighted the effect of justifying the adoption of target behaviours on casualties' adherence to evacuation or decontamination instructions. In Chapter 2, I explained that, based on predictions of Protection Motivation Theory (PMT) (R. W. Rogers, 1975, 1983) and the Extended Parallel Process Model (EPPM) (Witte, 1992, 1994), justification should consist of information about: the severity of the threat; casualties' susceptibility to hazardous chemical exposure; the efficacy of IOR at reducing the threat of contamination; and casualties' self-efficacy.

In the present study, interview participants recalled explaining why adhering to responders' instructions was necessary by a) referring to the severity and likelihood of contamination and b) explaining the efficacy of disrobing and showering at reducing contamination. Severity messages reported by interview participants included highlighting both the personal consequences of not undergoing IOR decontamination and the consequence of self-evacuating and potentially contaminating other people, including loved ones. Concern about this risk is well-founded. Following the sarin attacks in Matsumoto and Tokyo in 1994 and 1995, rescue and healthcare staff were

treated for exposure to off-gassing from casualties who had not been decontaminated (Eckstein, 1999; Rebera & Rafalowski, 2014). However, no guidance is given in official documents as to the importance of informing casualties about the risk of secondary contamination were they to leave the scene.

Messages aimed at informing casualties that they are contaminated that were found in guidance documents introduced a level of ambiguity as to whether the threat is certain for all casualties who hear the message, with qualifying words and phrases that casualties “might have” contaminant on them or that there is a “suspicion” or “strong belief” that they are contaminated. Furthermore, there were two recommended reassurance statements in guidance documents that understated the threat of contamination, “it is highly unlikely that any harm has come to you” and “you’re going to be fine”. Interview participants also made references to understating the threat of contamination to reassure casualties. It is possible that this type of messaging, whilst aiming to reduce casualties’ anxiety could potentially reduce adherence to instructions. As stated in Chapter 2, unsubstantiated reassurance is discouraged in the literature on disaster risk and crisis communication (Glik, 2007a; Rubin et al., 2012; Sorensen, 2000; World Health Organization, 2017). If the casualty is symptomatic then a statement from a responder along the lines of “you’re going to be fine” would be perceived as objectively false, reducing levels of trust. If the casualty is asymptomatic then such a statement might reduce the motivation of the casualty to engage in self-protective behaviour (Witte, 1992, 1994). Based on PMT and the EPPM, a more effective form of reassurance would be highlighting the efficacy of decontamination actions at reducing the threat rather than downplaying the threat itself.

Based on findings from studies included in the systematic review reported in Chapter 3, information about actions responders are taking would help to improve perceived legitimacy of responders and by extension compliance with decontamination instructions (Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015). Interview participants reported the use of statements about provision of medical assistance and protection of privacy and modesty. It is likely that this information would also improve casualties’ self-efficacy perceptions, particularly regarding disrobing, which is likely to improve adherence to IOR based on predictions of PMT and the EPPM, though further investigation is required to test this assertion.

4.4.5. Limitations

In this study, assessment of the standard practice for communication was based on: recommendations in guidance documents; responders’ reflections on what they would say in a real incident; recollections about communication with simulated casualties in

exercises; and recollections of information disseminated to casualties in real incidents. Each of these approaches has limitations.

With regards to recollection of communication with real-life casualties in the interview study, most reported cases were from incidents involving a small number of casualties, in some cases one casualty, so communication approaches that were reported to be effective in these cases may not be feasible in a mass casualty incident. Furthermore, interview participants explicitly acknowledged the limitation of inaccurate recall of words spoken to casualties both in exercises and in real-life incidents.

Half of the participants in the interview study had only interacted with role-playing casualty actors in decontamination exercises. The perceived artificiality of decontamination exercises, in which casualty actors are either required to follow instructions for the purposes of the exercise or are briefed to be obstructive to 'test' responders, was raised by participants. However, artificiality aside, the manner in which responders communicate with casualties in exercises when they are being monitored by official observers may reflect their perceptions of 'best practice' communication.

Whilst the sample size for the interview study was small, low variability in coding frequency for the themes of communication and message content indicated that the sample size was sufficient to answer the research question of how responders typically communicate and what they say to casualties during decontamination. In previous research on data saturation, a sample size of 12 was found to be sufficient to achieve saturation when the structure and content of the interview schedule are consistent across participants and when there is homogeneity in the knowledge, experiences or perceptions of participants (Guest, Bunce, & Johnson, 2006). The schedule for the present study was focused on specific instances of responders' use of communication. It was not an exploratory study on responders' attitudes toward broad concepts such as casualty behaviour in emergencies, which would have warranted a larger sample size. Participants in the present study were all emergency response staff who had taken part in decontamination exercises and/or responded to hazardous chemical release incidents. This use of a focused interview schedule and homogenous sample meant that the sample size was probably sufficient.

There was an anticipated risk of participants reporting on what they perceived to be optimum communication and not on how they actually communicate with casualties. A concerted effort was made to mitigate against this risk, as indicated in the preamble to the interview schedule in which participants were informed that the interview was not a test with a "right answer". However, it is not possible to rule out the possibility that

interview participants volunteered what they considered to be “best practice” when asked what they would say or what they have said to casualties. However, even if this were the case, the responses still reflect current perceptions on what constitutes effective communication and therefore provide insight into how responders are currently likely to communicate with casualties during IOR decontamination when attempting to follow best practice.

The approaches used to ascertain the standard practice of communication were limited to a guidance document review and interview study. Interview participants discussed the inaccuracy inherent in recalling previous instances of communication. Guidance documents were more focused on the technical parameters of decontamination, such as shower configurations. More comprehensive understanding of current standard practice of first responder communication in chemical incidents requires more robust methods. The first proposed measure would be a cross-sectional survey deployed to first responder agencies to assess the prevalence of communication practices identified in this study. An alternative approach would be an observational study in which casualties, played by research confederates, are instructed by participants sampled from first responder populations to undergo the same decontamination procedures. The responders would be audio recorded and a standard practice intervention would be derived from trends found in the transcripts of the recordings. However, the artificiality of such an approach and the potential for demand awareness would still limit the study’s validity as a measure of standard communication practices during mass casualty decontamination. A more objective measure would be to analyse data from body cameras worn by first responders in real chemical incidents to identify trends in real-life communication. Such an approach would also allow for assessment of the impact of different communication approaches on casualty behaviour.

4.4.6. Conclusion

Findings from this study pertaining to message content are promising as they indicate that theoretically effective messages are currently in use though it is not possible to assess prevalence of usage from the outcomes of this study. But there was also an apparent lack of a script or standardised approach to messaging. Interview participants also stated that, based on their experiences, it was impractical to script communication. This suggests that first response staff need to be trained to communicate using simple, easy to recall principles, rather than trained to memorise a script. On completion of this PhD, a script will have been developed and tested and, whilst this can be used as an exemplary guide, scope should be allowed for tailoring the script to the parameters of each incident. The next step in the process of developing these principles is to examine

how members of the public are likely to perceive the risk of chemical contamination.
The execution of this task is reported in the following chapter.

Chapter 5 Interview study to understand lay public mental models of acute chemical contamination and emergency decontamination

5.1 Introduction

The Initial Operational Response (IOR) to a mass casualty chemical incident consists of: evacuation from the source of the hazardous chemical; rapid removal of contaminated clothing; implementation of self-decontamination with either absorbent materials or water, depending on whether or not the contaminant is caustic; and remaining in place until specialist decontamination resources arrive (Home Office, 2015; Joint Emergency Services Interoperability Programme, 2013, 2016; National CBRN Centre, 2016). As explained in Chapter 1, the success of IOR decontamination as a countermeasure is contingent on all casualties adhering to this protocol. Theories and supporting studies discussed in Chapter 2, such as Protection Motivation Theory (PMT) (R. W. Rogers, 1975, 1983) and the Extended Parallel Process Model (EPPM) (Witte, 1992, 1994), point towards the inclusion of information about the threat of contamination and the efficacy of decontamination as information that would be conducive to successful promotion of adherence. As observed in Chapter 4, responders are currently advised to provide information about response efficacy, though this recommendation was not standardised across all reviewed documents. A proportion of first responders revealed in interviews that they have previously provided casualties with response efficacy information and have also informed casualties about the likelihood that they have been contaminated. But this type of messaging was not reportedly used by all participants and some reported preferring to offer reassuring words downplaying the likelihood of contamination and suggesting that decontamination was simply a precaution.

Whilst providing information about the level of threat or the response efficacy of decontamination may be theoretically effective, practical application of these principles is still hindered by a lack of clear guidance on what exactly first responders should say to convey these concepts quickly and clearly to casualties. The threat of chemical contamination and the effectiveness of the IOR protocol as a countermeasure are not necessarily intuitive to people outside the emergency response and decontamination research communities. Optimal wording of this information may require us to first understand pre-existing non-expert intuitions regarding chemical contamination and decontamination. Understanding how laypeople conceptualise chemical contamination may also reveal insights into what types of information would be sought by casualties

during this particular health threat and what actions they would be inclined to take in the absence of information from authorities.

The 'mental models' approach is an established method for understanding how laypeople conceptualise risks and how these conceptualisations can inform risk communication (Glik, 2007a; Morgan, Fischhoff, Bostrom, & Atman, 2002). Mental models are intrinsic representations or simulations of a concept (Johnson-Laird, 1983; N. Jones, Ross, Lynam, Perez, & Leitch, 2011; Whitmer, Sims, & Torres, 2017). Empirical assessment of lay mental models has been used to understand how people conceptualise abstract subjects such as the periodic table (Larson, Long, & Briggs, 2012) and the shape of the earth (Vosniadou & Brewer, 1992), and the concept of "emergencies" (Whitmer et al., 2017). The mental models approach has also been used to understand non-expert representations of the risks associated with health threats, such as HIV (Newman, Seiden, Roberts, Kakinami, & Duan, 2009), electromagnetic fields (Claassen, Bostrom, & Timmermans, 2016), flash floods (Lazrus, Morss, Demuth, Lazo, & Bostrom, 2016), nuclear waste disposal (Skarlatidou, Cheng, & Haklay, 2012), radon exposure (Bostrom, Fischhoff, & Morgan, 1992) and climate change (Bostrom, Morgan, Fischhoff, & Read, 1994). Findings from a review on communication with the public about Chemical, Biological, Radiological, Nuclear (CBRN) risks highlighted a need for communicators to tailor messages to public mental models to correct popular misconceptions about CBRN and ensure that the utility of protective measures is understood by a lay audience (Rubin et al., 2012).

The mental models approach has been used to understand how staff who work with hazardous chemicals in a professional capacity conceptualise hazardous chemical risks in the workplace, with implications for improving workplace safety information (Cox et al., 2003; Niewöhner, Cox, Gerrard, & Pidgeon, 2004; Pettersson-Stromback, Liljelind, Nordin, & Jarvholm, 2010; Quadrel et al., 1994) and to understand laypeople's perceptions of the risks associated with long-term exposure to toxic chemicals in the environment (Zikmund-Fisher et al., 2013). Less is known about the mental models of members of the public who do not have professional experience with hazardous chemicals but who are at risk of suffering the effects of acute chemical exposure in a deliberate or accidental hazardous chemical release incident. By learning more about the mechanisms used to make sense of the external world and the connections people make between concepts pertaining to a particular risk, communicators can identify knowledge gaps and common misconceptions that may exist in a non-expert population and use these insights to tailor risk communication to mitigate against popular misconceptions and highlight prevalent knowledge gaps (Breakwell, 2001).

Understanding the mental models used by the public to make sense of risks is particularly important when communicating during an emergency. The Mental Noise Model predicts that information processing is impaired in a highly stressful situation (Barry et al., 2013; Covello et al., 2001; Firestone & Everly, 2013). Human volunteer trials have indicated deterioration in cognitive performance following nerve agent exposure (DiGiovanni, 2003; DiGiovanni Jr, 1999) and following exposure to acute stressors modelled on emergency conditions (Porter & Leach, 2010; Robinson et al., 2013). But the Mental Noise Model also predicts that information is more easily understood under stressful conditions if the information corresponds to a pre-existing conceptual framework relating to the emerging risk (Barry et al., 2013).

The mental models method, as applied to risk, typically involves several stages. The first consists of developing an expert model of the risk in order to develop an expert 'influence diagram' which makes explicit how the particular risk 'works.' An influence diagram, consisting of nodes that represent concepts, and arrows that represent influences between concepts, is a standard approach to representing the mental model of a risk (Bostrom et al., 1992; Morgan et al., 2002). The second stage is to develop a similar, lay, influence diagram, which makes explicit how non-experts understand the risk. Cross-referencing trends in lay public beliefs with the expert model can then be used to highlight areas where misunderstandings may occur and content that would need to be included in risk communication (Maharik & Fischhoff, 1992; McComas, 2006; Skarlatidou et al., 2012).

In the present study, I developed an expert model influence diagram based on a rapid review of the decontamination guidance document and toxicology literature, outcomes of which are reported in Chapter 1. I then consulted with subject matter experts who either affirmed or proposed modifications to the diagram. Using an interview schedule based on the expert model influence diagram, I interviewed non-experts to identify knowledge gaps, misconceptions, anticipated behaviours, and factors that would influence engagement in or avoidance of IOR actions. My aims in this study were: a) to identify knowledge gaps and misconceptions that would need to be addressed in communication and; b) to identify concepts relating to chemical contamination that are likely to be intuitive to casualties so that communicators can map information on to pre-existing mental models when there is increased time pressure and/or reported anxiety among casualties.

5.2 Method

5.2.1. Expert model

I designed a first draft of an influence diagram to visually represent chemical skin contamination and the protective actions comprising IOR, based on a rapid review of the toxicology literature on skin decontamination and the most recent guidance documents on UK IOR protocols. The diagram was submitted, along with a covering letter (Appendix H) to nine emergency response policy and chemical toxicology experts who comprised a Technical Advisory Group attached to a Department of Health and Social Care funded project on the decontamination of skin and hair. I asked experts to assess whether the diagram: had any critical omissions; accurately represented the status of UK decontamination guidelines for chemical incidents; and was accurate from a toxicological standpoint.

5.2.2. Non-expert model

5.2.2.1 Design

The development of a non-expert mental model of chemical contamination and decontamination was based on qualitative interviews carried out with a sample of people recruited from the lay population, using an interview schedule that was informed by the influence diagram of the expert model.

5.2.2.2 Participants

Twenty participants aged between 18 and 45 ($M = 28.8$, $SD = 8.58$) took part in a one-on-one interview. The sample size for this study was 20, based on the recommendation by Morgan et al. (2002, p. 76) that 20 to 30 interviews are sufficient to gather all the main available concepts that people may have when it is expected that similar beliefs about the subject matter exist within the sample population. A self-selected convenience sampling method was used. The majority of participants were students. All participants had completed or were working towards completing an undergraduate degree but no participants had qualifications relevant to the subject of skin toxicology, CBRN or emergency response.

5.2.2.3 Materials

I used a semi-structured interview schedule (Appendix I) during all interviews to ensure consistency. Prompts in the schedule were informed by concepts outlined in the expert model influence diagram. I carried out practice interviews with two colleagues (one psychology research assistant and one research administrator, neither had worked in emergency response before) and with a member of a Public Involvement Panel attached to the Department of Health and Social Care funded decontamination project. The purpose of the practice interviews was to check that the wording of questions in

the interview schedule was appropriate for a lay public sample. Each pilot participant was provided with the participant information sheet for this study in advance of the interview so they would have the same level of knowledge about the study as a participant during data collection. At the conclusion of each interview, pilot participants provided feedback on my interview technique and on the structure of the interview. The key change made to the interview schedule following the practice interviews was the presentation of the scenario. In the practice interview, a recording of an emergency evacuation at a train station was played to participants to replicate the evacuation described in the interview. However, due to issues of sound quality during practice interviews, it was suggested that the text of the scenario be read to participants during the actual interviews. The panel member advised me to simply read the text of the evacuation alarm myself during data collection due to issues of sound quality when playing a video over the telephone. Other changes made as a result of the practice interviews were: asking demographic questions in a more informal, less rigid style; providing feedback on contributions made by the interviewee, such as “that’s a good point”, before probing for further information; and warning interviewees early on that some of the questions may seem redundant but they are necessary to uncover their reasoning for each assertion.

5.2.2.4 Procedure

Interviews took place in July and August 2017. Ethical approval for this study was granted by the King’s College London Psychiatry, Nursing & Midwifery Research Ethics Panel (reference: LRS-16/17-4476; Appendix J). Potential participants responded to a recruitment advertisement (Appendix K) that I posted on a university research webpage, distributed via a university circular email, or emailed to a database of contacts who had consented to be emailed about participation in studies conducted by the research team. The exclusion criterion, “you must . . . have no professional experience or expertise in the areas we are looking at (e.g. skin toxicology, Chemical, Biological, Radiological and Nuclear incidents, or decontamination)”, was made explicit to participants in the information sheet (Appendix L) and all recruitment materials for the study. Prior to each interview, I checked with the participant that they did not have professional experience or expertise in the subject area.

I sent an information sheet and consent form to participants who approached me to find out more about the study after seeing the recruitment advert and arranged an appointment with them on receipt of a completed consent form (Appendix M). Each participant took part in a one-on-one semi-structured open-ended interview, carried out remotely via telephone or Skype and audio recorded. The mean interview duration was 41.16 minutes (SD = 9.95). It is recommended that prompts and follow-up questions

are non-judgemental in the same vein as questions asked during client-centred therapy (Morgan et al., 2002, p. 65). To that end, I informed each participant, in advance of the interview, that the objective of the study was not to assess whether the participant's assertions were "correct" and that the purpose of asking follow-up questions was only to understand why the participant raised a particular point.

I asked demographic questions so that the generalisability of the non-expert model to other populations could be assessed in future studies. Following the demographic questions, the interview began with a broad, simple question, "Tell me what you already know about chemical contamination," modelled on opening questions used in previous research on lay mental models of health risks (Bostrom et al., 1994; Cousin & Siegrist, 2010; Lazrus et al., 2016; Morgan et al., 2002; Skarlatidou et al., 2012). This approach aimed to help the participant externalise their existing knowledge about chemical contamination in the absence of cues from me. The schedule included instructions for me to ask the participant follow-up questions about each item raised during this opening section of the interview. When participants reported not having any further knowledge on the subject, I presented neutral prompts, such as "How do you know if you have a chemical on you?".

Once the participant had responded to the opening question and neutral prompts, I asked them if there was anything further that they knew about chemical contamination or anything they had previously mentioned which they would like to elaborate. Once it was confirmed that all available knowledge had been provided by the participant, I presented them with a specific scenario of an emergency evacuation from a train station. The aim of providing the scenario was to standardise the context within which hazardous chemical contamination was discussed. The text for the scenario, outlined below, was read out loud.

You are standing in the middle of a queue for an automated ticket machine at a crowded train station. The weather is mild with no wind or rain. You are travelling alone and you have never been to this station before. Suddenly, you hear the following announcement on an overhead speaker: "Due to a reported emergency, all passengers must leave the station immediately. Go to the nearest exit." You join the crowd of people walking towards the nearest exit. You hear the announcement again: "Due to a reported emergency, all passengers must leave the station immediately. Go to the nearest exit." You follow the crowd outside the station. You are now standing on a street among roughly 100 people. In the distance, you can see a police van with blue lights flashing.

After discussing their reflections on the evacuation itself, I asked participants to consider whether and, if applicable, how they would know if they had been exposed to a hazardous chemical in this scenario. I then asked participants what they would do if

they thought that they had been contaminated. If the participant did not raise a protective measure included in the expert model (for example, disrobing or dry decontamination) after having the opportunity to raise any measure that they could articulate, I provided prompts about each protective measure in the expert model. I asked questions about whether and why each measure would or would not reduce health threats and how they reached their conclusion. Finally, I asked if there was anything else on the subject of chemical contamination or decontamination that participants had considered but not raised during the interview. Interviews were terminated once I confirmed that the participant had exhausted all relevant knowledge that they could associate with the subject.

Interviews took place in the context of wide media coverage of acid attacks but before the 2018 Novichok release in Wiltshire.

Recordings were transcribed by a third party transcription agency with a signed data confidentiality agreement in place. The data set consisted of all participant quotations in the collated transcripts.

5.2.2.5 Analysis

I carried out thematic analysis of interview transcripts using NVivo 11.2.1.616 (QSR International). Participant quotations were allocated to semantic categories using the data-derived approach to thematic analysis outlined by Braun and Clarke (2013) to “reflect the semantic content of the data” (p. 207), the same analysis approach that I used in Chapter 4. Instances of participants asking for clarification on a question were not coded to a theme. The minimum number of sources required to constitute a sub-theme was two, in order to avoid basing a sub-theme on one participant’s particular attitudes and experiences. Sub-themes based on fewer than two sources were not included in the influence diagram. Resulting themes and sub-themes were visually represented as nodes in non-expert influence diagrams to represent participants’ collated mental models about chemical contamination and emergency decontamination. Themes and sub-themes were reported in writing with broad theme titles as headings and theme titles italicised in the text.

I compared non-expert mental models against the expert mental model to identify potential knowledge gaps and misconceptions about contamination and decontamination that may exist within a non-expert population. Non-expert mental models were also used to identify factors that either facilitate or inhibit uptake of protective behaviours outlined in the expert model. I identified implications for communication based on my analysis and reported these in the Discussion section.

5.3 Results

5.3.1. Expert model

On reviewing my initial influence diagram that was derived from technical publications, three of the nine panel members (a CBRN research programme manager, a toxic health risks technical advisor, and a CBRN policy advisor) suggested that changes be made to the diagram, such as specifying that the latency of 4-12 hours following exposure to sulphur mustard applies when it is only skin that has been contaminated. The model was adapted based on these suggestions. After three iterations following feedback from members of the advisory group, the diagram (Figure 5-1) was finalised and used to inform the development of the interview schedule used to ascertain the layperson or non-expert mental model. The diagram depicts concepts associated with the risk of chemical contamination (left side) and steps that would be effective in reducing or alleviating the risks (right side). Concepts displayed in dashed borders are peripheral to the main concepts outlined in the diagram.

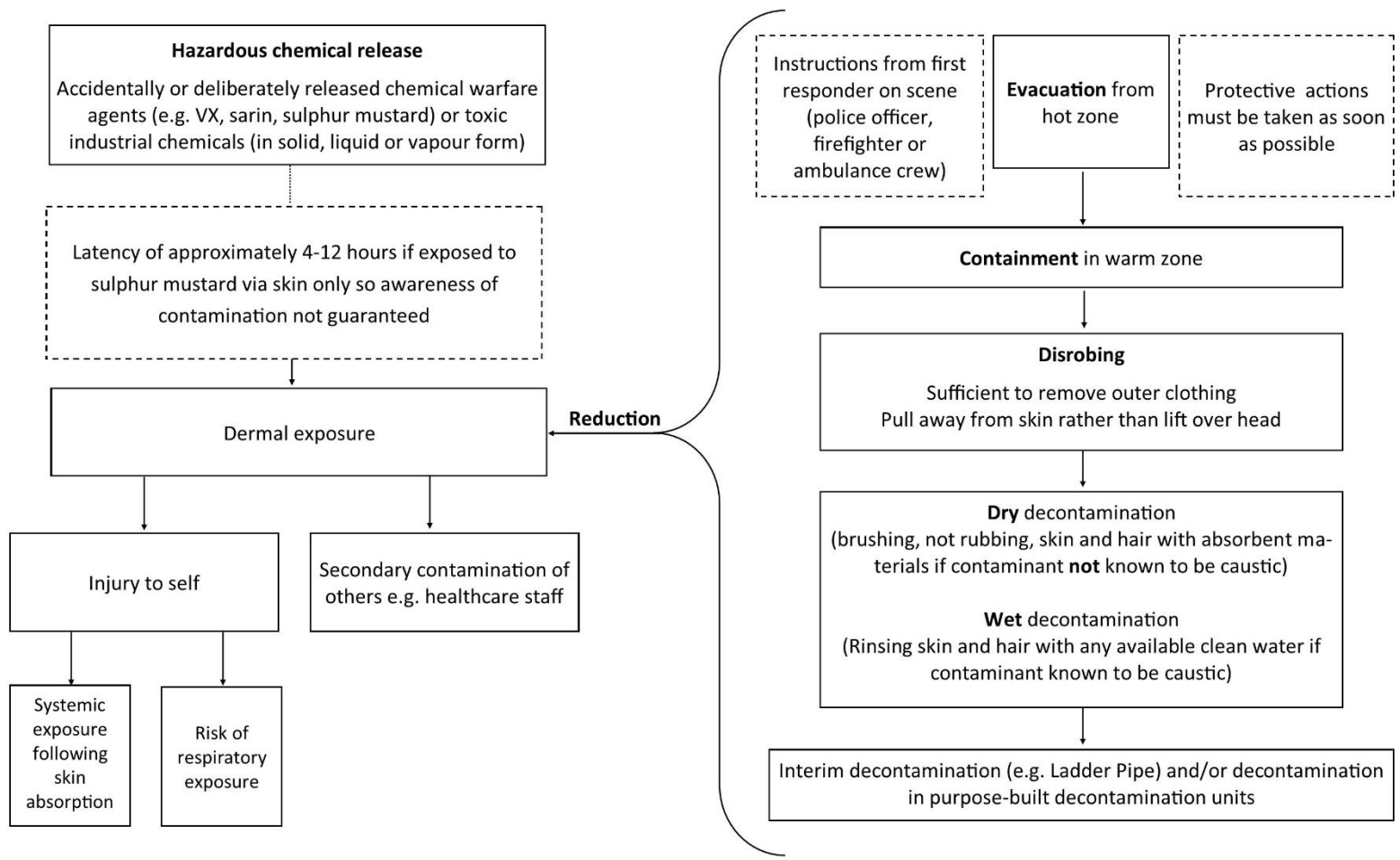


Figure 5-1 Influence diagram to visually represent the expert model of chemical skin contamination and decontamination. Dashed lines denote peripheral concepts.

5.3.2. Non-expert models

5.3.2.1 Sample characteristics

Demographic characteristics of the sample are reported in Table 5-1.

Table 5-1 Demographic characteristics of interview sample.

Characteristics	<i>N</i>
Age	
18-24	7
25-34	9
35-44	2
45-54	2
<hr/>	
Gender Identity	
Female	15
Male	5
<hr/>	
Highest Educational Qualification	
PhD	5
Postgraduate Degree	5
Professional Qualification	1
Undergraduate Degree	9
<hr/>	
Occupation	
Accountant	1
Admin/clerical	1
End user analyst	1
Events officer	1
Lobbyist	1
Research scientist	3
Student	12
<hr/>	
Nationality	
British	14
Chinese	1
German	1
Indonesian	1
Irish	1
Malaysian	1
Turkmen	1
<hr/>	
First language	
Cantonese	1
Chinese	1
English	14
German	1

Indonesian	1
Macedonian	1
Russian and English	1
<hr/>	
Ethnic group or background	
Asian/Asian British	8
Black/Black British	1
Other	2
White	9
<hr/>	
Religion	
Buddhist	1
Christian	5
Jewish	1
Muslim	1
Sikh	1
No religion	10
Prefer not to say	1
<hr/>	

5.3.2.2 Themes omitted from model

Due to the broad opening question, designed to facilitate the availability of all thoughts on the subject of chemical contamination, several themes were identified that appeared to be tangential or irrelevant to acute chemical contamination. Example themes included: *reflections on acid rain; prolonged exposure to everyday household chemicals; general inhalation of vehicle emissions in towns and cities and reported lack of available public information about chemical contamination*. Participants also described the effects of environmental contamination on communities affected by *contaminated food and water supplies*.

I think the first thing I think of is air pollution, I don't know if that falls within that category, but that's, kind of, my association (P2).

I'm sure I read somewhere about a company dumping loads of toxic waste into a river that provided clean water for, like, communities living on the banks of the river, obviously water to wash in, but also fish, and things that they feed off (P2).

one of the main ones I can think of is, perhaps, drinking water. So, I'm not sure exactly in the UK because I'm not sure how our drinking water is actually processed. Well, I have a slight clue, but I'm not sure. Perhaps it could be contaminated after the fact it's been processed. But food. So, the soil that we grow... So, chemical contamination, actually, pesticides as well. I guess that would come under it. (P3).

When it comes to hazardous chemicals there's not much public information about what your immediate steps should be (P6).

I think a lot of us don't understand that we're being exposed to so many chemicals every single day and we just don't even realise that (P11).

I feel like you're already in, you live in an urban area, you're already being contaminated with so much on a daily basis (P16).

I mean chemicals is a broad term. There are chemicals in everything from you know paint to cleaning products. ... We're exposed to chemicals on a daily basis. So yes, like because it's such a broad term, and because the amount is very significant, I would say like there's regular exposure to a vast range of things. (P20).

5.3.2.3 Non-expert model of acute chemical contamination

When discussing acute chemical contamination, participants raised concepts pertaining to: why and how a hazardous chemical would be released; mechanisms by which they could be exposed to or contaminated with a chemical; all possible effects resulting from contamination; and all possible indications of chemical contamination. All concepts pertaining to skin contamination from the expert model were discussed. The influence diagram of the model is displayed in Figure 5-2.

Most participants discussed hazardous chemical release in the context of a *deliberate attack*, including acid attacks, which were deemed to be currently high profile with increased public awareness for example due to increased news coverage, and chemical weapons used in either a terrorist or military attack.

Yes I can say I know quite a few, well even in London too, there's the issue of acid attacks which is rising so that is an example of, like, chemical, it is a chemical attack (P1).

I know in the Korean and the Vietnamese war there was a lot of use of them, and Napalm and, I know obviously in the Syrian conflict there's been some horrendous use of chemical weapons (P2).

Chemical warfare, which I believe, in the future, is going to be... It is already being rather dangerous, and it can only get more dangerous (P3).

The only thing I guess I can think about, which is all of the stuff that's going on at the moment, is around the kind of acid attacks where people are using unknown very noxious substances in quite a malicious way against other people (P13).

Although I guess chemical warfare is something that is used by potentially countries or governments as a threat or in real life against others, you know to threaten life. Something that can actually cause very much damage. I'd guess it's kind of the warfare term (P13).

I do have like, a sort of, like a brief understanding of like, I guess, chemical weapons are used obviously, within the army and to... well, they use that, I suppose, as a form of a gas maybe, as a weapon (P14).

I guess, I was thinking again, just the current news events, I was thinking about acid attacks (P16).

Well, I mean, not by name but certainly there's been a pretty horrible rise in the number of acid attacks in London and around the country and the world, so yes, it seems, like, every day, kind of, bleachers and acidic drain unblockers are able

to cause some pretty severe damage to people and life changing injury. So, yes, the stuff that you can buy over the counter can certainly have that kind of effect on someone's skin. (P17).

Scenarios involving the *accidental release of hazardous chemicals* were raised by a smaller proportion of participants, with examples including the accidental leak of industrial chemicals and the release of liquid chemicals following a transport accident. There was reflection on chemical contamination as something that would occur in *large-scale disasters*.

The things I think about when I think around chemical contamination are things like disasters which have happened in various places around the world. For example, something like Chernobyl or contamination potentially like oil spills or leaks which may obviously contaminate in terms of public health. That's as much as I'd say that I know really. (P13).

Chemical contamination, yes, then I just think of like, big kind of industrial incidents or accidents or what's it called when the stuff leaks off (P16).

It could be anything, I guess, so something like oil on a tanker, and a leak in a, kind of, a factory or a nuclear plant perhaps (P17).

Accidental release of industrial chemicals was linked to insufficient safety protocols and corporate negligence/corruption.

It's something which I think is actually widely prevalent with all of the new practices that we have today, in terms of, say, business practices. So, lots of factories will churn out a lot of chemicals, which they want to dispose of in the cheapest way they could, be that getting rid of it by avoiding the proper methods of getting rid of it; so just dumping it, could be by accident. ... And in terms of, say, the contamination through negligence, where these companies are earning hundreds of millions of profit every year, yet they're not getting rid of... This is part of the reason why they're earning such high amounts, because they're not spending the money to get rid of their waste. (P3).

There are certain industries where it's terribly worrying, particularly countries where there isn't necessarily the safety protocol we have here (P20).

The state of matter of the contaminant and the process by which it would be released was discussed. Routes of dispersal included *spray, liquid spillage*, or a liquid or a gas canister being *dropped from above*. Participants also described the contaminant as a *noxious gas in the atmosphere*, for example due to combustion.

Many of these materials, you know, when they combust they can release certain chemicals that can actually be, like, very, very hazardous (P1).

I think probably if there are chemicals in the atmosphere (P4).

I think a lot of them are air dropped (P5).

Maybe there was some sort of toxic gas or hazardous gas that was leaking (P12).

I guess it's about something potentially being spilled (P13).

I'm envisaging some sort of misty spray (P15).

Something liquid that was dripping through that ceiling (P17).

Unless like someone crazy just dumps dangerous liquids from the air (P18).

Participants reflected on *routes of exposure* by which contaminants could enter the organism, such as *inhalation*, *skin contact*, and *ingestion*.

If you inhale, kind of, gas coming off a chemical (P2).

They could touch terrible chemicals that could burn them (P3).

When someone says chemical contamination I assume someone's maybe swallowed something (P14).

It might be skin contact (P20).

On the subject of skin contact, there was discussion about the process of *skin penetration and absorption* and on how exposure could occur by *touching a hazardous chemical and then transferring the contaminant* to the face, specifically to mucus membranes, or to consumables that would then be ingested.

Perhaps, if, yes, they touch it, and then it gets into their food or drink, and then it enters their digestive tract, some chemicals may be more harmful through that method (P3).

And if you're not careful to wash your hands, you could potentially, I don't know, say, you play with your dog and then grab some crisps and eat it and then obviously it goes literally inside of your body (P11).

It would damage not only the top layer and the bottom layer. And I guess the top layer of skin we often get cuts and grazes, and it can sort of scab, but if it burns any more, than it would leave a larger scar and I guess it's even more dangerous if those parts are exposed. (P12).

...some form of acid, I'd imagine that'd literally burn through ... into your blood stream and what not (P14).

...or, yes, and after that, you ingest it because you have it on your hands or something (P19).

Acute health effects that were discussed included physical impairment, headache or dizziness, blindness, eye irritation, and nausea or stomach upset.

I can't remember exactly what... it was such a long time ago, I can't remember exactly what happened, but – I don't know – maybe there was blindness (P4).

Cough or some flu-like symptoms, a headache or things like that, feeling just generally unwell if it's poisonous (P6).

Eye irritation, that sort of a thing, is what I'm thinking about (P13).

Skin effects included abrasions, rashes, dry skin, blistering, painful skin burns (including severe painful burn following an acid attack), skin discolouring, skin irritation, and loss of skin.

You might get a rash or like almost, like a chemical burn or some pain, itching or allergic reaction-like symptoms (P2).

Yes, blistering would be, sort of, you know, one of the worst things that would happen (P4).

I'm not sure how they work but I'm assuming that they would first sort of irritate or burn the skin, causing irreversible damage. ... I guess the first sort of mode of action, either if it's a toxic gas or if it's some sort of spray, would be to irritate and burn the skin I think (P12).

I would imagine that it's, apart from just feeling like a burn you... from the past I think things like getting a welt or a blister (P15).

Very severe immediate skin blistering and burning (P16).

I mean, it's certainly a huge amount of damage to the skin and severe burns (P17).

Well, something like rashes or allergies, contact allergies (P19).

Respiratory effects included breathing difficulty; chemically-induced inflammation of the throat; haemorrhaging; respiratory irritation; damage to the nasal cavity and lungs; and a chemical reaction within the respiratory system.

If you inhale, kind of, gas coming off a chemical then perhaps a cough or maybe shortness of breath (P2).

I'd say sort of either breathing in, the damage to the nasal cavity or the lungs (P13).

Participants described how skin or respiratory contact with the chemical or ingestion of the chemical would affect other organs, including the brain. The level of detail provided varied between participants who discussed the path from skin contact to health effects and, in some cases, the process was likened to the process by which a virus causes adverse health outcomes for the host organism.

I think, because our skin is slightly porous so the chemicals can go inside, they can go, they can pass through your skin and that could, like, that could allow the chemical to be transported around one's body (P1).

I suppose [chemicals] get in your system somehow. I suppose they must come in through either inhalation or through the skin and then somehow they are transported around the body and then perhaps there are particular areas of the body that are more vulnerable to these particular chemicals. I don't actually know. That's what I'd imagine. (P4).

If it has gone into my air pipes and started affecting my cells, or going into my bloodstream and it would maybe start a... Some sort of a virus, I daresay it would be a virus or some sort of adverse reaction inside there (P6).

Because I feel like chemical substances, they can go into our blood vessels, right, so they would follow the blood, and they would just go to the brain ... so you feel like keeling over, like you'll go unconscious (P9).

The risk of death as a result of exposure was discussed.

I guess it gets released into the atmosphere and then causes, you know, death (P14).

It's certainly a huge amount of damage to the skin and severe burns, with death in obviously a huge number of cases (P17).

Participants discussed the potential for *long-term health effects* following exposure to a hazardous chemical, including *genetic effects* and *irreversible skin damage*. In one case, long-term health effects were discussed in relation to the nuclear accident at Chernobyl.

Perhaps, just missing limbs, or bigger body parts, or warped body parts, or decreased health. So, yes, just somehow adversely, yes, affects their health in the next generation (P3).

I mean if you know you see photos of people who've been affected by these kinds of weapons, and obviously if you're burned, you know that leaves a scar on your body basically forever and you can't really you know... You can have some sort of operation but it still leaves that kind of scar I guess, that's why I would call it irreversible. You know, you'll be left with disfigured limbs and face as well in some cases. (P12).

...causing deformities with babies, with pregnant women, I think (P16).

I'm sure I've read articles about people who lived in the surrounding areas of Chernobyl who suffered from cancer later in life, there are still certainly people who live there who die well before their age... the average life expectancy, I guess, is what I'm trying to say. But, I think, yes, certainly cancers and the issues with the lungs and breathing ability (P17).

I have heard there are some chemicals, but I don't know what it is, that once it got onto your skin for maybe quite some time it would just stay there forever (P18).

Long-term social and psychological consequences were discussed in the context of acid attacks.

They could be potentially depressed, upset, angry, they could be traumatised by the event. They could be scared to go out and other times (P8).

Well particularly in a society where you know we pay quite a lot of attention to what we look like, and also you know having, not even just that but meeting anyone, you know if you're working sort of customer-facing, getting that kind of work is slightly difficult if, let's say, you have a facial disfigurement that you

might look a bit different or a bit you know strange or sometimes even scary (P12).

Without using the phrase *secondary contamination*, participants expressed awareness of the potential for contamination of other people as a result of coming into direct or indirect contact with a contaminated casualty.

It would be the risk of contaminating others that I'd be concerned about and, you know, there are ultimately much more vulnerable people than me out there that don't need added problems with chemical contamination (P2).

whether that individual is then contaminated in a way where they would potentially pass that on to somebody (P13).

You could infect those around you (P15).

I could maybe contaminate others or something (P16).

Secondary chemical contamination was likened in some cases to a *biological or radiological contagion*.

I mean I guess it's like back to the whole coughing and sneezing common cold kind of thing, but that could be completely and utterly incorrect (P13).

If it's like with... with polonium, I think he was... I feel like I remember reading that they had try and trace his steps, so that they could see who else he came into contact with (P17).

If it's like Litvinenko then I'm not like terribly dangerous, but if they don't know, if they believe I'm exposed, and if you don't know then you must exercise all precautions (P20).

Reported *routes of secondary contamination* included exposure to exhaled air of contaminated persons and skin exposure to a chemical on the contaminated person or surface to which contaminated person has transferred the chemical.

There must be some chemicals which, perhaps, will linger on your skin. So, perhaps, if you touch someone else (P3).

By touching them, maybe, you know, the surfaces we touched, maybe if someone else touched those surfaces as well after us because I think anything we were exposed to would need to be wiped clean to make sure nobody else was affected (P4).

I guess if it's on your clothes and then you go and sit on a train seat, then it's on the train seat and you've got the potential to spread something that way (P5).

I guess it's like a deeper contamination within me that not only I have it on the surface of my skin but also have it, like, inside of my body. Whenever I were to sweat, like, whenever I have sweaty palms or something like that, again, you know, I would use public transportation, I'll touch like a railing, I'll touch the seat or whatever, right. And it will be contamination in the sweat of my palms. And then of course, when someone else touches the same seat or the same railing, you know what I mean, they'll get it. (P11).

So, I exhale a certain amount of air droplets, the same air droplets that could be inhaled by someone else if we were at a secluded environment, like underground (P11).

maybe if there was like a substance that was leaked and I stepped on it and it's on my shoes, I traipse around the carpet of the coffee shop and leave it there. And if there's, like, no air conditioning and the doors are closed, then it's kind of just sort of staying there in the room and people are breathing it in and there could be spread exposure if people step on it or touch, yes, I don't know. (P16).

Participants expressed diverging opinions on the subject of awareness of exposure to hazardous chemicals. The assertion that *symptoms of contamination would be felt immediately* was raised by a proportion of participants and lack of symptoms was associated with low danger.

Unless I started to experience some, you know, adverse symptoms and sort of coughing or something, feeling a bit unwell. I wouldn't know unless I was suddenly feeling unwell for no reason (P12).

My understanding is...contaminants get into your system straight away, and they start to cause discomfort (P14).

I mean if I don't have any symptoms then nobody there can tell me, that it's particularly dangerous for me (P19).

If it didn't manifest immediate symptoms, then I wouldn't know (P20).

However, participants also expressed awareness of the potential for delayed onset of symptoms.

I think sometimes the effects of that, of a particular chemical will not show for a very long time, so one example was with the aftermath of the tragic 9-11 attacks. So not only were people killed through the planes that crashed into the Twin Towers but the fire-fighters and the police officers who came in the aftermath were also affected, but they weren't affected immediately. And the reason why they were affected was because they inhaled all of this, like, smoke which contained so many different chemical, and it only showed up, like, in a few, like it, showed up, like, many, many years later. (P1).

So I suppose sometimes these things can take decade to develop. You don't necessarily know at the time. The contamination doesn't... You don't realise you're being contaminated, not instantly, the effect isn't instant (P4).

But I guess there could be side-effects that you know you wouldn't feel or know about until you know some time after exposure. And I guess that's the thing around sort of more long-term health conditions whereby you know somebody suddenly got some kind of nasty lung infection or cancer as a result of something that happened years before. (P13).

I would say it's safer to go to the doctor, to just check if there are any long term effects that might happen. Because sometimes you cannot see like just for the first few hours. Who knows what's going to happen? (P18).

In some cases, participants drew from their knowledge of *asbestos and radiological contamination* when discussing the delayed onset of symptoms.

I would say, well asbestos is one example, so many people inhaled it and, I mean, they weren't ill immediately but, I guess, later they became ill and they died from it (P1).

It could be a radioactive substance which you might not be able to tell you've been exposed to until later (P5).

Participants described *symptoms* that they believed would be indicative of hazardous chemical exposure. Symptoms included: blurred vision; changes to body temperature; dizziness; dryness of mouth; eye irritation or stinging; feeling generally unwell; feeling aggressive or agitated; headache; nausea or stomach upset; respiratory symptoms; and skin burning or skin irritation.

Maybe double vision or just like not having clear vision or blurred vision, will be one example of, like, symptoms that could show a chemical incident (P1).

If I start maybe feeling nauseous (P7).

You feel very like aggressive or agitated, yes. Then I would know if something is wrong. (P9).

I imagine it would start to burn the skin, and probably a lot of pain (P14).

I guess breathing difficulties (P15).

I think I may have some physical symptoms or indicators such as burning eyes, for example (P16).

In addition to symptoms of chemical contamination, participants discussed possible signs that would indicate that contamination may have occurred. Signs included *Olfactory cues*, such as a peculiar smell.

If I just smell something, that's something has gone wrong, yes that could make me think that there's been some, sort of, chemical incident (P1).

I know chemicals are invisible sometimes, so if there was no sort of visual then a sudden smell as well, like a gas, if I could smell something. That would be my way to sense it. (P6).

Information from authorities was cited as a sign that contamination had occurred.

If there was a report or if someone just... if it was like hearsay, maybe not but if it was explained how the incident occurred and I was told that I could have been contaminated or was within the vicinity which was contaminated (P16).

But when an expert tells you something you do have to listen (P17).

Visual cues that would be indicative of a chemical incident included the sight of liquid; smoke or fumes; and the presence of emergency responders, particularly responders wearing personal protective equipment.

I guess, if I looked around and I saw, like, you know, the emergency services they'll come in with these suits, you know, these white, I think Hazmat Suit...so basically it covers their entire skin and visor, so if they're coming that will make me think that, you know, like, for that, a chemical incident has taken place (P1).

So, something like a... like mustard gas or something like that. I imagine you can see... I think from what you've seen on television, I would imagine some things you can see as, kind of, clouds, so visible gases (P5).

I guess it's just a physical sign of a chemical, some sort of chemical being exposed, because... Unless of course, like, if it's liquid also, and there's a sign that that's a chemical that spilled (P7).

I mean I'm sort of thinking you know perhaps the days of the magic spells or where you know it would be really obviously bright green and flashing or something. It would be looking like something was not right. I guess what I'm sort of thinking around as well, is the sort of combustibles, for example, and you know just would look different to normal air, because normal air doesn't look like anything (P13).

I mean, I think maybe eventually you'd probably work it out, you know, maybe we've been exposed to something. And that's why... especially if there's people that turn up in hazard suits. (P14).

Seeing liquid spilled somewhere (P16).

If it's some kind of smoke from somewhere, coming out from somewhere, maybe like that" (P19).

Witnessing other people displaying symptoms was a visual indicator of possible chemical contamination. Symptoms mentioned were: coughing or sneezing; coughing up blood; fainting; skin or eye irritation; skin and limb removal; vomiting; people seeming generally unwell or in pain or discomfort; and people displaying the similar symptoms to those experienced by the participant.

If I saw I was having these symptoms and that people around me were also going through the same symptoms (P10).

Well, I'd see if other people were having the same. If they weren't, then maybe I'd think it was something that I was just feeling a bit funny, but if others were having the same symptoms, I'd maybe see if we could call an ambulance or something (P12).

People coughing and spluttering... People actually showing some kind of side-effects or something, you know (P13).

For me seeing other people being in discomfort and they may be in pain and worried and I think that would just sort of... you know, you, sort of, reflect through yourself and you think hang on a minute, if it's happening to them then maybe it's going to happen to me too (P14).

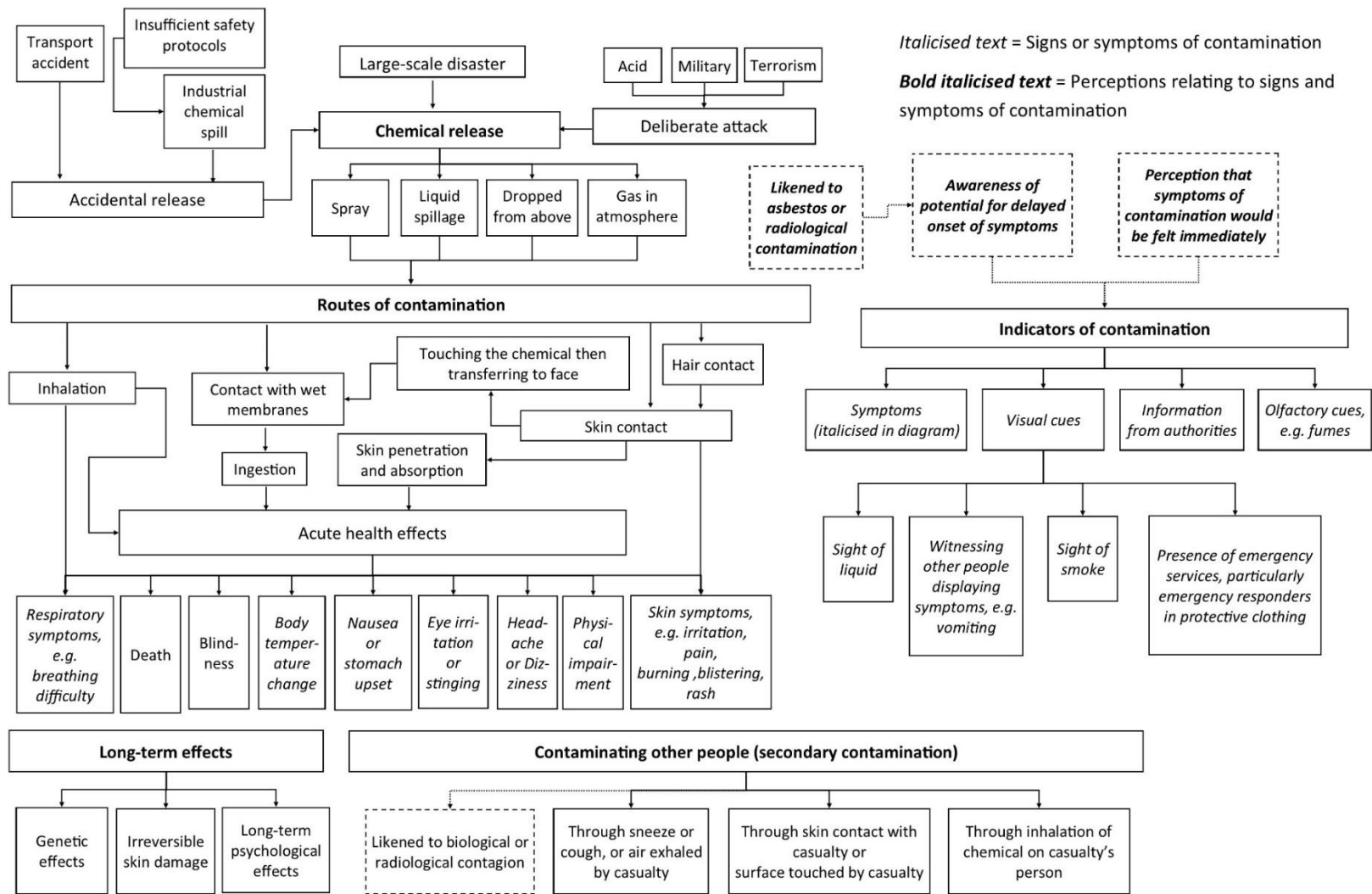


Figure 5-2 Influence diagram to visually represent the non-expert model of acute chemical contamination.

5.3.2.4 Non-expert model of decontamination

All IOR actions outlined in the expert model, except for dry decontamination, were raised without prompt. Due to the number of themes to which at least two quotations were coded, the non-expert model of decontamination has been separated into five diagrams. The diagram displayed in Figure 5-3 pertains to general expected behaviours and perceptions following evacuation in the scenario, whilst the diagrams displayed in Figures 5-4 through 5-7 pertain to each post-evacuation IOR action from the expert model, specifically containment in the warm zone, disrobing, dry decontamination, and wet decontamination.

When asked to reflect on what they would do and how they would feel having evacuated from the train station in the scenario, participants expected that they would be experiencing *anxiety*. Concerns were raised about *contamination*, particularly when long-term consequences of contamination were considered.

Well, the thing I fear most, I think, you know, is cancer, I suppose. That's the thing that, yes, one in three get. So I think it probably... Yes. That's what I'd be worried about, cancer. (P4).

It's knowing that you've already been contaminated is a bit horrible and not knowing what the consequences short and long term are of that, yes, I'll be scared (P16).

Anticipated anxiety was also attributed to *separation from family* and *unfamiliarity with the type of incident occurring*.

When can I see my family, you know, how am I going to get home? (P2).

I've got no, sort of, insight or professional knowledge about chemicals or infections so I wouldn't have a clue what was going on, so I'd just be terrified the whole time I guess (P15).

Expectations about how *other casualties would be panicking* were discussed and, in some cases, participants explained how, due to the anticipated anxiety of themselves and of other casualties, they would expect to try to *keep themselves and others calm*.

it is kind of obvious to me: not many people would, say, act rationally. I guess that's a very broad statement or whatnot, but not many people would... Say, even if you gave them a good reason as to why to stay put, a lot of people, I'm sure, would be in the panicked state (P3).

So, if there is a crowd of around 100 people, it's a lot of people; so, if we see that a certain individual, so one or two are extremely panicking, I will probably try my best to calm them because I think it would, in a situation like that it would only help for everyone just to calm and try to stick together and just be patient as opposed to running around and trying to run away from the station or actually create more chaos or something like that. I know it's not a direct answer but I guess my actions will be dependent on other people's action. ... But if

there is an official announcement that at a particular venue, so, like a train station, you were exposed to chemical, that sets off a lot of panic. (P11).

I imagine if this was an emergency, that maybe there'd be people screaming and shouting, running for their life (P14).

I'd probably just stand there and try and control my... calm myself down, control my anxiety (P16).

Related to the expectation that hazardous chemical release would lead to panic were two conflicting themes. Participants expected that *authorities would withhold information to prevent panic* but conversely, participants also expected that they would feel *anxious if provided with insufficient information* and that *information from authorities would reduce anxiety*.

When they're vague that leads me to think that something serious, really serious was going on and they just don't want to try and scare the public (P1).

The Police probably wouldn't want to give too much information ... Because they wouldn't want to panic people, whereas people can say what they want on the Internet (P4).

But if they're not giving us any information, then that may make you feel... Or would make me feel more likely to be worried, and uncomfortable, and just uncertain of what's going on (P8).

Ultimately you know I'd want to know, just as a bit of information I think, informing the public and keeping the public up to date on what is going on. If there is a potential you know situation of any sort, it's always helpful, either to calm people down or for at least them to understand (P13).

I do feel that authorities, paramedics and police, they may have access to information and updates that they don't want to share with the public to prevent people, you know, to prevent chaos and panic (P16).

The expected behaviour of *seeking further information* was discussed with reference to expected anxiety. Specifically, participants stated that they would want to know: *what the chemical is; the cause of the chemical incident; the health impact of the chemical; what protective actions to take; and what treatment would be provided by authorities*.

I'll be very worried and you know, try to find out well what exactly is this incident and what can I do, like, if I've inhaled anything, what can I do specifically so that, you know, we can, we can stop... this from happening (P1).

I'd also like to know, yes, so which chemical it was, and how we got contaminated, and if they were able to tell us, like, how much we were contaminated, or, you know, how severe the contamination was (P3).

Have someone, to me authorities or some sort of chemical expert, tell me the best course of action so I could be informed if that's what I would need to be treated (P6).

The first thing I would want to do would be to find out the extent of the contamination. So if it's... Like how serious it is, what, you know, what are the effects. (P10).

Because I'd want to know the potential impacts on myself in the short term, long term. And you know if it's something that they know causes certain things (P13).

I think I'd probably try and push for some kind of answer or response from whoever is deemed to be in charge for the situation. So, I'd probably look for a police office or a paramedic and ask them what was happening and why we're being asked to... I'd probably just want to get more information really just for my own peace of mind (P17).

I would ask the people or police or medical staff, what to do next. If I have to report somewhere, if I... if it's linked, to what extent it's dangerous, and if I need to get treatment, and if so where I can get treatment (P19).

Preferred sources of information included phoning 999 or loved ones or using a smartphone to access the *internet*, specifically *Google*, *news websites* or *emergency services webpages* or *Twitter accounts*. Search terms that would be entered included location details, emergency service details, and words associated with “chemical contamination”, “incidents”, and “accidents”.

I will go on Google, I will see if it, what exactly, I will try to narrow the scenario down (P1).

Because they would be able to see what's going on if it's already hit the news. They could... If there were rumours of what the agent possibly was, they could probably look some information up on my behalf and send me that information, so as to how to best protect myself (P5).

Sometimes the emergency centres do respond, or do actually post things on social media, particularly on Twitter where they you know update, 'we're attending an incident at this place for this reason'. And it may just be that there's some information on there. (P13).

First I would look up to see if there was any current media report about what was going on in the station, so probably like BBC news (P16).

Probably first Google (P19).

Emergency services or other authorities (e.g. train station staff) *at the scene* were cited as preferred sources of information. Participants anticipated that they would have *trust and confidence in authorities at the scene* and would *follow responders' instructions*. It was believed that instructions would be given for good reason that first responders would have more knowledge than the interviewee were the scenario to occur.

I guess I would assume that the authorities wouldn't allow people to leave if they had thought that there was a good chance that they'd been exposed. I think I would trust in what the emergency services were deciding. (P5).

I would trust that somebody in authority or in that fashion would know better than me what would be best (P6).

Whoever's in charge of the train station since they will know most probably what's happening (P7).

I would obviously do what I was told from... well, I'd hope I would do as I was told and follow guidance at the time (P15).

However, one dissenting participant cited the 2017 Grenfell Tower Fire as a reason why they would not follow emergency responders' instructions.

Actually I will just ignore the advice and I'd go and there's a very good reason for that because I'm, well generally I'm just sceptical of people in charge. But also with the recent...Grenfell Tower fire, so the people in the building, tragically they listened to the operator saying, just stay inside the building, stay inside the building. ... And actually, all the people who listened to that advice died and all those who ignored it and decided to run out are alive to this day. So if they told me to stay in place actually I will just ignore it, and my side is that they have no legal, like, there's no legal recourse that they can take, like, to punish me for leaving, I'll just leave and I'll will just, like, try to find it myself. (P1).

Confidence varied depending on the type of emergency response organisation (police officers, firefighters, ambulance crews) and there was no clear consensus as to which service would be trusted the most.

I would trust...the ambulance crew first and foremost, because I've got certain biases, that I'm aware of (P2).

You know, the Police, they are the law (P4).

Because they [firefighters] are good at... I hope that they would be good at dealing with burns, or have some knowledge about that (P8).

In particular, participants trusted authorities with *assumed medical knowledge*, such as nurses and doctors or a *medical professional or chemical expert*.

Some sort of chemical expert tell me the best course of action so I could be informed if that's what I would need to be treated (P6).

It would have to be someone that I'm satisfied has a reasonable amount of knowledge in how to deal with this... Doctors, nurses, healthcare assistants... (P8).

I'd probably trust the information if most of it was from a health professional whether they were you know a paramedic or an ambulance member of staff or a GP who was working with them or something (P13).

Let's see, certainly doctors, you know... Everybody else I would probably double-check (P20).

When discussing decontamination in general terms, participants demonstrated awareness that *decontamination should be carried out as soon as possible*. The importance of timely decontamination was specifically discussed with regards to removal of contaminated clothing and the application of water to skin.

The thing is that you don't want the chemical to settle on your skin because as I said before, our skin is slightly porous so sometimes, you know, it can actually, it can seep through one's skin and once they seep through one's then that means they can enter into a person's bloodstream. So the ability to remove it as quickly as possible is very important. (P1).

You should remove the chemical contamination from your skin as quickly as possible (P5).

You know if you ever pour water on yourself, on your clothes, it goes through, it will sort of seep through your clothes towards your skin, so if you remove it fast, before it actually gets there, then you might protect yourself (P12).

I guess, you don't want, I guess, my understanding of acid is it burns through. So you wouldn't want it to burn through your clothing and actually get on to your skin. So, you'd get it all removed as quickly as possible (P14).

Determinants of whether and how to actively self-decontaminate were what the chemical is and the severity of symptoms.

Well, I suppose it depends how... I suppose it depends what the effect... If we could feel the effect, so, if our skin was itchy or our eyes were runny or itchy and, so, if we'd been obviously affected then I would expect immediate assistance. If it was something that we'd been exposed to that, you know, we might not need... feel the effects then I suppose I could wait a bit longer to be seen, if they wanted us to remain there. (P4).

I guess it depends on what their advice is for this particular chemical that I would have been exposed to (P6).

If there's that liquid on my head, for example, and then it's causing like some rashes or like redness, then I would try to like get it off . . . But if it's not causing any rashes, I would like just wait for like medical treatment to come over and help me (P9).

Only if you realised that something's happened. If it was... if you saw people around you reacting or having symptoms, maybe coughing up blood or these sorts of things. (P14).

It probably depends on the chemical (P19).

It was assumed to be difficult to take protective action without help or if immobilised. In some cases, participants believed that it may not be possible to alleviate or prevent effects of chemical contamination.

There's not really much you can do about it once you've been contaminated, or if you're in the middle of being contaminated (P3).

Well, because once you've been exposed I suppose there's no going back. Yes. I don't think... I can't think what we could do after the event. (P4).

The reaction is going on means like it's too late for me to like wipe it off, because like the chemicals have already gone through (P9).

Without any professional help, I don't think I can do anything that would help me (P11).

I'm not sure what you could do really because if it happens it happens, there's not any way of stopping it ... I think you'd feel so much pain that you can't do anything (P14).

Whilst participants reported that they would *want medical attention or want to be assessed by a medical professional*, to the extent that they would *want to go to hospital* (discussed in the following sub-section), participants also discussed *protective actions* that they would take at the scene of the incident, on realisation of being contaminated. Actions included IOR actions, specifically disrobing and improvised wet decontamination, which are discussed in more detail in subsequent subsections.

Actions that participants would take to protect themselves that were extraneous or in contrast to the expert model included: *staying away from the chemical*, for example by keeping low to the ground; *drinking water*, and *covering nose and mouth for respiratory protection*.

I'd probably do something really foolish like put my potentially contaminated clothes up against my face if I thought it was airborne, if people were saying it was, you know, respiratory route (P5).

This is assuming that, say for example, it's close to me, I would just move back, I would create some distance...[from] the site, or the source of this chemical (P8).

I think I would try to like use a wet cloth, some type of like wet cloth, and then cover my mouth, just like to reduce the contamination (P9).

I suppose the only thing I could possibly do is just like to literally drink a lot of water, like, literally two litres of water. And just to kind of, very superficially to try kind of flush my system, if that makes sense, just to drink a lot of water. (P11).

covering the mouth and nose so you're not breathing in, or trying to protect yourself from breathing in anything further (P15).

To protect from skin exposure, participants reported that they would *not touch affected skin* or they would *keep skin covered*.

Maybe having clothing on is perhaps the safer option, you know, in terms of further contamination (P2).

Probably maybe just keep [skin] covered so nothing can interact, nothing can interfere with it ... If, for example, it's a rash, if I'm itching it, and like my nails have bacteria in it, it... I can make it infected. I could just make it even more sore than it already is...I feel like I would just like kind of try, I would try to leave it alone until like there's medical attention that can see me. (P8).

Whilst *protecting other casualties* was cited as a preliminary action that participants would take, participants also discussed the act of *avoiding other casualties to prevent succumbing to secondary contamination*.

Also trying to not yes, be near people who maybe are contaminated or whatever, because that's how it would spread (P13).

If it's passed on by people, trying to have as little contact as possible (P15).

Try and help everyone else in the same situation and ensure they're as safe as possible as well (P17).

Participants reported that they would *phone loved ones*, for example to check that they are unaffected by the incident or to update them on the situation, particularly if they were to suspect that the cause of evacuation was terrorism.

I'll probably also tell someone close to me that that had happened and just that I'd probably be going to seek medical help or whatever if it was appropriate (P2).

I would probably call someone in my family to let them know what was going on (P6).

And in these days of mobile phones I guess it would be pretty easy just to pick up the phone and call the family anyway. I would want... I guess I would not want to worry them, you know, unduly, and therefore I think, you know, I would probably want to know some sort of prognosis first or what was going to happen in terms of testing and things and... rather than just phone and panic my wife and children. (P15).

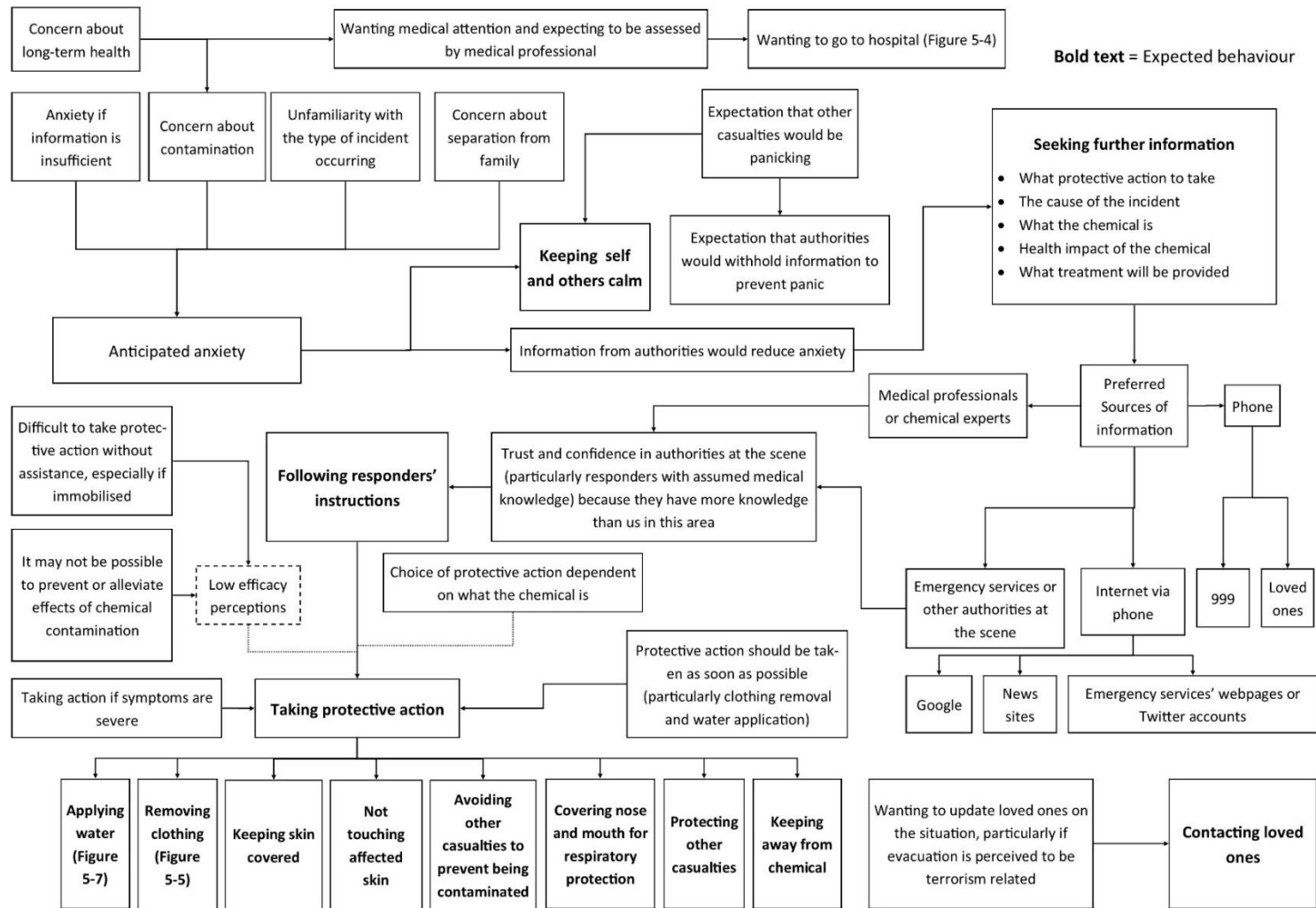


Figure 5-3 Influence diagram to visually represent the non-expert general model of decontamination from the point of evacuation.

5.3.2.5 Non-expert model of containment

Both *self-evacuating* and *remaining in place* were discussed when participants considered what they would do following evacuation from the train station. *Reasons for remaining in place* included: high symptom severity; provision of information, including the provision of justification for remaining in place and assurance that responders have the necessary resources to treat casualties; concern about falling unconscious when leaving the scene; concern about effects of prolonged exposure to the contaminant if the participant leaves without taking protective action; concern that leaving the scene would motivate other casualties to leave the scene as well; and willingness to remain in place if instructed by responders at the scene.

I will stay because then I will say that, you know, they probably know, they have the equipment and the necessary things to, you know, to solve whatever issues that I have, so I would stay in that event (P1).

Because in a situation I'm assuming that they knew... They know about this exposure, that they know more than I do about what's the best thing to do in this scenario (P10).

I guess I would stay most probably, but if I was feeling more unwell after the attack, then there'd be more chance of me actually staying rather than going home. If I was feeling fine, then I might be tempted to go home (P12).

Unless I knew exactly what was going on, I wouldn't really know that there was any point in hanging around (P13).

Gone untreated you would suffer worse than had you stuck around and been helped at the scene (P15).

I am also, I believe, under no obligation to stay there if they've not informed me after one or two hours what we're doing, and if they're not going to stop me, I will leave myself and go to the hospital, because if I am not informed, if I don't believe I am safe, then off I go. I will leave (P20).

Self-evacuation was discussed when participants perceived that the cause of evacuation was *terrorism*, particularly when they suspected that there would be a risk of subsequent attack.

So, it could be a terrorist attack, which might not be terror related, but it could be someone just going on a rampage almost, per se, destroying everything in their path, or everyone, so you'd want to get out of there as quickly as possible (P3).

Leaving the area was perceived to be an action that would *help emergency services to handle the situation*.

If there was some kind of incident then being in the way probably wouldn't be of any use to anyone unless I was called on to help (P17).

It's best to get out of the way and like let the situation be handled...Because the more people there, the more problems you make (P20).

Participants reported that they would leave the area on realisation that they were contaminated, that they would continue to evacuate to avoid further contamination, and to self-decontaminate.

The best option is to escape from the current place (P18).

Yes, actually I would leave, just to avoid further contamination (P9).

I would go to the bathroom and just go to the sink and just wash (P18).

Participants stated that they would self-evacuate to a location that is perceived to be safe. Indications that the area to which the participant evacuates is safe were lack of emergency service presence and people appearing calm or unaware of the emergency.

Because if there is a police emergency in the area, most likely it might not be so safe, especially because I'm travelling alone, and in a place that I've never been to before. So once the initial curiosity of what's going on subsides, I... Like my next priority would just to like get... Would just... Would be to get somewhere safe (P8).

Probably cues from other people around, I know that's a bit weak but we always look to social cues I guess. Yes, if everyone else seems kind of calm, if no one really knew about it or talking about it (P16).

When there...is no speaker announcements or there's no police or fire fighters around (P18).

Participants stated that they would leave the area to *present at a hospital* upon realisation of contamination. Self-presentation at a hospital was deemed to be more likely than returning home. Reasons for presenting at a hospital after self-evacuating included *receiving medical treatment* and *acquiring information or assurance*.

Participants reported that their decision to self-present at a hospital would be dependent on perceived severity of contamination.

Yes, yes I do think so, I think, I mean, it depends on how far A&E is, but the time that it takes to travel to A&E, by that time the chemical could have, like, you know, it could have done everything that it set out to do. So that's why I would be inclined to, like, to try to resolve it as quickly as possible myself before walking to A&E. (P1).

I'd consider visiting an emergency department, but it will be very much dependent on the severity of my symptoms and the degree of exposure that I could estimate... if it's, like, if you don't get treatment now or if you don't go to the hospital now it's going to get much worse very quickly and blah-blah-blah, then obviously I'd take myself to an A&E in some kind of way. (P2).

I don't think I would go home. I would always try and get to some sort of A&E first (P12).

I'd probably want to try and get to the hospital as quickly as possible. ... It's probably the best place to be if you're ill or need medical attention (P17).

The *risk of secondary contamination* was a cited justification for remaining in place. When discussing expectations of self-evacuating, participants expressed an awareness of the risks, specifically the burden on hospital resources and the risk of secondary contamination.

I don't know how these things work, but I wonder if you've been exposed to a chemical, in particular if it's on your clothes or anything like that, whether that would, you know, put others at risk, because obviously that would be a massive reason not to go to A&E (P2).

So, if they're telling us to stay, I would be guessing that there's good reason, in that they don't want to spread the chemical around further (P3).

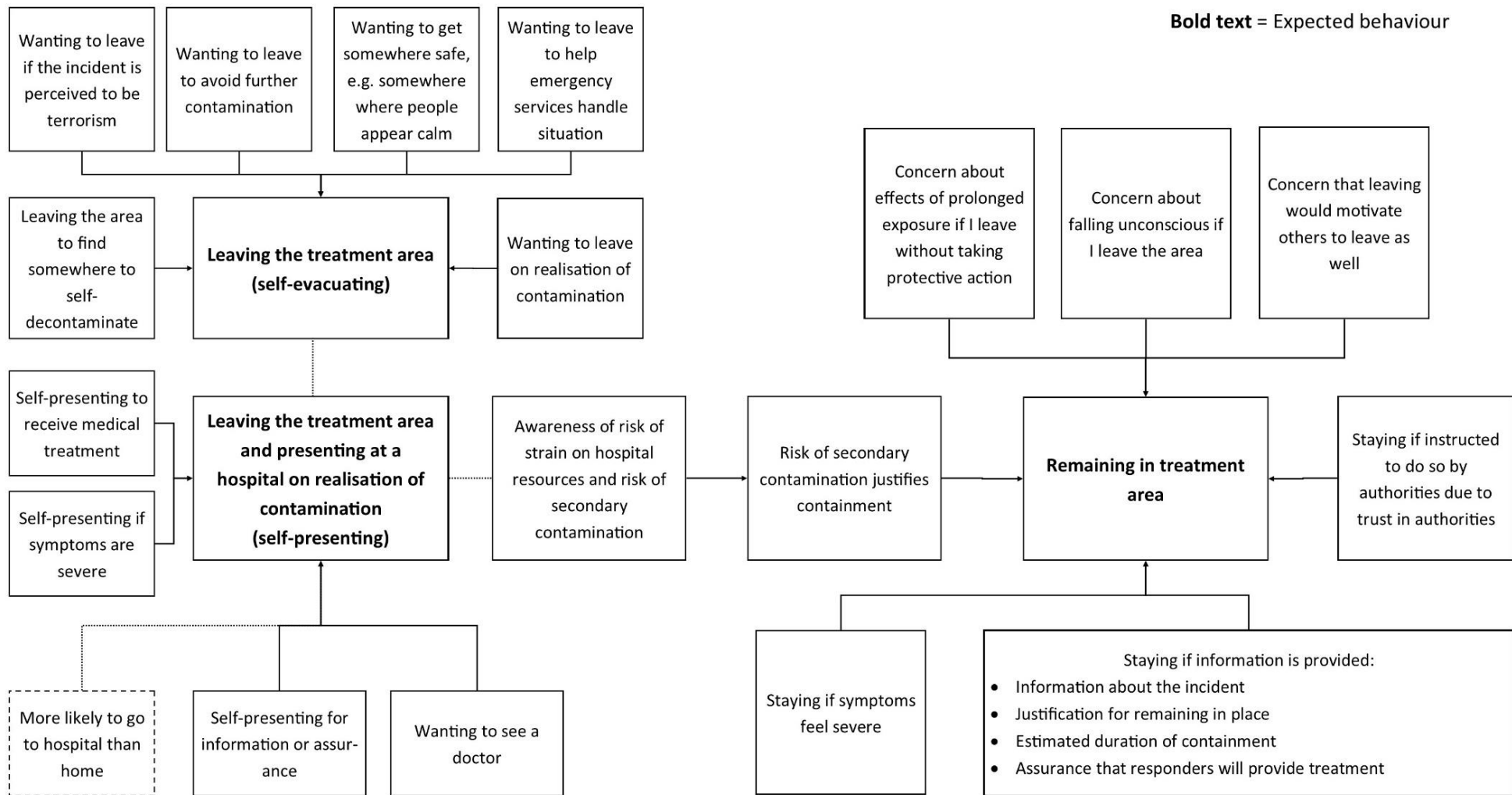


Figure 5-4 Influence diagram to visually represent the non-expert model of containment at the treatment area.

5.3.2.6 Non-expert model of disrobing

The subject of *disrobing* (removing clothing that may be contaminated) was raised by some participants without prompt from the interviewer. Participants discussed how *contaminated clothing should be removed as quickly as possible*.

You should remove the chemical contamination from your skin as quickly as possible (P5).

So, perhaps, take my clothes off, you know, yes, take my clothes off, if the chemical was like literally on me, like on my clothes (P11).

Well I guess sometimes you can remove your clothes if you think that this substance, particularly if it's some sort of liquid, has come into contact with you, then you know you'd remove your clothes maybe (P12).

I would have thought if it was a, sort of, materials, so it was on the skin it would be on the clothes, and therefore you would want to discard those clothes as quick as possible (P15).

Well, I guess, if someone told me it was, like, a contact-based contaminant and might like remove some clothes or shoes (P16).

The first thing coming to my mind is, it's on my skin, change my clothes and probably have a shower (P19).

Reasons for removing clothing included *stopping skin contact with the chemical and preventing inhalation of the chemical*. Clothing removal was cited as a protective action *if the chemical is flammable or if the chemical is a liquid*.

Because of, with some clothing, like things like... I guess a chemical can stay there, and as long as it's like near you, you'll be inhaling that chemical as well, so that will be one reason why it's important to remove the clothing as much as possible (P1).

If I thought my clothing was also, if the chemical was on my skin and there was clothing nearby that I saw was also contaminated, then yes, because obviously it would just continue to contaminate my skin (P2).

If it had been soaked into my clothes, it'd be in contact with my skin for a lot longer, so I'd want to take off my clothes (P3).

Say something's a flammable chemical then, I'd want to try and remove myself from that danger (P6).

If I'm literally wearing a jacket, it has been contaminated at the station, however it was contaminated, so basically if the jacket is not on me, I'm not longer breathing the chemicals off of it (P11).

I mean I guess obviously if your clothing's come into contact with it, then it may be that you'd want to remove your clothing, so that it was limiting its exposure on your skin (P13).

Just to get it away from me, and especially if it's emitting fumes, I would still be inhaling fumes if it was on the fabric of my clothes, so, just to take that off, yes (P16).

Any gas obviously would be just airborne anyway, so it probably wouldn't make much difference but if it was something which was liquid of some description and could've splashed on to clothing then, yes, I guess outer clothing is the first line of defence in that (P17).

Participants expected that they would disrobe *if instructed by authorities or if other people are removing clothing.*

I would say it would need to be the Police or a medical professional. I mean, to get someone to take their clothes off in public I think it needs to come from the Police or a medical professional (P4).

I think if everyone around me was stripping off, I'd probably do it because someone would have been told to get it off or someone else is having a reaction (P5).

The fact that everybody else was doing it, then I should probably also be doing it (P6).

Barriers to removing clothing included: *cold weather, concern about further exposure to contaminant if clothing is removed; and modesty concerns.*

Would that be indecent exposure? I don't know. I mean, that's illegal as well, isn't it? (P4).

Modesty reasons I guess, I don't want to be standing around not wearing much (P6).

But if I'm still in a situation which I'm still being exposed to it, then I suppose taking off my clothes would expose my skin more to [the chemical] (P10).

You know you're not anywhere close to home and people aren't really used to people walking around naked and I'm certainly not used to walking around naked (P13).

Taking off what you can afford to take off, given the weather and stuff (P16).

If there is still signs of chemical contamination outside the station, then I would keep wearing the jacket (P18).

It's fundamentally taboo, it's socially taboo, there are religious taboos, there are cultural taboos, so you're going to produce a) outrage and b) panic. You've made a potential problem about 500 times worse. Chemical spill is bad. Chemical spill with rioting, looting and lawsuits is worse. (P20).

When discussing their modesty concerns, participants stated that they would *deprioritise modesty for health protection* and that they would be *more likely to remove clothing if there is a change of clothing or a private area for changing provided.*

For me personally it would be a matter of, you know, if I thought something was going to burn my skin I'd have no qualms about not being fully dressed in public. But, still, it's obviously a public place, that would be something to think about (P2).

I mean, if they thought that keeping our clothes on would be, you know, dangerous for our health then, you know, my health would be my priority. I'd be very uncomfortable doing it in front of a group of strangers, but I would (P4).

I mean I don't know that I'd really be wanting to walk around without anything on, so unless there was some way of actually obtaining something else to cover yourself (P13).

if you're in that scenario and it's obviously serious enough that it's threatening either your life or your...quality of life...you would get over your modesty issues and just, sort of, instinct for survival would take over (P15).

Because patient dignity is very important. We don't live in a country where you know you just demand people get naked in public. This needs to happen like in a private context. You need to give me some sterile clothing to put on (P20).

Expected Clothing removal methods included: *cutting off the clothing; wearing hand protection when removing contaminated clothing; keeping clothing away from the face when removing it; and ripping clothing off the skin.*

If someone happened to have a pair of scissors then I'd probably just cut it off, because that's much easier and safer (P2).

Rip it off, to be honest. Give it a good tear (P3).

Probably without touching the clothing if at all possible. So, I guess using something as a... cover my hands, so maybe a pair of gloves or something lying around like a newspaper (P17).

There was also discussion of *safe disposal* of contaminated clothing after it has been removed though this aspect of disrobing was rarely cited.

Those clothes need to be put away somewhere that will not contaminate anything else (P7).

Removed and disposed of some way and you know put in a corner (P12).

Choice of clothing to remove varied from all or most clothing to only clothing that feels contaminated based on whether it looks or feels stained or damp. Participants also discussed how their decision regarding amount of clothing to remove and method of removal would be *influenced by authorities at the scene.*

And if I felt I still had to, I'll take everything else off, pull down my trousers and whatnot (P3)

Might double check with whoever's there...I suppose if they said it is harmful to take it over your head, it would be, and I'll just rather follow the instructions of the person that knows how to do it (P7).

I probably would keep on my jeans unless I could visually see that my jeans had like a stain or have been sprayed with something, then I would want to take them off (P16).

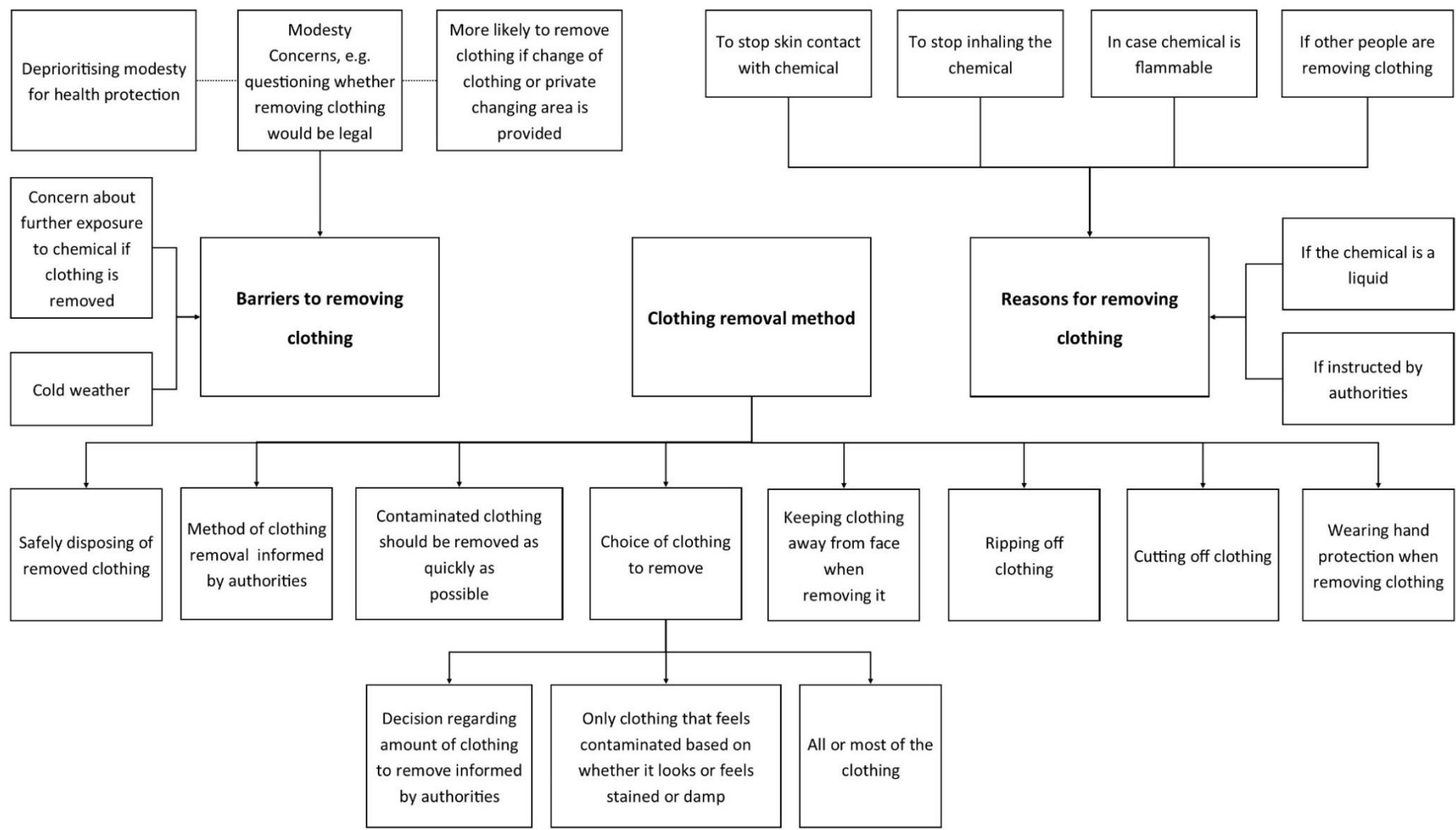


Figure 5-5 Influence diagram to visually represent the non-expert model of disrobing.

5.3.2.7 Non-expert model of dry decontamination

Dry decontamination was not raised without prompt when participants considered actions that they would take to protect themselves on realisation of chemical contamination in the scenario. When asked to consider dry decontamination as a method of decontamination, participants expressed *limited confidence in dry decontamination*. *Low perceptions of dry decontamination efficacy* were raised, primarily because dry materials are *not used for cleaning in everyday life*. There was also a *lack of confidence in dry decontamination relative to wet decontamination*.

I just believe that, you know, water is very powerful and with dry materials you can't really wipe everything off completely, there will always still be a miniscule amount on the skin. With water, because everything dissolves in water, if you wiped it on the skin it should, I would say it's much more effective than, you know, something like tissues (P1).

A dry wipe is not the same as wiping... you know, using a wet wipe, you know. That's why we have showers and baths rather than just wiping ourselves with a towel (P4).

In everyday life, unless it's, you know, like a baby wipe, you wouldn't go for absorbent material to clean yourself or decontaminate yourself in any other way (P5).

I suppose because like you always have the impression that if you wash it with water, it will just go... It will all flow out. But then if it's like tissue, it might just like... If it's dry, especially dry tissue, don't know if it has been like fully removed or not (P7).

Because if you use tissue or cloths it might just... Like you might just tap it on your body and it just absorbs. But I think the best to clean the area is to use water because after you use tissue there is still... After you wipe all of the chemicals out there has to be some that remains on your skin but you cannot see it. So just use water, like how we shower (P18).

Concerns were raised about *exacerbating the spread or absorption of the contaminant when rubbing the skin* and an *adverse reaction between chemicals in the absorbent materials and chemicals on the skin* (though this particular concern was based on the perception that the materials would be wet wipes).

You wouldn't know whether that was the safe thing to do or whether it would exacerbate the situation by maybe spreading a small area of infection wider (P15).

Well, I'm not sure because I don't want to go, like, rubbing at my skin if there's something already sitting on the surface of it. I don't want to, like, increase absorption ... especially if I don't know what's going on and what kind of chemical it is (P16).

I mean, most kind of cloths or any kind of clothing material or wet wipes or something like that is going to have some kind of substance, chemicals or, if you're otherwise... so you're not going to introduce another substance to my

skin when there might already be something else sitting there...Well, it could clearly make the situation worse (P17).

Motivation for applying absorbent materials was based on being able to see something to wipe away on the skin and trust in authorities.

I would do it, but very cynically. I would do it because I don't know any better and I trust the authorities that have told me to do it, so I assume it would serve a purpose, but to be honest, I would be doing it thinking, what on earth is this for? But I would do it out of self-protection (P5).

If like, a bystander is just, like, oh here, have some tissues, I would be not likely to do it. I would do it if it was a police person or like a paramedic or someone who had information on the chemical and what was the appropriate action to deal with it (P16).

Well, if I could see something, so, if it's like stuff I can see with my eyes on my skin, I probably would try that. But if I can't see it, I would either see no point or be afraid that I'd just rub it in deeper, so, I'd rather not (P19).

But if it's like one paramedic who hands me a tissue, or if it's like you know context-based, if like one street police officer hands me a tissue, no. But if there's an announcement, if there's an organised system for everybody to do the same thing, then yes, that's fine (P20).

When discussing dry decontamination, the methods that would be used included dampening absorbent materials before applying them to skin and simply wiping the chemical off the skin.

So I wet the tissue paper or whatever I have and then I will put it say in my hands and then I will just like gently wipe it off (P9).

Use some tissues to wipe off my face, wipe off my hands, wipe off my hair (P11).

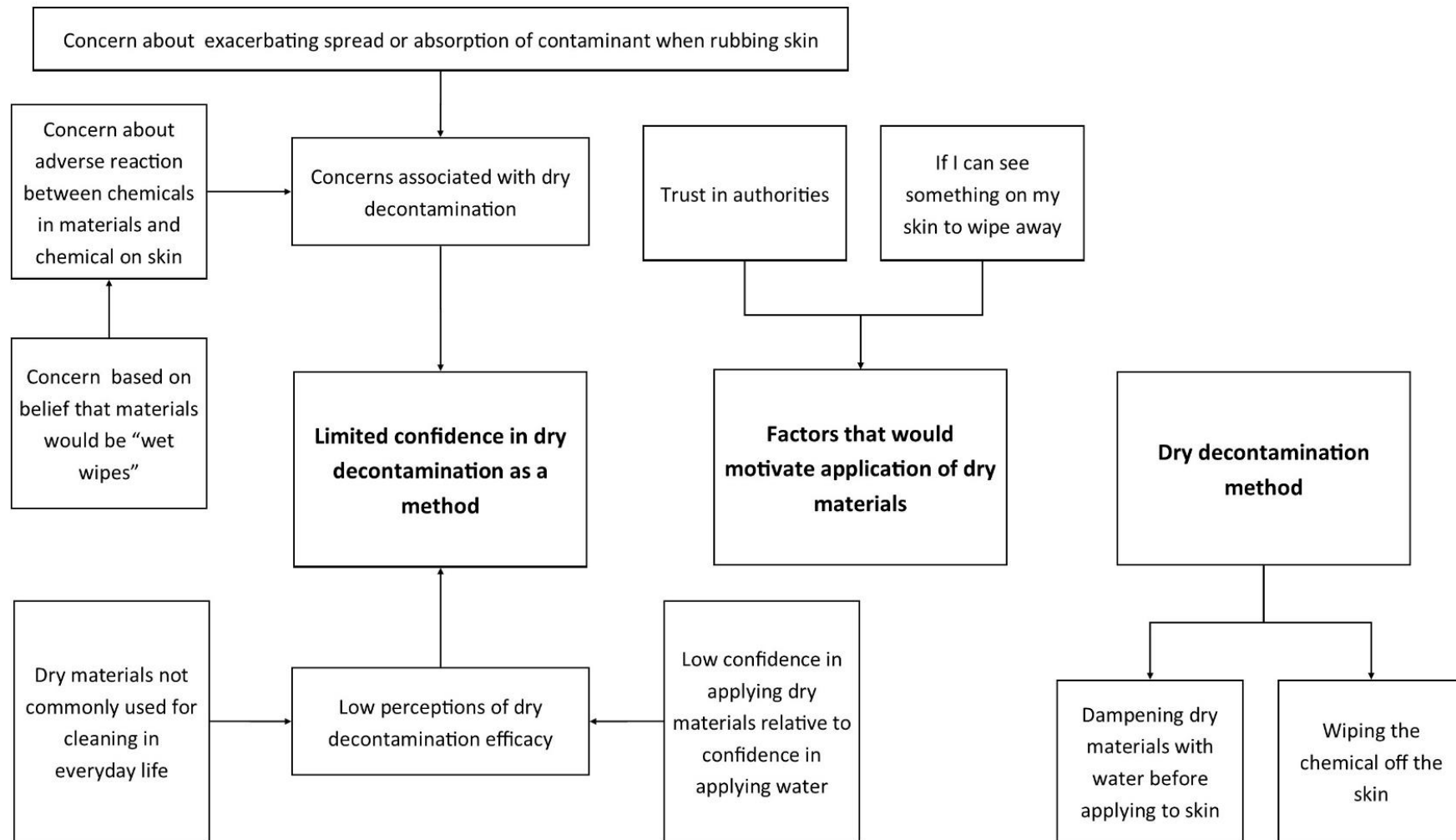


Figure 5-6 Influence diagram to visually represent the non-expert model of dry decontamination.

5.3.2.8 Non-expert model of wet decontamination

The application of water was raised as a likely protective action that participants would take and, in many cases, the action was raised without prompt. The application of water was perceived to be something that should be done *as soon as possible*.

That's probably the first thing I'd do (P2).

so, yes, I'd want it done as soon as possible and wash as much of the chemical away as possible (P4).

I'd like probably shower, just get it off my skin (P6).

The first thing coming to my mind is, it's on my skin, change my clothes and probably have a shower (P19).

Reasons for applying water were: removing the chemical from skin; neutralising, diluting or dissolving the chemical; preventing skin penetration of chemical; alleviating pain and burning.

There's a reason why they call water the universal solvent, because when you, you know, almost everything dissolves in it. So that, for me that will be the reason why I would be inclined to get water (P1).

It would remove the contaminant from the surface, one would hope (P2).

It would hopefully wash everything away before it permeated the skin... before it penetrated the skin (P4).

If you're feeling pain and it's a natural instinct to try and lessen the pain by using water, if it burns you'd automatically think to get something cold and just pour water on yourself (P14).

In the hope of getting rid of whatever chemical touches my skin (P19).

Participants also discussed the application of water to skin with reference to the *recommendation to use water in response to acid attack or observation of people using water in response to acid attacks in media reports.*

I was reading about acid attacks in London recently and there was a Guardian article about what to do if you witness or are involved in an acid attack, and it's basically just chuck loads and loads of water at it (P2).

Actually read a BBC article on how to deal with an acid attack, when all of this madness was going on. Yes, basically, pull off your clothes, spray as much water as you can, was basically the advice they gave. (P3).

I guess, it just stems maybe from the media seeing particularly people who have been faced by acid attacks, random acid attacks where they just seem to be drowning themselves in water after being attacked. That seems to help them in the sense that it seems to appear that it's relieving the pain (P14).

Participants discussed how they would apply water if instructed to do so by authorities.

Yes, if an expert was standing there telling me that was the best course of action, then I'd take that they'd be telling me for a good reason (P17).

If the authorities have indicated that it's fine, I would do so (P20).

Perceptions were raised about how the *effectiveness of showering is dependent on the properties of the contaminant.*

It would help, not in the case of a gas, but in the case of if this was some sort of acid (P12).

if it was something that my skin had been exposed to then possibly. If it's something that I've breathed in then obviously it's pointless (P15).

Participants raised concerns: that there would be an *adverse chemical reaction between water and chemical on skin*; that the water itself *would be contaminated*; and that *washing would exacerbate the spread of absorption of the chemical.*

I think I'd also be concerned that if there was something in my hair, actually pouring water down my hair would... it would go down my back and on my skin (P5).

If it's bottled water sitting outside of the station, I would assume that it had not been contaminated but if it's like tap water or a fire hose like you said, that's in, like, direct geographical proximity with the station, then I would assume that the water has been contaminated just in the same fashion as I was contaminated at the station just because the water source and I both were at the station (P11).

"if you get blood on some clothes and you put it in a hot wash, or even I think red wine's another example, if you put it in a hot wash, that actually ends up washing the product into your clothing, rather than actually removing the product... So I guess the same kind of thing could happen to some extent with skin" (P13).

Water and most chemicals don't mix very well, in my experience. It certainly could probably just make the situation worse, especially relating to burns, yes, and... any kind of chemical burn. (P17).

Although there was expressed *doubt about availability of public showering facilities* from a minority of participants, potential *sources of water* were discussed, for example: *bottled water, tap or drinking fountain*; and *emergency decontamination shower.*

Participants discussed the following *water application methods*: *pouring the water over themselves*; *applying to the affected area*; *using a cloth as a washing aid* and *showering as a passive process*, for example by being sprayed with a hose.

I would try to rub it off as much as I can, you know, go and find a physical shop, where they sell water and try to rub it off from my skin as much as possible (P1).

I would pour it on to wherever the contamination was, so that it was running down, obviously off my skin or off the clothing or whatever onto the ground in a specific place, away from people so that no one else is contaminated by the

water that has been in contact with the chemical, ideally into some kind of receptacle so that water could then be disposed of appropriately, but obviously that's quite a big ask and probably not all that feasible (P2).

Just straight up bottled drinking water (P3).

Well, I mean, given they probably wouldn't be able to provide showers in the middle of a street (P4).

Emergency shower station or something I would assume they'd have set up (P5).

Ask somebody to hose me down, if there was someone nearby (P6).

I would just pour it on the affected area (P8).

So I would just pour the water over wherever I thought I would have been exposed (P10).

Well more of a vigorous wash than just splashing a bit of water on yourself. So yes, washing in a more intense manner, probably using a flannel or a sponge of some sort, rather than just using your hands and some water (P13).

You'd just grab the bottle and you'd just be pouring, I guess, just on to the areas that you think you've been affected by (P14).

Pour it over me and, yes, that's pretty much it (P19).

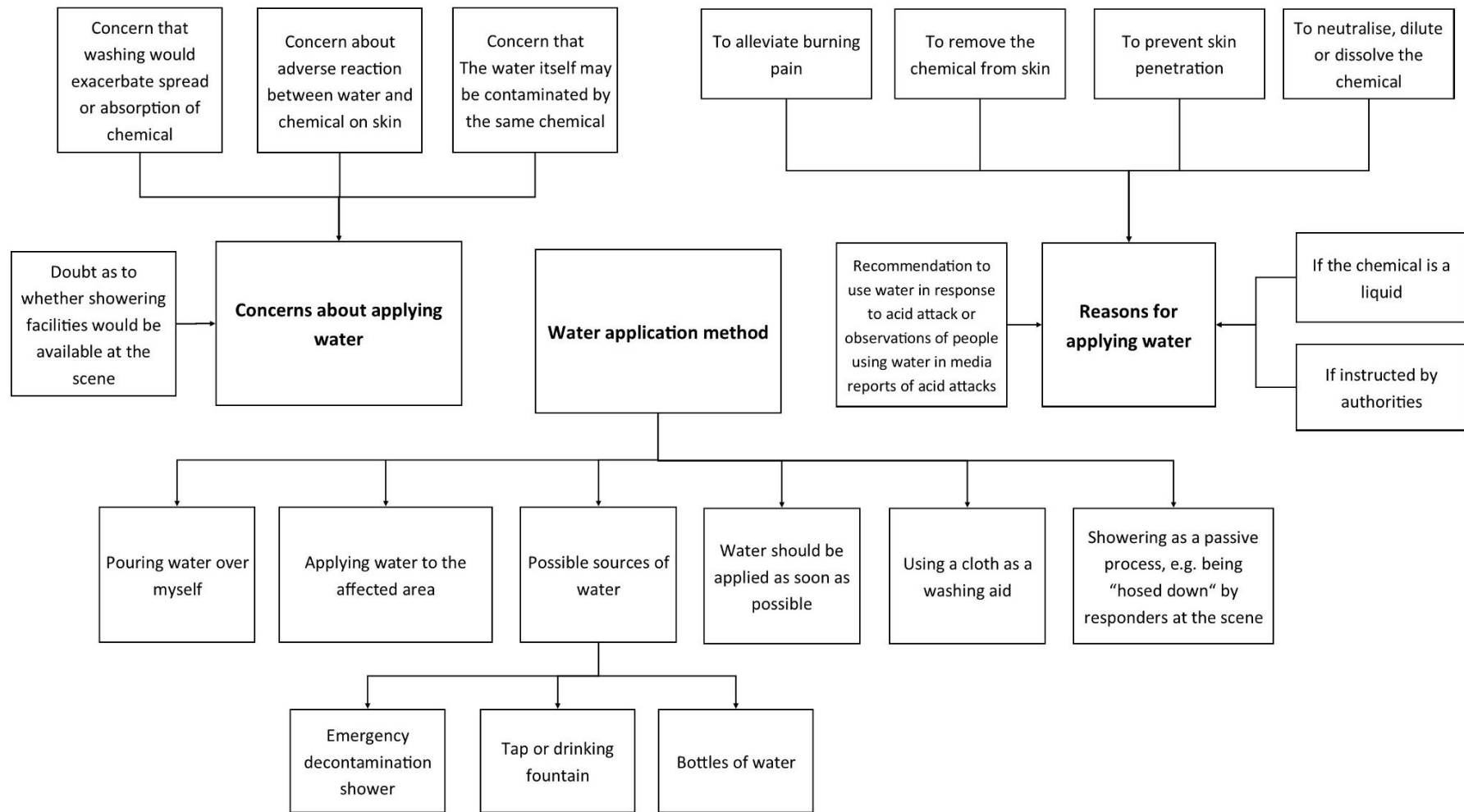


Figure 5-7 Influence diagram to visually represent the non-expert model of wet decontamination.

5.4 Discussion

IOR decontamination requires rapid uptake of specific behaviours, including disrobing, applying absorbent materials to skin and waiting for decontamination facilities to arrive. Understanding how laypeople conceive of the risks of chemical contamination and how particular actions may mitigate against these risks is an important step in the development of a communication intervention aimed at improving adherence to decontamination protocols. Guidelines for extrapolating findings from mental models research to communication interventions state that it may not be necessary for communicators to explain in detail concepts with which the audience are deemed to be familiar and to focus more on apparent knowledge gaps and misconceptions (Morgan et al., 2002). My semi-structured open-ended one-on-one interviews with 20 non-experts revealed several concepts that may not be as intuitive to casualties as they are to the first responders deployed to the scene.

Most concepts in the expert model were discussed by at least two non-expert participants. Concepts that were covered in both expert and non-expert models included: awareness of the effects of skin exposure to a chemical contaminant; awareness of the potential delay to the onset of symptoms following hazardous chemical exposure; the risk of secondary contamination of other people with whom casualties come into contact; the efficacy of disrobing and showering as protective measures against the effects of chemical contamination; and the fact that decontamination actions, specifically disrobing and applying water, would be most effective when performed as soon as possible. Based on the results of the present study, the concepts outlined above are likely to be congruent with casualties' existing conceptual framework. This is reassuring and suggests that, while messages about the need to engage in these actions may be required, information about why the actions are being recommended may not need to be highly detailed in order to be accepted by casualties.

Themes resulting from the present study can inform the development of messages to address constructs in Protection Motivation Theory (PMT) (R. W. Rogers, 1975, 1983) and the Extended Parallel Process Model (EPPM) (Witte, 1992, 1994). For example, participants conceived of the severity of chemical contamination in terms of acute effects (including death) and long-term health effects, such as irreversible skin damage. Severity was also discussed in terms of secondary contamination. The concept of secondary contamination was in some cases conflated with the risk of infection from a biological or radiological contagion. In previous mental models research, conflation of two separate risks has been shown to occur when the risks share similar elements (Bostrom et al., 2018). In this study, it appeared that the

concept of chemical secondary contamination fits within the model of how communicable diseases can be transferred.

Perceptions of susceptibility varied, with some participants citing an awareness of delayed onset of effects and other participants discussing how symptoms would be felt immediately. Explicitly informing casualties that symptoms do not necessarily occur immediately on contact with a chemical may therefore be a necessary step to ensure that casualties accept messages which are intended to address threat susceptibility.

Response efficacy perceptions included references to how removing clothing would stop skin contact with the chemical and how applying water would remove the chemical from skin. There was a misconception that it may not be possible to alleviate or prevent effects of chemical contamination or that decontamination involves the level of medical attention that can only be provided in a hospital. Responders may therefore need to explain that chemical contamination is not necessarily fatal and that action can be taken by the casualty themselves to reduce the extent of contamination. One of the reasons cited for self-evacuating was to present at a hospital and receive treatment for chemical contamination –a finding supported by questionnaire data from a previous study on attitudes of simulated casualties who participated in mass decontamination field exercises (Carter et al., 2012b). This should not be dismissed as an irrational response to realising that chemical contamination has occurred. In fact, presenting at an emergency department on realisation of a medical emergency is perhaps the most rational response available in the absence of pre-hospital decontamination. As stated in Chapter 1, medical staff have experienced secondary contamination following chemical poisoning and chemical suicides with hydrogen sulphide and phosphine (Gaskin et al., 2017) and the Matsumoto and Tokyo sarin attacks (Clarke et al., 2008; Eckstein, 1999; Nakajima et al., 1997; Nishiwaki et al., 2001; Okumura et al., 2005) and following the Tokyo sarin attack, 23% of hospital staff at one of the receiving hospitals were subjected to secondary contamination due to a lack of personal protective equipment and on-site decontamination facilities (Okumura et al., 2005). Participants demonstrated awareness of the risk of secondary contamination of hospital staff so this could be made salient when communicating the instruction to remain in place. Responders would also need to make clear that decontamination without hospitalisation is an effective countermeasure and make salient that going to a hospital would delay their decontamination and put staff and patients at risk of secondary contamination.

There was a misconception that dry decontamination would be an ineffective countermeasure. Participants believed that wet would be more effective than dry

decontamination, particularly because water is used more in everyday hygiene behaviours. This perception is supported by findings from previous focus group discussions in which participants expressed low confidence in the efficacy of dry decontamination, relative to wet decontamination (Carter, Weston, Betts, Wilkinson, & Amlôt, 2018). The perception of dry decontamination as an ineffective measure is supported by the finding from a simulated decontamination study in which participants reported low confidence in cleanliness after undergoing a dry decontamination procedure, though there were no comparator groups that underwent a different form of decontamination or no decontamination at all (Amlôt et al., 2017). If dry decontamination is to be performed by the casualty, responders need to explain how applying absorbent materials to skin is an effective form of decontamination and also explain how the safe application (dabbing, blotting or brushing) of dry material would not result in the risk of exacerbating contamination that was raised in this study. Messages to address response cost and self-efficacy constructs could be informed by themes pertaining to barriers to taking protective actions from the expert model. For example, whilst the efficacy of disrobing as a means of limiting skin contact with and inhalation of the chemical was discussed, participants also discussed factors that they believed would limit their willingness to disrobe in the context of a chemical incident, including ambient cold weather, concern about further exposure to contaminant if clothing is removed, and modesty concerns. Participants did point out that they would deprioritise their aversion to removing clothing in public if they felt that their health was in danger. When instructing casualties to disrobe during IOR, responders should point out that the more clothing removed, the more contaminant removed but they also need to specify that it is sufficient for outer clothing to be removed (until the arrival of disrobe packs, containing ponchos, that arrive concurrently with specialist decontamination shower facilities).

Several themes pertained to participants basing their decision as to what protective action to take on the instructions provided by responders at the scene. Participants also discussed how they would base their method of disrobing and dry decontamination on the guidance provided by responders. When discussing trust and confidence in authorities at the scene, participants indicated that they would trust that first responders would have more knowledge than them in the context of a chemical incident and would follow their guidance. However, confidence varied depending on the type of emergency response service, with participants reporting greater confidence in responders with assumed medical knowledge, such as paramedics. According to current IOR guidance, the first person to communicate with casualties should be the first responder on scene (Joint Emergency Services Interoperability Programme, 2013;

National CBRN Centre, 2016) so the designation of a medical responder to the communication role may not be an option. Responders who are not affiliated with the medical profession, such as police officers and firefighters, may need to make salient their authority in the area of decontamination or state that they are speaking on behalf of a health authority.

Specific details that participants would want to know and that would reportedly influence their compliance with instructions were: what the chemical is; the cause of the chemical incident; the health impact of the chemical; whether and what treatment would be provided; and what protective actions to take. These perceptions as to what information would be required correspond with best practice guidelines for crisis communication message content in the literature (Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015; Firestone & Everly, 2013; Glik, 2007b; Liu et al., 2017; Mallett et al., 1999; Mileti & Sorensen, 1990; Omori et al., 2017; Sorensen, 2000; Sutton et al., 2015; Sutton et al., 2014; Sutton, Vos, et al., 2018; World Health Organization, 2017). Whilst emergency services at the scene were cited as an information source from which participants would seek information, participants also reported that they would seek information from remote sources, including 999, loved ones via phone or accessing the internet on their phone. Specifically, participants mentioned accessing emergency services' webpages or Twitter accounts. Information transmitted via emergency services' media accounts and webpages would have to be consistent with information delivered by responders at the scene in order to promote trust and prevent anxiety (Rubin et al., 2012). The implication of this finding is that responders should quickly communicate information about the incident and what actions are required of casualties to their commanding officers so that the information can be disseminated to communication teams who can broadcast the information to affected casualties via social media.

5.4.1. Limitations

I used a data-driven approach to thematic analysis to attempt to ensure that coding of transcripts to themes was based on the data rather than an *a priori* framework, in order to best capture the mental model of participants. But, as argued by Braun and Clarke (2006), "researchers cannot free themselves of their theoretical and epistemological commitments, and data are not coded in an epistemological vacuum" (p. 12). This means that I cannot rule out the possibility that my approach to thematic analysis was driven subconsciously by what I expected the themes to be, based on previous research.

Given that this was a qualitative investigation and not a population-wide quantitative assessment, the communication implications outlined above are not to be treated as robust evidence to inform emergency response practice; rather they are reasonable assumptions to be subjected to further scrutiny ideally through a cross-sectional survey or intervention trial. Some assertions raised in the present study are supported to an extent by quantitative data in previous research. For example, in a questionnaire study on perceptions of hazardous substances, the majority of participants reported that the first signs of ill health would appear within two days of exposure to anthrax, carbon monoxide, swine flu, and radiological agent, Polonium 210 (Rubin, Amlôt, Page, Pearce, & Wessely, 2013). For the purposes of this thesis, the present interview study is deemed sufficient to inform the development of the messaging intervention tested in subsequent studies. However, it may be beneficial in future research to use a closed question survey to investigate the prevalence of assertions raised in the present study.

Chapter 6 Development of preliminary messages to promote IOR adherence following the release of a chemical skin contaminant

6.1 Introduction

The aim of my PhD was to develop and test an effective communication strategy for the promotion of IOR among casualties to reduce contamination of the skin in a chemical incident. My literature reviews in Chapters 2 and 3 indicated no clear advantage of using a particular communication channel. Rather the available evidence supported the use of multiple channels conveying a consistent message. In Chapter 4, I outlined a range of channels that would be available to first responders, including pictorial instruction sheets in disrobe kits and voice amplification devices for communicating via the auditory route. For the remainder of this thesis, I will focus on decisions that need to be made regarding the content of the message that would be disseminated to casualties via the available channels.

The evidence to date provides guidelines for developing an optimal message. There are two message components that I would consider essential. Firstly, the message needs to include instructions pertaining to specific behaviours. The provision of information about actions that casualties should take to protect themselves emerged as a minimum requirement for message content in the reviews reported in Chapters 2 and 3. Secondly, the message needs to contain contextual information about who the responders are. Trust in authorities at the scene was raised by participants interviewed in the study reported in Chapter 5 as a factor in their adherence to each IOR action. Trust in the communicator also emerged as one of the key determinants of adherence in an emergency in my crisis communication literature review (Chapter 2). In the interview study reported in Chapter 5, participants reported that they would want to know what treatment would be provided and what steps are being taken to protect casualties. This finding was related to one of the message content recommendations informed by the literature review reported in Chapter 3, that perceived legitimacy of responders by message recipients, which is in turn associated with increased adherence, could be improved by providing information about actions responders are taking (Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015). Aside from these two basic elements, the rationale for including other message components is less clear in the absence of further empirical assessment to address uncertainties. For example, whilst making salient the severity of and susceptibility of message recipients to the threat of chemical contamination is supported by theory (Chapter 2), in practice responders reported often understating the threat to reassure casualties (Chapter 4). This assumption that reassurance is an effective measure

seems to be widespread. Most recently the Chief Medical Officer (CMO) deliberately provided reassuring messages which understated the threat of contamination following the Salisbury Novichok attack, whilst also advising members of the public to engage in protective measures, such as washing clothes worn at the scene of the incident (Public Health England, 2018). In the aftermath of the incident, the CMO described the risk of contamination as “slight”, framed the need to engage in personal decontamination as “precautionary advice... a belt and braces approach” and added that she was “confident this has not harmed the health of anyone.” Given that these communicators have substantial real-world experience in this proficiency and given that there is no study to date in which the effect of threatening information has been assessed in the context of IOR, it is unclear whether information that makes salient the threat of contamination would be more effective in promoting adherence than information that understates the threat or vice versa.

Similarly, it is unclear, in the absence of further empirical testing, whether information about the efficacy of IOR is necessary to promote adherence or whether it is sufficient to simply provide the instructions. Outcomes of reviews reported in Chapters 2 through 4 indicate that response efficacy information may be conducive to adherence and that provision of some form of response efficacy information is already likely to be part of standard practice. But participants interviewed in the study reported in Chapter 5 demonstrated clear understanding of the efficacy of IOR actions, particularly disrobing and showering, at reducing risks. It may not be necessary to make efficacy explicit. Given the limited amount of time responders have to communicate with casualties and the potential for limited information processing capabilities due to stress (Barry et al., 2013; Covello et al., 2001; Firestone & Everly, 2013), it would be useful to check whether message components are superfluous.

The primary aim of this chapter was to develop separate message variants based on all constructs outlined above. The relative strength of including efficacy information as opposed to no efficacy information and the relative strength of including information to make explicit the threat (High Threat information) as opposed to information to understate the threat (Low Threat information) would best be resolved by comparing the effect of these message components on adherence outcomes in a randomised controlled trial (RCT). The secondary aim of this chapter was to refine messages to ensure they were consistent in terms of word count and readability in order to allow a subsequent empirical test to determine which approach would be most effective.

6.2 Method

I developed multiple message components, within four key domains: instruction, context, threat and efficacy. Within the threat and efficacy domains, I developed components intended to portray high, neutral and low threat, and high and neutral efficacy.

6.2.1. Development of contextual scenario

To help with the development of the messages, I first developed a short scenario in which an IOR message might be used. This depicted a group of casualties (chosen to be university students to facilitate future testing of the message) whose skin and clothing had been contaminated with liquid sulphur mustard present on furniture in a lecture theatre. In many ways, this is a worst-case scenario for IOR. Firstly, the latency between contamination and symptom onset for liquid sulphur mustard can range from 30 minutes to 12 hours (Borak & Sidell, 1992; Clarke et al., 2008; Kales & Christiani, 2004; Spiandore et al., 2017; Wattana & Bey, 2009) so chemical contamination is not obvious to casualties at the point of IOR implementation. First responders at the scene may also be unclear as to what the chemical is. Secondly, it is probable that in such a scenario the only available decontamination provisions will be rolls of tissue paper available at the university or provided by the first emergency service vehicle to arrive and, eventually, an interim decontamination shower consisting of hoses mounted to fire appliances. There are very unlikely to be disrobe kits containing modesty gowns available to the casualties. The scenario used as the context to guide the drafting of the message is presented below.

At 09:15, an administrator in the university department receives an email sent to the General Enquiries inbox from an unrecognised account, which reads: "You didn't listen. Now you will pay."

The administrator forwards the email to security then phones them to ask what should be done. Because the university has previously received other, credible threats, the security guard tells the administrator that she will escalate this.

At 09:30, the head of security phones 999 and informs them that the university has received an anonymous threat. Two officers are dispatched to the campus as a precaution due to the heightened threat level.

At 09:45, the police arrive at the campus and meet with the Head of Security.

At 09:48, the administrator receives a follow-up email from the same email address as before. This time it reads: "You might want to check the cleaning products used in the lecture theatres this morning. I just hope no one's been in them! Which lecture theatres I hear you ask? You know, I forget. Just like you all forgot about us. We don't want money. You have nothing you can bargain with. WE ONLY WANT JUSTICE!!!!!"

The administrator immediately forwards the email to Security then phones them.

At 09:51, a senior officer at police headquarters advises the attending officers to treat the incident as a chemical attack, based on previous intelligence. Hazardous Area Response Team (HART) paramedics and fire engines are dispatched. The officer instructs all buildings on campus to be evacuated. The fire alarm is sounded.

The police officer asks campus security to retrieve as many dry absorbent materials as possible. The other police officer sets up a cordon at the entrance to the campus then picks up a handheld loudhailer.

Students and a lecturer evacuate from the nearest lecture theatre. The police officer guides them to the area on the ground where the tissue paper is positioned. This is the point in the scenario when the officer will need to deliver a message to the casualties, in this case, via amplified voice.

6.2.2. Development of instructional components

Target behaviours for which instructional messages were drafted were informed by the IOR actions outlined in Chapter 1 and confirmed by stakeholders at a mass decontamination instructors' course and by members of the Technical Advisory Group. I developed instructional messages by first amalgamating instructional messages extracted in the standard practice investigation (Chapter 4) relating to each target behaviour. I then composed an instructional message for each behaviour that addressed both information included in the quotations and the circumstances of the scenario. Instructional messages are displayed in the column furthest to the right in Table 6-1. The instructional statement pertaining to dry decontamination was predominantly informed by suggested instructions from communication guidance provided in the National Ambulance Resilience Unit (2016) guidance document included in the review reported in Chapter 4. These suggested instructions were shown to improve performance in a field experiment included in the systematic review reported in Chapter 2, relative to simply asking participants to use the available dry materials to clean themselves (Amlôt et al., 2017). The inclusion of the words "down to your underwear" in the disrobe instruction was a departure from standard practice instructions reported in Chapter 4, which tended to stress the removal of *outer* clothing and did not mention underwear. I included these four words to make explicit the maximum extent of disrobing that would be required in the scenario.

6.2.3. Development of contextual components

Three statements, displayed in the right-hand column of Table 6-2, were composed to address: the organisation represented by the communicator; the competence of the organisation at responding to a chemical incident; and actions taken by the communicator to protect casualties. I selected a police officer as the communicator because, according to insights provided by stakeholders in the emergency response

profession, including a proportion of emergency responders interviewed in Chapter 4, the police are likely to be the first on the scene in a chemical incident. Findings from interviews reported in Chapter 5 suggested that responders who are not affiliated with the medical profession, including police officers, would need to make salient their authority in the area of decontamination or state that they are speaking on behalf of a health authority in order to increase trust. I therefore included the statements, “we train for this type of incident regularly” in the *message source* and “we are working with the ambulance crews to resolve the situation” in the *actions responders are taking* message components respectively.

6.2.4. Development of threat components

I developed three types of Threat message: High (emphasising the threat), Low (understating the threat), and Neutral (neither emphasising nor understating the threat). The Threat message construct consisted of information about the *severity* of chemical contamination and the *susceptibility* or likelihood of contamination. Findings pertaining to the lay mental model of acute chemical contamination from the study reported in Chapter 5 indicated that whilst the potential for delayed onset of symptoms may be an accessible concept to some, there is likely to be a misconception that, unless there are available signs and/or symptoms of chemical exposure, it is unlikely that message recipients have been affected by the contaminant. I manipulated susceptibility by making salient the delayed onset of symptoms in the High Threat message whilst stating that the absence of symptoms means that contamination is unlikely to have occurred in the Low Threat message.

I manipulated severity in the High Threat message by highlighting hazardous effects of dermal exposure, specifically skin burns, the risk of death, and the risk of secondary contamination, all of which were included in the non-expert model of acute chemical contamination. In the Low Threat message, the corresponding statement highlighted the precautionary nature of the response and included no information about health effects for casualties or others with whom casualties may come into contact. The wording of the severity subcomponent of the Low Threat message was adapted from wording used in Public Health England and Chief Medical Officer risk communications following the Salisbury Novichok incident in March 2018, e.g. “the risk to anyone that visited The Mill pub or Zizzi restaurant from this incident is low. The advice about clothing is precautionary” (Public Health England, 2018).

In all three types of Threat message component, I included statements pertaining to the communicating organisation’s uncertainty about specific details about the incident, specifically the type of chemical that was released. This decision was based on the

recommendation to communicate uncertainty as justified in the review reported in Chapter 2.

I needed to keep word count consistent between messages to control for the potentially confounding effect of amount of information in future studies. This meant that I included text in the Neutral message to keep the word count consistent with the High and Low messages. The information consisted of: additional information about uncertainties; reiteration of actions responders are taking, specifically the action of investigating the incident and the intention of updating casualties when more information is known; and reiteration of the instruction to remain in place. This information was also present, albeit in a marginally lower quantity, in the High and Low Threat messages.

The wording of message components in each type of Threat message component is displayed in Table 6-3. I ensured that sentence structure was as consistent as possible between High, Low, and Neutral threat components.

6.2.5. Development of efficacy components

The efficacy construct in both Protection Motivation Theory and the Extended Parallel Process Model comprises response efficacy and self-efficacy. I originally drafted a statement to address self-efficacy, based on expected behavioural barriers to disrobing (modesty and cold weather concerns) raised in the mental models study (Chapter 5). However, I decided to remove the statement because it was predicated on the availability of disrobe packs containing gowns and, based on stakeholder input, this is not a guaranteed in all IOR cases, including the worst-case scenario outlined above. I therefore focused entirely on response efficacy. Efficacy message items were designed for all target behaviours outlined in Table 6-1, except for the instruction pertaining to casualties assisting one another as the efficacy of asking for help if unable to perform actions appeared axiomatic.

For each efficacy message component, I drafted a corresponding neutral component to ensure that messages without efficacy information would be of similar length/duration to messages with efficacy information in subsequent studies. Neutral components consisted of the same instructions displayed in efficacy items but including sentences designed not to address efficacy or threat. Efficacy and neutral items are displayed in Table 6-4 along with the rationale for framing efficacy information based on the mental models interview study reported in Chapter 5.

6.2.6. Combining message components and assessing word count and readability

When combining message components into one message, I used the following order.

1. Message source: Statement 1;

2. Threat component;
3. Message source: Statement 2;
4. Statement about actions responders are taking;
5. Instruction to remain in place;
6. Instruction to disrobe (with efficacy or neutral statement);
7. Instruction to undergo dry decontamination (with efficacy or neutral statement);
8. Instruction to ask for assistance if required; and
9. Instruction to continue to remain in place (with efficacy or neutral statement).

The word count for each type of message was checked to ensure minimal variability between conditions. Readability of text across conditions was assessed using the Automatic Readability Calculator (Automatic Readability Checker) that amalgamates readability scores derived from seven tools including the Coleman-Liau Index (Coleman & Liau, 1975) and Flesch-Kincaid Grade Level (Kincaid, Fishburne, Rogers, & Chissom, 1975; Walters & Hamrell, 2008).

6.3 Results

The preliminary message components are displayed in the columns furthest to the right in each of the following four tables.

Table 6-1 Instructional message components.

Target behaviour for which instructional messages were targeted	Direct quotes (where available) from guidance documents (GD) and interview transcripts (IT) analysed in Chapter 4	Preliminary message after amalgamating quotes and applying to scenario context
<p>Remaining in place after evacuating (not self-evacuating, e.g. to home or hospital)</p>	<p><i>Do not make your own way to the hospital – medical assistance is on its way (GD)</i></p> <p><i>Wait for the emergency services to arrive and act upon their instruction (GD)</i></p> <p><i>Do not approach the fire truck (GD)</i></p> <p><i>Wait for the emergency services to arrive and act upon their instruction (GD)</i></p> <p><i>If you come towards us we can't help you, if you rush at us we can't help you (IT)</i></p> <p><i>Stay in that area, stay away from us (IT)</i></p> <p><i>Stay where you are and listen, we're going to give you some instructions (IT)</i></p>	<p>Stay where you are. I'm going to give you some instructions.</p>
<p>Disrobing</p>	<p><i>Remove outer clothing – do not pull clothing over head unless absolutely necessary (GD)</i></p> <p><i>Remove outer layer of clothing (GD)</i></p> <p><i>I need you to take your clothes off where you are. Stay there. Leave your clothes where they are (GD)</i></p> <p><i>I need you take your clothes off where you are. Stay there. Drop your clothes in a pile and come towards me (GD)</i></p>	<p>Carefully remove as much clothing as you can, down to your underwear. Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head. If you have to lift it over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face.</p>

Target behaviour for which instructional messages were targeted	Direct quotes (where available) from guidance documents (GD) and interview transcripts (IT) analysed in Chapter 4	Preliminary message after amalgamating quotes and applying to scenario context
	<p><i>You need to drop your clothes and come to us. We can take care of you once you've left your clothes and come to us. Just leave them in a pile and come this way (GD)</i></p> <p><i>I want you to put on the blue garbs and the mask from the disrobe pack and I want you to start removing your outer layer of clothing. Don't move it over your head. Cut it off if it needs to be. Take that off. (IT)</i></p> <p><i>What I need you to do is take your clothes off, not over your head if that's possible, if you've got a jumper on ideally I'd like you to cut it down the front I don't want anything going past your face. Take your outer layer of your clothes off, put it in a pile in one corner of the room and then move away from that pile of clothing to the opposite side of the room.(IT)</i></p> <p><i>Okay, everybody, you all need to take your outer clothes off (IT)</i></p> <p><i>We need you to put your clothes down, just put the clothes down gently and walk away from them (IT)</i></p> <p><i>Come towards me, and just take off your top layer of clothing (IT)</i></p> <p><i>Please come towards me, walk towards me now, and as you're doing so take off your top layer of clothing (IT)</i></p>	
Dry decontamination	<p><i>Please use this material (state or show what you mean; e.g. blue roll), to remove the substance from your skin (GD)</i></p> <p><i>Use some of the blue roll to blot and then rub your hands first (GD)</i></p> <p><i>Use a new piece of blue roll to blot and then rub your face and neck (GD)</i></p>	Use the tissue paper on the ground to blot and then rub your skin. Start by blotting then rubbing your hands and then use a new piece of paper to blot and then rub your face. Repeat this process from your neck down to your toes.

Target behaviour for which instructional messages were targeted	Direct quotes (where available) from guidance documents (GD) and interview transcripts (IT) analysed in Chapter 4	Preliminary message after amalgamating quotes and applying to scenario context
	<p><i>Use a new piece blue roll to blot and rub your left arm and then repeat for your right arm (GD)</i></p> <p><i>Use a new piece of blue roll to blot and rub your torso and back (GD)</i></p> <p><i>Use a new piece of blue roll to blot and rub your left leg and foot and then repeat for your right leg and foot (GD)</i></p> <p><i>Get some of that paper towel and then start blotting and rubbing and wiping anything off of you, especially your face, work your way down your body concentrating on your hands and anywhere that anything could have nestled into you, any crevices (IT)</i></p>	
Assisting other casualties	<p><i>Assist others who are less able or injured to carry out tasks - if you can (GD)</i></p> <p><i>If you cannot walk and can hear my voice, raise a hand (GD)</i></p> <p><i>Have one of these [self-help packs], help someone else (IT)</i></p>	If anyone requires assistance, please ask someone next to you.
Remaining in place to await the arrival of a decontamination shower		A shower is on its way here now. Please remain where you are.

Table 6-2 Contextual message components.

Message Component	Statements pertaining to message construct
Message Source	1. This is the police. Please listen carefully. 2. We train for this type of incident regularly. <i>[Statements 1 and 2 are interspersed with the threat item displayed in Table 6-3]</i>
Actions that responders are taking	We are working with the ambulance crews to resolve the situation. We're waiting on equipment to arrive so that we can set up a shower for you. The equipment should be here in 20 minutes.

Table 6-3 Threat message item in each threat level.

High Threat Message Component	Low Threat Message Component	Neutral Threat (Control) Message Component
<p>We've been informed that a harmful chemical <i>was</i> released in one of the lecture theatres. We are still investigating what type of chemical it is but, based on what we know, the risk to the public is <i>high</i>.</p> <p>It can sometimes take a while to feel the effects. You might feel fine right now but still be affected. The chemical may cause painful skin burns and may even be fatal. People who come into contact with you could be exposed to the chemical.</p>	<p>We've been informed that a chemical <i>may have been</i> released in one of the lecture theatres. We are still investigating what type of chemical it is but, based on what we know, the risk to the public is <i>low</i>.</p> <p>Had you been exposed to the substance, you would have felt some symptoms by now. You will probably be fine but we will still need to take some precautions. The instructions we are about to give you are a precaution.</p>	<p>We've been informed that a chemical <i>may have been</i> released in one of the lecture theatres. We are still investigating what type of chemical it is, where the chemical would have originated, and what time it would have been released.</p> <p>Please stay where you are and listen for updates. If you have just arrived, please remain where you are. We will update you when we know more about the situation. Listen out for updates and instructions.</p>

Table 6-4 Efficacy and neutral (no efficacy) message items.

Instruction	Rationale for framing of message based on non-expert mental model (Chapter 5)	Efficacy statement		Matched Neutral statement
<p>Remaining in place after evacuating (not self-evacuating, e.g. to home or hospital)</p>	<p>Outcomes from interviews in Chapter 5 indicated that responders should make clear to casualties that decontamination without hospitalisation is an effective countermeasure and that action can be taken by the casualty themselves to reduce the extent of contamination.</p>	<p><i>High Threat:</i> There are things you can do right now that <i>will</i> remove the chemical from your skin. Staying here and following our instructions is the best <i>thing you can do</i> right now to protect yourselves.</p>	<p><i>Low and Neutral Threat:</i> There are things you can do right now that <i>would</i> remove the chemical from your skin. Staying here and following our instructions is the best <i>precaution you can take</i> right now to protect yourselves.</p>	<p>We are still currently looking into the cause of the incident. We are also looking into the source of the chemical and the precise time when the incident was reported.</p>
<p>Disrobing</p>	<p>One of the implications of the interviews in Chapter 5 is that when instructing casualties to disrobe during IOR, responders should tailor efficacy information to the concept of removing clothing to stop skin contact with the chemical and inhalation of the chemical as this is likely to be intuitive.</p>	<p><i>High Threat</i> Most of the chemical <i>is</i> on your clothing. So the more clothing you remove, the more chemical <i>you'll</i> prevent from getting onto your skin or into your lungs.</p>	<p><i>Low and Neutral Threat:</i> Most of the chemical <i>would be</i> on your clothing. So the more clothing you remove, the more chemical <i>you'd</i> prevent from getting onto your skin or into your lungs.</p>	<p>If you have just arrived, please stay where you are and listen out for updates. We are currently investigating this incident. We will be giving you some instructions in a moment. Please listen.</p>

Instruction	Rationale for framing of message based on non-expert mental model (Chapter 5)	Efficacy statement	Matched Neutral statement
Instruction 4: Dry decontamination	The ineffectiveness of dry decontamination emerged as a likely misconception in Chapter 5 so responders need to explain how applying absorbent materials to skin is an effective form of decontamination and also state that it is safe to blot then wipe (as opposed to rub) the skin to address concerns about exacerbating the spread and absorption of the chemical. Participants expressed lack of confidence in dry decontamination relative to wet decontamination, for example because dry materials are not used as much as water in daily hygiene behaviour so responders should reiterate that water will be provided as well.	A decontamination shower is on the way. Blotting then wiping the skin with dry paper is a safe and effective way to remove some of the chemical from your skin before showering.	A decontamination shower is on the way. We are investigating what type of chemical this is and the cause of the incident. Remain where you are and listen out for further instructions.
Instruction 6: Remaining in place to await the arrival of a decontamination shower	According to the interviews in Chapter 5, the efficacy of wet decontamination is likely to be intuitive to casualties.	After using the tissue paper, going through a decontamination shower is the best way to ensure that you are thoroughly cleaned.	Listen out for further updates. We are looking into the situation to find out more about what has happened here.

6.3.1. Word count and readability

The full communication interventions, consisting of message items outlined in preceding tables, are displayed in Table 6-5. Word count variability between conditions was minimal, the maximum percentage difference between conditions being 1.82%. The amalgamated readability score was equal across conditions. Scores indicated that the message in all conditions was tailored to the US 6th-grade reading level (age: 10 to 11, equivalent UK level: Year 7 [key stage 3]) as recommended in the emergency communication literature (Omori et al., 2017).

Table 6-5 Message components assembled into three threat and two efficacy conditions.

Threat condition	Efficacy condition	
	Efficacy	No Efficacy (Control)
High	<p><i>[Word count = 389]</i></p> <p>This is the police. Please listen carefully.</p> <p>We've been informed that a harmful chemical was released in one of the lecture theatres. We are still investigating what type of chemical it is but, based on what we know, the risk to the public is high.</p> <p>It can sometimes take a while to feel the effects. You might feel fine right now but still be affected. The chemical may cause painful skin burns and may even be fatal. People who come into contact with you could be exposed to the chemical.</p> <p>We train for this type of incident regularly. We are working with the ambulance crews to resolve the situation. We're waiting on equipment to arrive so that we can set up a shower for you. The equipment should be here in 20 minutes.</p> <p>There are things you can do right now that will remove the chemical from your skin. Staying here and following our instructions is the best thing you can do right now to protect yourselves.</p> <p>Stay where you are. I'm going to give you some instructions.</p> <p>Most of the chemical is on your clothing. So the more clothing you</p>	<p><i>[Word count = 389]</i></p> <p>This is the police. Please listen carefully.</p> <p>We've been informed that a harmful chemical was released in one of the lecture theatres. We are still investigating what type of chemical it is but, based on what we know, the risk to the public is high.</p> <p>It can sometimes take a while to feel the effects. You might feel fine right now but still be affected. The chemical may cause painful skin burns and may even be fatal. People who come into contact with you could be exposed to the chemical.</p> <p>We train for this type of incident regularly. We are working with the ambulance crews to resolve the situation. We're waiting on equipment to arrive so that we can set up a shower for you. The equipment should be here in 20 minutes.</p> <p>We are still currently looking into the cause of the incident. We are also looking into the source of the chemical and the precise time when the incident was reported.</p> <p>Stay where you are. I'm going to give you some instructions.</p> <p>If you have just arrived, please stay where you are and listen out for</p>

Threat condition	Efficacy condition	
	Efficacy	No Efficacy (Control)
	<p>remove, the more chemical you'll prevent from getting onto your skin or into your lungs.</p> <p>Carefully remove as much clothing as you can, down to your underwear. Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head. If you have to lift it over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face.</p> <p>A decontamination shower is on the way. Blotting then wiping the skin with dry paper is a safe and effective way to remove some of the chemical from your skin before showering.</p> <p>Use the tissue paper on the ground to blot and then rub your skin. Start by blotting then rubbing your hands and then use a new piece of paper to blot and then rub your face. Repeat this process from your neck down to your toes.</p> <p>If anyone requires assistance, please ask someone next to you.</p> <p>After using the tissue paper, going through a decontamination shower is the best way to ensure that you are thoroughly cleaned.</p> <p>A shower is on its way here now. Please remain where you are.</p>	<p>updates. We are currently investigating this incident. We will be giving you some instructions in a moment. Please listen.</p> <p>Carefully remove as much clothing as you can, down to your underwear. Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head. If you have to lift it over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face.</p> <p>A decontamination shower is on the way. We are investigating what type of chemical this is and the cause of the incident. Remain where you are and listen out for further instructions.</p> <p>Use the tissue paper on the ground to blot and then rub your skin. Start by blotting then rubbing your hands and then use a new piece of paper to blot and then rub your face. Repeat this process from your neck down to your toes.</p> <p>If anyone requires assistance, please ask someone next to you.</p> <p>Listen out for further updates. We are looking into the situation to find out more about what has happened here.</p> <p>A shower is on its way here now. Please remain where you are.</p>
Low	<p><i>[Word count = 386]</i></p> <p>This is the police. Please listen carefully.</p> <p>We've been informed that a chemical may have been released in one of the lecture theatres. We are still investigating what type of chemical it is but, based on what we know, the risk to the public is low.</p> <p>Had you been exposed to the substance, you would have felt some symptoms by now. You will probably be fine but we will still need to take</p>	<p><i>[Word count = 385]</i></p> <p>This is the police. Please listen carefully.</p> <p>We've been informed that a chemical may have been released in one of the lecture theatres. We are still investigating what type of chemical it is but, based on what we know, the risk to the public is low.</p> <p>Had you been exposed to the substance, you would have felt some symptoms by now. You will probably be fine but we will still need to take</p>

Threat condition	Efficacy condition	
	Efficacy	No Efficacy (Control)
	<p>some precautions. The instructions we are about to give you are a precaution.</p> <p>We train for this type of incident regularly. We are working with the ambulance crews to resolve the situation. We're waiting on equipment to arrive so that we can set up a shower for you. The equipment should be here in 20 minutes.</p> <p>There are things you can do right now that would remove the chemical from your skin. Staying here and following our instructions is the best precaution you can take right now to protect yourselves.</p> <p>Stay where you are. I'm going to give you some instructions.</p> <p>Most of the chemical would be on your clothing. So the more clothing you remove, the more chemical you'd prevent from getting onto your skin or into your lungs.</p> <p>Carefully remove as much clothing as you can, down to your underwear. Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head. If you have to lift it over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face.</p> <p>A decontamination shower is on the way. Blotting then wiping the skin with dry paper is a safe and effective way to remove some of the chemical from your skin before showering.</p> <p>Use the tissue paper on the ground to blot and then rub your skin. Start by blotting then rubbing your hands and then use a new piece of paper to blot and then rub your face. Repeat this process from your neck down to your toes.</p> <p>If anyone requires assistance, please ask someone next to you.</p> <p>After using the tissue paper, going through a decontamination shower is the best way to ensure that you are thoroughly cleaned.</p>	<p>some precautions. The instructions we are about to give you are a precaution.</p> <p>We train for this type of incident regularly. We are working with the ambulance crews to resolve the situation. We're waiting on equipment to arrive so that we can set up a shower for you. The equipment should be here in 20 minutes.</p> <p>We are still currently looking into the cause of the incident. We are also looking into the source of the chemical and the precise time when the incident was reported.</p> <p>Stay where you are. I'm going to give you some instructions.</p> <p>If you have just arrived, please stay where you are and listen out for updates. We are currently investigating this incident. We will be giving you some instructions in a moment. Please listen.</p> <p>Carefully remove as much clothing as you can, down to your underwear. Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head. If you have to lift it over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face.</p> <p>A decontamination shower is on the way. We are investigating what type of chemical this is and the cause of the incident. Remain where you are and listen out for further instructions.</p> <p>Use the tissue paper on the ground to blot and then rub your skin. Start by blotting then rubbing your hands and then use a new piece of paper to blot and then rub your face. Repeat this process from your neck down to your toes.</p> <p>If anyone requires assistance, please ask someone next to you.</p> <p>Listen out for further updates. We are looking into the situation to find out more about what has happened here.</p>

Threat condition	Efficacy condition	
	Efficacy	No Efficacy (Control)
	A shower is on its way here now. Please remain where you are.	A shower is on its way here now. Please remain where you are.
Neutral (Control)	<p><i>[Word count = 383]</i></p> <p>This is the police. Please listen carefully.</p> <p>We've been informed that a chemical may have been released in one of the lecture theatres. We are still investigating what type of chemical it is, where the chemical would have originated, and what time it would have been released.</p> <p>Please stay where you are and listen for updates. If you have just arrived, please remain where you are. We will update you when we know more about the situation. Listen out for updates and instructions.</p> <p>We train for this type of incident regularly. We are working with the ambulance crews to resolve the situation. We're waiting on equipment to arrive so that we can set up a shower for you. The equipment should be here in 20 minutes.</p> <p>There are things you can do right now that would remove the chemical from your skin. Staying here and following our instructions is the best precaution you can take right now to protect yourselves.</p> <p>Stay where you are. I'm going to give you some instructions.</p> <p>Most of the chemical would be on your clothing. So the more clothing you remove, the more chemical you'd prevent from getting onto your skin or into your lungs.</p> <p>Carefully remove as much clothing as you can, down to your underwear. Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head. If you have to lift it over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face.</p>	<p><i>[Word count = 382]</i></p> <p>This is the police. Please listen carefully.</p> <p>We've been informed that a chemical may have been released in one of the lecture theatres. We are still investigating what type of chemical it is, where the chemical would have originated, and what time it would have been released.</p> <p>Please stay where you are and listen for updates. If you have just arrived, please remain where you are. We will update you when we know more about the situation. Listen out for updates and instructions.</p> <p>We train for this type of incident regularly. We are working with the ambulance crews to resolve the situation. We're waiting on equipment to arrive so that we can set up a shower for you. The equipment should be here in 20 minutes.</p> <p>We are still currently looking into the cause of the incident. We are also looking into the source of the chemical and the precise time when the incident was reported.</p> <p>Stay where you are. I'm going to give you some instructions.</p> <p>If you have just arrived, please stay where you are and listen out for updates. We are currently investigating this incident. We will be giving you some instructions in a moment. Please listen.</p> <p>Carefully remove as much clothing as you can, down to your underwear. Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head. If you have to lift it over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face.</p>

Threat condition	Efficacy condition	
	Efficacy	No Efficacy (Control)
	<p>A decontamination shower is on the way. Blotting then wiping the skin with dry paper is a safe and effective way to remove some of the chemical from your skin before showering.</p> <p>Use the tissue paper on the ground to blot and then rub your skin. Start by blotting then rubbing your hands and then use a new piece of paper to blot and then rub your face. Repeat this process from your neck down to your toes.</p> <p>If anyone requires assistance, please ask someone next to you.</p> <p>After using the tissue paper, going through a decontamination shower is the best way to ensure that you are thoroughly cleaned.</p> <p>A shower is on its way here now. Please remain where you are.</p>	<p>A decontamination shower is on the way. We are investigating what type of chemical this is and the cause of the incident. Remain where you are and listen out for further instructions.</p> <p>Use the tissue paper on the ground to blot and then rub your skin. Start by blotting then rubbing your hands and then use a new piece of paper to blot and then rub your face. Repeat this process from your neck down to your toes.</p> <p>If anyone requires assistance, please ask someone next to you.</p> <p>Listen out for further updates. We are looking into the situation to find out more about what has happened here.</p> <p>A shower is on its way here now. Please remain where you are.</p>

6.4 Discussion

The message development process described in this chapter has enabled me to assemble a set of six messages that convey essential baseline information but vary across two domains that are of theoretical interest. Which of these messages is most effective in encouraging protective behaviours is an empirical question that I will answer in an RCT, reported in Chapter 8. Readability was constant in all messages and word count variability was minimal, which allows for a more robust test of the effect of wording. Whilst differences in wording between messages may appear subtle, slight variation in wording has been shown to have significant effects in previous studies. For example side-effect symptom reporting was lower when a patient information leaflet was subtly manipulated to be positively framed (Webster, Weinman, & Rubin, 2018). The steps I took to determine the optimum type of message out of the options presented in this chapter are documented in the following two chapters.

Chapter 7 Pilot study to validate messaging interventions for use in subsequent study on the effect of communication on IOR adherence

7.1 Introduction

Following the development of a preliminary message to promote casualty adherence to IOR in a chemical incident (Chapter 6), I identified six messaging options that could be effective in promoting IOR adherence. The approaches are as follows:

1. Making salient the threat of contamination and the efficacy of IOR (High Threat, Efficacy);
2. Making salient the threat of contamination but not the efficacy of IOR (High Threat, No Efficacy);
3. Understating the threat of contamination and making salient the efficacy of IOR (Low Threat, Efficacy);
4. Understating the threat of contamination and not making salient the efficacy of IOR (Low Threat, No Efficacy);
5. Neither making salient nor understating the threat of contamination and making salient the efficacy of IOR (Neutral Threat, Efficacy);
6. Neither making salient nor understating the threat of contamination and not making salient the efficacy of IOR (Neutral Threat, No Efficacy).

The ideal approach to testing which of these messages is most effective would be to use a randomised controlled trial (RCT) including actual or intended behaviour as an outcome. But before an RCT can be conducted, an important preliminary test is to check whether messages would be perceived as intended. In other words, do the manipulations alter perceptions of threat and efficacy in the intended directions, but without altering other perceptions?

In this chapter, I report the results of a small experiment conducted to act as a manipulation check. I used the following null and directional alternative hypotheses to check Threat and Efficacy manipulations.

RQ1. Does the presentation of information about Threat affect threat (severity and susceptibility) perceptions?

H₀. The manipulation of Threat information will have no effect on threat severity and susceptibility perceptions.

H_{a1}. Threat (severity and susceptibility) perceptions will be higher in the High Threat condition than in the Low or Neutral Threat conditions.

H_{a2}. Threat perceptions (severity and susceptibility) will be higher in the Neutral Threat condition than in the Low Threat condition.

RQ2. Does the presentation of information about Efficacy affect response efficacy perceptions?

H₀. The manipulation of Efficacy information will have no effect on threat response efficacy perceptions.

H_a. Response efficacy perceptions will be higher in the Efficacy condition than in the No Efficacy condition.

Perceived legitimacy of emergency responders and expected identification with responders were not designed to vary in response to the different messages but these variables are likely to impact on compliance expectations (Carter, Drury, et al., 2018; Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015). Similarly, self-efficacy perceptions were not targeted in any of the messages but self-efficacy is a predictor of behaviour change in both Protection Motivation Theory (PMT) (R. W. Rogers, 1975, 1983), and the Extended Parallel Process Model (EPPM) (Witte, 1992, 1994). As an additional manipulation check, I tested whether measures of perceived responder legitimacy and identification with responders and measures of self-efficacy differed between conditions. I used qualitative data to ascertain whether participants understood the messages as intended.

7.2 Method

7.2.1. Design

I carried out an online RCT with a 3x2 (three levels of Threat and two levels of Efficacy) independent measures design to assess the effect of messages read by participants in a text vignette of an emergency on outcome measures pertaining to perceptions of threat severity, threat susceptibility, response efficacy, self-efficacy, responder legitimacy, and identification with responders.

7.2.2. Participants

G*Power 3.1.9.2 (Franz Faul, Universität Kiel) was used to compute required sample size for ANOVA (fixed effects, special, main effects and interactions) using *a priori* power analysis. An effect size from a previous meta-analysis of studies that included attitude perceptions as outcomes of threat and efficacy information, $\eta^2 = 0.21$ (Witte & Allen, 2000), was used as the basis of the effect size in the power analysis. The

number of groups, number of predictors, number of response variables, alpha, power and effect size (f) were set at 6, 2, 5, 0.05, 0.95, and 0.51 respectively. The computed required sample size was 52, which was rounded up to 54 to allow for an equal number of participants across groups (9 per group). All participants were at least 18 years of age and fluent in written English. In line with the scenario which presented the incident as taking place within a university, participants were all university undergraduates or graduates. All participants were recruited via a King's College London research participation circular email and webpage (recruitment advertisement displayed in Appendix N). Each participant received an online gift voucher to the value of £10 as reimbursement for their time.

7.2.3. Materials

One of six messages was presented to participants in the context of a text vignette depicting the scenario described in the preceding chapter but from the perspective of a casualty. The wording of the vignette and the instruction given to participants to imagine themselves in the situation were adapted from the approach used in a previous mass casualty decontamination visualisation experiment (Carter, Drury, Amlôt, et al., 2015). Specifically, participants were asked: "Try to imagine that you were involved in the incident and think about how you might feel and act in this type of situation".

The vignette presented to participants read as follows: "Imagine you are waiting in a crowded lecture theatre for a lecture to begin. You hear a fire alarm. You and your fellow students walk out of the room and walk outside the building. Roughly 20 university staff and students are gathered outside. You are now standing among them. You see a police van parked nearby and there are rolls of blue tissue paper on the ground. You hear the following announcement on a megaphone... [one of six messages displayed to participant]".

At the point in the scenario when the participant was informed that they hear a voice on a megaphone, they read one of the six messages displayed in Table 6-5.

7.2.4. Measures

7.2.4.1 Quantitative measures

I adapted perceived severity (two items), susceptibility (two items), response efficacy (3 items), and self-efficacy (one item) Likert items from a study on public reactions to a hypothetical chemical spill by Pearce et al. (2013). These scales were deemed to be appropriate for the present pilot test due to the thematic similarity between the scenarios used in the two studies. The scales used in the previous study were adapted

from threat and coping appraisal items used by Teasdale, Yardley, Schlotz, and Michie (2012) in a study on pandemic flu.

I adapted four Likert items pertaining to perceptions of responders' legitimacy and two items pertaining to expected identification with responders. The scales had good internal reliability ($\alpha = .85$ and $.89$ respectively) in an online visualisation experiment centred on a hypothetical incident involving mass casualty decontamination (Carter, Drury, Amlôt, et al., 2015). All items presented below had response options ranging from 1 (Strongly disagree) to 7 (Strongly agree).

Severity

- *If I was exposed to the chemical released in this incident it is likely that I would become seriously ill*
- *I would feel anxious about being exposed to the chemical released in this incident*

Susceptibility

- *It is likely that I had been exposed to the chemical released in this incident*
- *If I didn't take preventative action, it is likely that I would be exposed to the chemical released in this incident*

Response efficacy

- *Staying where I am and following instructions would help to protect me if I had been exposed to the chemical*
- *Removing the clothing that I am wearing would help to protect me if I had been exposed to the chemical*
- *Blotting then rubbing my skin with tissue paper would help to protect me if I had been exposed to the chemical*

Self-efficacy

- *I would be able to follow all instructions in this incident*

Legitimacy

- *I imagined the police officer to be respectful*
- *I imagined the police officer to be fair*
- *I imagined the police officer to be open about the actions they were taking*
- *I imagined the police officer to be trustworthy*

Identification

- *If this situation had been real, I would have felt a sense of unity with the police officer responding to the incident*
- *If this situation had been real, I would have identified with the police officer responding to the incident*

7.2.4.2 Qualitative measure

After completing the quantitative measures, participants were asked: "Was there anything that the police officer said that you didn't understand or that they should have

said differently? Also, are there any reasons as to why you answered particular questions a certain way?” Participants were provided with a text box in which to record their responses.

7.2.5. Procedure

Ethical approval for this study was granted by the King’s College London Psychiatry, Nursing & Midwifery Research Ethics Panel (reference: LRS-17/18-7875; Appendix O). I emailed the information sheet and instructions on how to access the online survey, developed and hosted on Qualtrics (Appendix P), to participants who responded to the recruitment materials. Reattempting an online survey or experiment by deleting browser cookies or using a different device or browser is a recognised problem in online research (J. J. Chandler & Paolacci, 2017). To account for this possibility, a list of unique user codes was generated and stored on a database. Each email sent to a prospective participant included a unique code which the participant was asked to enter when prompted on the first page of the experiment. Codes entered in the survey were checked against the list of sent codes prior to analysis to ensure there were no duplicates, indicating that no one had completed the study twice. After clicking on the link to the survey and completing the consent form, the participant was randomly allocated by the survey tool to receive one of the six messages outlined in Table 6-5. All other information in the survey was identical across conditions, including the scenario used to contextualise the message. After reading the scenario and the message that they would hear from a police officer during the scenario, participants completed all outcome measures outlined above. Data collection occurred between 28th and 31st August 2018.

7.2.6. Analysis

7.2.6.1 Quantitative analysis

I carried out quantitative analyses using IBM SPSS Statistics 25. Scale reliability was assessed using Cronbach’s alpha for scales consisting of more than two items and Pearson correlation coefficient for scales consisting of two items. Two-way ANOVAs with Bonferroni post hoc comparisons were applied to test the main effects and interaction of Threat and Efficacy manipulations on the sum of items in each scale. Bootstrapping was used if assumptions of normality were not met. Normality was first assessed using Kolmogorov-Smirnov and Shapiro-Wilk statistics. If both values were non-significant, the ANOVA was carried out without bootstrapping. If Levene’s statistic for homogeneity of variance was significant but Kolmogorov-Smirnov and Shapiro-Wilk statistics were not significant, the analysis was repeated with bootstrapping as a precaution. The number of samples for bootstrapping was 1000.

Given the controversy associated with applying parametric tests to individual Likert items (Carifio & Perla, 2008), non-parametric tests were applied to the self-efficacy item. Kruskal-Wallis H test with Bonferroni-corrected post hoc comparisons was used to test the effect of the Threat manipulation as there were three levels to this variable. Mann-Whitney U test was used to test the effect of the Efficacy manipulation as there were two levels to this variable.

7.2.6.2 Qualitative analysis

I carried out thematic analysis on responses to the qualitative measure using NVIVO 11.2.1.616 (QSR International). I used the same data-derived approach to thematic analysis that I used in the studies reported in Chapters 4 and 5. A minimum of two statements was required to constitute a theme. Themes were compared across conditions to identify whether the patterns of responses would have been related to the message read by the participant. Themes are denoted in italics in the Results section.

7.3 Results

A total of 56 participants completed the online experiment. Two extra participants began the study before I could close the link to the online survey, so I allowed them to complete the study before ceasing data collection.

7.3.1. Quantitative outcomes

Reliability was relatively low for severity, $r = .46$, and susceptibility, $r = .47$, but acceptable for response efficacy, $\alpha = .79$, legitimacy, $\alpha = .85$, and identification, $r = .78$, scales. As indicated in Table 7-1, reported agreement was generally high for most items, particularly response efficacy and self-efficacy items and the item pertaining to expected anxiety.

There was no significant effect of Threat, $F(2, 50) = 2.11$, $p = .13$, $\eta_p^2 = 0.08$, Efficacy, $F(1, 50) = 0.23$, $p = .63$, $\eta_p^2 = 0.01$, or interaction between Threat and Efficacy, $F(2, 50) = 0.12$, $p = .89$, $\eta_p^2 = 0.01$, on perceived severity (Figure 7-1).

There was a significant effect of Threat, $F(2, 50) = 7.57$, $p < .005$, $\eta_p^2 = 0.23$, on perceived susceptibility (Figure 7-2). Participants in the High Threat condition had higher susceptibility perceptions than participants in the Low Threat condition, $M_{diff} = 2.12$, 95% CI [0.39, 3.85], $p < .05$, and participants in the Neutral Threat condition also had higher susceptibility perceptions than participants in the Low Threat condition, $M_{diff} = 2.75$, 95% CI [1.24, 4.28], $p < .005$. There was no difference in susceptibility perceptions between the High and Neutral conditions, $M_{diff} = 0.63$, 95% CI [-0.63, 1.85], $p = 1$.

There was no effect of Efficacy, $F(1,50) = 0.51, p = .48, \eta_p^2 = 0.01$, on perceived susceptibility. There was a significant interaction effect between Threat and Efficacy, $F(2, 50) = 4, p < .05, \eta_p^2 = 0.14$, on perceived susceptibility (Figure 7-3). When Efficacy information was provided, participants in the High Threat condition had higher susceptibility perceptions than participants in the Low Threat condition, $M_{diff} = 3.98, 95\% \text{ CI } [1.8, 6.3], p < .001$, and participants in the Neutral Threat condition also had higher susceptibility perceptions than participants in the Low Threat condition, $M_{diff} = 3.11, 95\% \text{ CI } [1.09, 5.33], p < .005$, with no difference in susceptibility perceptions between the High and Neutral conditions, $M_{diff} = 0.87, 95\% \text{ CI } [-0.59, 2.25], p = .4$. But when no Efficacy information was provided, susceptibility perceptions were higher in the Neutral Threat group than they were in both the High, $M_{diff} = 2.26, 95\% \text{ CI } [0.5, 4.02], p < .05$, and Low, $M_{diff} = 2.37, 95\% \text{ CI } [0.15, 4.7], p < .05$, Threat conditions, with no difference in susceptibility perceptions between the High and Low conditions, $M_{diff} = 0.11, 95\% \text{ CI } [-2.29, 2.67], p = .92$.

There was no significant effect of Threat, $F(2, 50) = 0.35, p = .71, \eta_p^2 = 0.01$, or interaction between Threat and Efficacy, $F(2, 50) = 0.64, p = .53, \eta_p^2 = 0.03$, on perceived response efficacy (Figure 7-4).

There was a significant effect of Efficacy on perceived response efficacy, $F(1,50) = 4.81, p < .05, \eta_p^2 = 0.09$ (Figure 7-5), with participants in the Efficacy group having higher response efficacy perceptions than participants in the No Efficacy group, $M_{diff} = -1.93, 95\% \text{ CI } [-3.48, -0.2]$.

There were no significant differences in self-efficacy perceptions between Threat, $H = 1.26, p = .53$, or Efficacy, $U = 280, p = .05$, conditions (Figure 7-6).

There was no significant effect of Threat, $F(2, 50) = 2.1, p = .13, \eta_p^2 = 0.08$, Efficacy, $F(1,50) = 3.17, p = .08, \eta_p^2 = 0.06$, or interaction between Threat and Efficacy, $F(2, 50) = 0.38, p = .69, \eta_p^2 = 0.02$, on perceived legitimacy of the communicator (Figure 7-7).

There was no significant effect of Threat, $F(2, 50) = 1.01, p = .37, \eta_p^2 = 0.04$, Efficacy, $F(1,50) = 0.01, p = .93, \eta_p^2 = 0$, or interaction between Threat and Efficacy, $F(2, 50) = 1.32, p = .28, \eta_p^2 = 0.05$, on identification with the communicator (Figure 7-8).

Table 7-1 Median and IQR (interquartile range) for each Likert item (response options range from 1 [strongly disagree] to 7 [strongly agree]) in the total sample (N = 56).

Scale	Behavioural expectation Likert item	Median	IQR
Severity	<i>If I was exposed to the chemical released in this incident it is likely that I would become seriously ill</i>	5	2
	<i>I would feel anxious about being exposed to the chemical released in this incident</i>	7	1
Susceptibility	<i>If I didn't take preventative action, it is likely that I would be exposed to the chemical released in this incident</i>	6	1
	<i>It is likely that I had been exposed to the chemical released in this incident</i>	5	2
Response Efficacy	<i>Staying where I am and following instructions would help to protect me if I had been exposed to the chemical</i>	7	1
	<i>Removing the clothing that I am wearing would help to protect me if I had been exposed to the chemical</i>	6	1
	<i>Blotting then rubbing my skin with tissue paper would help to protect me if I had been exposed to the chemical</i>	6	2
Self-Efficacy	<i>I would be able to follow all instructions in this incident</i>	6	2
Legitimacy	<i>I imagined the police officer to be respectful</i>	6	1
	<i>I imagined the police officer to be fair</i>	6	1
	<i>I imagined the police officer to be open about the actions they were taking</i>	5	3
	<i>I imagined the police officer to be trustworthy</i>	6	1
Identification	<i>If this situation had been real, I would have felt a sense of unity with the police officer responding to the incident</i>	5	2
	<i>If this situation had been real, I would have identified with the police officer responding to the incident</i>	5	2

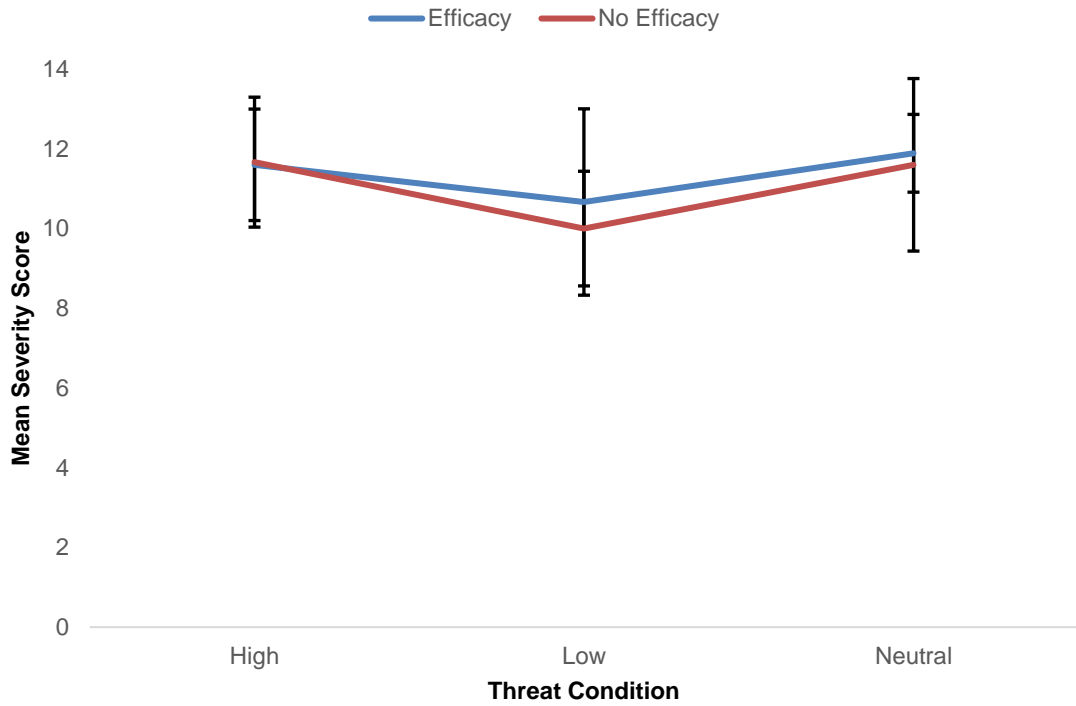


Figure 7-1 Mean threat severity score by Threat and Efficacy condition. Error bars represent lower and upper 95% confidence intervals.

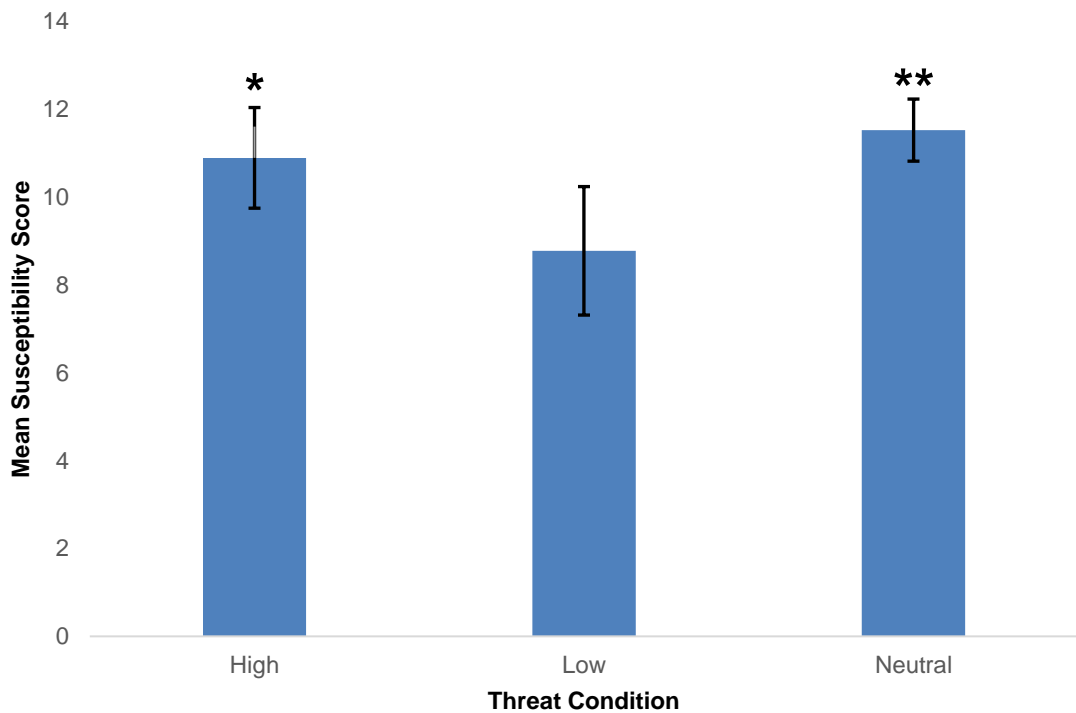


Figure 7-2 Mean threat susceptibility score by Threat condition. Error bars represent lower and upper 95% confidence intervals. * = difference from Low Threat condition significant, $p < .05$; ** = difference from Low Threat condition significant, $p < .005$.

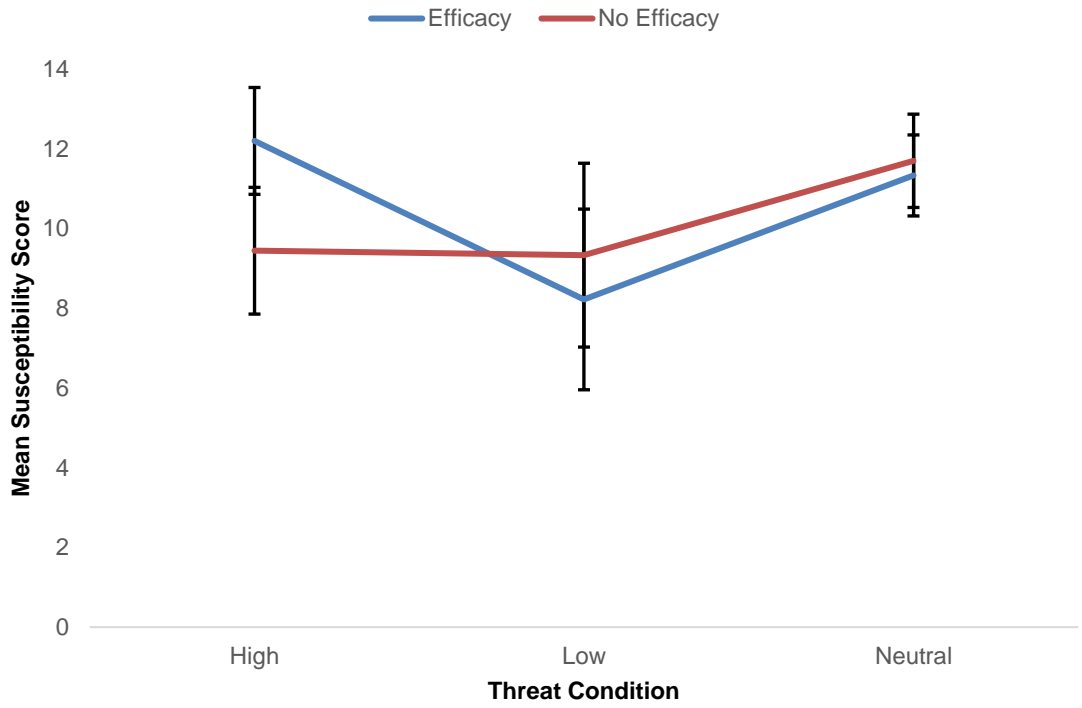


Figure 7-3 Mean threat susceptibility score by Threat and Efficacy condition. Error bars represent lower and upper 95% confidence intervals.

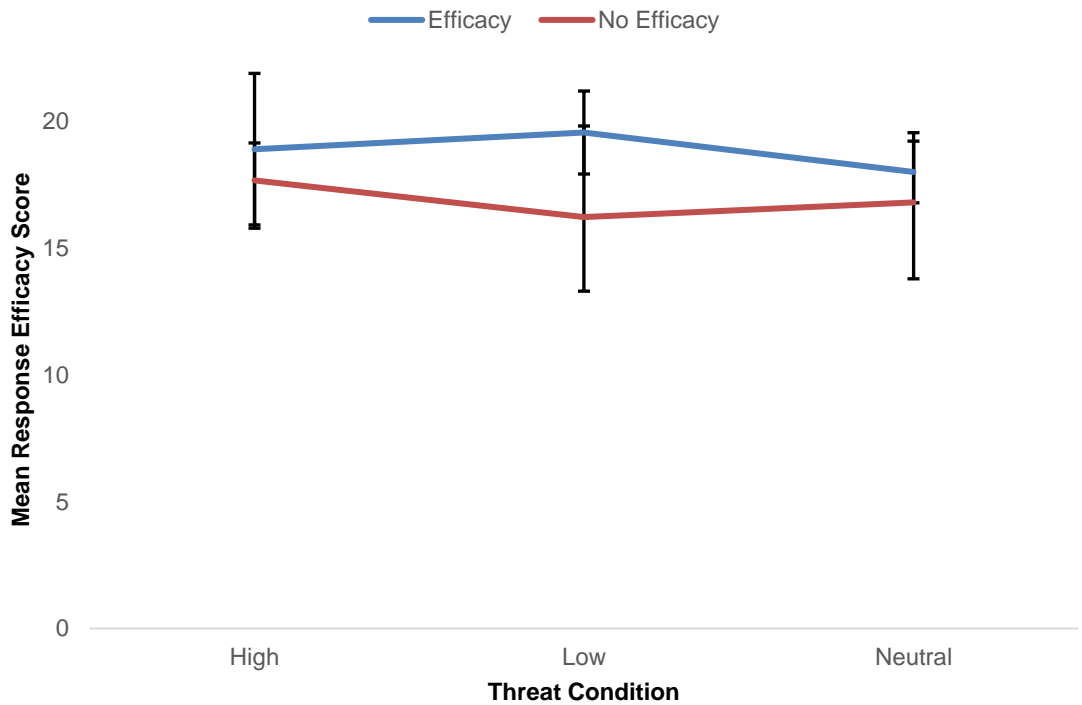


Figure 7-4 Mean response efficacy score by Threat and Efficacy condition. Error bars represent lower and upper 95% confidence intervals.

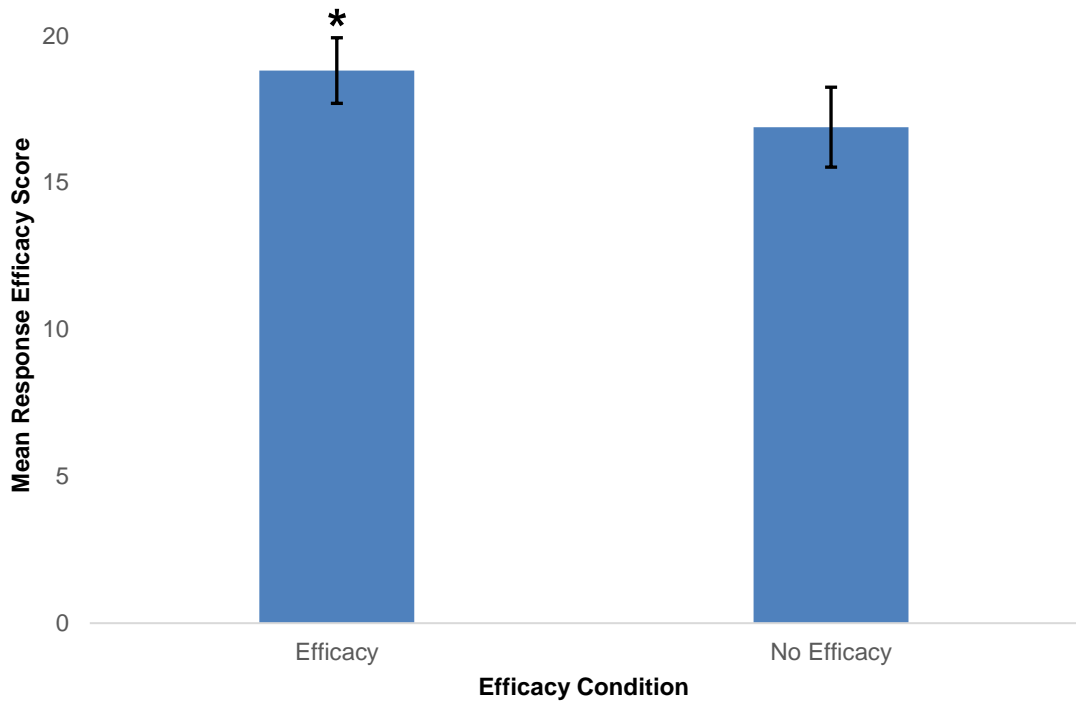


Figure 7-5 Mean response efficacy score by Efficacy condition. Error bars represent lower and upper 95% confidence intervals. * = difference between means significant, $p < .05$.

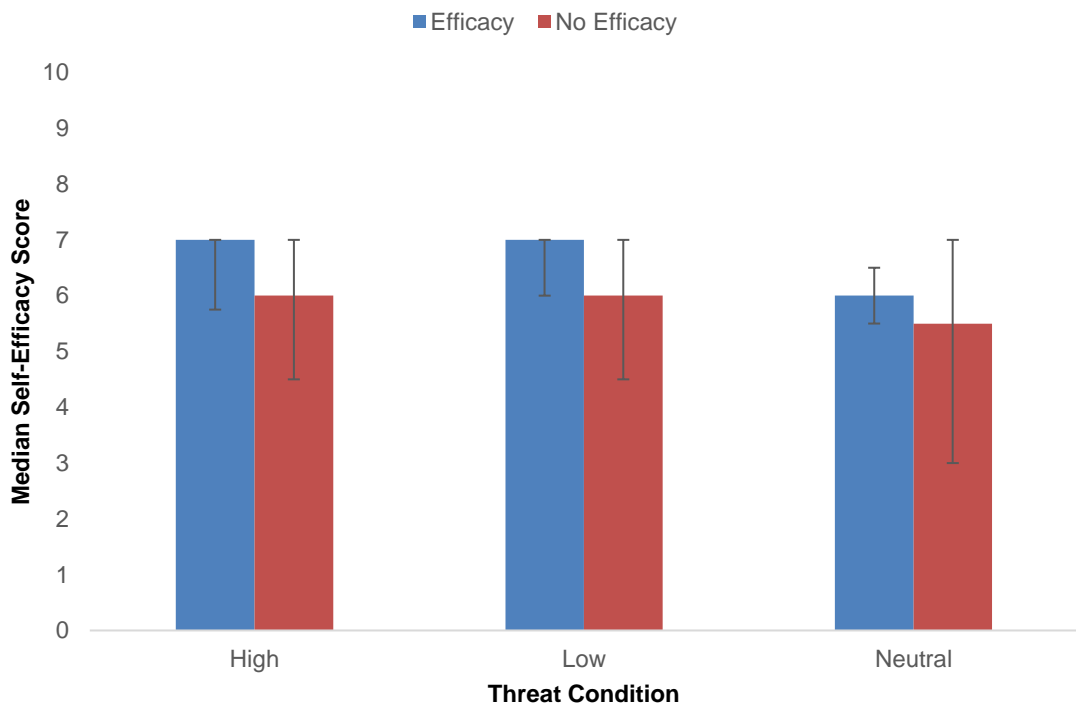


Figure 7-6 Median self-efficacy score by Threat and Efficacy condition. Error bars represent 25th and 75th percentiles.

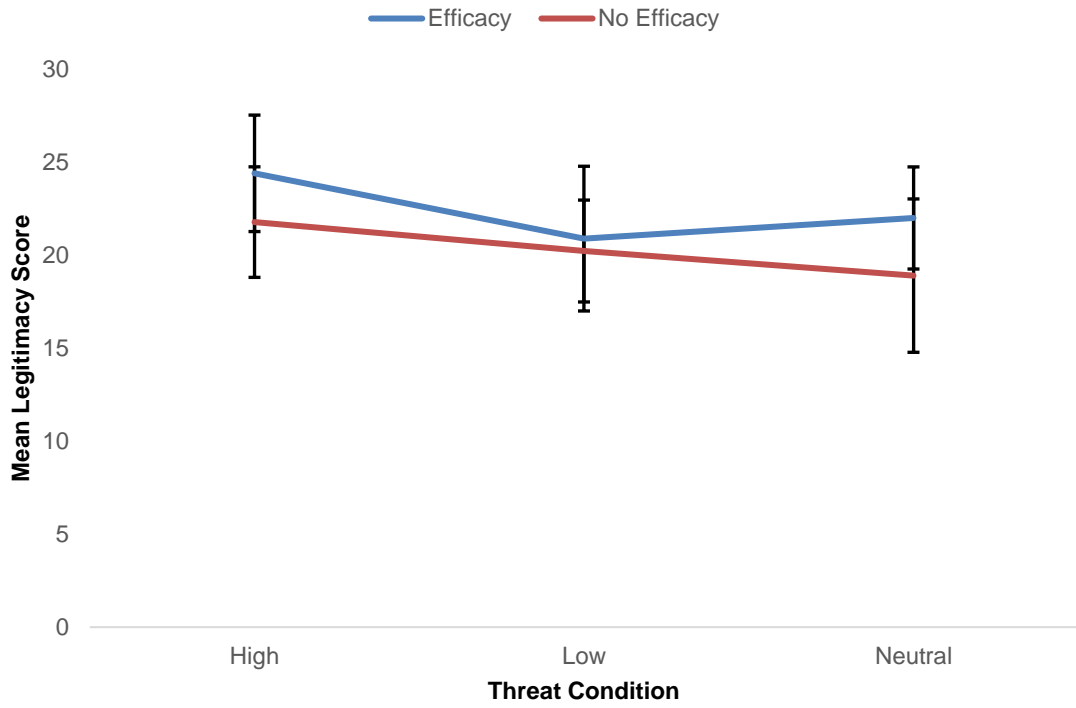


Figure 7-7 Mean legitimacy score by Threat and Efficacy condition. Error bars represent lower and upper 95% confidence intervals.

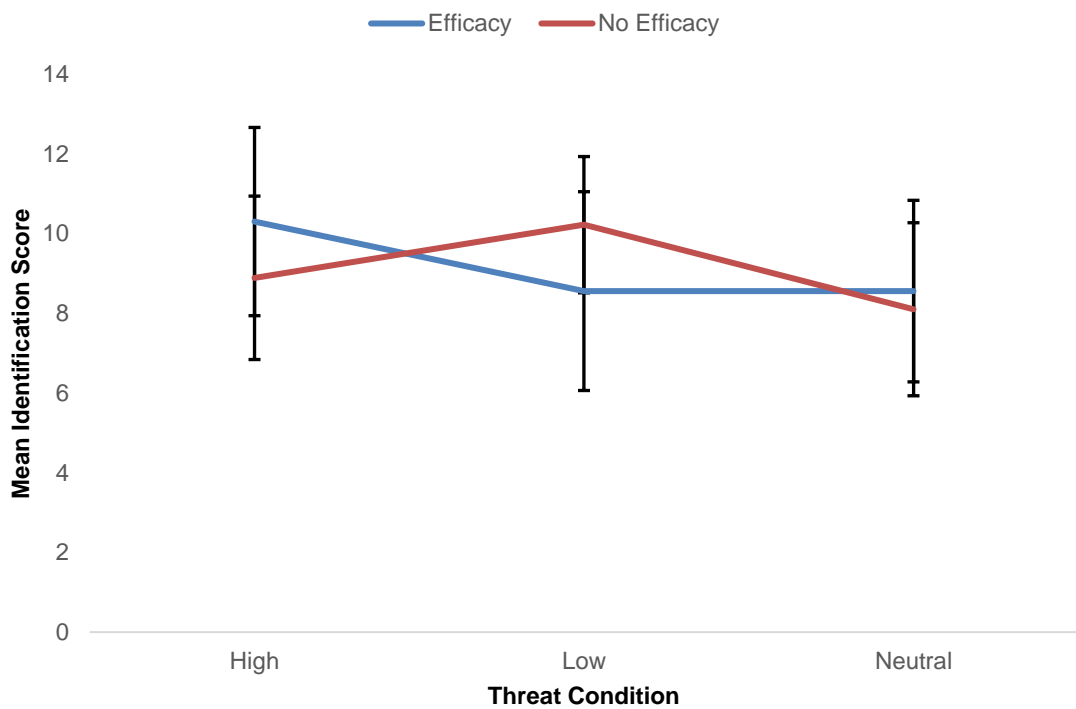


Figure 7-8 Mean identification score by Threat and Efficacy condition. Error bars represent lower and upper 95% confidence intervals.

7.3.2. Qualitative outcomes

Thirty-three participants responded to the open-ended item pertaining to their perception of the message that would be delivered by the police officer. In all groups, aside from the Neutral Threat, No Efficacy group, participants expressed a *positive appraisal of the message and communicator*, for example by appreciating the officer's honesty on the subject of the effects of hazardous chemicals.

Clear guidelines on what to do is important and I believe that was portrayed logically (High Threat, Efficacy).

I would appreciate the honesty of letting us know that it can be fatal and that's why we were being instructed to take certain actions (High Threat, No Efficacy).

I understood everything the police officer said, and I think he said it appropriately (Neutral Threat, Efficacy).

However, *insufficient practical instructions* were raised in all threat conditions and were not confined to one efficacy condition.

I think the instruction to blot and then rub my skin was slightly unclear - I usually think of blotting as involving water but did this mean dab myself with a dry tissue, and then use the same tissue to rub my skin? (Low Threat, Efficacy).

The police officer mentioned cutting away the clothes. Yet I heard no information on access to scissors (High Threat, No Efficacy).

Concerns about *disrobing in front of people* were expressed in all threat conditions.

I would be concerned about removing clothing in front of men (Neutral Threat, Efficacy).

We live in the age of the smartphone. It is quite something to ask people to strip in public when there is a risk of people taking photos. (Low Threat, Efficacy).

injunctions to do things that by no means I'll do in public such as removing my clothes where somebody can see me, can you imagine? peers and colleagues...just awful (High Threat, Efficacy).

Suggestions for addressing modesty concerns were raised.

I think the policeman should have announced that the use of smartphones was forbidden. I also think there should have been disposable gowns provided for anyone who had stripped off (Low Threat, Efficacy).

I feel like men and women should be separated in such situation - many would feel uncomfortable getting undressed to underwear in front of members of opposite sex (High Threat, No Efficacy).

Concerns about the *20-minute waiting time for the shower* were discussed.

20 minutes is a very long time in a situation like this - that would be very anxiety provoking to know/wait that long (High Threat, No Efficacy).

I did not feel complete trust in the police officer. I felt that I needed to shower sooner than 20 minutes (Low Threat, Efficacy).

In the High threat condition only (both Efficacy and No Efficacy groups), the severity of the message was noted.

I think that the police officer's messages would instill unnecessary and unhelpful panic in the crowd. They could have avoid mentioning the possible effects of the chemical and state that the measures they were taking were precautionary (High Threat, No Efficacy).

I also think she should not have mentioned that there is a high risk/it is potentially fatal - instead she should have said that there's a possibility it could have harmful effects so you need to make sure you follow instructions (High Threat, No Efficacy).

Anxiety resulting from ambiguous information about the incident was discussed by participants in the Neutral threat condition. Relating to this, participants in the Neutral threat condition expressed *willingness to follow instructions because potential severity was clear.*

The fact that they don't know what the chemical is (or won't tell you) is quite anxiety inducing and would probably make me more frightened (Neutral Threat, No Efficacy).

In terms of the incident itself, I got a real sense of the urgency of the situation and the importance of taking action as instructed. I didn't get a clear sense of whether or not I had actually been exposed to the chemical, but if I had been in that situation, I would have gone about the preventative measures as described anyway, because the potential severity was clear. (Neutral Threat, Efficacy).

I would do as I was told as I feel like the seriousness of the situation is clear (Neutral Threat, No Efficacy).

Participants in the Low threat condition *perceived reassuring messages to be false and intended to reduce panic.*

Obviously a police officer would want to contain any release of the chemical, and would want to avoid panic - so regardless of what a police officer says I would be distrustful in such an incident (Low Threat, Efficacy).

I would think he was lying about the extent the chemical would effect me in order for us all to remain calm (Low Threat, Efficacy).

Criticism of the communicator being monotonous and robotic was discussed by participants in the Neutral threat condition only (both efficacy groups).

I understand that there needs to be repetition in case people did not hear the initial statements, but the repetition of the same minimal information is somewhat unnerving (Neutral Threat, No Efficacy).

I said that I would not have identified with the police officer, nor felt a sense of unity, as I imagined it being very robotic. Perhaps when spoken it would seem more empathetic, but the transcript sounds very basic and monotonous on its own (Neutral Threat, No Efficacy).

Participants in the No Efficacy groups in both the high and neutral threat conditions expected that they would have *difficulty following instructions due to anticipated anxiety resulting from the wording of the message.*

The way the police officer provided information and the information itself would have put me in a seriously frightened state and that could have reduced my ability to follow instructions (Neutral Threat, No Efficacy).

I disagreed about being able to follow all instructions because the panic and fear would make it difficult to listen - especially if a lot of crucial instructions and information is being given all at once (High Threat, No Efficacy).

In the No Efficacy condition only, there was a reported *deficit of information about why disrobing and dry decontamination are necessary.*

I would also appreciate a quick explanation to why blotting skin with blue paper towel would help me (High Threat, No Efficacy).

It was not explained why we would need to remove our clothes or blot our skin. This would have made me feel unsettled about stripping down in front of strangers if I weren't certain as to why I should do so. I imagine I would have been reluctant to follow this instruction without reassurance from the police officer that the action was necessary. (Neutral Threat, No Efficacy).

7.4 Discussion

The purpose of this study was to assess whether the manipulations of threat and efficacy information carried out in Chapter 6 would have the intended effect on perceptions relating to severity, susceptibility and response efficacy and whether the manipulations would have any unanticipated effect on legitimacy, identification and self-efficacy.

The efficacy manipulation affected response efficacy perceptions in the expected direction. Participants who received information as to the efficacy of each IOR action reported higher overall agreement that adhering to the instructions would be conducive to self-protection. Outcomes from the qualitative analysis further supported the difference in message perceptions between efficacy conditions, with participants in the No Efficacy condition questioning the lack of information as to why disrobing and dry decontamination are necessary and protective. There was no effect of efficacy

information on scores for the item pertaining to expected self-efficacy, which was hypothesised given that there was no attempt to manipulate self-efficacy perceptions.

I expected that ratings of severity and susceptibility would be higher in the High than in the Neutral and Low Threat conditions and lower in the Low than in the Neutral condition. The threat manipulation had no effect on severity perceptions, possibly due to limitations outlined in the following paragraph. Participants in the Low Threat threat condition indicated lower ratings of threat susceptibility than participants in the other Threat conditions. In this respect, the Low threat manipulation was sufficient to lower a proportion of threat perceptions, relative to the control condition. However, the High threat manipulation did not have the intended effect of increasing susceptibility perceptions relative to the Neutral condition. One explanation for this was found in the qualitative analysis. Participants in the Neutral threat condition discussed both the expectation of anxiety resulting from the communicator's use of repetition and the apparent uncertainty about the impact of the chemical. They discussed anticipated willingness to follow instructions due to the potential severity. Participants in all conditions were aware, on reading the message that a hazardous chemical had been released but only in the Low Threat condition were participants informed that the threat was low. Emergencies involving the release of CBRN materials are likely to be fear-arousing (Krieger et al., 2014; Sheppard et al., 2006; Sullivan & Bongar, 2007) so the mere mention of a hazardous chemical release without a qualifying, reassuring statement about the low risk of exposure may explain why susceptibility scores were high in both the Neutral and High Threat condition, relative to the Low Threat condition. The wording of the statement about the incident was sufficiently severe in the High threat condition, based on concerns about the severity of the message identified in the qualitative data. Implications for the hypotheses in subsequent studies are raised. Rather than the High Threat Efficacy message being most effective in improving adherence, it is possible that both the High Threat and Neutral Threat conditions would be equally conducive to expected behaviour change, relative to messages that understate the threat.

It is difficult to draw conclusions about the threat manipulation from the present study due to the poor reliability of severity and susceptibility scales and the low number of items per scale. There were also limitations associated with the wording of items that were realised after data collection. For example, the item, "I would feel anxious about being exposed to the chemical released in this incident", may be more representative of expected anxiety than perceived threat severity. In retrospect, the qualifying clause, "If I didn't take preventative action", in one of the susceptibility items may have complicated participants' reflections on the likelihood that they will have been affected

and may have accounted for the interaction between threat and efficacy manipulations. Further work was required to identify more appropriate items for threat appraisal scales to be used in a further manipulation check nested in the study reported in the next chapter.

The null hypothesis that responder legitimacy perceptions and expected identification with the responder would not differ between groups was retained. This was expected because information about the communicator, their competence and expertise in managing the incident, and actions they are currently taking was present in all conditions.

For all items in the present study, responses were skewed toward the positive end of the scale. All items had a median and mode ranging from 5 (somewhat agree) to 7 (strongly agree). Visual analogue scales (VAS) may therefore be more appropriate measurement tools in future studies. If VAS data are skewed, there is the option to categorise them into ranges akin to ordinal Likert scale points, whereas the reverse cannot be achieved. Reliability and validity are broadly consistent between the two scale types (Musangu & Kekwaletswe, 2012; Tucker-Seeley, 2008) though significant change is more easily detected in VAS (Musangu & Kekwaletswe, 2012) and VAS are less conducive to ceiling effects (Voutilainen, Pitkääho, Kvist, & Vehviläinen-Julkunen, 2015). But literature searches for VAS used to measure expected behaviour in a hypothetical incident have so far resulted in no findings. I decided that the most appropriate approach to outcome measure development was to refine and improve the use of Likert measures prior to the RCT reported in the next chapter, rather than attempt to introduce a novel outcome measure approach.

The results of this study indicate that messages designed to improve response efficacy perceptions improved response efficacy perceptions, relative to messages designed to have no impact. Messages designed to reduce perceptions of threat susceptibility, relative to High and Neutral messages, had the intended effect. And, as expected, the known extraneous variables of legitimacy, identification and self-efficacy were not significantly affected by my experimental manipulations. The outcomes of this study provide no conclusive guidance on how to improve the wording of Threat messages so that severity perceptions vary as intended and no guidance on how to improve the wording of the High and Neutral Threat message components so that susceptibility perceptions would be higher following receipt of the High, rather than Neutral message. This is because it is difficult to draw valid conclusions about the effect of Threat message components due to the previously discussed threat outcome measure

limitations. Improvement of threat perception outcome measures was addressed prior further empirical assessment of messages in Chapter 8.

Chapter 8 The effect of responder communication on expected adherence to initial decontamination protocols by casualties in a virtual chemical incident: A double-blind randomised controlled trial

8.1 Introduction

The aim of this PhD is to test optimum parameters for communication with casualties during the early stages of a chemical incident to promote adherence to IOR procedures. The objective of this study is to assess the effectiveness of discrete message components, specifically the inclusion of information about the threat of contamination and the efficacy of decontamination, at promoting adherence.

Findings from the systematic review reported in Chapter 2, the crisis communication review reported in Chapter 3, and the lay public interview study reported in Chapter 5, suggest that engagement in protective actions by casualties in an emergency is likely to be facilitated by the provision of information about the emergency. There is more than one approach to conveying this information. In the investigation into current communication practice reported in Chapter 4, example messages emerged from the guidance documents and interviews with first responders that described the nature of the incident in a manner that understated the threat posed by a hazardous chemical, such as “It is highly unlikely that any harm has come to you”. Conversely, there were also messages that unequivocally described the threat posed to casualties, such as “as far as we're concerned you're all contaminated”. There is a strong theoretical rationale, based on Protection Motivation Theory (PMT) (R. W. Rogers, 1975, 1983) and the Extended Parallel Process Model (EPPM) (Witte, 1992, 1994), for framing information about the incident in a way that makes salient the severe consequences of chemical contamination and the likelihood that casualties have been contaminated in order to improve the likelihood of acceptance and adherence to first responders' instructions. Specifically, the EPPM predicts that a level of fear is required as part of the message acceptance process.

Based on PMT and the EPPM, it is likely that the framing of information to increase perceptions of threat would only be conducive to message acceptance and casualties undertaking protective actions when these messages are accompanied by information about the effectiveness of protective actions at reducing or preventing the threat. In the absence of this perceived ‘response efficacy’, message recipients engage in a process of fear control whereby they attempt to protect themselves from the fear of the threat rather than the danger posed by the threat (Witte & Allen, 2000). The direction of

processes in the EPPM is such that the message audience is unlikely to assess the efficacy of target behaviours unless they have first assessed the threat as high. Findings from the interviews with first responders and the review of guidance documents reported in Chapter 4 show that information about the efficacy of protective actions is currently used in practice (e.g. “the best thing you can do is to release that outer layer and wipe away from your face and stuff; and that's scientifically what's best for you”. As stated in Chapter 6, it is still unclear whether information about the efficacy of IOR is necessary to promote adherence or whether it is enough to simply provide instructions, given that the efficacy of following instructions at reducing exposure is likely to be intuitive, based on outcomes from Chapter 5.

Meta-analyses have indicated that the most effective fear appeals at promoting reported or intended behaviour change are high in both threat and efficacy information (Peters et al., 2013; Sheeran et al., 2014; Witte & Allen, 2000). However, in the studies included in such meta-analyses, the timeframe for behaviour change is extensive. Less is known about the effect of the combination of threat and efficacy information in the context of a chemical incident when message recipients need to accept and act on directives to take protective actions within a narrow, 15-minute timeframe in order to minimise detrimental effects of the chemical on their health and on the health of others. The aim of this study was to test whether the presentation of information about the threat of chemical contamination (low, high, or neutral threat) and efficacy of decontamination (efficacy or no efficacy) would affect willingness to adhere to initial decontamination protocols. I used the following null and directional alternative hypotheses to address this question.

RQ1. Does the presentation of Threat and Efficacy information affect expected adherence to IOR?

H₀1. Threat and Efficacy information will have no main or interaction effects on expected adherence to IOR.

H_a1. Messages in which the threat of chemical contamination is understated by the communicator (Low Threat) will result in lower expected adherence to the initial decontamination protocol than messages in which the threat is emphasised (High Threat) or in which there is no attempt to emphasise or understate the threat beyond stating that there is a suspected chemical release (Neutral Threat).

H_a2. Messages in which the communicator emphasises the efficacy of initial decontamination actions at reducing the threat of chemical contamination (Efficacy) will result in higher expected adherence to the

initial decontamination protocol than messages in which the efficacy of initial decontamination is not addressed (No Efficacy).

H_{a3}. High Threat and Neutral Threat messages with Efficacy will result in higher expected adherence to the initial decontamination protocol than High Threat and Neutral Threat messages with No Efficacy.

Participants interviewed about their perceptions of chemical contamination (Chapter 5) volunteered alternative courses of action that they would consider taking during a chemical incident in the absence of adequate information from authorities. Actions of interest were: leaving the area; self-presenting at a hospital; and seeking further information prior to taking action. I selected these behaviours for inclusion as outcome measures in this study because engagement in any of these behaviours would increase the interval between contamination and decontamination, thereby undermining the effectiveness of decontamination (Borak & Sidell, 1992; Chan et al., 2013; Chilcott, 2014; Hewitt et al., 1995; Hui et al., 2012; Kales & Christiani, 2004; Leary et al., 2014; Levitin et al., 2003; Wester et al., 1999). Self-evacuating is also a public health concern due to the risk of secondary contamination of other members of the public (Chilcott, 2007a; Clarke et al., 2008; Eckstein, 1999; Gaskin et al., 2017; Horton et al., 2003; Nakajima et al., 1997; Nishiwaki et al., 2001; Okumura et al., 2005; Spiandore et al., 2017; Vale et al., 2016). In this study, I tested whether the presentation of threat and efficacy message components would affect expected engagement in these alternative courses of action and, if so, what the direction of these effects would be.

RQ2. Does the presentation of Threat and Efficacy information affect expected engagement in alternative behaviours to IOR adherence?

H₀. Threat and Efficacy information will have no main or interaction effects on expected adherence to alternative behaviours to IOR adherence.

As a secondary objective, I tested whether the presentation of Threat and Efficacy information would have the expected effect on perceptions of threat severity, susceptibility and response efficacy and whether these perceptions predict adherence expectations. Self-efficacy is a sub-component of coping appraisal in PMT and perceived efficacy in the EPPM. As explained in Chapter 6, I did not target self-efficacy perceptions in the messaging intervention. Similarly, perceptions about the costs of behaviour change (response costs) are a sub-component of coping appraisal in PMT that were not addressed in the messaging intervention in this study. I included an additional secondary research objective to test whether self-efficacy and response cost

perceptions would be affected by the messaging intervention and whether these perceptions predict adherence expectations.

RQ3. Does the presentation of information about Threat affect threat (severity and susceptibility) perceptions?

H₀. The manipulation of Threat information will have no effect on threat severity and susceptibility perceptions.

H_{a1}. Threat (severity and susceptibility) perceptions will be higher in the High Threat condition than in the Low or Neutral Threat conditions.

H_{a2}. Threat perceptions (severity and susceptibility) will be higher in the Neutral Threat condition than in the Low Threat condition.

RQ4. Does the presentation of information about Efficacy affect response efficacy perceptions?

H₀. The manipulation of Efficacy information will have no effect on threat response efficacy perceptions.

H_a. Response efficacy perceptions will be higher in the Efficacy condition than in the No Efficacy condition.

RQ5. Does the presentation of information about Threat and Efficacy affect self-efficacy and response cost perceptions?

H₀. The manipulation of Threat and Efficacy information will have no effect on self-efficacy and response cost perceptions.

The crisis communication review (Chapter 3) highlighted the role of trust in the communicator as a facilitator of compliance with emergency directives (Bass et al., 2015; Glik, 2007a; Liu et al., 2017; Maxwell, 2003; McComas, 2006; Pearce et al., 2013; Reynolds & Seeger, 2005; Rubin et al., 2009; Sherman-Morris & Lea, 2016) and how this can be improved by highlighting the competence and expertise of the communicator. This recommendation was supported by the finding from the lay public interviews reported in Chapter 5 that trust in first responders who communicate instructions would be improved by making salient the responders' authority about decontamination, for example by stating that they are trained to respond to chemical incidents. As outlined in Chapter 6, this contextual information would be recommended in any message used to promote IOR. Unsubstantiated reassurance during crisis communication may be a barrier to trust in the messenger (Glik, 2007a; Maxwell, 2003; Pearce et al., 2013; Rubin et al., 2012; Sorensen, 2000; World Health Organization,

2017), which raises questions as to whether a Low Threat message would result in lower trust perceptions, relative to a High or Neutral Threat message with the same contextual information about the communicator. In previous studies on communication during mass casualty decontamination, messages that included health-focused information as to why decontamination was necessary improved perceptions of the legitimacy of responders (Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015) which suggests that messages with Efficacy information would improve trust perceptions. In this study I tested whether trust would be affected by Threat and Efficacy information and whether trust perceptions predict adherence expectations.

RQ6. Does the presentation of information about Threat and Efficacy affect trust perceptions?

H₀. The manipulation of Threat and Efficacy information will have no effect on trust perceptions.

H_{a1}. Low Threat messages will result in lower perceptions of trust in the communicator than High or Neutral Threat messages.

H_{a2}. Efficacy messages will result in higher perceptions of trust in the communicator than No Efficacy messages.

The justification raised by interviewees in Chapter 4 for understating the threat was to reassure casualties. I therefore included research question to test whether anxiety would be reduced by understating the threat posed to casualties and whether anxiety perceptions predict adherence expectations.

RQ7. Does the presentation of information about Threat and Efficacy affect state anxiety?

H₀. The manipulation of Threat and Efficacy information will have no effect on state anxiety.

H_{a1}. Low Threat messages will result in lower expectations of state anxiety than High or Neutral Threat messages.

A common limitation in mass casualty incident communication intervention studies included in the systematic review (Chapter 2) was that communication interventions were tested with one group of participants per condition (Amlôt et al., 2017; Boyce et al., 2017; Carter, Drury, Amlôt, et al., 2014; Proulx & Sime, 1991; Purser, 2010). Testing each condition in one session makes it difficult to rule out the confounding effect of baseline group characteristics or extraneous factors, such as weather, in which the intervention is tested. In this study, I attempted to resolve this limitation by

using an immersive virtual environment to simulate the experience of being part of a group of casualties, whilst ensuring complete consistency in the behaviour of all “casualties” across multiple study sessions. Immersive virtual environment technology (IVET) has been applied extensively in the emergency domain, for example in studies on: wayfinding behaviour in emergency egress (Duarte et al., 2014; Feng, González, Amor, Lovreglio, & Cabrera-Guerrero, 2018; Kinateder, Comunale, & Warren, 2018; Tucker et al., 2018; Vilar et al., 2014); mass evacuation (Drury, Cocking, Reicher, et al., 2009); and bystander behaviour in an emergency (Bakker et al., 2018; Stubbe et al., 2017). In this study, I used IVET to test the effect of threat and efficacy information on expected IOR adherence in a simulated mass casualty chemical incident.

8.2 Method

8.2.1. Design

I used a double-blind randomised controlled trial with a 3x2 independent measures factorial design (Table 8-1) and an allocation ratio of 1:1 to assess the effects of threat and efficacy message constructs on participants’ self-reported hypothetical expectations of adherence to preliminary self-protective behaviours during a simulated chemical incident. Participants were presented with a simulated chemical incident scenario via a virtual reality headset, and during this incident the communication interventions were delivered by a first responder using a voice amplification device.

Table 8-1 Segmentation of treatment groups according to the combination of Threat and Efficacy information received in the study.

		IV2: Efficacy	
		Efficacy Message items pertaining to efficacy of instructed behaviours at reducing threat	No Efficacy (Control) No message items pertaining to efficacy of instructed behaviours at reducing threat
IV1: Threat	High Message items designed to increase perceptions of severity and susceptibility	<i>Condition 1: High Threat - Efficacy</i>	<i>Condition 2: High Threat – No Efficacy</i>
	Low Message items designed to decrease perceptions of severity and susceptibility	<i>Condition 3: Low Threat - Efficacy</i>	<i>Condition 4 –Low Threat – No Efficacy</i>
	Neutral (Control) Message items designed to inform casualties about the threat without increasing or decreasing perceptions of severity and susceptibility	<i>Condition 5: Neutral Threat - Efficacy</i>	<i>Condition 6 – Neutral Threat – No Efficacy</i>

8.2.2. Randomisation and blinding

My first supervisor computed a block randomisation sequence of condition allocations using the randomisation programme, sealedenvelope.com. The order of videos was randomised in blocks of six (one per threat x efficacy group) so that if the trial needed to be terminated early, the variability in number of participants between conditions would be reduced.

My second supervisor copied and pasted 22 versions of each video in the order specified in the random allocation sequence. The filename for each video was re-labelled with a number from 1 to 132 determined by the order of the video in the sequence. My third supervisor and a colleague of the supervisory team carried out checks of the blinded video files to ensure that they corresponded to the correct condition in the random allocation sequence. I allocated each participant on a consecutive basis to the next video in the sequence during each study session, whilst remaining blind to study condition myself.

The list of randomly ordered, coded video files was stored in a shared folder that was configured to not display file size, to reduce the risk of me accidentally unblinding myself by identifying a pattern in file sizes. All videos were exactly six minutes in length to further reduce the risk of accidental unblinding. Equal duration was achieved by extending the duration of the title card that informs participants that the video has completed. I remained blind to condition throughout data collection. Participants were aware of the information they received during the intervention but unaware of the condition to which the information corresponded.

I asked my second supervisor to relabel the random allocation sequence with randomly generated codes pertaining to each level of each independent variable to keep me blind to condition during data analysis. Random codes were obtained from the website, randomcodegenerator.com. The randomisation code was broken on completion of all analyses. The full procedure for allocation concealment is displayed as a flow diagram in Figure 8-1.

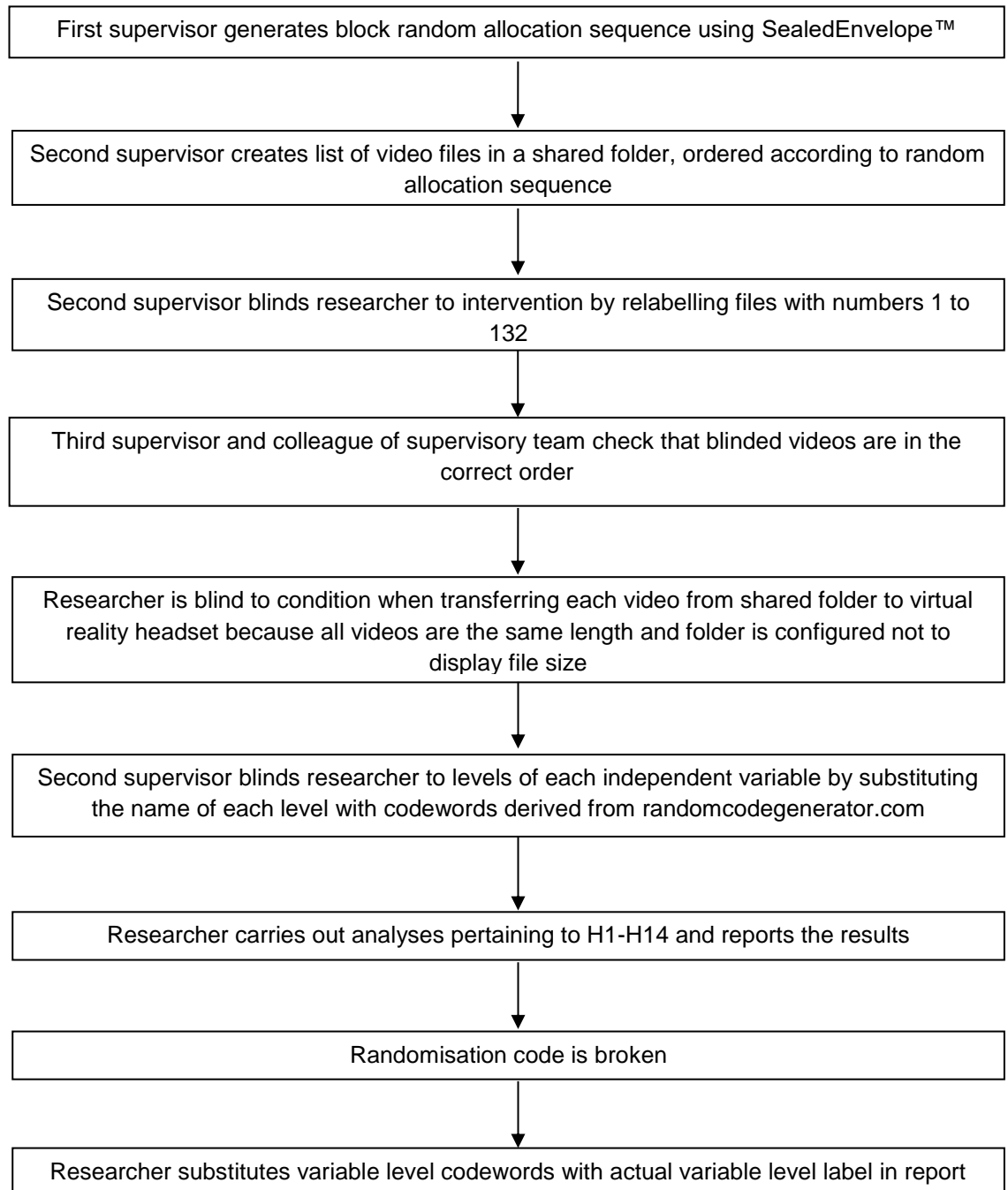


Figure 8-1 Allocation concealment flow diagram.

8.2.3. Participants

132 participants aged 18 to 81 ($M = 26.13$, $SD = 10.83$) completed the study from 29th October to 5th December 2018 at the Public Health England South West regional office in Temple Quay, Bristol. Participants were reimbursed with £30 for their time.

I used a convenience sampling method. Recruitment channels consisted of: advertisements placed in the University of Bristol study participation webpage and

circular email; circular emails distributed to University of Bath and City College Bristol students; and word-of-mouth promotion of the study by participants to friends and colleagues. To mitigate against the risk of demand awareness resulting from word-of-mouth promotion, I asked each participant not to disclose information about the study, apart from information they received in advance of their participation. I also asked each participant to state whether they had received any information about the study aside from information provided by me prior to their participation. All participants confirmed that the only information they knew prior to their arrival at the assessment centre was the information contained in the information sheet and recruitment materials.

Participants were eligible for participation if they were 18 years of age or older and fluent in written and spoken English. For methodological reasons, I excluded people from participating if they had: hearing impairments including active ear infections; visual impairments that cannot be corrected with glasses or contact lenses; professional experience or expertise in emergency response or toxicology. In accordance with the risk assessment that was based on health and safety guidelines published by the manufacturer of the virtual reality headset used in the study, I advised all participants to consult their GP before participating if they: were pregnant; had a pre-existing binocular vision disorder or heart condition; or previously had a seizure, loss of awareness, or other symptom linked to an epileptic condition. Participants were also informed that they would need to reschedule their participation if, on the day of their scheduled study session: they felt over-tired or unwell (including cold, flu, headaches, migraines, and earaches) or if they were under the influence of drugs (including alcohol but not including nicotine, caffeine, and prescribed medication) or experiencing emotional stress and anxiety.

8.2.3.1 Sample size calculation

I used G*Power 3.1.9.2 (Franz Faul, Universität Kiel) to compute the required sample size for ANOVA fixed effects, special, main effects, and interactions using *a priori* power analysis. The number of groups, numerator df, alpha, power and effect size (f) were set at 6, 2, 0.05, 0.95, and 0.35 respectively. The computed required sample size was 130, which was rounded up to 132 to allow for an equal number of participants across groups (22 per group). The effect size used in the power analysis was informed by a meta-analysis effect size of studies that tested the effect of combined high threat and high efficacy information on true behavioural outcomes, $d = 0.71$ (Peters et al., 2013), which equates to $f = 0.3550$. Other meta-analyses of studies that included attitude and/or behavioural intention as outcome measures, which are more proximal to the measures used in the present study, found meta effect sizes, $\eta^2 = 0.21$ (Witte & Allen, 2000) and $d = 0.98$, (Sheeran et al., 2014), which, if entered into the power

analysis, would have yielded a required sample size of 63 or 68 respectively. I decided to use the lower effect size based on true behavioural outcomes, $f = 0.35$ (Peters et al., 2013), as a conservative estimate. This higher sample size was also justifiable given that the experiment itself posed very few risks or burdens to participants.

8.2.4. Materials

8.2.4.1 Immersive video

An immersive video was recorded, using a 360 camera, from the vantage point of a student attending a lecture at a university-style campus (in reality, a lecture theatre at a Public Health England facility). The camera was mounted to a tripod held in a backpack worn by the camera operator.

I based the video plot on the vignette used in an online visualisation experiment (Carter, Drury, Amlôt, et al., 2015) and the scenario used in a field experiment (Carter, Drury, Amlôt, et al., 2014) on mass casualty decontamination. The video depicts events described in the scenario presented in Section 6.2.1, from the perspective of the casualties. The full outline for the video is presented in Appendix Q. In summary, the video depicted students ($n = 15$) in a lecture theatre watching a lecturer present introductory slides for a course. A fire alarm sounds and the students and lecturer start to evacuate the lecture theatre (Figure 8-2). The students and lecturer evacuate the building via the nearest exit (Figure 8-3) then walk away from the building (Figure 8-4). Outside, the casualties ($n = 17$: lecturer, university warden and 15 students) are guided by a police officer to assemble at an area marked by rolls of tissue paper on the ground. The police officer stands in front of a police van and communicates to casualties using a handheld loudhailer (Figure 8-5). The actual communication interventions were not recorded during filming and were instead added during post-production. I briefed actors portraying the casualties to look concerned as they “listened” to the police officer (Figure 8-6) and to examine their skin at the point in the intervention when the threat manipulation would be delivered. I recruited all actors, with the exception of the police officer, warden and two of the students, via the casting website, starnow.co.uk.

A local police officer (who portrayed the officer in the video) and a police officer from the National CBRN Centre served as consultants during production to ensure that the scenario being filmed was representative of an emergency in which IOR protocols would be implemented. Changes made as a result of stakeholder input included the police officer instructing casualties to walk towards the sound of their voice during the scene when casualties were walking in the direction of the police van.

One video was produced and used in all conditions, the only variation being the audio communication intervention superimposed during post-production. The text of the communication intervention in each condition, as displayed in Appendix R, was recorded using an ambisonic audio recorder to ensure that the audio was 360° directional. In other words, as the participant turned their head while wearing the VR headset, the direction of sound changed accordingly. Sound effects were added to simulate the use of voice amplification technology. The same professional voice artist recorded all six messages to ensure consistency in accent and fundamental frequency. The voice artist was briefed to keep his tone consistent across conditions though it was not possible to measure this.

The communication intervention was implemented at the same timepoint in all conditions (two minutes and 22 seconds from the beginning of the video). Symptoms of chemical exposure were not depicted in the video in order to account for the delayed onset of symptoms following exposure to certain chemical agents, such as sulphur mustard in liquid form (Borak & Sidell, 1992; Clarke et al., 2008; Kales & Christiani, 2004; Spiandore et al., 2017; Wattana & Bey, 2009). The visual content of the video during the communication intervention was identical across conditions so that the behaviour of casualties, including their reactions to the communication intervention, remained the same in all conditions.



Figure 8-2 Scene in the immersive video depicting students first hearing the fire alarm and starting to evacuate the lecture theatre.



Figure 8-3 Scene in the immersive video depicting students and lecturer evacuating the building.

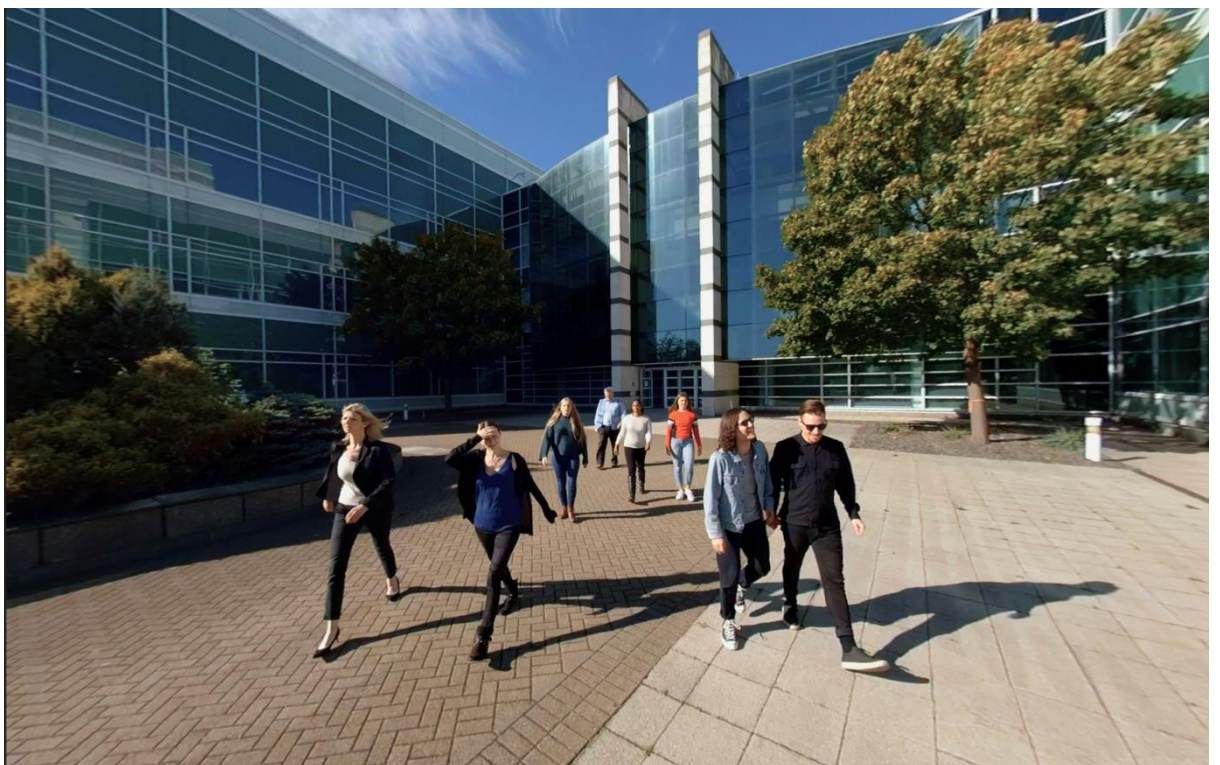


Figure 8-4 Scene in the immersive video depicting lecturer, university warden, and a sample of students walking towards the direction of a police officer.



Figure 8-5 Scene in the immersive video depicting the police officer delivering the communication intervention to casualties.



Figure 8-6 Scene in the immersive video depicting casualties looking concerned whilst the police officer is speaking to them.

8.2.4.2 Communication interventions

The process used to draft the messaging framework is outlined in Chapters 6 and 7. Following the method testing reported in the previous chapter, further amendments were made to messages during immersive video production. The first amendment addressed concerns raised during filming about presenting instructions as imperatives for actions that need to be taken right now. The actors portraying the casualties would either need to follow the actions (compliance) or not follow the actions (non-compliance). In either case, there would be a confounding effect of casualty behaviour on participants' perceptions of what they would do. There was the option of having a proportion of the actors as compliant and the rest noncompliant but in an immersive video, it is not possible to control for the attention afforded to compliant or non-compliant "casualties". The least problematic solution was for the wording of instructions in all conditions to be adjusted in such a way that the actions would be taken immediately following rather than concurrently with the presentation of instructions (e.g. "We will ask you to carefully remove as much clothing as you can" rather than "Carefully remove as much clothing as you can"). The point in time when actions would need to be taken in the scenario coincided with the exact point in time in the study when the video would stop and measures of behavioural expectation would be recorded. The second amendment was to change the instruction pertaining to dry decontamination from "blot then wipe" to "brush". This adjustment was proposed by the police officers present who served as consultants during video production and the suggestion was based on up-to-date wording of dry decontamination instruction in updated public-facing IOR guidance.

Amendments were only made to the wording of instructions, rather than threat and efficacy message components, and the same amendments were applied to all conditions. This means that the outcomes from the pilot test reported in the previous chapter were still considered valid but, as a precaution, manipulation checks were included in the present study. Following the adjustments, readability scores for each condition remained unchanged. As explained in Chapter 6, the text in all messages had the same readability score (appropriate for aged 10+), as calculated using an amalgamation of seven readability tools (Automatic Readability Checker). Word count variability between conditions remained minimal, the maximum percentage difference between conditions being 2.02%.

The message in all conditions contained a statement as to who the communicator was (i.e. the police) and their competence in responding to a chemical incident. All messages contained the same instructions for actions that message recipients would have to take. Aside from the threat manipulation and the inclusion or exclusion of

statements pertaining to the efficacy of IOR actions, information was identical across conditions. Statements that were present in more than one condition were recorded once then duplicated across the six conditions to minimise variability in vocal performance between conditions. As displayed in Appendix R, Table R-1, the duration of messages ranged from 165 seconds (High Threat & Efficacy) to 177 seconds (Neutral Threat & Efficacy) ($M = 172.17$, $SD = 3.89$). The maximum percentage difference in duration between any two conditions was 7.02%.

8.2.5. Measures

All measures, aside from demographic questions, were Likert items. All measures were recorded using the online survey tool, Qualtrics. I informed participants that the measures apply to how they would feel at the point in the scenario when the communication intervention concludes. All outcome measures are presented in Appendix S.

8.2.5.1 Behavioural expectation (primary outcome measure)

Consistent with self-report scale measures used in previous studies on expected behaviour in a disaster situation (Amlôt et al., 2017; Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015; Liu et al., 2016; Sutton, Vos, et al., 2018), participants indicated their hypothetical likelihood of engaging in selected behaviours. Given that participants were asked to rate the likelihood of behaviour during a hypothetical scenario, behavioural *expectation* or *willingness* are more appropriate measures than *intention*. Intention implies a plan to engage in a particular course of action, whereas expectation denotes the perceived likelihood that a course of action will be taken (Gibbons, 2005). Behavioural expectation was measured with three items for each behaviour that corresponded to wanting to, trying to, and expecting to engage in the behaviour. I based the wording of each item on the wording used in previous a study carried out by Teasdale et al. (2012) on intended behaviours during a hypothetical pandemic flu outbreak. In the present study, participants rated the extent to which they would be likely to *want*, *try*, or *do* each behaviour. The purpose of including the “want to” and “try to” items is to account for the role of perceived behavioural control (Ajzen, 1991) in the participant’s decision-making process when considering each action. The wording of each type of item is presented below.

- *I would remain where I am until the shower arrives;*
- *I would try to remain where I am until the shower arrives;*
- *I would want to remain where I am until the shower arrives.*

I used both adherent and alternative, non-adherent behavioural expectation measures. Adherence behaviours were: remaining in place for the arrival of a decontamination

shower; disrobing; and undergoing dry decontamination. Non-adherence behaviours were: going straight to a hospital without following any of the police officer's instructions; leaving the area without following any of the police officer's instructions; and seeking further information before taking any action.

8.2.5.2 PMT variables

Participants completed measures pertaining to threat severity, threat susceptibility and response efficacy so that I could carry out a manipulation check of the messages akin to the one carried out in Chapter 7. To check that messages did not affect non-targeted PMT perceptions, participants completed measures pertaining to self-efficacy, and response costs. Three items pertaining to perceived threat severity were adapted from items used in a pandemic flu study (Teasdale et al., 2012). Three perceived threat susceptibility items were adapted from susceptibility measures used in the Risk Behavior Diagnosis Scale (Witte, McKeon, Cameron, & Berkowitz, 1995). Three response efficacy items were adapted from response efficacy items used in a study on public reactions to a hypothetical chemical spill by Pearce et al. (2013).

Three self-efficacy items were adapted from items used in a pandemic flu study (Teasdale et al., 2012) and the Risk Behavior Diagnosis Scale (Witte et al., 1995). Two response cost items were based on perceived response costs discussed by participants in Chapter 5.

8.2.5.3 Anxiety

Anxiety was measured using a modified version of the 6-item state version of the Spielberger State-Trait Anxiety Inventory (STAI-6) (Marteau & Bekker, 1992). The scale was modified so that states were presented in the conditional rather than indicative tense, for example "I would feel calm" instead of "I feel calm". This adjustment was made because participants were asked to reflect on how they would feel if they were in the situation presented in the video, rather than how they actually feel at the point in time when the question is presented. Scores for the items, "calm", "relaxed", and "content" were reverse-coded.

8.2.5.4 Trust

A 7-item trust scale was adapted from items used in the Trust in Government scale developed by Quinn, Kumar, Freimuth, Kidwell, and Musa (2009) to cover the key determinants of trust, as outlined in the literature. In the adapted version of the scale used in the present study, the terms "government" and "swine flu" were substituted with "police officer" and either "chemical" or "emergency" respectively. On some items the tense was changed from present to past to make them more appropriate to context.

8.2.5.5 Stimulus check

Two items used by Carter, Drury, Amlôt, et al. (2015) were used to check if there were differences between groups in terms of perceived realism of and emotional engagement with the scenario. The items were not designed to form a scale.

8.2.5.6 Demographic measures

Participants stated their age, gender, occupation, highest educational qualification to date, and national identity for descriptive purposes only.

8.2.6. Procedure

Ethical approval for this study was granted by the King's College London Psychiatry, Nursing & Midwifery Research Ethics Panel (reference: LRS-15/16-3406; Appendix T). I submitted the protocol for this study to the ISRCTN, in advance of data collection, on 24th October 2018 (Reference Number: 35889). The trial was registered on 7th November 2018 (<https://doi.org/10.1186/ISRCTN17886859>).

I asked potential participants who saw the study advertisement (Appendix U) to contact me for more information and were provided with an information sheet (Appendix V). I asked participants who wished to take part in the study to make an appointment for a single study session. Each study session began with me escorting the participant from the Reception at the assessment centre to the experiment room. At the experiment room, the participant re-read the information sheet and provided informed consent via an electronic form (Appendix W).

I informed each participant via written instruction (Appendix S) that they would be watching an immersive video through a virtual reality headset. I asked them not to reveal to me any aspect of what they heard in the video in order to keep me blind to condition. I instructed them to listen carefully to what is said during the video because they would answer a series of questions on completion of the video.

The participant wore an Oculus Go virtual reality headset (Oculus VR, LLC) (Figure 8-7 and Figure 8-8) and watched one of six immersive videos, determined by the condition to which they had been randomly allocated. The participant wore a disposable protective mask around the perimeter of their eyes prior to donning the headset for hygiene reasons as the same headset was used in all sessions. During the presentation of the video, the participant sat in a swivel chair to allow them to watch the video from all possible angles. The participant listened to the audio content of the video at the same volume, which was the maximum available volume on the headset. The participant watched the video whilst I stood outside the room wearing closed-back

headphones so that I could monitor the safety of the participant but not hear the intervention, thus ensuring that I was blind to condition during intervention.

At the point in the immersive video when casualties would be required to undergo the disrobing component of IOR, text was displayed informing the participant that the video had ended, at which point I re-entered the room, removed the headset from the participant, and instructed them to proceed to the computer to record all outcome measures in an online Qualtrics survey.

Measures were recorded immediately after the conclusion of the immersive video and the removal of the headset, and always in the following order: behavioural expectation; anxiety; threat susceptibility; threat severity; response efficacy; self-efficacy; response costs; trust; emotional engagement with and perceived realism of scenario; and demographic questions.

The participant read the debrief document (Appendix X) then completed their expenses claim form for reimbursement of their participation. I asked the participant not to share their recollection of the content of the immersive videos with anyone else, to reduce the risk of demand characteristics among friends or colleagues of theirs who may participate in subsequent study sessions.

I documented potential protocol deviations during each study session and, if applicable, recorded them at the end of the study session.

The study session procedure is displayed as a flow diagram in Figure 8-9.



Figure 8-7 Virtual reality headset (Oculus Go) through which immersive video and communication intervention were presented to participants.



Figure 8-8 Participant watching the immersive video through the headset.

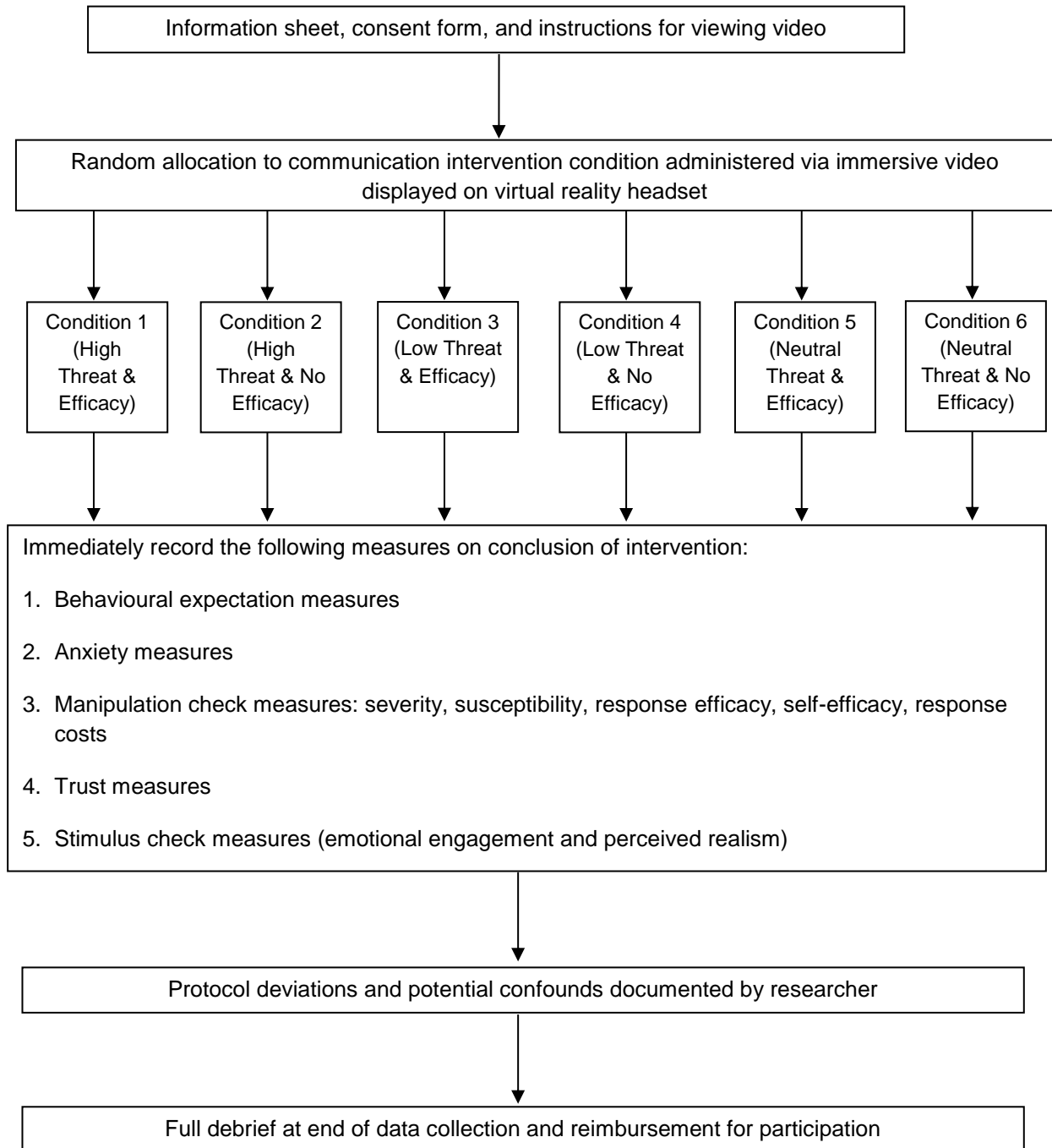


Figure 8-9 Participation procedure flow diagram.

8.2.7. Analysis

I carried out all analyses in IBM SPSS 25.

8.2.7.1 Screening of protocol deviations

Prior to data analysis, potential methodological issues observed and documented by me during study sessions were screened by the supervisory team who were blinded to study condition. Each documented issue was discussed and a decision was made based on consensus among supervisors as to whether issues constituted a serious deviation and, if so, whether cases should be excluded from analysis as part of a sensitivity test. A decision was made based on consensus between all supervisors.

8.2.7.2 Primary outcome scale reduction

Likert items used to measure behaviour expectation were novel. I therefore subjected behavioural expectation items ($n = 18$) to exploratory factor analysis (EFA) with unweighted least squares extraction and promax rotation with kappa kept at the SPSS default value of 4. I chose unweighted least squares (ULS) as the extraction method because Monte Carlo simulations have indicated that, independently of the ratio of sample size to number of items included in factor analysis, ULS results in less bias and error in factor loading matrices and stronger correlations between factor scores and population factor scores than both Maximum Likelihood and Principal Axis extraction methods (Coughlin, 2013, 2015). I used an oblique rotation because correlation between factors could not be ruled out in advance given that items were designed to measure adherence or non-adherence. If the factor correlation matrix indicated that all correlations were equal to or less than the threshold of ± 0.32 (Tabachnick & Fidell, 2007), then the EFA was repeated with an orthogonal (varimax) rotation.

The loading of each item was incorporated into the factor score. When interpreting the type of behaviour represented by each factor, I based the decision on the wording of items that loaded at .512 or higher, in accordance with recommended guidelines for sample sizes of 100 (Field, 2009; Stevens, 2002). Factor scores computed with the regression method were used as dependent variables in subsequent primary outcome analyses that are outlined below. Factor scores were used in place of scores based on the mean or sum of items to account for variability in loading between items on each factor and to provide a more accurate representation of expected engagement in each behaviour.

8.2.7.3 Primary outcome analysis

Two-way ANOVAs were applied to each factor score computed in the preceding factor analysis with Threat and Efficacy as independent variables. Bonferonni post hoc tests were used to assess differences between threat condition levels. Despite there being

more than one scale as a dependent variable, MANOVA was ruled out as an analysis because there was limited confidence that all scales would increase or decrease as a vector. I applied bootstrapping if assumptions of normality were violated. Normality was first assessed using Kolmogorov-Smirnov and Shapiro-Wilk statistics. If both values were non-significant, the ANOVA was carried out without bootstrapping. If Levene's statistic for homogeneity of variance was significant but Kolmogorov-Smirnov and Shapiro-Wilk statistics were not significant, the analysis was repeated with bootstrapping as a precaution. The number of samples for bootstrapping was 1000. For all analyses, alpha was set at .05. If the effect of Efficacy was significant for any outcome, I subsequently ran an independent samples *t*-test on the dependent variable solely to calculate confidence intervals for the difference between Efficacy and No Efficacy group means. If bootstrapping was used, confidence interval values were derived from the bootstrap for multiple comparisons for post hoc tests for the Threat condition and from bootstrapped *t*-tests for the Efficacy condition.

8.2.7.4 Secondary outcome analysis

Kruskall-Wallis H test and Mann-Whitney U test were used to check whether there was a significant effect of Threat and Efficacy respectively on each of the two stimulus check Likert items. The reason for using non-parametric tests was because these items did not have –and were not expected to have – sufficient reliability to constitute a scale and individual Likert items are not suitable for parametric analysis.

Each remaining secondary outcome scale was subjected to reliability analysis using Cronbach's alpha for scales consisting of more than two items and Pearson correlation coefficient for scales consisting of two items. On determining that reliability was sufficient for each scale ($\geq .7$), the sum of items in each secondary outcome scale was entered as the dependent variable in a two-way ANOVA with Threat and Efficacy condition as the independent variables and Bonferonni-corrected post hoc tests used to assess differences between threat condition levels.

Stepwise multiple linear regression was carried out with each behavioural expectation as dependent variable and trust, anxiety, threat severity, threat susceptibility, response efficacy, self-efficacy, and response costs perceptions as predictors to determine which perception predictors accounted for variance in behavioural expectation scores. Analysis was repeated for each type of expected behaviour resulting from EFA. The assumption of no perfect multicollinearity was checked by ensuring that: no two predictors had correlations exceeding $\pm .7$; tolerance statistics were greater than .1; and VIF statistics were less than 10 (Pallant, 2007). The assumption of independent errors was checked by ensuring that the Durbin-Watson statistic was greater than 1 and less

than 3 (Field, 2009). Unless otherwise stated in the multiple regressions report, these two assumptions were met. The standardized, rather than unstandardized, coefficients were reported for all regression models.

8.2.7.5 False discovery rate to account for multiplicity of analysis

A total of 43 tests were carried out, increasing the risk of Type 1 errors due to the interpretation of multiple p values. As a precaution, I applied the Benjamini–Hochberg procedure (Benjamini & Hochberg, 1995) on completion of all analyses to correct for multiple p values. The calculation was carried out using SPSS syntax obtained on researchgate.net (Weaver & Mulyono, 2015). The highest p value that was equal to or less than its Benjamini-Hochberg critical value [p value rank (i) divided by number of tests (m) multiplied by false discovery rate (q)] was defined as the maximum threshold for interpretation of significance. The false discovery rate (q) was set at 0.15.

8.3 Results

All recorded demographic characteristics of the study sample are presented in Table 8-2. As indicated in Figure 8-10, the withdrawal rate for participants who were randomised to a condition was 1.49%. Participant recruitment continued until the predetermined sample quota of 132 was reached. All 132 participants who completed the intervention subsequently completed all outcome measures and were included in all planned analyses.

One participant was deemed eligible to participate but could not be randomised to a condition due to a loss of connectivity to the internet at the assessment centre. Two participants were deemed eligible to participate and were randomised to a condition but had to be withdrawn from the study. In one case, the participant was withdrawn because the video file (labelled “Video 2”) was corrupted and could not be played all the way through. The next participant to arrive at the assessment centre was assigned to the next playable video in the sequence (“Video 3”), as identified by my second supervisor. The technical issue was resolved by my second supervisor. The sixth participant was therefore allocated to the second video (“Video 2”) in the sequence and the allocation order for the first block of six conditions was changed to reflect this. In the other case, the participant was withdrawn because they experienced a headache and nausea that were attributed to watching the immersive video. The study session was immediately terminated and the participant confirmed that they had fully recovered at post-24hr follow-up. The next participant to arrive at the assessment centre who met the eligibility criteria was assigned to the same condition as the withdrawn participant.

It was decided that the two withdrawn participants would not have their missing values included in an intention-to-treat analysis because their exclusion was unrelated to the intervention itself, i.e. the information provided by the police officer in the video. In other words, the lack of outcomes in these two cases did not provide us with any information about the communication interventions.

Following screening of potential protocol violations documented during completed study sessions, the supervisory team highlighted two cases. In one case, the participant reported that the video became gradually blurrier because of condensation within the headset. In the other case, the headset malfunctioned partway through the communication intervention so the video had to be repeated from the point that the intervention begins, which means that the participant heard part of the intervention twice and there was a disruption to the flow of the intervention. The supervisory team concluded that these two cases should be included in all analyses but sensitivity analyses would be carried out with the two cases removed. The analyses reported below pertain to the dataset with the two cases included. The sensitivity analysis is reported subsequently.

Table 8-2 Demographic characteristics of the sample.

Characteristics	<i>N</i>
Age	
18-24	84
25-34	35
35-44	2
45-54	6
55+	5
<hr/>	
Gender	
Female	95
Male	36
Non-binary	1
<hr/>	
Education (attained or working towards)	
Undergraduate degree	64
A-Level, AS-Level, or equivalent	30
Postgraduate degree or higher	28
GCSE or equivalent	2
Professional qualification	1
Trade apprenticeship	1
Other qualification	6
<hr/>	
Employment status	
Full-time education at college or university	79
Full-time employed	24
Part-time employed	14
Unemployed	4
Retired from paid work	4
Self-employed (full or part-time)	3
Full-time student whilst working	3
On career break	1
<hr/>	
Reported national identity	
English	72
British	31
Polish	5
Indian	4
Bulgarian	3
American	2
Welsh	2
Other (one participant per national identity)	13
<hr/>	

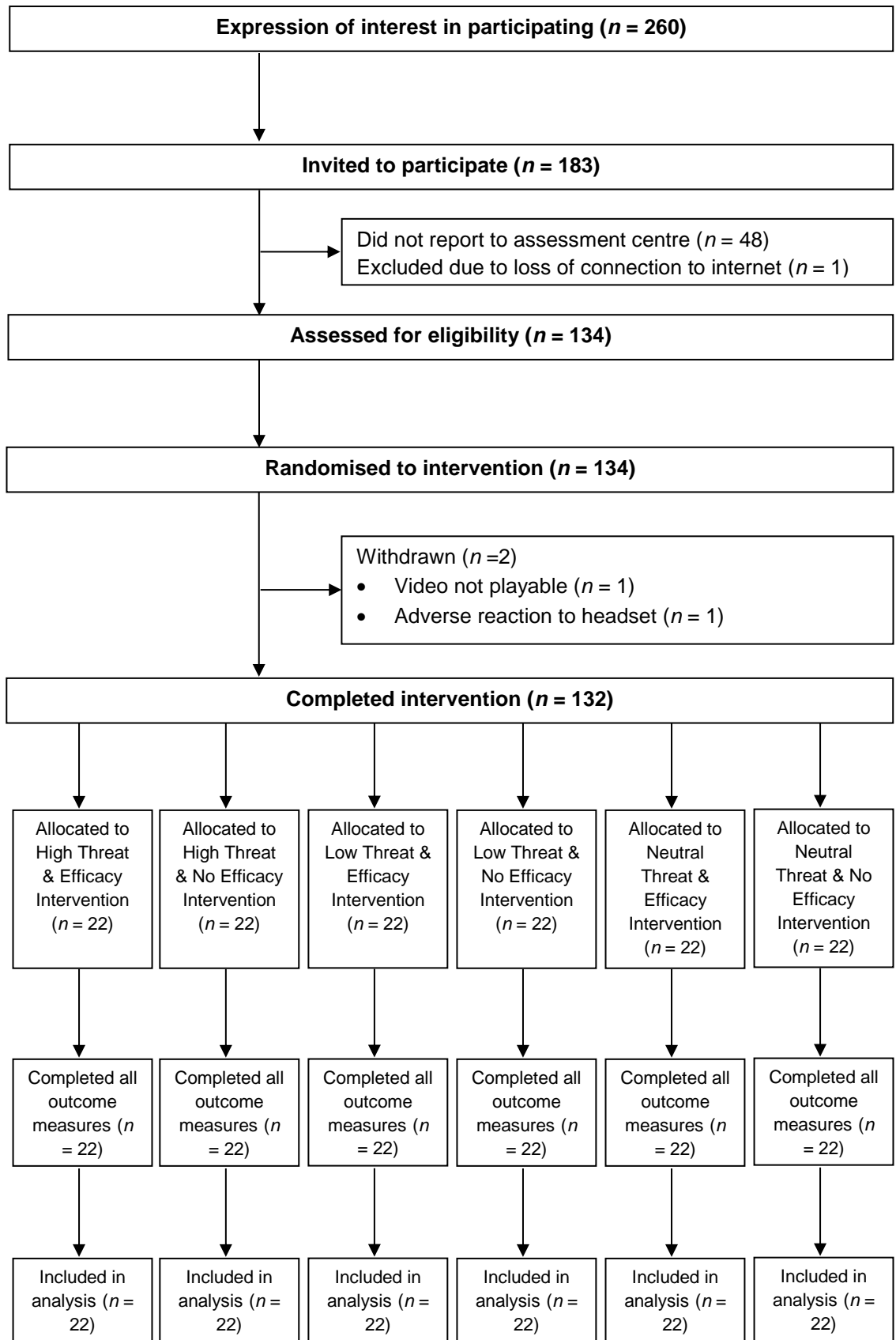


Figure 8-10 Flow of participants numbers through the trial.

8.3.1. Manipulation check

There was a significant effect of Threat on threat severity perceptions, $F(2, 126) = 6.32$, $p < .005$, $\eta_p^2 = 0.09$, with participants in the High threat group having higher severity scores than participants in the Low threat group, $M_{diff} = 3.10$, 95% CI [1.47, 4.77], $p < .005$ (Figure 8-11). There was no difference in mean scores for threat severity between the High and Neutral groups, $M_{diff} = 2.00$, 95% CI [0.26, 3.78], $p = .07$, or between the Low and Neutral groups, $M_{diff} = 1.05$, 95% CI [-0.78, 2.86], $p = .71$. There was no effect of Efficacy, $F(1, 126) = 2.45$, $p = .12$, $\eta_p^2 = 0.02$, and no interaction between Threat and Efficacy, $F(2, 126) = 1.34$, $p = .27$, $\eta_p^2 = 0.02$, on threat severity perceptions (Figure 8-12).

There was a significant effect of Threat on threat susceptibility perceptions, $F(2, 126) = 5.90$, $p < .005$, $\eta_p^2 = 0.09$, with participants in the High threat group having higher susceptibility scores than participants in the Low threat group, $M_{diff} = 2.18$, 95% CI [0.96, 3.43], $p < .005$ (Figure 8-13). There was no difference in mean scores for threat susceptibility between the High and Neutral groups, $M_{diff} = 1.20$, 95% CI [-0.03, 2.50], $p = .18$, or between the Low and Neutral groups, $M_{diff} = 0.98$, 95% CI [-0.32, 2.22], $p = .38$. There was no effect of Efficacy, $F(1, 126) = 2.30$, $p = .13$, $\eta_p^2 = 0.02$, and no interaction between Threat and Efficacy, $F(2, 126) = 1.78$, $p = .17$, $\eta_p^2 = 0.03$, on threat susceptibility perceptions (Figure 8-14).

There was a significant effect of Efficacy information on response efficacy perceptions, $F(1, 126) = 13.96$, $p < .001$, $\eta_p^2 = 0.1$, with participants in the Efficacy group having a higher mean rating than participants in the No Efficacy group $M_{diff} = 2.05$, 95% CI [0.97, 3.15] (Figure 8-15). There was no effect of Threat, $F(2, 126) = 2.45$, $p = .09$, $\eta_p^2 = 0.04$, and no interaction between Threat and Efficacy, $F(2, 126) = 0.24$, $p = .79$, $\eta_p^2 = 0.004$, on response efficacy perceptions (Figure 8-16).

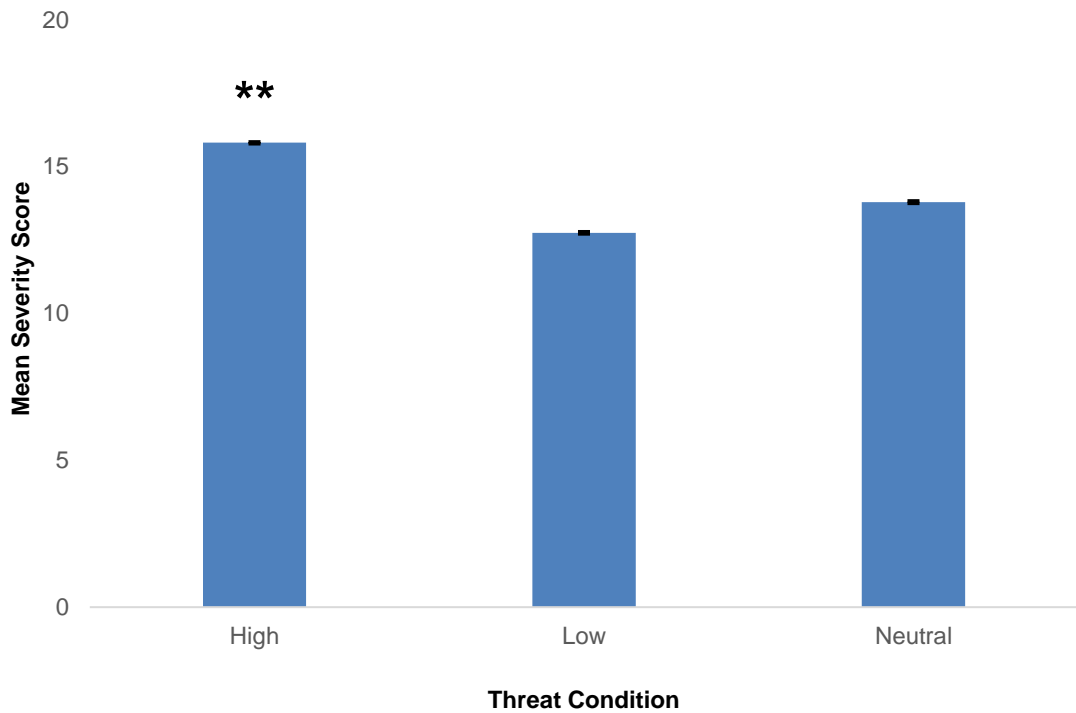


Figure 8-11 Mean threat severity score by Threat condition. Error bars represent lower and upper 95% confidence intervals. ** = difference from Low Threat condition significant, $p < .005$.

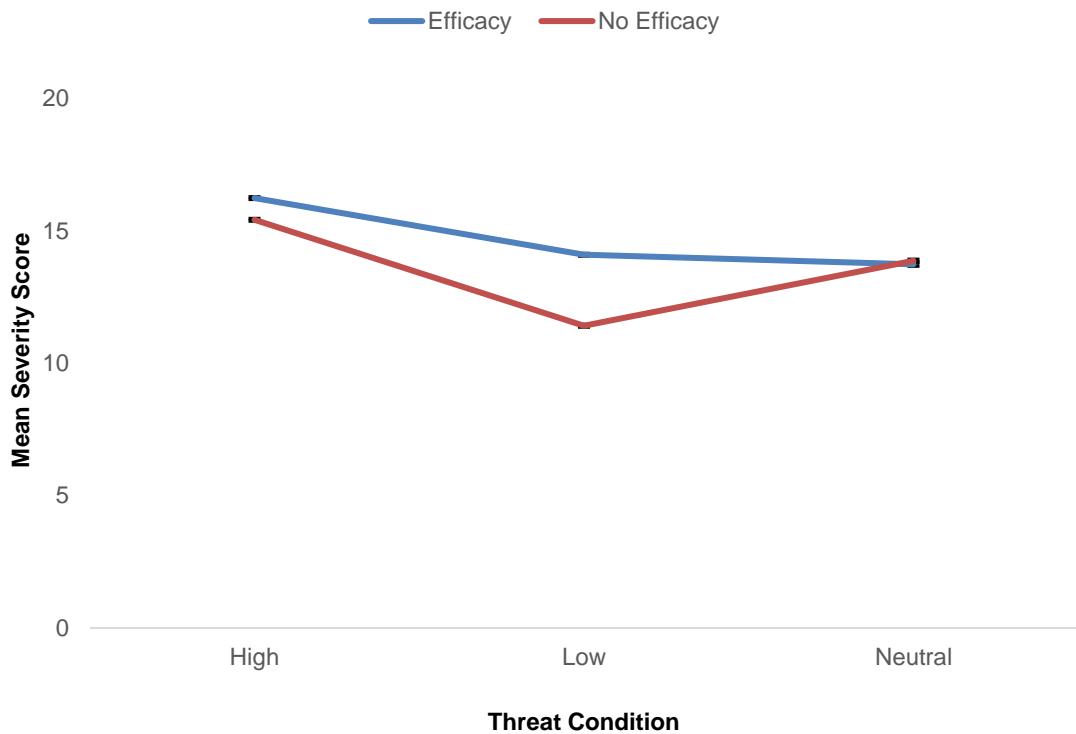


Figure 8-12 Mean threat severity score by Threat and Efficacy condition. Error bars represent lower and upper 95% confidence intervals.

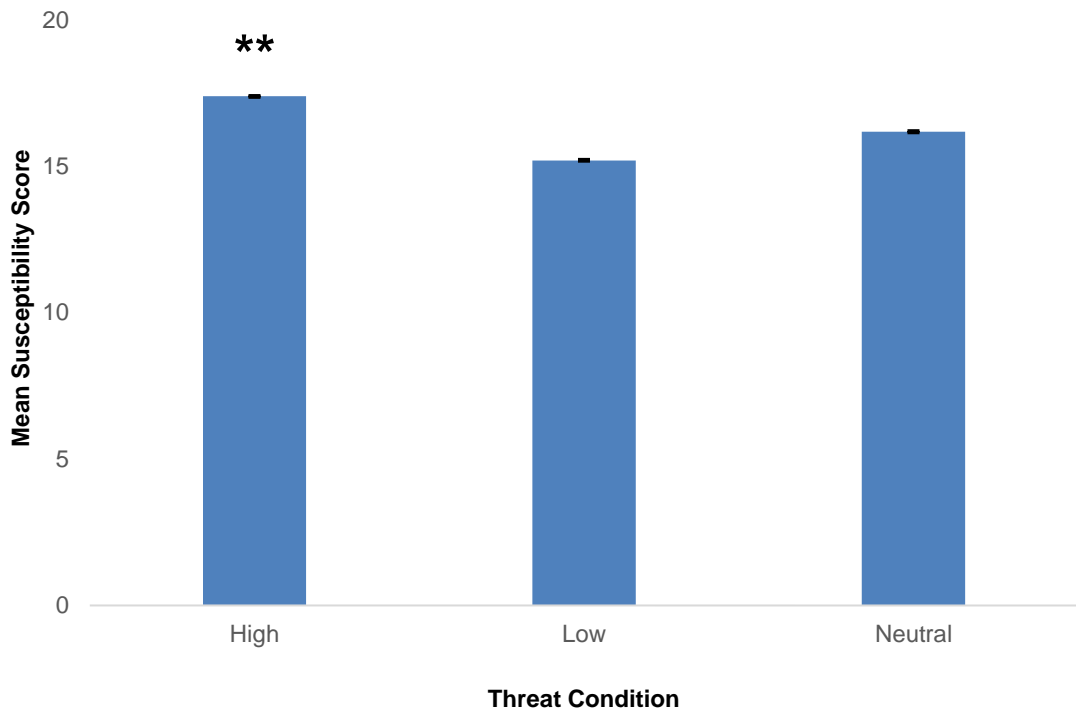


Figure 8-13 Mean threat susceptibility score by Threat condition. Error bars represent lower and upper 95% confidence intervals. ** = difference from Low Threat condition significant, $p < .005$.

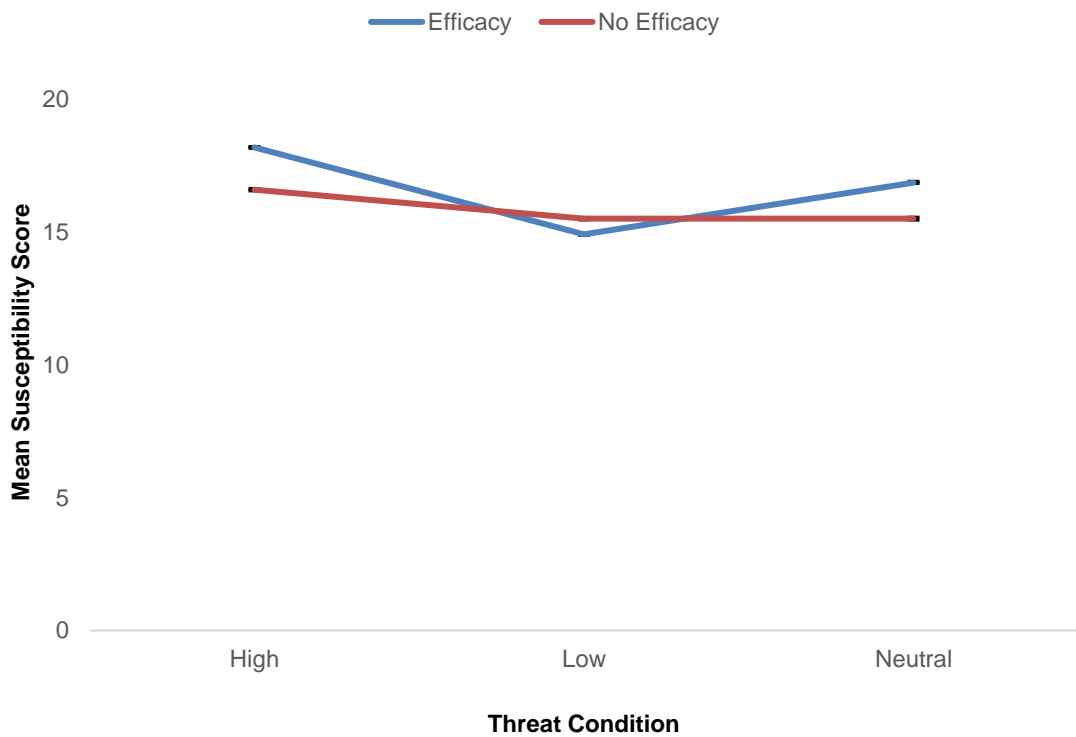


Figure 8-14 Mean threat susceptibility score by Threat and Efficacy condition. Error bars represent lower and upper 95% confidence intervals.

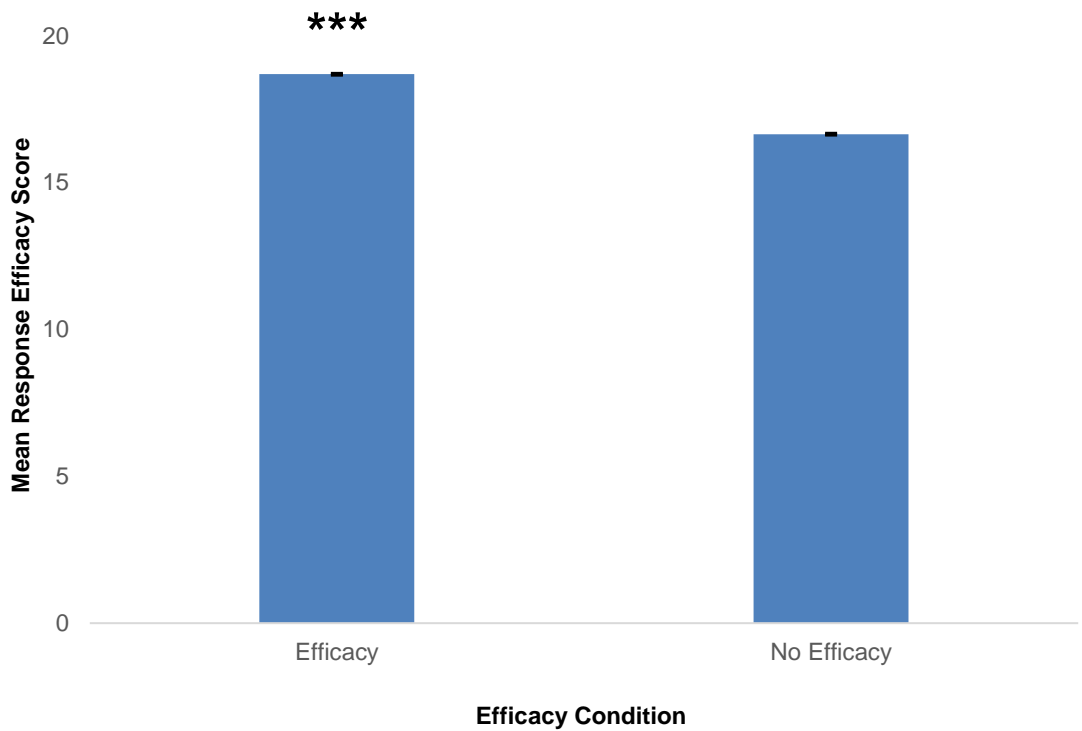


Figure 8-15 Mean response efficacy score by Efficacy condition. Error bars represent lower and upper 95% confidence intervals. *** = difference between means significant, $p < .001$.

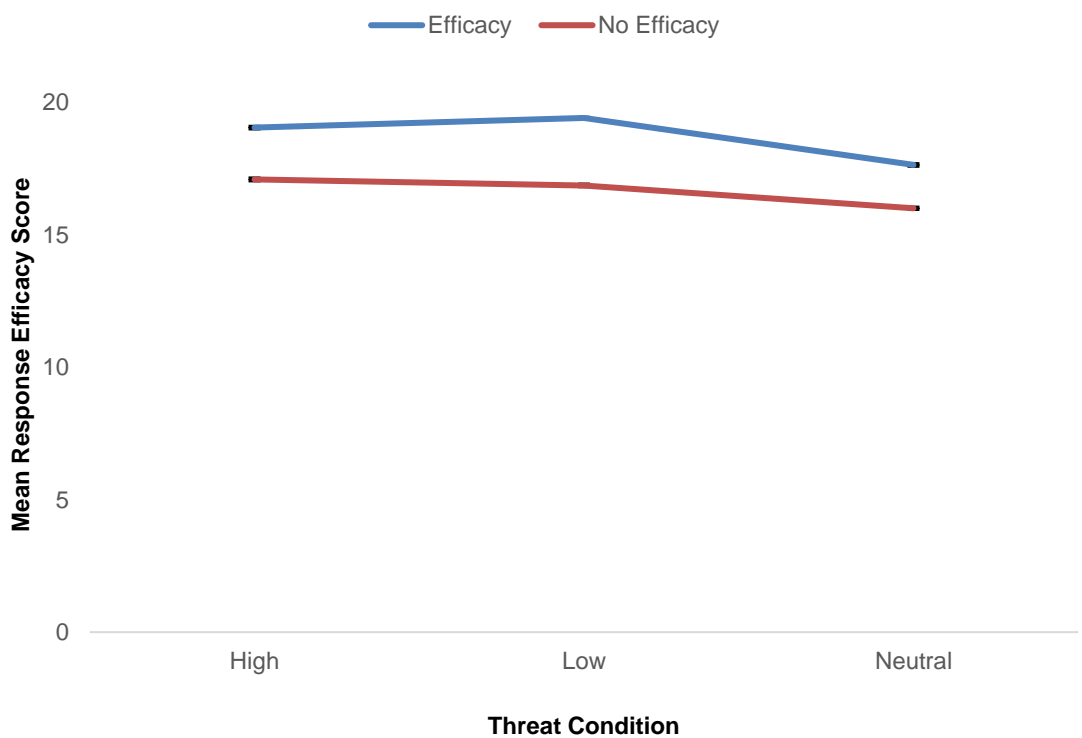


Figure 8-16 Mean response efficacy score by Threat and Efficacy condition. Error bars represent lower and upper 95% confidence intervals.

8.3.2. Primary outcomes

8.3.2.1 Exploratory factor analysis

The first iteration of EFA indicated cross-loading of variables between two of the five factors in the structure matrix. For example, the item, "I would want to leave the area without following any of the police officer's instructions" loaded .661 on to Factor 1 and -.661 on to factor 5. Given the thematic similarity between these two factors (factor 1 appearing to represent going to hospital and factor 5 indicating leaving the area), I repeated the EFA but limited extraction to four factors rather than base the number of factors on Kaiser's criterion. The resulting EFA indicated that variables that had previously loaded on either "leaving the area" and "going to hospital" factors now loaded on one factor.

The Kaiser-Meyer-Olkin measure verified sampling adequacy, $KMO = .79$, and Bartlett's test of sphericity, $\chi^2 (153) = 1647.65$, $p < .001$, indicated significantly large correlations between items. The factor correlation matrix indicated strong correlations between factors, e.g. .49, ruling out the use of orthogonal rotation. The four factors accounted for 67.01% of variance.

Based on the items that loaded at or above .512 on each factor, Factor 1 appeared to represent *leaving the treatment area* (including going straight to the nearest hospital) without following instructions at the scene, Factor 2 *seeking further information* before taking any action, Factor 3 adhering to the *dry decontamination* protocol, and Factor 4 adhering to the *disrobing* protocol. All factors and constituent variables are displayed in Table 8-3.

Table 8-3 Factor loadings and communalities based on unweighted least squares extraction with promax rotation for 18 items used to measure behavioural expectation in a simulated chemical incident.

Variables	Factor 1: Leaving the treatment area		Factor 2: Seeking further information		Factor 3: Dry Decontamination		Factor 4: Disrobing		Communality	
	Pattern	Structure	Pattern	Structure	Pattern	Structure	Pattern	Structure	Initial	Extraction
<i>I would try to go straight to the nearest hospital without following any of the police officer's instructions</i>	.871	.851	.116	.344	.039	-.207	.162	-.120	.859	.754
<i>I would go straight to the nearest hospital without following any of the police officer's instructions</i>	.844	.815	-.187	.371	-.057	-.199	-.012	-.151	.843	.692
<i>I would try to leave the area without following any of the police officer's instructions</i>	.818	.802	.148	.124	.057	-.308	.119	-.211	.741	.674
<i>I would leave the area without following any of the police officer's instructions</i>	.757	.743	-.260	.083	-.100	-.368	-.143	-.308	.738	.621
<i>I would want to leave the area without following any of the police officer's instructions</i>	.700	.706	-.044	.227	-.003	-.265	-.068	-.257	.603	.502
<i>I would want to go straight to the nearest hospital without following any of the police officer's instructions</i>	.533	.588	.246	.426	.154	-.122	-.077	-.256	.550	.419
<i>I would want to remain where I am until the shower arrives</i>	-.408	-.485	-.047	-.360	.019	.341	.123	.322	.485	.308
<i>I would remain where I am until the shower arrives</i>	-.353	-.466	-.173	-.242	.142	.228	.081	.269	.352	.239
<i>I would try to seek further information before taking any action</i>	.024	.353	.911	.932	-.021	-.249	-.020	-.401	.803	.871
<i>I would seek further information before taking any action</i>	-.030	.296	.828	.830	.020	-.279	.019	-.399	.764	.699
<i>I would want to seek further information before taking any action</i>	-.022	.245	.800	.805	-.079	-.152	-.047	-.293	.601	.651
<i>I would brush my skin with the tissue paper</i>	.064	-.278	-.027	-.225	.993	.967	-.022	.453	.834	.938

Variables	Factor 1: Leaving the treatment area		Factor 2: Seeking further information		Factor 3: Dry Decontamination		Factor 4: Disrobing		Communality	
	Pattern	Structure	Pattern	Structure	Pattern	Structure	Pattern	Structure	Initial	Extraction
<i>I would try to brush my skin with the tissue paper</i>	.019	-.285	.040	-.179	.878	.890	.056	.462	.817	.796
<i>I would want to brush my skin with the tissue paper</i>	-.109	-.371	-.099	-.281	.704	.743	-.045	.369	.649	.575
<i>I would remove my clothing, down to my underwear</i>	.012	-.256	.011	-.382	-.109	.399	1.059	.998	.816	.999
<i>I would try to remove my clothing, down to my underwear</i>	-.008	-.282	-.019	-.359	.117	.502	.779	.845	.806	.726
<i>I would want to remove my clothing, down to my underwear</i>	-.024	-.250	-.244	.443	.012	.305	.471	.581	.509	.392
<i>I would try to remain where I am until the shower arrives</i>	-.099	-.154	.060	-.063	.065	.174	.185	.221	.138	.063

8.3.2.2 Primary outcome analysis

As indicated in Table 8-4, Likert item scores for the total sample were generally high for adherence to remaining in place, disrobing, and dry decontamination protocols and were generally high for seeking further information. Scores were generally low for leaving the area and going straight to the nearest hospital.

ANOVA revealed no significant effect of Threat, $F(2, 126) = 0.76, p = .47, \eta_p^2 = 0.01$, Efficacy, $F(1, 126) = 0.02, p = .90, \eta_p^2 = 0$, or interaction between Threat and Efficacy, $F(2, 126) = 0.75, p = .48, \eta_p^2 = 0.01$, on factor scores for leaving the treatment area without following instructions at the scene (Figure 8-17).

There was no significant effect of Threat, $F(2, 126) = 1.81, p = .17, \eta_p^2 = 0.03$, Efficacy, $F(1, 126) = 2.16, p = .14, \eta_p^2 = .02$, or interaction between Threat and Efficacy, $F(2, 126) = 0.04, p = .96, \eta_p^2 = 0$, on factor scores for seeking further information before taking any action (Figure 8-18).

There was a significant effect of Efficacy, $F(1, 126) = 6.17, p < .05, \eta_p^2 = 0.05$, on dry decontamination factor scores, with participants in the Efficacy group indicating greater likelihood of engaging in dry decontamination than participants in the No Efficacy group, $M_{diff} = 0.42, 95\% \text{ CI } [0.09, 0.74]$ (Figure 8-19). Threat had no effect, $F(2, 126) = 0.43, p = .65, \eta_p^2 = 0.01$, and there was no interaction between Threat and Efficacy, $F(2, 126) = 0.17, p = .84, \eta_p^2 = 0$, on dry decontamination scores (Figure 8-20).

There was a significant effect of Threat, $F(2, 126) = 3.90, p < .05, \eta_p^2 = 0.06$, on disrobing factor scores with participants in the High threat group indicating greater

likelihood of removing clothing down to their underwear than participants in the Neutral threat group, $M_{diff} = 0.54$, 95% CI [0.15, 0.93], $p < .05$ (Figure 8-21). There was no difference in mean scores between the High and Low groups, $M_{diff} = 0.48$, 95% CI [0.08, 0.88], $p = .08$, or between the Low and Neutral groups, $M_{diff} = 0.06$, 95% CI [-0.41, 0.51], $p = 1$. Efficacy had no effect, $F(1, 126) = 1.60$, $p = .21$, $\eta_p^2 = 0.01$, and there was no interaction between Threat and Efficacy, $F(2, 126) = 0.42$, $p = .66$, $\eta_p^2 = 0.01$, on disrobing scores (Figure 8-22).

Table 8-4 Median and IQR (interquartile range) for each behavioural expectation Likert item (response options range from 1 [strongly disagree] to 7 [strongly agree]) in the total sample ($N = 132$).

Behavioural expectation Likert item	Median	IQR
<i>I would remain where I am until the shower arrives</i>	7	1
<i>I would try to remain where I am until the shower arrives</i>	7	1
<i>I would want to remain where I am until the shower arrive</i>	7	2
<i>I would remove my clothing, down to my underwear</i>	6	2
<i>I would try to remove my clothing, down to my underwear</i>	6	2
<i>I would want to remove my clothing, down to my underwear</i>	4	4
<i>I would brush my skin with the tissue paper</i>	7	1
<i>I would try to brush my skin with the tissue paper</i>	7	1
<i>I would want to brush my skin with the tissue paper</i>	7	2
<i>I would go straight to the nearest hospital without following any of the police officer's instructions</i>	1	1
<i>I would try to go straight to the nearest hospital without following any of the police officer's instructions</i>	1	1
<i>I would want to go straight to the nearest hospital without following any of the police officer's instructions</i>	3	4
<i>I would leave the area without following any of the police officer's instructions</i>	1	1
<i>I would try to leave the area without following any of the police officer's instructions</i>	1	1
<i>I would want to leave the area without following any of the police officer's instructions</i>	2	3
<i>I would seek further information before taking any action</i>	5	3
<i>I would try to seek further information before taking any action</i>	6	3
<i>I would want to seek further information before taking any action</i>	6	2

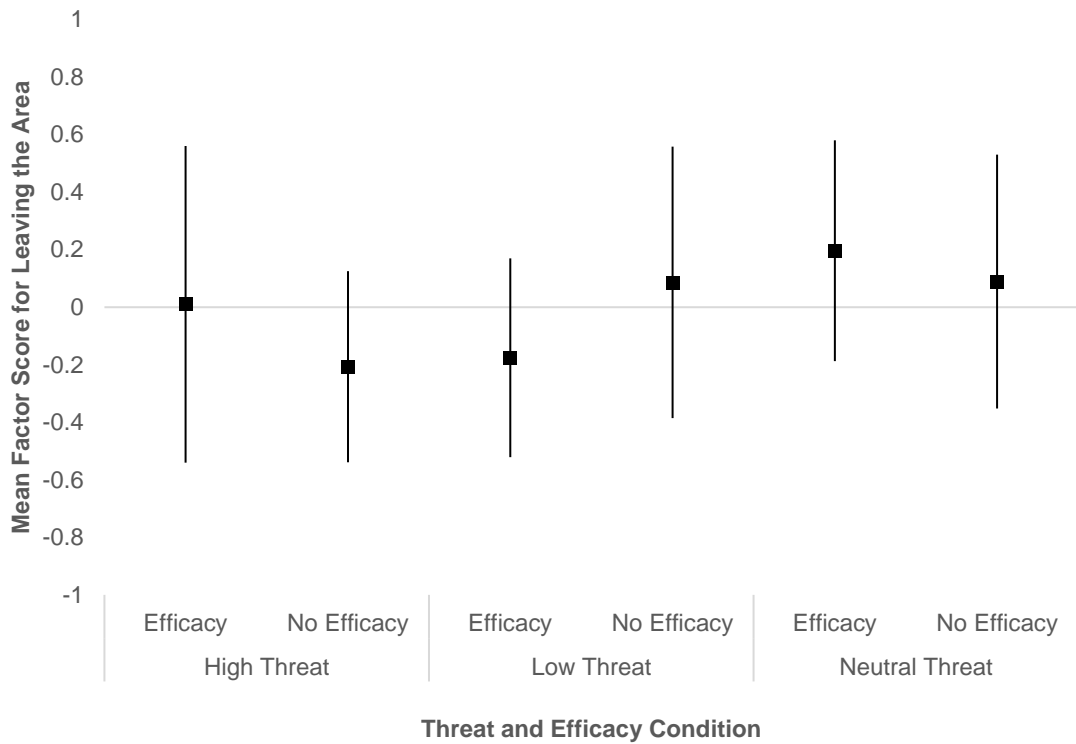


Figure 8-17 Mean factor score for leaving the treatment area without following the police officer's instructions by Threat and Efficacy condition. Error bars represent lower and upper 95% confidence intervals. Higher scores indicate higher perceived likelihood of engaging in the behaviour.

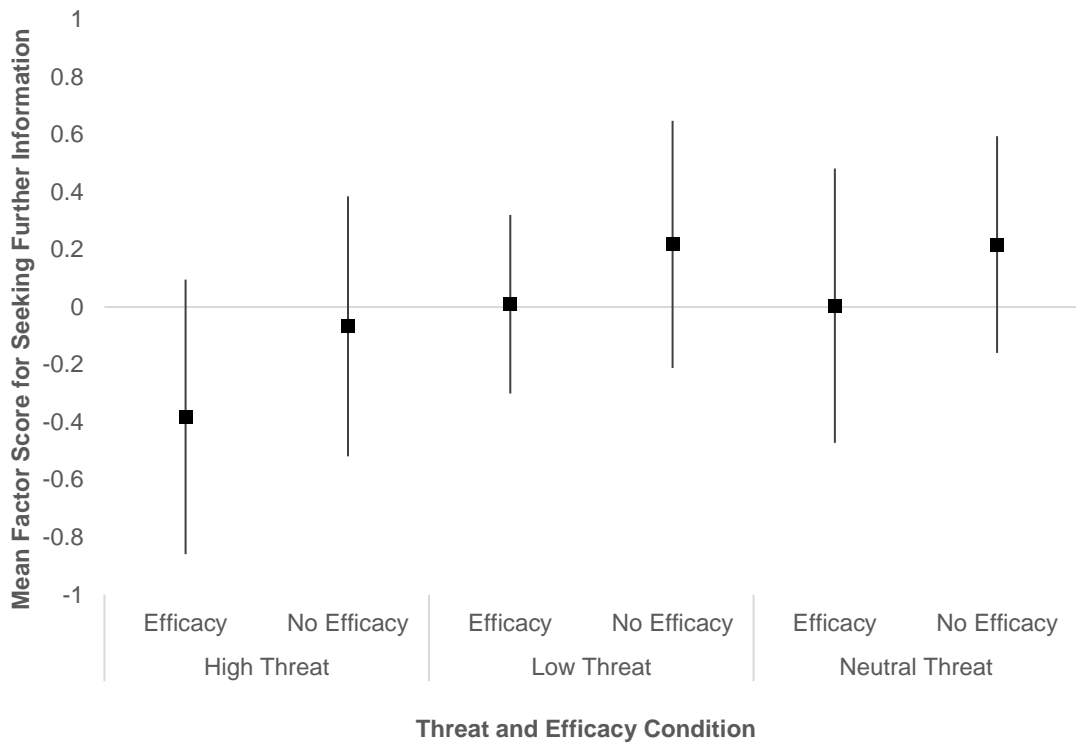


Figure 8-18 Mean factor score for seeking further information by Threat and Efficacy condition. Error bars represent lower and upper 95% confidence intervals. Higher scores indicate higher perceived likelihood of engaging in the behaviour.

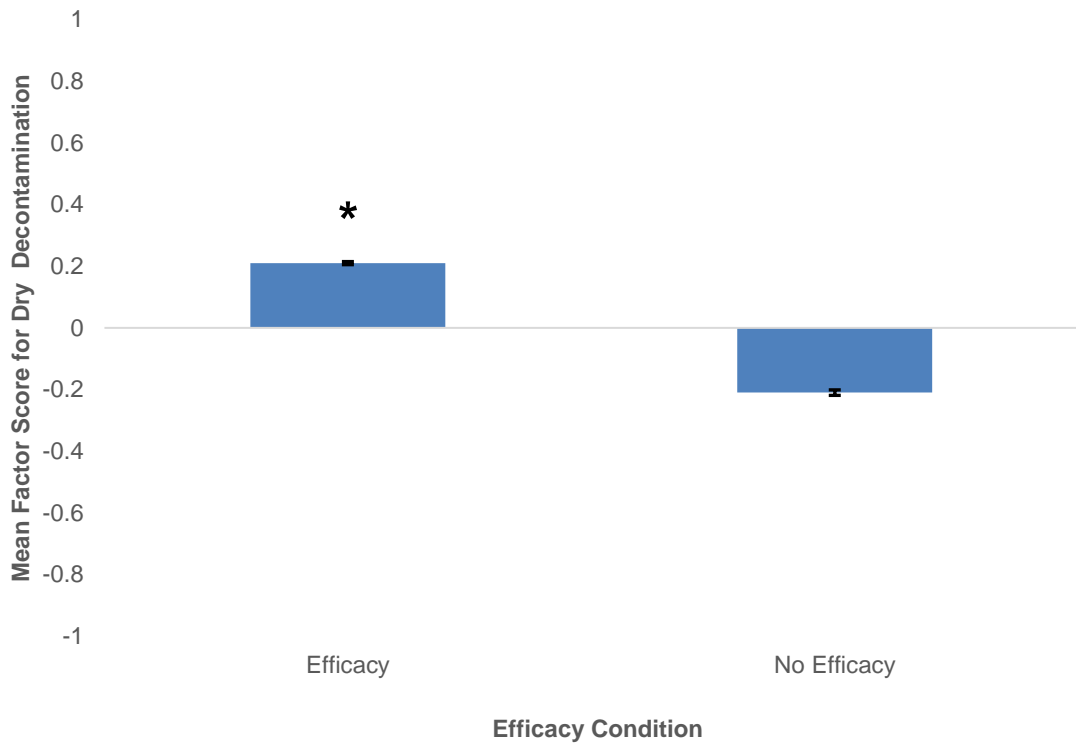


Figure 8-19 Mean factor score for dry decontamination by Efficacy condition. Error bars represent lower and upper 95% confidence intervals. * = difference between means significant, $p < .05$. Higher scores indicate higher perceived likelihood of engaging in the behaviour.

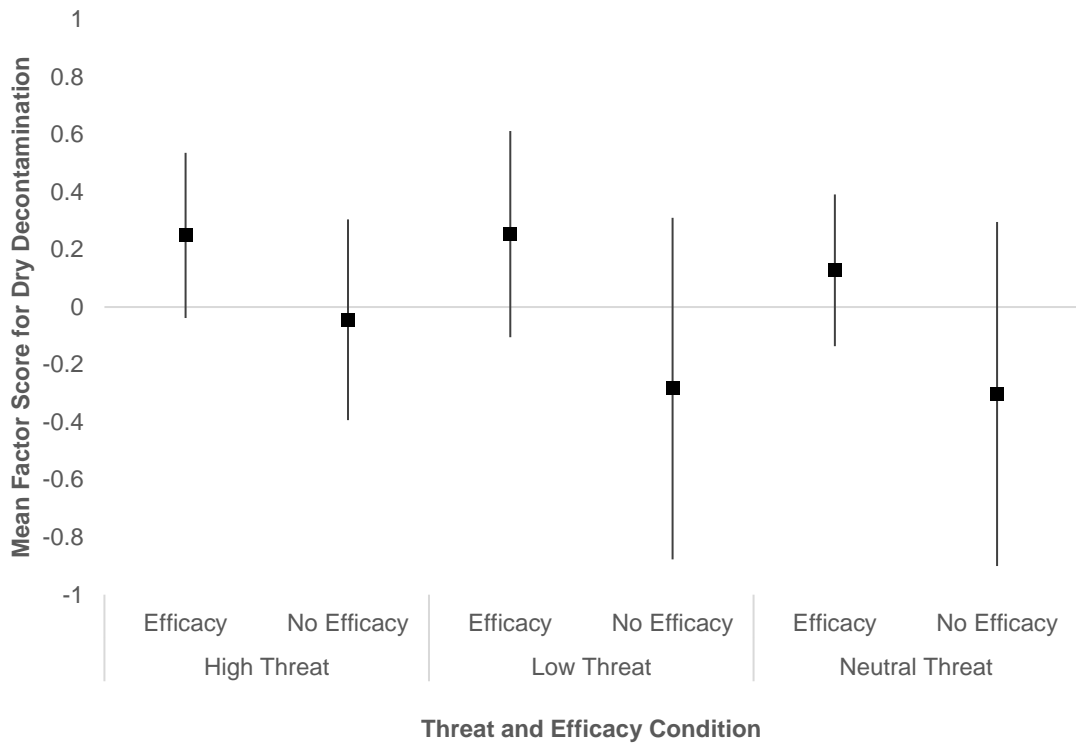


Figure 8-20 Mean factor score for dry decontamination by Threat and Efficacy condition. Error bars represent lower and upper 95% confidence intervals. Higher scores indicate higher perceived likelihood of engaging in the behaviour.

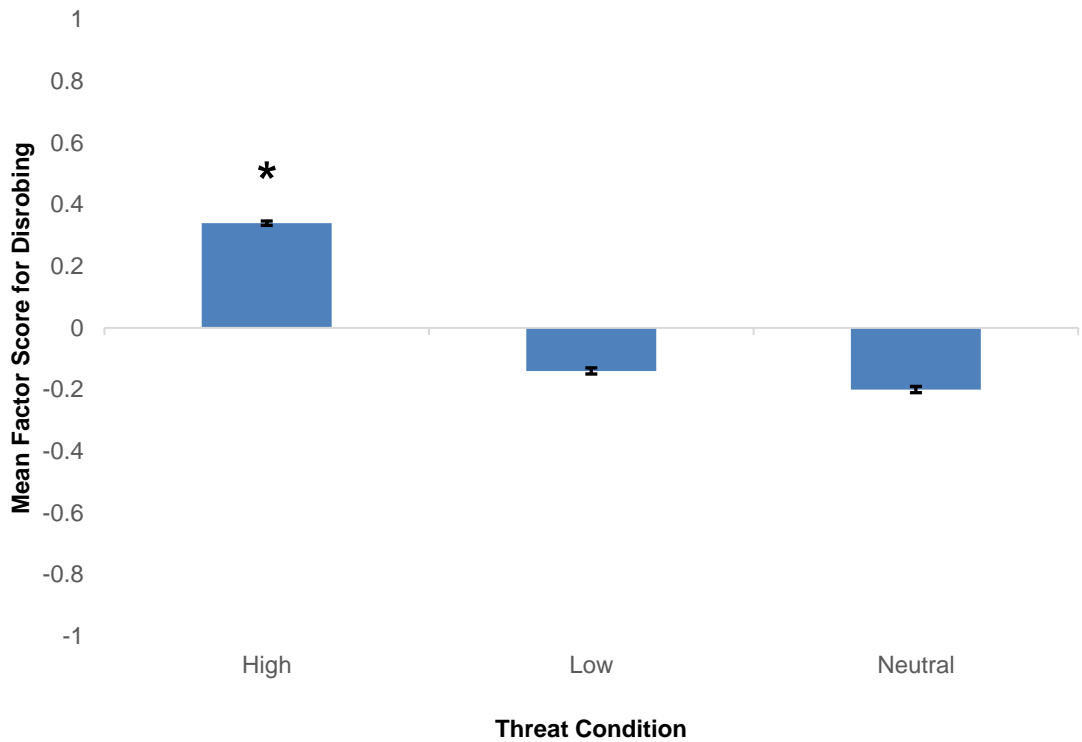


Figure 8-21 Mean factor score for disrobing by Threat condition. Error bars represent lower and upper 95% confidence intervals. * = difference from Neutral Threat condition significant, $p < .05$. Higher scores indicate higher perceived likelihood of engaging in the behaviour.

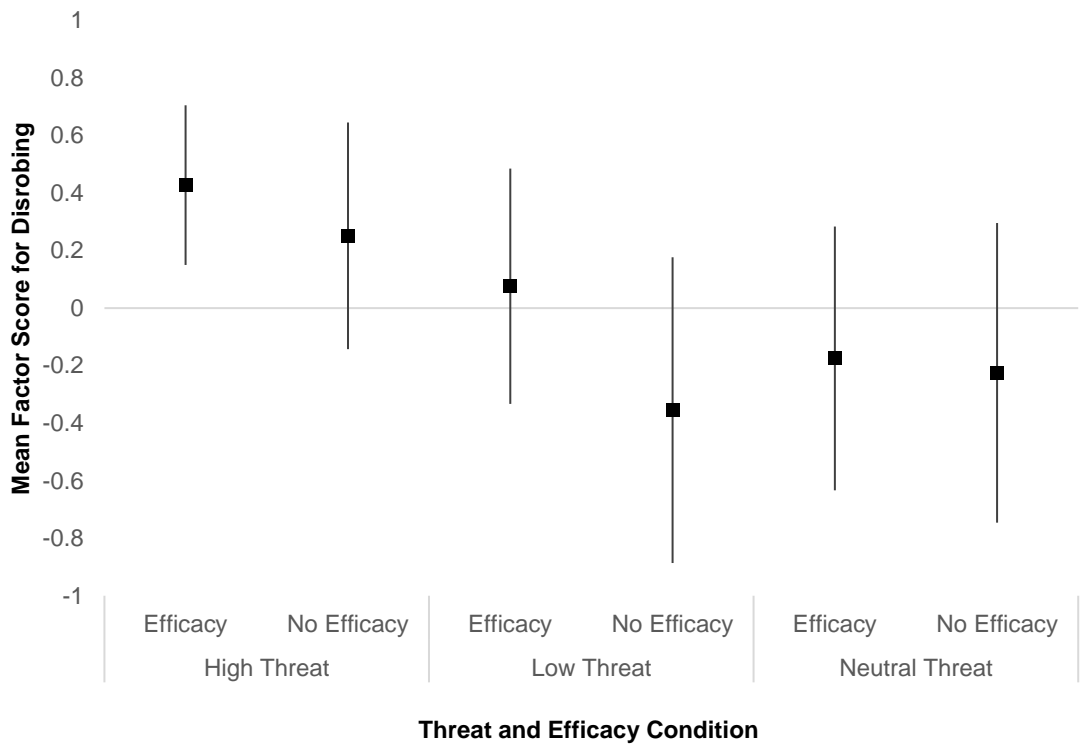


Figure 8-22 Mean factor score for expecting to disrobe by Threat and Efficacy condition. Error bars represent lower and upper 95% confidence intervals. Higher scores indicate higher perceived likelihood of engaging in the behaviour.

8.3.3. Secondary outcome analysis

As displayed in Table 8-5, all secondary outcome scales showed good internal reliability.

There was no effect of Threat, $F(2, 126) = 3.07, p = .05, \eta_p^2 = 0.05$, Efficacy, $F(1, 126) = 0.79, p = .38, \eta_p^2 = 0.01$, or interaction between Threat and Efficacy, $F(2, 126) = 0.87, p = .42, \eta_p^2 = 0.01$, on anxiety (Figure 8-23).

There was no effect of Threat, $F(2, 126) = 0.33, p = .72, \eta_p^2 = 0.01$, Efficacy, $F(1, 126) = 3.26, p = .07, \eta_p^2 = 0.03$, and no interaction between Threat and Efficacy, $F(2, 126) = 0.64, p = .53, \eta_p^2 = 0.041$ on trust perceptions (Figure 8-24).

There was no effect of Threat on perceived response costs, $F(2, 126) = 1.19, p = .31, \eta_p^2 = 0.02$ or self-efficacy, $F(2, 126) = 1.16, p = .32, \eta_p^2 = 0.02$. Efficacy had no effect on either response costs, $F(1, 126) = 0.11, p = .74, \eta_p^2 = 0.001$, or self-efficacy, $F(1, 126) = 0.46, p = .50, \eta_p^2 = 0.004$, and there was no interaction between Threat and Efficacy for either response costs, $F(2, 126) = 0.54, p = .58, \eta_p^2 = 0.01$ (Figure 8-25), or self-efficacy, $F(2, 126) = 0.54, p = .59, \eta_p^2 = 0.01$ (Figure 8-26).

Stepwise multiple linear regressions were calculated to predict participants' expectations of engaging in each behavioural outcome derived from exploratory factor analysis based on their trust, anxiety, threat severity, threat susceptibility, response efficacy, self-efficacy, and response costs perceptions.

For the behaviour of leaving the treatment area, a significant regression equation was found, $F(3,128) = 9.95, p < .001$, with an adjusted R^2 of .17. Perceived response efficacy, $\beta = -.30, 95\% \text{ CI } [-0.14, -0.03], p < .005$, and perceived trust, $\beta = -.19, 95\% \text{ CI } [-0.10, -0.001], p < .05$, were negative predictors whilst perceived threat severity was a positive predictor, $\beta = .22, 95\% \text{ CI } [0.01, 0.09], p < .01$, of leaving the area.

For the behaviour of seeking further information before taking any action, a significant regression equation was found, $F(2,129) = 15.99, p < .001$, with an adjusted R^2 of .19. Perceived response efficacy was a negative predictor, $\beta = -.40, 95\% \text{ CI } [-0.16, -0.07], p < .001$, whilst perceived response costs associated with disrobing was a positive predictor, $\beta = .17, 95\% \text{ CI } [0.003, 0.08], p < .05$, of seeking further information before taking any action.

For the behaviour of undergoing dry decontamination, a significant regression equation was found, $F(1,130) = 24.46, p < .001$, with an adjusted R^2 of .15. Response efficacy was a positive predictor, $\beta = .40, 95\% \text{ CI } [0.07, 0.17], p < .001$, of undergoing dry decontamination.

For the behaviour of disrobing, a significant regression equation was found, $F(4,127) = 40.65, p < .001$, with an adjusted R^2 of .55. Perceived response costs associated with

disrobing was a negative predictor, $\beta = -.46$, 95% CI [-0.14, 0.08], $p < .001$, whilst perceived self-efficacy, $\beta = .38$, 95% CI [0.07, 0.14], $p < .001$, trust in the officer, $\beta = .23$, 95% CI [0.03, 0.09], $p < .001$, and anxiety, $\beta = .22$, 95% CI [0.03, 0.11], $p < .001$, were all positive predictors of removing clothing down to the underwear.

Kruskal-Wallis H test indicated no significant difference between threat conditions on emotional engagement with the video, $H = 0.46$, $p = .8$, or perceived realism of the depicted chemical incident, $H = 1.18$, $p = .55$. Mann-Whitney U test indicated no significant effect of efficacy information on emotional engagement, $U = 2116.5$, $p = .77$, or perceived realism, $U = 2103$, $p = .73$. There was also no effect of threat and efficacy combination on emotional engagement, $H = 0.64$, $p = .99$, or perceived realism, $H = 2.86$, $p = .72$. Both the median and mode response for the total sample was 6 (agree) and 5 (somewhat agree) for emotional engagement and perceived realism respectively.

Table 8-5 Number of items, Cronbach's alpha, and sample mean, standard deviation and range for each secondary outcome scale ($N = 132$).

Secondary outcome measure	Number of items	Reliability	Possible range	Actual Range	Mean	Standard Deviation
Anxiety	6	$\alpha = .83$	6-24	10-24	20.24	3.18
Threat Susceptibility	3	$\alpha = .74$	3-21	6-21	16.26	3.13
Threat Severity	3	$\alpha = .95$	3-21	4-21	14.12	4.31
Response Efficacy	3	$\alpha = .81$	3-21	7-21	17.67	3.31
Self-Efficacy	3	$\alpha = .87$	3-21	6-21	17.63	3.72
Response Costs (Disrobing)	2	$r = .89$	2-14	2-14	8.74	4.13
Trust	7	$\alpha = .82$	7-28	9-26	17.93	3.81

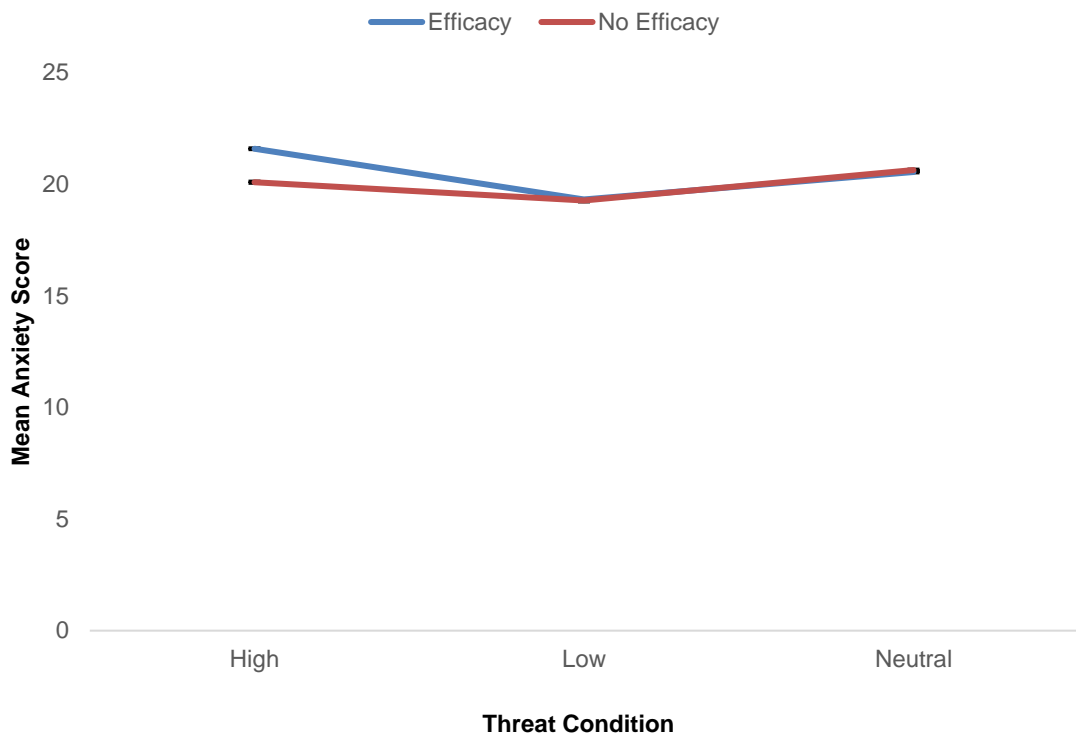


Figure 8-23 Mean anxiety score by Threat and Efficacy condition. Error bars represent lower and upper 95% confidence intervals.

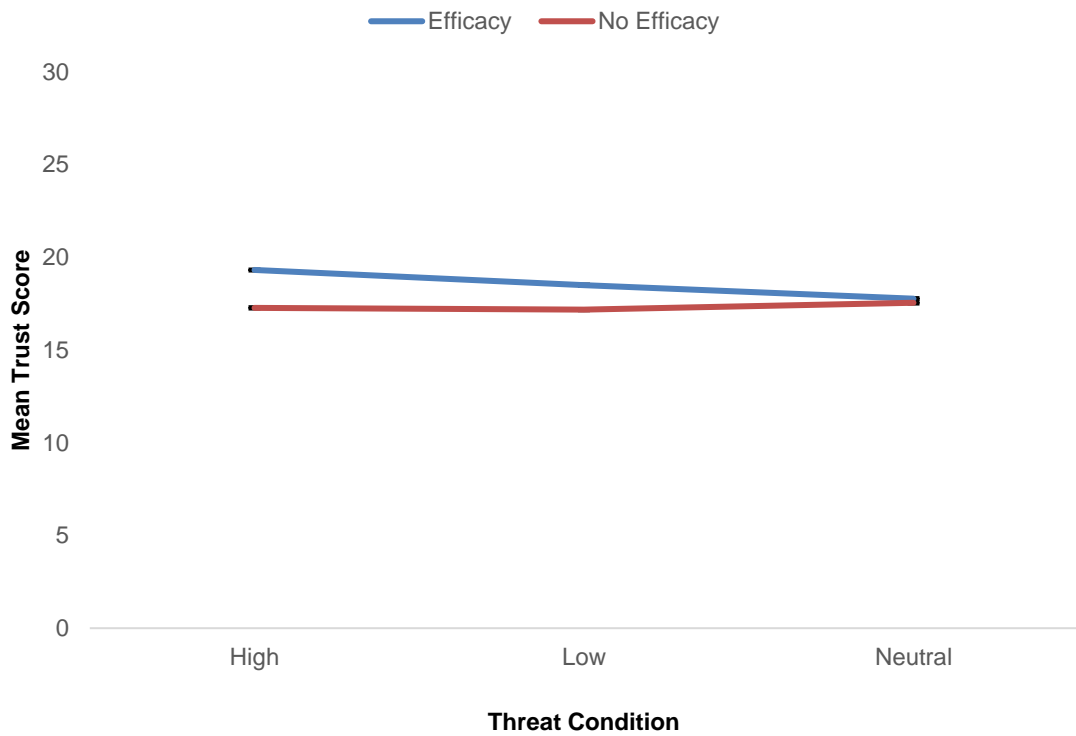


Figure 8-24 Mean trust score by Threat and Efficacy condition. Error bars represent lower and upper 95% confidence intervals.

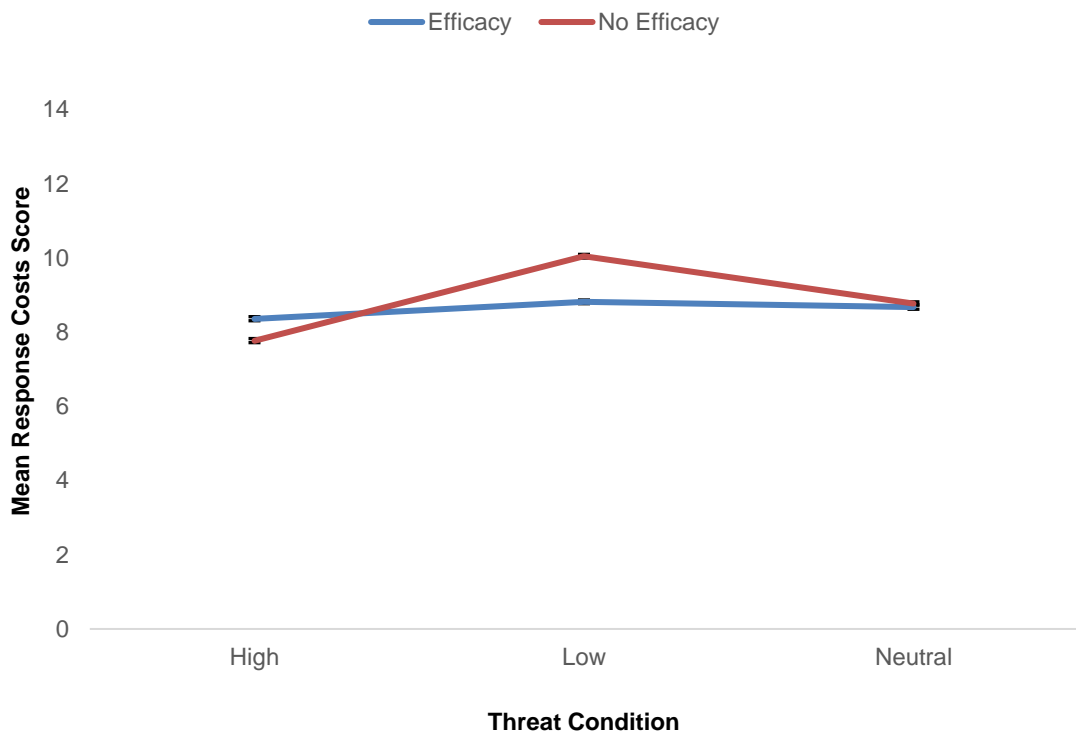


Figure 8-25 Mean score for response costs associated with disrobing by Threat and Efficacy condition. Error bars represent lower and upper 95% confidence intervals.

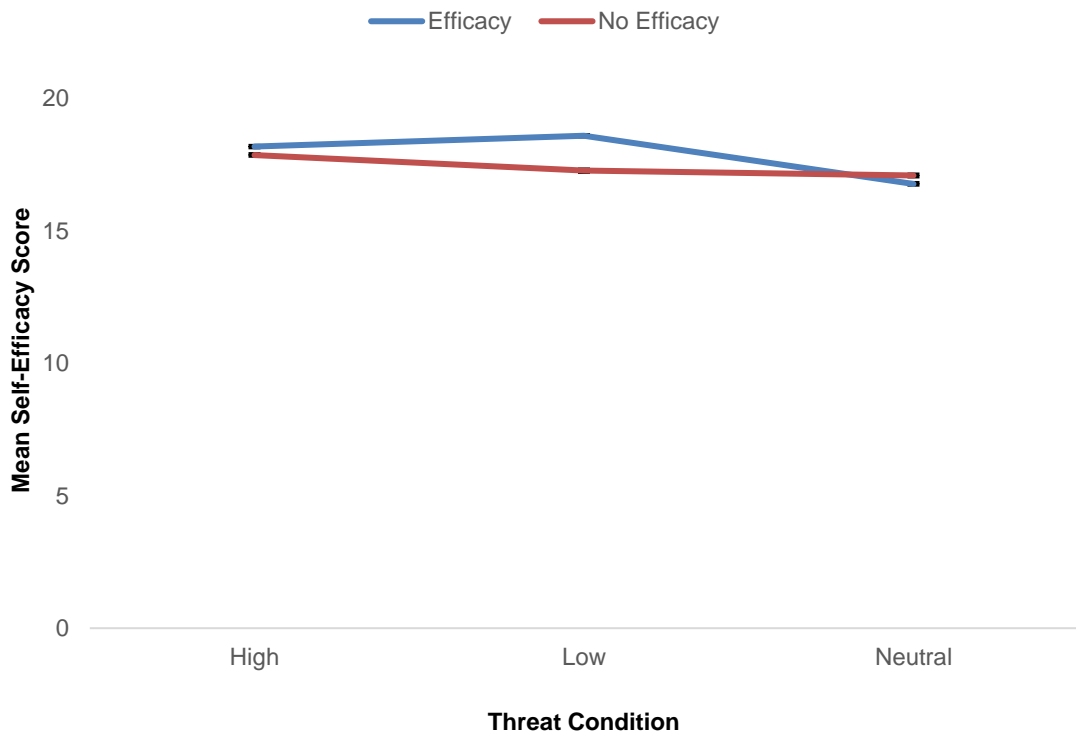


Figure 8-26 Mean self-efficacy score by Threat and Efficacy condition. Error bars represent lower and upper 95% confidence intervals.

8.3.4. False discovery rate to account for multiplicity of analysis

The Benjamini–Hochberg procedure indicated that the largest p value that was equal to or less than its Benjamini-Hochberg critical value was .023 which means that all p values $\leq .023$ are considered significant. All previously reported tests with significance values, $p < .05$, were also $\leq .023$ so the rejection of the null hypotheses for these tests is not considered a Type 1 error given a false discovery rate of 0.15 for multiple comparisons.

8.3.5. Sensitivity analysis

When the cases highlighted by the supervisory team during the protocol deviation review were removed from the dataset, significance values and directions of effects were the same as reported above, with one exception. Threat had a significant effect on anxiety, $F(2, 124) = 3.52$, $p < .05$, $\eta_p^2 = 0.05$, when the two cases were excluded. Post hoc tests indicated that participants in the High threat group had higher anxiety scores than participants in the Low threat group, $M_{diff} = 1.70$, 95% CI [0.29, 3.24], $p < .05$, when the two cases were removed. There were no differences in anxiety scores between the High and Neutral, $M_{diff} = 0.32$, 95% CI [-0.84, 1.46], $p = 1$, and Low and Neutral groups, $M_{diff} = 1.38$, 95% CI [-0.01, 2.76], $p = .13$.

8.4 Discussion

The primary objective of the present study was to assess the effect of information about the threat of contamination and the efficacy of IOR on expected adherence to IOR. A total of 132 participants were immersed in a simulated chemical incident, with no salient signs and symptoms of chemical contamination, and answered questions about their expected adherence and non-adherence behaviours. The communication intervention was delivered by the police officer at the scene of the incident depicted in the video. In line with PMT and the EPPM, I hypothesised that a message in which the severity of chemical contamination and the likelihood of casualties' exposure to the chemical was either addressed or not understated would result in greater adherence expectations, relative to a message in which the threat was understated. I also hypothesised that messages in which the threat was addressed or not understated would have a greater effect when IOR instructions were accompanied by statements about the efficacy of each instruction at reducing the extent of contamination. The results indicated that the effectiveness of threat and efficacy manipulations varied according to type of behaviour under consideration.

Whilst the inclusion of efficacy information had no effect on disrobing expectations, messages in which the severity of contamination and susceptibility of casualties to the contaminant were made salient resulted in higher expectations of disrobing compared

to neutral messages in which the severity and likelihood of exposure to the contaminant were not explicitly addressed. Disrobing expectations were not significantly reduced when the threat of contamination was explicitly underestimated by the communicator, compared to when the threat was explicitly addressed. But messages in which the threat was underestimated did not significantly increase willingness to disrobe, relative to neutral messages, indicating that appraisal of the danger posed by a harmful chemical is likely to be necessary when disrobing is required. It is also possible that this conceptualisation of disrobing as removal of the chemical from skin was made more accessible to participants in the high threat condition as these participants were explicitly informed that the chemical could cause skin burns.

The implication of this finding is that, if signs and symptoms of contamination are non-salient but IOR is still deemed necessary by responders, then responders should be open about the risks posed to casualties and be explicit about why decontamination is required. In contrast, recommendations in guidance documents and example messages used by responders, reported in Chapter 4, demonstrate a perceived need among responders to reassure casualties. The results suggest that this desire to reassure casualties is misplaced on several levels. First, it is ineffective. In the intention-to-treat analysis, anxiety did not decrease when the threat was understated, compared to when the threat was made salient. Second, it may be counterproductive. Although willingness to disrobe did not increase in the low threat condition compared to the neutral condition, anxiety itself was associated with increased willingness to disrobe – attempting to reduce it would therefore be misguided. Third, it may detract from more effective strategies, such as emphasising the nature of the threat that casualties are facing.

This does not necessarily mean that all forms of reassurance should be abandoned. Instead, it may be that reassurance focused exclusively on the actions responders are taking to protect casualties would be more productive. For example, reassurance can be given that treatment will be provided in the form of a decontamination shower, and that IOR actions are effective in reducing the threat. Such forms of reassurance would assist in promoting the efficacy of the suggested IOR behaviours which would in turn improve adherence to the dry decontamination protocol, based on the results of the present study.

Neither response efficacy perceptions nor messages pertaining to response efficacy had any effect on disrobing expectations, but participants in all conditions indicated agreement that disrobing would help to protect them from the chemical. Participants'

perceptions about their self-efficacy at adhering to IOR instructions were associated with increased willingness to disrobe while perceptions about the costs of disrobing, including the embarrassment of removing clothing in public, were associated with decreased willingness to disrobe and increased expectations of seeking further information before taking any action. Self-efficacy and response costs were not addressed in the messaging interventions and, as expected, threat and response efficacy manipulations had no effect on self-efficacy or response cost perceptions. An earlier draft of the messages included the statement, “you will be provided with a gown to wear before you undress to protect your modesty and keep you warm” in the efficacy conditions. This component was designed to address the response costs raised in the interview study reported in Chapter 5, in which interview participants raised cold weather and modesty concerns as potential barriers to clothing removal. In the present study, it was decided that the communicator would not address these concerns because a worst-case scenario was used as the premise for the simulated incident. In this worst-case scenario, disrobe packs containing gowns would not be available. In future studies on the effect of communication on IOR adherence, it would be useful to test the adherence-promoting effectiveness of the statement on gown provision and the effectiveness of statements that address disrobing response costs in a worst-case scenario in which disrobe gowns are unavailable. Statements would need to be pre-tested in advance following the protocol outlined in Chapter 7.

Whilst information about the threat of contamination had no effect on dry decontamination expectations, the inclusion of statements about the efficacy of IOR increased expectations of applying dry material to skin. It is unclear whether it was the specific efficacy statement, “brushing the skin with dry paper is a safe and effective way to remove some of the chemical from your skin before showering” that increased dry decontamination expectations or whether this increase was a result of the combination of response efficacy statements in the efficacy condition that also included information about the efficacy of remaining in place and following instructions. Response efficacy perceptions, which were higher in the efficacy condition, were also associated with increased willingness to perform dry decontamination. Underestimation of the efficacy of applying dry material to skin at reducing the extent of chemical contamination emerged as a lay public misconception in a previous focus group study (Carter, Weston, et al., 2018) and in the interview study reported in Chapter 5. Whilst there was general agreement from participants in all conditions in this study that application of dry material would help protect participants from the chemical, the results indicate that explicitly addressing this misconception about the efficacy of dry decontamination would increase willingness to engage with this particular IOR action.

The results of the interview study reported in Chapter 5 provide a tentative qualitative explanation for the contrast between self-efficacy perceptions affecting engagement in disrobing and response efficacy perceptions affecting engagement in dry decontamination. Interview participants' perceived barriers to undergoing dry decontamination were focused on doubts about the efficacy of the action itself, whereas perceived barriers to disrobing were focused on perceived costs of publicly removing clothing. In the absence of a cross-sectional survey to assess the prevalence of these beliefs it is not possible to state whether this contrast in activation of different coping appraisal components for different behaviours in the same health context truly exists when there is no communication from authorities.

Neither the threat nor the efficacy manipulation had any effect on expectations regarding leaving the treatment area without adhering to IOR or seeking further information before taking any action. Increases in perceptions about the efficacy of IOR were associated with decreases in expectations of engaging in both behaviours. Whilst increased response efficacy perceptions were associated with decreased expectations of leaving the area, increased threat severity perceptions were associated with *increased* expectations. Whilst there was no interaction observed between threat and efficacy information for self-evacuation, the contrasting effects of severity and response efficacy perceptions highlights the importance of explaining the efficacy of IOR to casualties, particularly when the danger posed to casualties is salient, either due to signs and symptoms or due to the messaging administered by responders. If casualties do not think that IOR is effective at reducing the threat, perceived threat severity is likely to motivate people to actions that are considered adaptive based on their mental model of medical emergencies. Seeking treatment in a hospital or evacuating further from the source of a harmful chemical are intuitively adaptive actions, as indicated by the results of the interview study reported in Chapter 5. Based on the results of the present study, casualties need to know that they are in danger to improve the likelihood of adherence to the disrobing procedure but casualties also need to know that IOR itself is an effective countermeasure to reduce the likelihood of self-evacuation.

There was no effect of the experimental manipulation on perceived trust in the communicator. It was hypothesised that understating the threat of contamination whilst instructing casualties to perform IOR would be interpreted as unsubstantiated reassurance which would undermine trust in the responder (Glik, 2007a; Maxwell, 2003; Pearce et al., 2013; Rubin et al., 2012; Sorensen, 2000; World Health Organization, 2017). It was also hypothesised that the components of trust pertaining to the perceived legitimacy of responders would be increased by statements about the efficacy of instructions (Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al.,

2015). Trust itself was one of the perception variables that were associated with increased disrobing expectations and decreased expectations of leaving the treatment area. The lack of difference in trust perceptions between conditions is attributed to statements designed to promote trust, i.e. actions responders are taking and the expertise and competence of responders at managing this type of emergency due to regular training, that were consistent across conditions. In the absence of any comparison group that did not receive such information, it is not possible to state whether excluding these items from a communication intervention would lower trust perceptions. But, based on previous studies on crisis and emergency communication (Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015; Latré et al., 2017), it is likely that inclusion of this information would promote trust.

8.4.1. Limitations and implications for future research

The primary limitation in the study was the hypothetical nature of the threat of contamination and the relatively comfortable setting in which the experiment took place. Whilst participants' ratings of emotional engagement with and perceived realism of the scenario depicted in the video were generally high, messages were still processed in the context of a comfortable environment with no real threat of contamination and no requirement for participants to actually engage in IOR. This may explain the ceiling effect for IOR adherence expectations and floor effect for self-evacuation expectations. Whilst the use of a virtual environment is an immersive and cost-effective way of exploring these research questions, a further study is warranted to test the effectiveness of threat and efficacy messaging in the context of a field experiment in which participants are actually required to undergo IOR rather than simply indicate willingness to undergo IOR in a series of Likert items.

One of the recruitment channels inadvertently employed in the convenience sampling process was word-of-mouth promotion of the study by participants. I asked each participant not to share details about the study until the cautiously estimated date of data collection completion in order to reduce the risk of participant crosstalk, whereby participants share details about the study with future participants (Nichols & Edlund, 2015). I also used a self-report measure to find out if crosstalk had occurred and the results for this measure indicated zero cross-talk. But in the absence of an observed measure of crosstalk, such as having a confederate ask the participant for specific details about the study (Walsh & Stillman, 1974), it is not possible to rule out the possibility that a proportion of participants were aware of the instructions that would be issued during the scenario and based their behavioural expectations on pre-experiment premeditation and not on the scenario itself.

The framing of information in control conditions was problematic. In an earlier draft of the design, the control condition consisted of no information or of information unrelated to the incident. But there was a concern that behavioural expectation outcome measures would be inappropriate in the absence of any relevant information. In this type of control condition, participants would essentially be answering questions about the likelihood of removing clothing down to their underwear following evacuation from a lecture theatre in the absence of any instruction. I was also mindful of the need to keep the amount of information consistent across conditions in case effects attributed to threat or efficacy were in fact a result of the act of providing more information rather than of the content of that information. This is why control condition messages included additional information designed not to affect threat or efficacy perceptions and piloted to ensure they did not. The control condition in this study consisted of a baseline messaging intervention, comprising instructions for casualties and statements about who the responders are and what actions they are taking plus the additional information. The baseline approach was based on outcomes of the literature reviews reported in Chapters 2 and 3 and on the apparent standard practice of communicating instructions to casualties reported in Chapter 4. The methodological approach used in this experiment could be applied to a parallel design to compare a message consisting of instructions plus trust statements against a message consisting of just instructions to check whether the trust statements themselves have any additional effect on IOR adherence.

Participants were informed in advance of the study, via the information sheet, that they would be participating in a study on the effect of communication on behaviour during an emergency. The fact that participants were anticipating that the study would be about an emergency situation may have primed them to expect severe information, which may have impacted on perceived severity. In a subsequent study, it may be necessary to employ deception and not allude to the actual content of the video. In a previous study in which an immersive virtual environment was used to test compliance with emergency exit signage, participants were not informed about the true nature of the research and were instead told that the study was an evaluation of immersive virtual environment technology (Duarte et al., 2014, p. 1371). A similar approach could be used in a modification of the present experiment.

The minimum message duration in this study was two minutes and 45 seconds. The reason for the long duration was due to the constraints of the study. In a real incident, the information would be staggered over the course of the full IOR procedure. This means that information about disrobing would be provided whilst casualties are required to disrobe and information about dry decontamination would be provided

following the disrobing procedure. In the present study it was not possible to stagger information in this way. The IVET did not allow for measures to be recorded during the scenario so all of the information had to be presented in one block. In future studies, outcome measures could be recorded during the presentation of the scenario using a handheld device and measures programmed into the video. An alternative approach to measure self-report during a sequence of staggered instructions could be for participants to record their behavioural expectations via a verbal protocol. As used in previous studies of emergency behaviour in hypothetical scenarios (Lawson, 2011; Rickard, Schuldt, Eosco, Scherer, & Daziano, 2017), participants would be prompted to say what they would do at different stages of the intervention. Responses would then be coded as completely compliant, partially compliant or not at all compliant. The coding scheme would need to be pilot tested using the IVET used in the present study. There would be a requirement for two other researchers to code a subsample of talk-aloud scripts. Analysis would consist of a two-way chi-square test of coded compliance outcome.

In the present study, all instructions had to be presented in the future tense rather than as a sequence of imperatives, e.g. "We will ask you to carefully remove as much clothing as you can ..." rather than "carefully remove as much clothing as you can...". The reason for this was that if instructions were presented as a sequence of immediate imperatives, the depiction of the behaviour of casualties in the video would have a confounding effect on behavioural expectation. If casualties are depicted following instructions, this would likely constitute supportive feedback, whereas if they were depicted not following instructions, this would likely constitute opposing feedback. Given the role of social cues (observations of other people's behaviour) in decision-making during environmental hazards and disasters, as predicted by the Protective Action Decision Model (Lindell & Perry, 2012), supporting and opposing feedback are likely to be conducive to ceiling and floor effects respectively. In a previous study on expected behaviour in a crisis involving the release of a hazardous chemical (Verroen et al., 2013), there was a significant interaction between efficacy and peer feedback. In the low efficacy condition, the difference between opposing and supporting peer feedback was significant. In the high efficacy condition, participants did not respond to differences in peer feedback on the intention to engage in self-protective behaviour. Peer feedback was manipulated through the wording of social media messages. If the messages in the present study were to be reframed as a sequence of imperatives rather than a single notification about upcoming instructions then the role of peer feedback would need to be addressed. There are two approaches to this. The first is to test the messages on groups of participants in a cluster randomised controlled trial. If

participants follow instructions due to other participants following instructions then the normative influence of other participants would be measured as a moderating outcome. The second approach is to use a two-way design, akin to the approach used by Verroen et al. (2013), with message as one variable and peer feedback as the other variable. Half of the sample would watch a video in which other “casualties” are depicted following each instruction whilst the other half of the sample would see other “casualties” refusing to follow instructions or even engaging in alternative courses of action, such as leaving the scene.

Further investigation is required to reduce the duration of the message delivered to casualties whilst retaining the effects observed in the present study to increase communication efficiency. For example, it was not possible to isolate the specific effects of severity and susceptibility components as both of these were concurrently manipulated. It was also not possible to separate specific components of threat severity. In the high threat condition, participants were informed about the severity of contamination for themselves (skin burns) and for others (exposing other people to the chemical). In total, threat consisted of three separate items of information. Separating all these components would have increased the number of comparisons, increasing the risk of Type 1 errors. But it is unclear whether *all* of this information was necessary to improve disrobing willingness. It would be useful to repeat the experiment and only manipulate the threat components of the message, with efficacy information in all conditions and a control group receiving the neutral threat message. If it transpires that only one of these items of threat information has the effect then it allows for more specific guidance for responders on what to say to sufficiently increase threat perceptions. A similar modification to the experiment could be conducted with the efficacy information.

An additional approach to reducing the duration of the message that would need to be tested is to manipulate tone of voice to be either alarming or neutral. In the present study, tone of voice was consistent across conditions. Only the information was manipulated to be threatening or non-threatening. But vocal communication has more parameters than the content of messages. In previous studies, an urgent or emotional vocal tone affected response time latency (Ljungberg & Parmentier, 2012), attention capture (Ljungberg et al., 2012) and intended carefulness (Barzegar & Wogalter, 1998). The present study could be repeated with a two-way design with two levels of threat information (high and neutral) and two levels of threat tone (alarming and neutral) to address this question. Alarming and neutral tones would need to be pre-tested to determine whether they are perceived as intended.

Trust was not affected by the communication manipulation in the present study. The communicator in all conditions was a uniformed police officer. An outstanding question is whether the effects of messages would be the same if the communicator were a member of a different emergency response organisation or if the communicator were a member of the public. The latter eventuality is not unlikely given that the audience for IOR training is set to increase following the roll-out of preparedness information campaigns, such as the “Remove, Remove, Remove” campaign discussed in Chapter 9 (Carter, Weston, Symons, & Amlôt, 2019). And first responders interviewed in the study in Chapter 4 discussed previous instances of asking a casualty to relay information to other casualties. It is unknown whether the High Threat High Efficacy message used in the present study would be effective when communicated by someone without the authority afforded to the emergency services. This question could be answered by repeating this study but with type of communicator as an independent variable.

Further recommendations for subsequent applications of the immersive virtual model to emergency communication research in general, and chemical incident communication research in particular, are discussed in Chapter 9.

8.4.2. Implications for communication practice

The caveats outlined in the preceding subsection highlight the need for further empirical assessment and communication practice will need to update accordingly as this field develops. However, the results of the present study provide sufficient evidence on which to base the scripting of communication with multiple casualties in a chemical incident by first responders in UK emergency services, including non-medical response organisations. The High Threat High Efficacy message used in the present study can serve as the basis for a script but, as pointed out by responders interviewed in the study reported in Chapter 4, it is not always feasible to follow a predefined script because information will vary according to the circumstances of the chemical incident. Therefore, recommendations for practical application are based on messaging principles, with example messages offered as guidance. Recommendations are presented below.

1. *Do not reassure casualties by understating the risk that they are contaminated.* Currently, there is a tendency for emergency planners to withhold information in order to “prevent panic” (Drury et al., 2013). But the findings of the present study indicate that being informed about the severity and likelihood of contamination improved willingness to follow disrobing instructions. Attempted reassurance about the threat of contamination did not reduce anxiety.

2. *Provide casualties with information about the efficacy of IOR, in particular the efficacy of dry decontamination.*

Participants in the present study indicated greater likelihood of adhering to the dry decontamination protocol when information about the efficacy of dry decontamination was included.

3. *Inform casualties about any means of providing warmth and protecting privacy during the disrobing process, for example if disrobe packs containing modesty gowns are available*

In the present study information was not provided to address perceived costs associated with disrobing but findings indicated that these perceptions were negatively associated with willingness to disrobe.

The process by which outcomes from this study and preceding research are translated to practical end use by first responders is outlined in the following chapter.

Chapter 9 Discussion

9.1 Summary of recommendations

The aim of this PhD was to develop communication strategies that can be incorporated into the Initial Operational Response (IOR) protocols used by non-specialist first responders in the early minutes of an incident. The specific context of interest was the release of a chemical with a long interval between exposure and symptom onset, for example liquid sulphur mustard, which has an estimated latency of four to 12 hours (Borak & Sidell, 1992; Clarke et al., 2008; Kales & Christiani, 2004), though cell and tissue damage can occur within minutes of exposure (Borak & Sidell, 1992; Davis & Aspera, 2001; Garcia et al., 2011; Kales & Christiani, 2004). This scenario is a particular challenge for first responders because the need to take protective action may not be immediately obvious to affected casualties. Messaging principles were informed by Protection Motivation Theory (PMT), the Extended Parallel Process Model (EPPM), outcomes of two literature reviews, and an interview study to ascertain lay mental models about chemical contamination and decontamination. Messaging principles were subjected to empirical assessment in the form of a double-blind RCT.

In terms of contribution to health and social psychology, this thesis indicates that messaging interventions informed by established theories and models on the processing of fear-arousing information do not have the hypothesised effect when applied to decontamination. The effectiveness of threat-based and efficacy-based information varied according to the type of decontamination people were asked to do. This thesis also contains the novel application of immersive virtual environment technology to the study of communication by first responders in an emergency. As outlined in Chapter 8, the use of IVET allows for a high standard of methodological rigour and experimental control and enables researchers to employ a double-blind approach to assessing communication whilst retaining more realism than can be achieved by conveying hypothetical scenarios through other channels, such as text vignettes. The methodology can be adapted to measure other characteristics of on-scene emergency communication.

In terms of practical impact, this thesis has resulted in evidence-based scripts (Appendix Y) which will be finalised and disseminated to frontline responders and control room operators by the UK Home Office National Resilience Policy Team (Appendix Z) thereby leading to standardisation of evidence-based communication practice. Over time the scripts will develop into aides-memoires and/or mobile application and used as a training tool to ensure that first responder communication will

promote casualty adherence to IOR. It is hoped that by furthering the specific recommendations on communication, translation from science to practice will be ensured. The anticipated consequence will be a reduction in injury in the event of a chemical incident.

9.1.1. Message content

9.1.1.1 Provide clear guidance on what protective actions should be taken

There was strong support for this recommendation from the literature reviews (Chapters 2 and 3). The provision of instructions was associated with significant increases in adaptive behaviour change at the scene of real or simulated mass casualty emergencies (Chapter 3). Lay participants in Chapter 5 also discussed how they would want to know what action to take and how they would take their cue from authorities, including emergency services, at the scene.

The results of the qualitative investigation into standard practice reported in Chapter 4 indicated that the provision of instructions is already part of standard practice. First responders indicated that the provision of instructions could be facilitated through the use of pictograms contained in disrobe kits and physical gestures performed by responders to illustrate how casualties should disrobe and apply dry material.

9.1.1.2 Provide information about responders

Findings from Chapters 2, 3 and 5 suggested that responders should make salient the fact that the communicator is a representative of an emergency response organisation, that responders have the necessary competence to respond to a chemical incident, and that responders are providing casualties with the treatment they require.

Participants in Chapter 5 specifically cited emergency responders with medical expertise, such as paramedics, as people whose advice they would trust most in a chemical incident. Responders who are not affiliated with the medical profession, such as police officers and firefighters, may need to make salient their training and expertise in decontamination or state that they are speaking on behalf of a health authority.

Findings from Chapter 5 also suggested that informing casualties that further decontamination facilities will be provided, and providing an estimate for when they will arrive, would reduce the risk of self-evacuation and self-presentation at a hospital. This supports findings from Chapter 2 that information about actions responders are taking is conducive to improved legitimacy perceptions which are in turn associated with expected adherence (Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015).

I included components to address the above information in all messages tested in the RCT (Chapter 8). Therefore, this PhD provides no quantitative support for the inclusion

of this information. However, the evidence to support the inclusion of this information is supported by outcomes of the two literature reviews (Chapters 2 and 3) and further qualitative evidence from the mental models study (Chapter 5).

9.1.1.3 Inform casualties about the threat facing them

Whilst the provision of instructions was consistently reported by responders and cited in guidance documents in the study reported in Chapter 4, there was variability in how the threat of contamination is currently conveyed to casualties. A proportion of currently used statements informed casualties that they were in danger whilst other statements informed casualties that decontamination was “precautionary”. The justification for understating the threat was to reassure casualties. However, participants in Chapter 5 stated that they would want to know the health impact of the chemical and findings from Chapter 8 indicated that being informed about the severity and likelihood of contamination improved willingness to follow disrobing instructions. Understating the threat of contamination had no effect on anxiety perceptions in the intention-to-treat data analysis. However, anxiety perceptions were themselves positively associated with willingness to disrobe – successful reassurance might therefore decrease this willingness. The implication is that while understating the threat of contamination may seem like a humane approach during a decontamination incident, it may put people at greater risk if it prevents them from adhering to decontamination. Misconceptions about the need for threat-focused reassurance to prevent “panic” during decontamination should be challenged during decontamination training.

Participants in Chapter 5 demonstrated an awareness of the potential for a delayed onset of adverse health effects following chemical contamination. In some cases, the delayed onset was conceived in relation to other health risks, such as asbestos. This suggests that communicating the likelihood of exposure in the absence of symptoms would not necessarily run counter to lay mental models of chemical contamination. Participants in Chapter 5 also stated that they would want to know what the chemical is so if this information is known by responders, it should be provided to casualties both to fulfil a reported information requirement and to address the severity of the incident.

9.1.1.4 Provide casualties with information about the efficacy of IOR

Theories and models of behaviour change in response to fear appeals (PMT and the EPPM) discussed in Chapter 2 suggest that information about the threat of contamination would only be effective when participants have high perceptions of self-efficacy and response efficacy. In this context, response efficacy refers to the efficacy of IOR as a means of reducing chemical contamination and reducing the risk of health effects from chemical exposure. In the RCT (Chapter 8), threat severity perceptions

were associated with increased expectations of leaving the area but response efficacy perceptions were associated with decreased expectations of leaving the area, indicating the importance of explaining the efficacy of IOR to casualties to prevent self-evacuation when severity perceptions are high.

Whilst the efficacy of disrobing and showering conformed to the lay mental model in Chapter 5, there was also a perception that decontamination should consist of medical treatment. Responders should make clear to casualties that decontamination without hospitalisation is still an effective countermeasure.

Participants in Chapter 5 expressed doubts about the efficacy of dry decontamination, relative to applying water. Participants in the RCT (Chapter 8) indicated greater likelihood of adhering to the dry decontamination protocol when information about the efficacy of IOR was included. Response efficacy perceptions were improved by the information about IOR efficacy, and response efficacy perceptions were associated with increased willingness to undergo dry decontamination and decreased willingness to leave the treatment area or seek further information before taking any action.

9.1.1.5 Inform casualties about privacy provisions

Perceptions regarding response costs are a subcomponent of coping appraisal in PMT (Chapter 2). Participants in Chapter 5 discussed several perceived barriers to disrobing, but particularly concerns about modesty. In Chapter 8, information was not provided to address perceived costs associated with disrobing, such as embarrassment, but findings indicated that these perceptions were negatively associated with willingness to disrobe and positively associated with seeking further information before taking any action. It is therefore recommended that responders inform casualties about any means of protecting privacy during the disrobing process, for example if disrobe packs containing modesty gowns are available.

9.1.2. Message delivery

9.1.2.1 Deliver information to casualties as soon as it is available

Based on findings from the literature review (Chapter 2), responders need to deliver information to casualties as soon as it is available to improve or maintain trust and legitimacy perceptions and to ensure that casualties decontaminate themselves as soon as possible. This means that the best communication channel is one that allows for fast communication. Outcomes from the review of mass casualty decontamination guidance documents and interviews with first responders trained to respond to hazardous chemical incidents (Chapter 4) indicated a range of available communication channels, the most frequently cited being voice amplification technology. Given the likely effect of communication on decontamination outcomes

based on the evidence in this PhD, voice amplification technology should be regarded by first responder agencies as essential decontamination equipment as it allows for fast dissemination of messages that would be conducive to promoting protective actions.

9.1.2.2 Use multiple channels of communication to disseminate consistent information

There is more empirical support for using multiple channels to disseminate one consistent message than there is for using any one particular modality (Chapter 2). Participants in Chapter 5 stated that they would be likely to check for further information via their smartphone. If feasible, it is recommended that responders communicate information about the incident and what actions are required of casualties to their commanding officers so that the information can be disseminated to communication teams who can broadcast the information to affected casualties via social media.

9.1.2.3 Use non-technical language

Findings from the crisis communication literature review (Chapter 2) suggest that responders should use simple, non-technical language to ensure that information is understood by as many casualties as possible, particularly if information processing capabilities are impaired due to stress, as findings from the literature review in Chapter 2 would predict. The messages tested in Chapter 8 were aimed at a low level of literacy in accordance with crisis communication recommendations for extending the reach of communication (Glik, 2007a). An amalgamation of readability assessment tools was used to ensure that all messages would be understood by audiences at the minimum UK Key Stage 3 reading level (Automatic Readability Checker).

9.2 Links for theory

In previous research in this field, the Elaborated Social Identity Model and Social Identity Model of Collective Resilience have informed the development of messages designed to promote compliance during mass casualty decontamination by improving perceived legitimacy of and identification with the communicator (Amlôt et al., 2017; Carter, Drury, Amlôt, et al., 2014; Carter, Drury, Amlôt, et al., 2015; Carter et al., 2013; Carter, Drury, Rubin, Williams, & Amlôt, 2014; Carter, Drury, Rubin, et al., 2015). Findings from this PhD demonstrated the applicability of behaviour change theories from the health psychology literature to the development of specific message components during the acute response phase of a mass casualty emergency.

PMT and the EPPM predict that an appeal to perceived severity and susceptibility are more likely to be conducive to message acceptance when perceptions of response efficacy and self-efficacy are high and, in the case of PMT, when perceptions

pertaining to response costs and benefits of maladaptive behaviour are low. As stated in Chapter 2, the EPPM is supported by findings from previous meta-analyses which indicate that the most effective interventions at promoting behaviour change, based on measures of attitudes, intentions or real behaviour, are high in both threat and efficacy information (Peters et al., 2013; Sheeran et al., 2014; Witte & Allen, 2000). Findings from this PhD indicate that the effects of threat and efficacy information on behaviour are more complicated when it comes to decontamination. IOR is a sequence of behaviours rather than one discrete behaviour. And, based on findings from Chapters 5 and 8, the effectiveness of threat and efficacy message components varied according to type of behaviour in this sequence. Only threat information affected disrobing expectations, only efficacy information affected dry decontamination expectations, and there was no interaction between the two message components.

Whilst response costs and self-efficacy were not factored into messages tested in Chapter 8, findings indicated that both constructs were associated with expectations of disrobing in a chemical incident. It is hypothesised, based on these findings that the interaction between information about the threat of contamination and information to counter perceived costs of disrobing raised by participants in Chapter 5 would result in similar effects to those observed in previous research on the EPPM.

Components of fear control, such as perceived manipulation or message deprecation, were not measured in Chapter 8. Fear control occurs when message recipients take steps to reduce their emotional response to the danger posed to them rather than reducing the danger itself, and is predicted to occur when perceived threat is higher than perceived efficacy in the EPPM (Beatson & McLennan, 2010, pp. 15-16). It would be useful to repeat the study from Chapter 8 with measures of fear control to determine the optimum balance of threat and efficacy information to avoid message recipients reaching the critical juncture where threat appraisal surpasses efficacy appraisal and the message is rejected even though the threat of contamination is made salient.

9.3 Practical application of thesis findings

During this PhD, I consulted with emergency response professionals, Chemical, Biological, Radiological and Nuclear (CBRN) policy advisors, and toxicology experts to ensure that outcomes of the project would be in line with current decontamination protocols and prevailing medical expertise and that outcomes would lead to recommendations that would be of use to frontline staff. I regularly communicated my progress to emergency response professionals so that people who work in mass casualty decontamination were aware that research on the practice of communication for this type of emergency was ongoing. Practitioner and technical advisory

involvement included discussions following presentations at workshops, meetings and seminars, as well as email exchanges and one-on-one meetings with emergency response professionals. Stakeholders with whom I engaged included mass decontamination instructors and staff at the Public Health England Emergency Response Department (ERD), an organisation that supports and advises healthcare professionals who respond to emergencies, including emergencies involving the release of CBRN materials. The department includes Training and Exercises teams that serve as a bridge between emergency response research and practice. The full list of stakeholder engagements is presented in Table 9-1.

Table 9-1 Stakeholder engagements.

Date	Venue	Stakeholder group
28 th June 2017	National CBRN Centre	Policymakers and emergency response practitioners
15 th February 2018	Emergency Response Department, PHE	Training and exercise co-ordinators
7 th March 2018	Merseyside FRS	Mass decontamination instructors
19 th June 2018	PHE	Home Office policy advisor
26 th July 2017 9 th March 2018 24 th April 2019	Various	Experts in toxicology and emergency response policy

At the time of writing (May 2019), outcomes from this PhD are beginning to have an impact on the communication component of UK IOR protocols. Following a meeting with policy advisors from the UK Home Office National Resilience Policy Team, I was asked to write scripts for responders to use during IOR. Emergency response practitioners have long expressed the need for more detailed guidance on the precise wording of communication. Considering references made by interview participants (Chapter 4) about the impracticality of scripting communication, the aim in writing the scripts was to provide exemplary messages that responders can use, whilst maintaining scope to tailor the script to the circumstances of the incident. Scripts were developed for the following scenarios: communicating at the scene of a chemical

incident when there are no signs or symptoms of chemical contamination; communicating at the scene when there are signs and/or symptoms; communicating at the scene when the contaminant is a caustic (burning) substance; and communicating from a control room. I based the script for the first of these scenarios on the High Threat, High Efficacy message that I tested in the RCT (Chapter 8). For the remaining scenarios, I edited the message to account for circumstantial differences. For example, the pain associated with a caustic chemical burn would render it unnecessary for responders or control room operators to make salient the likelihood and severity of exposure. The IOR scripts (Appendix Y) will be disseminated to frontline responders and control room operators (Appendix Z).

The scripts are currently being subjected to end user assessment in decontamination exercises to identify any limitations in the usability of scripts by responders in a real-world context with a casualty audience. I anticipate that the most useful next step would be to carry out a series of controlled field experiments, using the outcome measures for field experiments suggested in Section 9.4.4, to test the effectiveness of the script at promoting observable IOR adherence among a heterogeneous sample of role-playing casualties recruited from lay populations.

Over-reliance on scripts is discouraged, however, because it limits the flexibility of first responders to adapt to the specific parameters of the incident. A proportion of responders interviewed in Chapter 4 recognised the problem with scripts when communicating with casualties and the need to be able to adapt communication to different situations and different casualty populations. Scripting frontline responders would further fuel the tendency in the emergency response community to try to impose a superficial order to an emergency and to try to force every aspect of a disaster into a predefined, rigid structure (Easthope, 2018). Reliance on scripts may also lead to a continuation of paternalistic strategies “to give an appearance that a highly structured ‘order’ is now in place” (Easthope, 2018, p. 34). Whilst stakeholders, including frontline responders have asked for clearer guidance on the wording of communication and scripts will satisfy that demand, scripts should be regarded as a means to operationalising the principles emerging from this thesis and the work on which this thesis builds.

The critical component that determines the success of practical applications of evidence from this PhD is training. Drawing from theory used to inform the development of public-facing communication in this PhD, it is anticipated that both highlighting the efficacy of messaging guidelines at promoting IOR adherence and improving trainees’ perceptions of their own efficacy at communicating given their

professional experience in engaging with the public would improve the rate at which responders adhere to the latest communication guidance. Ongoing work to improve effectiveness of health emergency exercises at preparing responders for practice (Skryabina, Reedy, Amlôt, Jaye, & Riley, 2017) should incorporate perceptions by emergency response trainees of the quality and usability of communication training. Multi-agency training is a recommended step to improving interoperability between first responder agencies (House, Power, & Alison, 2014). It is particularly important that training on communication with casualties is incorporated into multi-agency training because, as explained in Chapter 2, consistent messaging between different sources facilitates trust in the message.

As stated in Chapter 1, first responders constitute the primary end user group for the recommendations arising from the outcomes of this PhD. Other end user groups include organisations for which there is a legally binding responsibility in place to protect the lives of patrons, occupants or clients in the event of an emergency. This group includes: Category 1 response organisations, such as hospitals and healthcare facilities; critical national infrastructure organisations; and crowd safety professionals operating in large venues or shopping centres. The communicator at the scene of a chemical incident could also be a member of the public. First responders interviewed in the study reported in Chapter 4 discussed how they had asked casualties to relay messages on to other casualties. Findings from studies on the bystander effect (Fischer et al., 2011), studies on behaviour in decontamination exercises (Carter, Drury, Amlôt, et al., 2014), and from studies on real incidents (Cocking, Drury, & Reicher, 2009; J. Cole, Walters, & Lynch, 2011; DiGiovanni, 2003; Drury, Cocking, & Reicher, 2009; Glik, 2007a; Lemyre, Johnson, & Corneil, 2010; Sheppard et al., 2006), including chemical incidents (Sheppard et al., 2006), suggest that people in emergencies adopt prosocial behaviours, with casualties themselves assisting in the emergency response effort as “civilian responders” (J. Cole et al., 2011; Drury et al., 2013; Monteith & Pearce, 2015; Perry & Lindell, 2003). Recommendations from this PhD could be used to develop guidance for members of the public to communicate instructions to casualties in a chemical incident. Stakeholders specifically recommended incorporating recommendations from this PhD in CitizenAID™, a UK web application that provides public guidance on emergency response aimed at members of the public.

9.4 Limitations and implications for future research

9.4.1 Tailoring messages to other target behaviours

The evidence base for mass casualty decontamination is continuously under review as operational guidance is reviewed and updated. Target behaviours used as outcome measures in the present investigation reflect the latest guidance informed by recent toxicology findings (Amlôt et al., 2017; Kassouf et al., 2017; Matar, Price, & Chilcott, 2010a; Matar et al., 2010b). But irrespective of any potential adjustments to UK standard decontamination protocols, the principles of effective communication will remain the same. Responders still need to instruct casualties to undergo specific actions within a short interval of time. It is anticipated that the principles of communication informed by this thesis can therefore be applied to any decontamination procedure used by emergency services. The validity of this assertion could be tested using a modified version of the RCT reported in the previous chapter with expectation of following different decontamination protocols as the revised outcome measure.

IOR was the decontamination protocol of interest in this PhD, but decontamination is unlikely to end with IOR. IOR is usually followed by showering. Behaviours tested in the RCT (Chapter 8) included remaining in place for the arrival of showers, but there was no measure of willingness to enter a decontamination shower and remain in place following the shower to undergo triage. In the interview study reported in Chapter 5, the benefit of showering to remove a harmful chemical appeared to be more intuitive to the lay public mental model of decontamination, relative to IOR procedures such as dry decontamination. A modified version of the RCT with willingness to enter a decontamination shower could address whether this behaviour is subject to the same variability in response to threat and/or efficacy information.

IOR is not the only emergency medical countermeasure for which the messaging guidelines developed during this PhD could be applied. Applying the methodology used in the RCT in Chapter 8 to testing communication in other types of emergency would be a useful, low-cost approach to testing and improving the messaging framework.

9.4.2. Audience considerations

One key source of bias in all studies in this PhD was the use of convenience sampling. Samples in all studies were drawn from a WEIRD (White, Educated, Industrialized, Rich, and Democratic) population, which is not representative of global populations in other psychological domains, for example moral reasoning (Henrich, Heine, & Norenzayan, 2010). Samples were mostly homogenous, consisting primarily of students enrolled in higher education courses in Southern England. This fulfils the homogenous sampling criterion that differentiates a controlled efficacy study from a less controlled but more ecologically valid effectiveness study (Singal, Higgins, & Waljee, 2014) but limits extrapolation of findings to the wider UK population. Outcomes

from studies reported in Section 2.5, suggest that trust in the communicator may be affected by socio-cultural characteristics of the sample (Chryssochoidis et al., 2009) and previous experience of injustice (Cordasco et al., 2007) from representatives of the communicating organisation depicted in the scenario.

Modesty concerns associated with disrobing in a chemical incident featured in Chapters 5 and 8. The act of disrobing was not assessed in terms of diverse cultural and religious norms relating to modesty. Modesty perspectives among women from various religious and cultural backgrounds, such as Chinese-American (e.g. Mo, 1992), Jewish-American (e.g. Andrews, 2011) and Muslim-American (e.g. Guimond & Salman, 2013) backgrounds, have been explored in other healthcare contexts, including cervical screening and breast examination. A prevalent practical recommendation in this literature is to respect female patients' preferences to be seen by a female healthcare provider (e.g. Guimond & Salman, 2013; Tackett et al., 2018). Cultural norms relating to public disrobing are discussed in the decontamination guidance document literature and the key recommendation based on the available evidence is to address privacy and modesty concerns, for example by providing cover from bystanders or protective clothing (Carter & Amlôt, 2016). According to some scholars of religion in medicine, the principle, "*al-ḍarūrāt tubīḥ al-maḥzūrā* (necessity makes for allowing the prohibited)" provides precedent in Islamic law for the suspension of routine moral regulation in the event of an emergency (Padela, 2006, p. 114; Padela & del Pozo, 2011, p. 43). This further supports the finding from this thesis that responders need to address explicitly the threat of chemical contamination and to be upfront about the risks facing casualties in a chemical incident. The need to address diverse cultural perspectives of modesty supports the recommendation from Chapters 5 and 8 of this thesis to address available privacy provisions but also highlights the need for further research on perceptions of first responder communication by participants sampled according to cultural background.

Participants in all studies were anglophone and the messaging interventions tested in the RCT were written in English. It is not possible to confirm that the translation of the text of a messaging intervention to another language would entail the equivalent communication of meaning. Scholars of applied linguistics (e.g. Bühler, 1986; Hartmann, 1990) have argued that translation means more than transcoding linguistic units of the source language to a target language; translation means finding equivalent *meanings*, not equivalent words. The implication of the English language limitation in this thesis is that it would not be sufficient to translate the words of an English-language messaging intervention or "script". This constitutes an additional concern with the reliance on scripts at the expense of communication training. The development and

evaluation of a decontamination communication intervention for non-anglophone audiences would be a useful applied linguistics research programme.

The perspective of children was not factored into communication assessment in this thesis. Participants in all studies were over the age of 18 and no studies included in the systematic review (Chapter 3) focused on the effect of communication on the behaviour of children. Only a small subset of studies in the broader literature review included assessment of children's perspectives. Whilst the behaviour of children and families with young children has been assessed in previous decontamination exercises (e.g. Fertel, Kohlhoff, Roblin, & Arquilla, 2009), further research is necessary to test the effectiveness of a communication strategy aimed at children and guardians in a chemical incident.

The methodology used in the RCT (Chapter 8) could be repeated to test the efficacy of messaging at promoting behaviour change among heterogenous audiences. As a precursory step, a cross-sectional survey could be carried out on a stratified UK sample, informed by latest Office for National Statistics socio-demographic data, to assess the prevalence of beliefs and misconceptions identified in the public interview study in Chapter 5 within a wider, more demographically representative UK sample. Such a survey would also allow for comparison of perceptions between demographic groups.

9.4.3. Assessing the effectiveness of different communication channels

Amplified voice was the communication channel used to deliver the message in all conditions in the RCT (Chapter 8). This was a pragmatic decision since voice amplification was consistently recommended as a communication channel in all guidance documents on mass casualty decontamination in the study reported in Chapter 4. But the effectiveness of different communication channels in the context of a mass casualty chemical incident remains an unanswered question (Carter & Amlôt, 2016), that can be addressed by repeating the RCT (Chapter 8) with one consistent message and communication channel as the independent variable. Based on previous research (Glik, 2007a, 2007b; Mileti & Sorensen, 1990; Omori et al., 2017; Rubin et al., 2012; Sorensen, 2000; World Health Organization, 2017), it is hypothesised that it would be the number rather than the type of channel that predicts behaviour change with multiple channels disseminating consistent information having a greater effect on trust and behaviour change than one channel in isolation.

Specifically, further work is required to inform the practice of social media communication in a chemical incident. Social media was not raised as an available communication channel in the qualitative investigation into standard practice (Chapter

4) and was explicitly ruled out as an on-scene communication channel by a Home Office policy stakeholder consulted. But, as indicated in the literature review on crisis communication, the role of social media in crisis communication has been addressed in other emergency contexts (Austin et al., 2012; Y. Cheng, 2018; Finch et al., 2016; Freberg, 2012; Knuth et al., 2016; Liu, Austin, & Jin, 2011; Liu, Fraustino, & Jin, 2015; Liu et al., 2016; Liu, Jin, & Austin, 2013; Ma & Yates, 2014; Rasmussen & Ihlen, 2017; Silver & Matthews, 2017; Snoeijers et al., 2014; Sutton et al., 2015; Sutton et al., 2014; Sutton, Vos, et al., 2018; Wang & Zhuang, 2018). And findings from the study in Chapter 5 indicate that casualties may check their phones for further information. A modification of the RCT (Chapter 8) could be used to compare social media messaging targeted at people in the vicinity of a chemical contaminant against voice-amplified spoken communication by responders.

9.4.4. Improving outcome measures to test IOR adherence in response to presentation of message components

The behavioural outcome measures used in the RCT (Chapter 8) were all self-report Likert items. Such measures are commonly used in crisis communication research with items, such as “I would evacuate from the area affected by the disaster if instructed to evacuate by government officials” (Liu et al., 2016) and “How likely would you be to take action to protect yourself before confirming the information somewhere else?” (Sutton, Vos, et al., 2018) used to measure intended behaviour in response to different communication strategies. But a more objective, observed measure of behaviour is warranted to determine the true effectiveness of messages tested in Chapter 8 at promoting expected adherence to emergency directives.

The first suggested approach is to test the messages through field exercises and use the observation coding schemes used in previous field experiments on behaviour during mass casualty decontamination (Amlôt et al., 2017; Carter, Drury, Amlôt, et al., 2014). The coding schemes include behaviours such as noncompliance (Carter, Drury, Amlôt, et al., 2014) and avoiding cross-contamination when applying dry material to skin (Amlôt et al., 2017). An additional measure that would be possible to implement in a field exercise is the use of an ultraviolet tracer applied to skin and clothing to simulate contamination. In previous decontamination efficacy research, the area or intensity of the simulant ultraviolet-fluorescent “contaminant” was used to measure how effective the decontamination procedure would be at removing a chemical from skin (Amlôt et al., 2010; Amlôt et al., 2015; Symons et al., 2015a, 2015b; Wakefield & Chilcott, 2008). In a test of communication, ultraviolet tracers could be used to measure how thoroughly participants remove a “contaminant” from their skin surface in response to communication received at the scene of the incident. Ultraviolet tracers would also

confer a measure of cross-contamination which would indicate how closely participants adhere to instructions designed to promote safe adherence to decontamination protocols, for example not letting contaminated clothing come into contact with the face.

The second approach is to use a form of immersive virtual environment technology (IVET) that allows for behavioural observation. In previous studies in which IVET was used, participants operated virtual bodies from a first-person perspective within a rendered animated environment (Duarte, Rebelo, & Wogalter, 2010; Kinateder et al., 2018; Tucker et al., 2018). In the RCT (Chapter 8), participants passively observed the scenario which made the use of IVET more akin to an elaborate version of text vignettes used in previous research on behaviour in chemical incidents (Carter, Drury, Amlôt, et al., 2015; Pearce et al., 2013). In future studies, a simulation can be programmed that allows participants to demonstrate observable behaviours within a rendered environment modelled on the scene of a chemical incident. Both of the above approaches have an element of self-report in that it is not possible to determine whether participant behaviour in response to the manipulation is an objective measure of how they would behave in a real incident or a practical demonstration of how they expect that they would behave.

The third suggested approach is to use a modified version of the autobiographical Implicit Association Test (aIAT) as an outcome measure of behavioural intention following presentation of communication strategies. The aIAT is a reliable method that has been validated in forensic studies of deception. The test allows the researcher to determine which of two alternative autobiographical events is true by pairing them with objectively true and false sentences on a logical dimension, e.g. "I am sitting down right now" (true) or "I am underwater right now" (false) with contrasting autobiographical statements, e.g. "I stole that harmonica 20 years ago". The outcome measure is reaction time when responding as to whether the logical statement is true when it is paired with either a "true" or "false" memory or intention. It is also possible to measure the neural correlates of reaction times via electroencephalogram (Agosta, Castiello, Rigoni, Lionetti, & Sartori, 2011). When modifying and applying this measure to emergency behaviour research, the equivalent to autobiographical statements would be re-worded versions of the behavioural expectation items used in the RCT (Chapter 8), for example "I would remain where I am until the showers arrive". The aIAT has previously been adapted to test behavioural intentions (Agosta et al., 2011) but extensive further validation work would be required before applying it as a measure for hypothetical or expected behaviour.

An alternative approach to assessing the applicability of health behaviour theories to messaging in IOR is to carry out observational analysis of real chemical incidents, for example using video data acquired through closed-circuit television cameras (CCTV) or body cameras worn by responders, to assess the impact of communication on observed behaviour in real-world incidents. Observational analysis of CCTV data has been used in previous research on bystander behaviour (Liebst, Philpot, Heinskou, & Lindegaard, 2018). In the proposed study, researchers could use an adapted version of the method used by Vos et al. (Vos et al., 2018) to code the content of Tweets published in the USA during the 2016 Zika outbreak and compare the effects of different coded categories of messages on retransmission rates. In the proposed study, statements spoken by recorded first responders would be coded, for example with an EPPM-based coding scheme. Categories of messages could be assessed via the interval of time between communication and IOR completion by all message recipients or via frequency of behaviours in an IOR adherence coding scheme.

In terms of outcome measures pertaining to stress and anxiety responses to communication in emergencies, objective measures of stress and anxiety, such as heart rate and skin conductance, have been used in previous IVET studies on emergency evacuation (Feng et al., 2018; Tucker et al., 2018) and could be used as secondary outcome measures in an improved version of the RCT (Chapter 8).

9.4.5. Adapting messages to contexts in which signs and symptoms of chemical exposure are salient

In the scenario presented to participants in the RCT (Chapter 8), symptoms were not depicted as salient. The participants themselves did not experience any pain or feel any symptoms indicative of hazardous chemical exposure, nor did they witness anyone displaying symptoms or see signs indicative of a chemical release. Questions remain as to whether it would be necessary to emphasise the threat when signs and symptoms of exposure are salient. It is likely that, when experiencing or witnessing symptoms of chemical contamination, threat perceptions would be sufficiently high so the focus should be on highlighting the efficacy of protective actions when instructing casualties on what to do. One of the determinants of taking protective action raised in the mental models study (Chapter 5) was the severity of symptoms. Emphasising or making salient the threat of chemical contamination would be unproductive when symptoms themselves are salient. This hypothesis could be easily tested by repeating the study but introducing the depiction of signs and symptoms as a new variable. In Chapter 3, I discussed the issue of immersion in emergency exercises and the balance between achieving sufficient immersion to improve external validity, whilst not

committing psychological harm by convincing participants that the emergency is real. In the subsection, I discuss approaches to potentially achieving this compromise.

In previous IVET studies, smoke exposure was used concurrently with immersion in the simulated environment to induce olfactory stimulation (Feng et al., 2018) so it would be possible to repeat the RCT (Chapter 8) with the addition of this procedure to replicate one of the environmental cues associated with a hazardous chemical release in the lay mental model ascertained in Chapter 5. When testing the effectiveness of the messages in a field experiment, it is possible to simulate salient chemical exposure by using artificial smoke and acetic acid to induce mild irritation of skin, eyes, and mucous membranes, as used with the appropriate health and safety restrictions in a previous study on evacuation (Fridolf et al., 2013).

In addition to signs and symptoms of chemical exposure, as stated in Chapter 2, casualties are likely to experience physiological stress and anxiety in an emergency (Leach, 2004, 2005; Porter & Leach, 2010; Robinson et al., 2013; Robinson et al., 2008). The unfamiliarity of CBRN hazards is also likely to be conducive to anxiety and stress (Krieger et al., 2014; Sheppard et al., 2006; Sullivan & Bongar, 2007). Stressors were not induced in any study in this PhD. Whilst participants predominantly reported themselves to be emotionally engaged with the scenario depicted in the video used in the RCT (Chapter 8), messages were still processed in the context of a comfortable environment with no real threat of contamination. Ethical responsibilities prohibit deceiving participants into believing that they have actually been exposed to a hazardous chemical but there are other approaches to inducing stress whilst using the IVET procedure, such as applying the physiological stressor of CO₂-enriched air inhalation to increase stress levels (Ehlers et al., 1986; Ree et al., 2008; Van Den Bergh et al., 1995).

9.4.6. Long-term pre-incident communication

Scholars of risk and crisis communication have argued that “communication should not begin at the point of crisis” (M. B. Rogers & Pearce, 2016) and I would not recommend limiting communication about chemical incidents to situations in which hazardous chemicals have been released. Communication about chemical incident preparedness over a longer timeframe is an important exercise to promote resilience among potential future chemical casualties (Noy, 2004; Ruggiero & Vos, 2015). The “Remove, Remove, Remove” campaign is a public-facing communication initiative, akin to “Run, Hide, Tell” and “See it, Say it, Sorted”, launched by the UK National CBRN Centre and Home Office and designed to inform the public about IOR (Figure 9-1). Concurrently with this PhD, I contributed to a study to assess public acceptability of these pre-incident

materials through focus group discussions and questionnaire measures (Carter et al., 2019). Findings indicated generally positive perceptions among a lay sample regarding both the materials themselves and the act of providing such information as part of long-term public education. Findings from this thesis indicate that public-facing preparedness materials could be improved by emphasizing the efficacy of IOR, relative to waiting for medical assistance, at reducing chemical exposure.

The RCT (Chapter 8) could be repeated with the “Remove, Remove, Remove” materials as the key stimulus to determine whether this pre-incident information improves engagement in IOR in a simulated chemical incident. The additional variable of interval between receiving pre-incident information and immersion in the simulated chemical incident would address whether the effectiveness of the pre-incident messaging is contingent on the length of time between receiving pre-incident information and acting on the information. It is anticipated that wider dissemination of public-facing educational materials about IOR would reduce the demand on first responders to need to explain in detail how and why casualties need to self-decontaminate.

9.4.7. Immersive virtual environment technology (IVET)

IVET, used in the assessment of discrete messaging components in Chapter 8, is a cost-effective way of testing outstanding questions relating to communication in emergency settings. IVET enables researchers to address these questions in double-blind controlled trials with multiple participants per communication condition whilst maintaining a variation of the “mass casualty” context which is usually only achieved in field experiments.

Insert Relevant Logo

If you think you have been exposed to a **HAZARDOUS SUBSTANCE** **CALL 999**



REMOVE YOURSELF...

...from the immediate area to avoid further exposure to the substance. Fresh air is important.

**IF SKIN IS ITCHING
OR IN PAIN, FIND A
WATER SOURCE.**



REMOVE OUTER CLOTHING

Try to avoid pulling clothing over the head if possible.

Do not pull off clothing stuck to skin.

**DO NOT SMOKE,
EAT OR DRINK.**



REMOVE THE SUBSTANCE...

**BLOT THEN BRUSH
FROM** your skin with an absorbent material, like tissue. **IF SKIN IS
ITCHING OR IN PAIN,
WASH CONTINUALLY
WITH LOTS OF WATER
FOR AT LEAST 20 MINS.**

Avoid it running onto other parts of body.

ACT QUICKLY these actions can **SAVE LIVES**

Figure 9-1 “Remove Remove Remove” poster designed by UK National CBRN Centre and UK Home Office to promote public preparedness for undergoing IOR in a chemical incident, Figure 1 in Carter et al. (2019).

9.5 Conclusion

The 2018 nerve agent release in Wiltshire was a reminder that hazardous chemical exposure on a mass scale remains a threat to public health in the UK. Should a future incident result in multiple casualties, the challenge facing responders is not only toxicological but also behavioural. The simple action of removing clothing and using absorbent materials can reduce injury and may save lives. Whether the public will readily engage in these actions continues to cause much concern among policy makers.

Findings from the literature reviews indicated that the use of non-technical language and fast dissemination of information, ideally through multiple channels, would promote adherence to decontamination protocols. In terms of message content, findings from the literature reviews and mental models study suggested that the provision of clear instructions on actions that need to be taken and the provision of information about the competence of responders and the actions they are taking to protect casualties would improve the likelihood of casualty adherence. The results of the RCT indicated that in addition to providing this information, responders need to be open about the danger facing casualties and need to explain that on-scene decontamination is an effective form of treatment. This is particularly the case if dry decontamination is required. Outcomes from the mental models study and the RCT also suggest that taking action to address privacy concerns would further improve the likelihood of adherence. Based on the assessment of standard communication practice in Chapter 4, it is likely that these principles of communication are already used by some responders but that the principles are not standardised across emergency response organisations. I hope that this thesis and the scripts developed as a result will contribute to standardisation of evidence-based communication practice.

The results of my research are reassuring. Firstly, members of the public do seem to intuitively understand why such actions are important, suggesting that first responders should have confidence in their ability to convince the public to engage in them. Secondly, simple communication strategies can increase the likelihood of people undertaking these behaviours. I anticipate that the research agenda outlined above will further strengthen the evidence base that guides recommendations for communication during mass casualty decontamination and could have wider implication for a range of acute incidents that require casualties to undertake protective actions.

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Appendix A: Electronic database search terms in systematic review (Chapter 3)

The following search terms were applied to MEDLINE® (Table A-1), PsycINFO (Table A-2) and Web of Science™ (Table A-3) databases. The search results were obtained on 14th March 2018.

Table A-1 Search terms used to search Ovid MEDLINE® on 14th March 2018.

Concept	Combinations	Notes	Database: Ovid MEDLINE® In-Process & Other Non-Indexed Citations and Ovid MEDLINE® 1946 to Present		
			Search Number	Terms	Results
Population / context (casualties in mass casualty emergencies)	Combine with OR	Controlled vocabulary	1	exp Accidents, Aviation/	2589
			2	exp Biohazard Release/	117
			3	exp Biological Warfare/	5986
			4	exp Bioterrorism/	4506
			5	exp Chemical Hazard Release/	469
			6	exp Chemical Terrorism/	147
			7	exp Chemical Warfare/	1243
			8	exp Civil Defense/	2487
			9	exp Decontamination/	4246
			10	exp Disasters/	67726
			11	exp Disaster Planning/	12780
			12	exp Disaster Victims/	121
			13	exp Emergencies/	37993
			14	exp Emergency Shelter/	156

	15	exp Explosions/	3719
	16	exp Fires/	8699
	17	exp Floods/	1918
	18	exp Mass Casualty Incidents/	1659
	19	exp Nuclear Warfare/	4567
	20	exp Quarantine/	1995
	21	exp Radiation Injuries/	64707
	22	exp Radioactive Hazard Release/	6311
	23	exp Relief Work/	4273
	24	exp Rescue Work/	1946
	25	exp September 11 Terrorist Attacks/	1032
	26	exp Terrorism/	11658
Free Text (Title and Abstract)	27	anthrax.ab,ti.	5787
	28	avalanche.ab,ti.	2048
	29	"bio* warfare".ab,ti.	883
	30	"bio* weapon*".ab,ti.	971
	31	"bioterror*".ab,ti.	3621
	32	blizzard.tw.	172
	33	bomb.ab,ti.	4045
	34	"casualt*".ab,ti.	9210
	35	"cbrn*".ab,ti.	168
	36	chemical spill.ab,ti.	68
	37	chemical warfare.ab,ti.	1751
	38	"chemical weapon*".ab,ti.	631
	39	Chernobyl.ab,ti.	4395
	40	cyclone.ab,ti.	852
	41	"decontaminat*".ab,ti.	9921
	42	"disaster*".ab,ti.	20317
	43	earthquake.ab,ti.	5757

44	egress.ab,ti.	3768
45	"emergency respon*".ab,ti.	2434
46	"evacuat*".ab,ti.	18594
47	"explosion*".ab,ti.	10369
48	fire.ab,ti.	20068
49	"first responder*".ab,ti.	1564
50	"flood*".ab,ti.	12810
51	Fukushima.ab,ti.	2170
52	hurricane.ab,ti.	2332
53	industrial accident.ab,ti.	319
54	landslide.ab,ti.	268
55	"mass casualt*".ab,ti.	1886
56	"mass gathering*".ab,ti.	490
57	mass killing.ab,ti.	38
58	"mass shooting*".ab,ti.	111
59	massacre.ab,ti.	145
60	"multi* casualt*".ab,ti.	176
61	nuclear radiation.ab,ti.	124
62	"radi* warfare".ab,ti.	12
63	"radi* weapon*".ab,ti.	32
64	September 11th.ab,ti.	191
65	"terroris*".ab,ti.	5454
66	Three Mile Island.ab,ti.	182
67	tidal wave.ab,ti.	102
68	tornado.ab,ti.	417
69	tsunami.ab,ti.	1935
70	typhoon.ab,ti.	379
71	volcanic eruption.ab,ti.	182
72	white powder.ab,ti.	191

73 World Trade Center.ab,ti.

859

AND

Intervention (communication)	Combine with OR				
	Controlled Vocabulary	74	exp Health Communication/		1439
		75	"communicat*".ab,ti.		235642
	Free Text (tw= Title and Abstract)	76	"instruct*".ab,ti.		78862
		77	"messag*".ab,ti.		49121
		78	signage.ab,ti.		345

AND

Outcome (casualty behaviour)	Combine with OR				
	Controlled Vocabulary	79	exp Mass Behavior/		591
		80	"adher*".ab,ti.		156401
		81	"behav*".ab,ti.		1048077
	Free Text (tw= Title and Abstract)	82	compliance.ab,ti.		98639
		83	comply.ab,ti.		9194
		84	"co?operat*".ab,ti.		119356
		85	"non?compl*".ab,ti.		9544

Combined Population / Context terms	86	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66 or 67 or 68 or 69 or 70 or 71 or 72 or 73	263282
Combined Intervention Terms	87	74 or 75 or 76 or 77 or 78	353683
Combined Outcome Terms	88	79 or 80 or 81 or 82 or 83 or 84 or 85	1394485
ALL COMBINED	89	86 and 87 and 88	788

Table A-2 Search terms used to search Ovid PsycINFO on 14th March 2018.

Concept	Combinations	Notes	Database: Ovid PsycINFO 1806 to March Week 1 2018		
			Search Number	Terms	Results
Population / context (casualties in mass casualty emergencies)	Combine with OR	Controlled vocabulary	1	exp Air Traffic Accidents/	453
			2	exp BIOTERRORISM/	111
			3	exp DISASTERS/	8188
			4	exp Emergency Management/	624
			5	exp Emergency Preparedness/	1013
			6	exp Emergency Services/	7390
			7	exp Fires/	478
			8	exp Industrial Accidents/	1209
			9	exp Natural Disasters/	4473
			10	exp Risk Management/	4712
			11	exp TERRORISM/	7137
	Free Text (ab,ti = Title and Abstract)	12	anthrax.ab,ti.	154	
		13	avalanche.ab,ti.	162	
		14	"bio* warfare".ab,ti.	52	
		15	"bio* weapon*".ab,ti.	51	
		16	"bioterror*".ab,ti.	234	
		17	blizzard.ab,ti	39	
		18	bomb.ab,ti.	561	
		19	"casualt*".ab,ti.	1769	
		20	"cbrn*".ab,ti.	28	
		21	chemical spill.ab,ti.	8	
		22	chemical warfare.ab,ti.	79	

23	"chemical weapon*".ab,ti.	47
24	Chernobyl.ab,ti.	221
25	cyclone.ab,ti.	57
26	"decontaminat*".ab,ti.	109
27	"disaster*".ab,ti.	10413
28	earthquake.ab,ti.	2109
29	egress.ab,ti.	152
30	"emergency respon*".ab,ti.	691
31	"evacuat*".ab,ti.	1523
32	"explosion*".ab,ti.	2440
33	fire.ab,ti.	5863
34	"first responder*".ab,ti.	575
35	flood.ab,ti.	2413
36	Fukushima.ab,ti.	231
37	hurricane.ab,ti.	1744
38	industrial accident.ab,ti.	73
39	landslide.ab,ti.	49
40	"mass casualt*".ab,ti.	140
41	"mass gathering*".ab,ti.	22
42	mass killing.ab,ti.	95
43	"mass shooting*".ab,ti.	161
44	massacre.ab,ti.	323
45	"multi* casualt*".ab,ti.	13
46	nuclear radiation.ab,ti.	17
47	"radi* warfare".ab,ti.	3
48	"radi* weapon*".ab,ti.	7
49	September 11th.ab,ti.	430
50	"terroris*".ab,ti.	7604

	51	Three Mile Island.ab,ti.	127
	52	tidal wave.ab,ti.	63
	53	tornado.ab,ti.	189
	54	tsunami.ab,ti.	767
	55	typhoon.ab,ti.	72
	56	volcanic eruption.ab,ti.	43
	57	white powder.ab,ti.	13
	58	World Trade Center.ab,ti.	757

AND

Intervention (communication)	Combine with OR	Controlled Vocabulary	59	exp Communication Theory/	980
			60	exp Public Service Announcements/	325
		Free Text (ab,ti = Title and Abstract)	61	"communicat*".ab,ti.	181006
			62	"instruct*".ab,ti.	126035
			63	"messag*".ab,ti.	36638
			64	signage.ab,ti.	255

AND

Outcome (casualty behaviour)	Combine with OR	Controlled Vocabulary	65	exp Collective Behavior/	5704
			66	exp Compliance/	17818
			67	exp Psychological Reactance/	939
		68	"adher*".ab,ti.	31599	

	69	"behav*".ab,ti.	857232
Free Text (ab,ti = Title and Abstract)	70	compliance.ab,ti.	21425
	71	comply.ab,ti.	3350
	72	"co?operat*".ab,ti.	39987
	73	"non?compl*".ab,ti.	4026
<hr/>			
Combined Population / Context terms	74	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58	48430
<hr/>			
Combined Intervention Terms	75	59 or 60 or 61 or 62 or 63 or 64	325228
<hr/>			
Combined Outcome Terms	76	65 or 66 or 67 or 68 or 69 or 70 or 71 or 72 or 73	932249
<hr/>			
ALL COMBINED	77	74 and 75 and 76	901
<hr/>			

Table A-3 Search terms used to search Web of Science™ on 14th March 2018.

		Database: Web of Science™ v5.27.2 (Search in TOPIC: Title; Abstract; Author Keywords; Keywords Plus® in Web of Science™ Core Collection, BIOSIS Citation IndexSM, KCI-Korean Journal Database, Russian Science Citation Index, and SciELO Citation Index)		
Concept	Combinations	Search Number	Terms	Results
Population / context (casualties in mass casualty emergencies)	Combine with OR	1	anthrax	12,445
		2	avalanche	30,983
		3	"bio* warfare"	4,056
		4	"bio* weapon*"	2,319
		5	bioterror*	8,914
		6	blizzard	879
		7	bomb	23,904
		8	casualt*	20,238
		9	cbrn*	509
		10	"chemical spill"	343
		11	"chemical warfare"	7,867
		12	"chemical weapon*"	2,251
		13	Chernobyl	14,135
		14	cyclone	24,575
		15	decontaminat*	40,290
		16	disaster*	136,186
		17	earthquake	124,638
		18	egress	7,984
		19	"emergency respon*"	9,239
		20	evacuat*	45,390

21	explosion*	112,849
22	fire	267,091
23	"first responder**"	3,101
24	flood*	152,248
25	Fukushima	7,235
26	hurricane	22,297
27	"industrial accident"	1,279
28	landslide	22,523
29	"mass casualt**"	3,610
30	"mass gathering**"	729
31	"mass killing"	203
32	"mass shooting**"	246
33	massacre	3,788
34	"multi* casualt**"	259
35	"nuclear radiation"	1,967
36	"radi* warfare"	29
37	"radi* weapon**"	88
38	"September 11th"	714
39	terroris*	36,516
40	"Three Mile Island"	1,367
41	"tidal wave"	1,025
42	tornado	5,567
43	tsunami	14,746
44	typhoon	8,404
45	"volcanic eruption"	3,520
46	"white powder"	719
47	"World Trade Center"	2,293

AND

Intervention (communication)	Combine with OR	48	communicat*	1,682,715
		49	instruct*	325,483
		50	messag*	199,906
		51	signage	1,637

AND

Outcome (casualty behaviour)	Combine with OR	52	adher*	326,233
		53	behav*	5,938,645
		54	compliance	239,635
		55	comply	46,984
		56	co\$operat*	497,058
		57	non\$compl*	16,904

Combined Population / Context terms	58	#47 OR #46 OR #45 OR #44 OR #43 OR #42 OR #41 OR #40 OR #39 OR #38 OR #37 OR #36 OR #35 OR #34 OR #33 OR #32 OR #31 OR #30 OR #29 OR #28 OR #27 OR #26 OR #25 OR #24 OR #23 OR #22 OR #21 OR #20 OR #19 OR #18 OR #17 OR #16 OR #15 OR #14 OR #13 OR #12 OR #11 OR #10 OR #9 OR #8 OR #7 OR #6 OR #5 OR #4 OR #3 OR #2 OR #1	1,026,943
Combined Intervention Terms	59	#51 OR #50 OR #49 OR #48	2,092,106
Combined Outcome Terms	60	#57 OR #56 OR #55 OR #54 OR #53 OR #52	6,827,915
ALL COMBINED	61	#60 AND #59 AND #58	6,706
	62	#60 AND #59 AND #58 Refined by: [excluding] Databases: (MEDLINE)	4,165

Appendix B: Excluded full texts in systematic review (Chapter 3)

The full texts of the electronic database search results, which were deemed potentially relevant following title and abstract screening, were reviewed by the first author. Where there was ambiguity regarding whether criteria were met, one or more members of the supervisory team were consulted. The citations of rejected papers and justifications for exclusion are displayed in Table B-1.

Table B-1 Search results excluded from review on full text screening and reasons for exclusion.

Citation	Exclusion Justification
Ahsan, M. N., Takeuchi, K., Vink, K., & Warner, J. (2016). Factors affecting the evacuation decisions of coastal households during Cyclone Aila in Bangladesh. <i>Environmental Hazards-Human and Policy Dimensions</i> , 15(1), 16-42. doi:10.1080/17477891.2015.1114912	The study does not meet the intervention criteria for this review.
Arrabito, G. R. (2009). Effects of talker sex and voice style of verbal cockpit warnings on performance. <i>Human Factors</i> , 51(1), 3-20.	The study does not meet the population/context criteria for this review.
Bass, S. B., Gordon, T. F., Gordon, R., & Parvanta, C. (2016). Using eye tracking and gaze pattern analysis to test a "dirty bomb" decision aid in a pilot RCT in urban adults with limited literacy. <i>BMC Medical Informatics & Decision Making</i> , 16, 67.	The study does not meet the population/context criteria for this review: The stimuli consisted of preparedness materials rather than information delivered during a simulated or real emergency.
Bass, S. B., Gordon, T. F., Maurer, L., Greener, J., Mora, G., Ruggieri, D., . . . Parvanta, C. (2016). How Do Low-Literacy Populations Perceive "Dirty Bombs"? Implications for Preparedness Messages. <i>Health Security</i> , 14(5), 331-344.	The study does not meet the intervention criteria for this review: Communication interventions were not tested in this study
Bass, S. B., Greener, J. R., Ruggieri, D., Parvanta, C., Mora, G., Wolak, C., . . . Gordon, T. F. (2015). Attitudes and perceptions of urban African Americans of a "dirty bomb" radiological terror event: results of a	The study does not meet the population/context criteria for this review: This is a study on communication with the wider public during an emergency, rather

Citation	Exclusion Justification
<p>qualitative study and implications for effective risk communication. <i>Disaster Medicine & Public Health Preparedness</i>, 9(1), 9-18.</p>	<p>than communication with affected casualties at treatment area.</p>
<p>Bergeron, C. D., & Friedman, D. B. (2015). Developing an evaluation tool for disaster risk messages. <i>Disaster Prevention and Management</i>, 24(5), 570-582. doi:10.1108/dpm-11-2014-0224</p>	<p>The study does not meet the population/context criteria for this review: Participants were experts at a Public Health Agency in Canada rather than members of the lay public.</p>
<p>Bradley, D. T., McFarland, M., & Clarke, M. (2014). The effectiveness of disaster risk communication: a systematic review of intervention studies. <i>PLoS currents</i>, 6.</p>	<p>The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.</p>
<p>Brandeau, M. L., Zaric, G. S., Freiesleben, J., Edwards, F. L., & Bravata, D. M. (2008). An ounce of prevention is worth a pound of cure: improving communication to reduce mortality during bioterrorism responses. <i>American Journal of Disaster Medicine</i>, 3(2), 65-78.</p>	<p>The study does not meet the study type criteria for this review: There are no original data and the authors use a simulation model based on assumptions about behaviour. Citations were searched.</p>
<p>Cairns, G., de Andrade, M., & MacDonald, L. (2013). Reputation, relationships, risk communication, and the role of trust in the prevention and control of communicable disease: A review. <i>Journal of Health Communication</i>, 18(12), 1550-1565.</p>	<p>The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.</p>
<p>Carattin, E., Meneghetti, C., Tatano, V., & Pazzaglia, F. (2016). Human navigation inside complex buildings: using instructions and maps to reach an area of refuge. <i>International Journal of Design Creativity and Innovation</i>, 4(2), 105-118. doi:10.1080/21650349.2015.1135760</p>	<p>The study does not meet the intervention criteria for this review: The communication intervention was administered in preparation for a simulated emergency rather than during the emergency.</p>
<p>Carter, H., Drury, J., Amlôt, R., Rubin, G., & Williams, R. (2013). Perceived responder legitimacy and group identification predict cooperation and compliance in a mass decontamination field exercise. <i>Basic and Applied Social Psychology</i>, 35(6), 575-585.</p>	<p>The study does not meet the intervention criteria for this review: There is no assessment of communication variables.</p>

Citation	Exclusion Justification
Carter, H., Drury, J., Rubin, G. J., Williams, R., & Amlôt, R. (2012). Public experiences of mass casualty decontamination. <i>Biosecurity & Bioterrorism</i> , 10(3), 280-289.	The study does not meet the outcome criteria for this review: There is no behavioural outcome
Carter, H., Drury, J., Rubin, G. J., Williams, R., & Amlôt, R. (2013). The effect of communication during mass decontamination. <i>Disaster Prevention and Management</i> , 22(2), 132-147. doi:10.1108/09653561311325280	The study does not meet the intervention criteria for this review: There is no assessment of the effect of communication variables on behavioural intentions in this study.
Carter, H., Drury, J., Rubin, G. J., Williams, R., & Amlôt, R. (2015). Applying crowd psychology to develop recommendations for the management of mass decontamination. <i>Health Security</i> , 13(1), 45-53.	The paper does not meet study type criteria for this review: There are no original data.
Casteel, M. A. (2016). Communicating Increased Risk: An Empirical Investigation of the National Weather Service's Impact-Based Warnings. <i>Weather Climate and Society</i> , 8(3), 219-232. doi:10.1175/wcas-d-15-0044.1	The study does not meet the population/context criteria for this review: The participants in this study were required to adopt the role of a plant manager who receives warnings.
Cava, M. A., Fay, K. E., Beanlands, H. J., McCay, E. A., & Wignall, R. (2005). Risk perception and compliance with quarantine during the SARS outbreak. <i>Journal of Nursing Scholarship</i> , 37(4), 343-347.	The study does not meet the population/context criteria for this review.
Contzen, N., & Mosler, H.-J. (2013). Impact of different promotional channels on handwashing behaviour in an emergency context: Haiti post-earthquake public health promotions and cholera response. <i>Journal of Public Health</i> , 21(6), 559-573.	The study does not meet the population/context criteria for this review: The focus of the study is on long-term communication with the public in the recovery phase of an emergency.
Conzola, V. C., & Wogalter, M. S. (2001). A communication-human information processing (C-HIP) approach to warning effectiveness in the workplace. <i>Journal of Risk Research</i> , 4(4), 309-322.	The paper does not meet study type criteria for this review: There are no original data.
de Hoog, N., Stroebe, W., & de Wit, J. B. F. (2007). The impact of vulnerability to and severity of a health risk on processing and acceptance of fear-arousing communications: A meta-analysis. <i>Review of General</i>	The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.

Citation	Exclusion Justification
<p>Psychology, 11(3), 258-285. doi:10.1037/1089-2680.11.3.258</p>	
<p>de Jong, M., & Helsloot, I. (2010). The effects of information and evacuation plans on civilian response during the National Dutch flooding exercise 'Waterproef'. In S. P. Hoogendoorn, A. J. Pel, M. A. P. Taylor, & H. Mahmassani (Eds.), 1st Conference on Evacuation Modeling and Management (Vol. 3, pp. 153-162).</p>	<p>The study does not meet the population/context criteria for this review.</p>
<p>DiGiovanni, C., Conley, J., Chiu, D., & Zaborski, J. (2004). Factors influencing compliance with quarantine in Toronto during the 2003 SARS outbreak. <i>Biosecurity & Bioterrorism</i>, 2(4), 265-272.</p>	<p>The study does not meet the population/context criteria for this review.</p>
<p>Duarte, E., Rebelo, F., Teles, J., & Wogalter, M. S. (2014). Behavioral compliance for dynamic versus static signs in an immersive virtual environment. <i>Applied Ergonomics</i>, 45(5), 1367-1375.</p>	<p>The study does not meet the intervention criteria for this review: The study tested installations inherent in the structural design of the environment in which participants underwent emergency wayfinding, rather than signage established or activated by emergency responders in response to an MCE.</p>
<p>Emolo, A., Picozzi, M., Festa, G., Martino, C., Colombelli, S., Caruso, A., . . . Miranda, N. (2016). Earthquake early warning feasibility in the Campania region (southern Italy) and demonstration system for public school buildings. <i>Bulletin of Earthquake Engineering</i>, 14(9), 2513-2529. doi:10.1007/s10518-016-9865-z</p>	<p>The study does not meet the population/context criteria for this review.</p>
<p>Finch, K. C., Snook, K. R., Duke, C. H., Fu, K.-W., Tse, Z. T. H., Adhikari, A., & Fung, I. C.-H. (2016). Public health implications of social media use during natural disasters, environmental disasters, and other environmental concerns. <i>Natural Hazards</i>, 83(1), 729-760. doi:10.1007/s11069-016-2327-8</p>	<p>The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.</p>

Citation	Exclusion Justification
<p>Firestone, R. M., & Everly, G. S., Jr. (2013). A pilot investigation in constructing crisis communications: What leads to best practice? <i>International Journal of Emergency Mental Health and Human Resilience</i>, 15(2-3), 159-164.</p>	<p>The study does not meet the outcome criteria for this review: There is no behavioural outcome</p>
<p>Fischhoff, B., & Eggers, S. (2006). <i>Mental Models of Warning Decisions: Identifying and Addressing Information Needs</i>. Wogalter, Michael S [Ed] (2006) <i>Handbook of warnings</i> (pp 279-287) xxi, 841 pp Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers; US, 279-287.</p>	<p>The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.</p>
<p>Fridolf, K., Ronchi, E., Nilsson, D., & Frantzich, H. (2013). Movement speed and exit choice in smoke-filled rail tunnels. <i>Fire Safety Journal</i>, 59, 8-21. doi:10.1016/j.firesaf.2013.03.007</p>	<p>The study does not meet the intervention criteria for this review: The study tested installations inherent in the structural design of the environment in which participants underwent emergency wayfinding, rather than signage established or activated by emergency responders in response to an MCE.</p>
<p>Galarce, E. M., & Viswanath, K. (2012). Crisis communication: an inequalities perspective on the 2010 Boston water crisis. <i>Disaster Medicine & Public Health Preparedness</i>, 6(4), 349-356.</p>	<p>The study does not meet the population/context criteria for this review. Respondents were not casualties in an MCE but residents of an area in which crisis communication was implemented.</p>
<p>Galea, E. R., Xie, H., Deere, S., Cooney, D., & Filippidis, L. (2017). An international survey and full-scale evacuation trial demonstrating the effectiveness of the active dynamic signage system concept. <i>Fire and Materials</i>, 41(5), 493-513. doi:10.1002/fam.2414</p>	<p>The study does not meet the intervention criteria for this review: The study tested installations inherent in the structural design of the environment in which participants underwent emergency wayfinding, rather than signage established or activated by emergency responders in response to an MCE.</p>
<p>Galea, E. R., Xie, H., Deere, S., Cooney, D., & Filippidis, L. (2017). Evaluating the effectiveness. of an improved active dynamic signage system using full scale evacuation trials. <i>Fire Safety Journal</i>, 91, 908-917. doi:10.1016/j.firesaf.2017.03.022</p>	<p>The study does not meet the intervention criteria for this review: The study tested installations inherent in the structural design of the environment in which participants underwent emergency wayfinding, rather than signage established</p>

Citation	Exclusion Justification
	or activated by emergency responders in response to an MCE.
Girandola, F. (2000). Fear and persuasion: Review and re-analysis of the literature (1953-1998). <i>Annee Psychologique</i> , 100(2), 333-376.	The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.
Groeger, J. L., Stellman, S. D., Kravitt, A., & Brackbill, R. M. (2013). Evacuating damaged and destroyed buildings on 9/11: Behavioral and structural barriers. <i>Prehospital & Disaster Medicine</i> , 28(6), 556-566.	The study does not meet the intervention criteria for this review: No assessment of communication on behaviour, rather communication in general is mentioned as one of the behavioural barriers attributed to evacuation decisions.
Gutteling, J. M., & de Vries, P. W. (2017). Determinants of seeking and avoiding risk-related information in times of crisis. <i>Risk Analysis</i> , 37(1), 27-39.	The study does not meet the population/context criteria for this review.
Han, W., Ada, S., Sharman, R., & Rao, H. R. (2015). CAMPUS EMERGENCY NOTIFICATION SYSTEMS: AN EXAMINATION OF FACTORS AFFECTING COMPLIANCE WITH ALERTS. <i>Mis Quarterly</i> , 39(4), 909-+.	The study does not meet the intervention criteria for this review: The message used in the alerts was framed in the same way and the manner in which alerts were broadcast was the same in all incidents. The independent variables were characteristics of the message audience.
Horlick-Jones, T., & Prades, A. (2009). On interpretative risk perception research: Some reflections on its origins; its nature; and its possible applications in risk communication practice. <i>Health, Risk & Society</i> , 11(5), 409-430.	The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.
Huang, S.-K., Lindell, M. K., & Prater, C. S. (2016). Who leaves and who stays? A review and statistical meta-analysis of hurricane evacuation studies. <i>Environment and Behavior</i> , 48(8), 991-1029.	The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.
Ibrahim, N. H., & Allen, D. (2012). Information sharing and trust during major incidents: Findings from the oil industry. <i>Journal of the American Society for Information Science and</i>	The study does not meet the population/context criteria for this review: Participants were drawn from emergency response population/context.

Citation	Exclusion Justification
Technology, 63(10), 1916-1928. doi:10.1002/asi.22676	
Kellens, W., Terpstra, T., & de Maeyer, P. (2013). Perception and communication of flood risks: A systematic review of empirical research. <i>Risk Analysis</i> , 33(1), 24-49.	The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.
Kievik, M., & Gutteling, J. M. (2011). Yes, we can: motivate Dutch citizens to engage in self-protective behavior with regard to flood risks. <i>Natural Hazards</i> , 59(3), 1475-1490. doi:10.1007/s11069-011-9845-1	The study does not meet the intervention criteria for this review: The communication was aimed at promoting protective behaviour in the long-term rather than during an incident.
Kinaterder, M., Muller, M., Jost, M., Muhlberger, A., & Pauli, P. (2014). Social influence in a virtual tunnel fire-Influence of conflicting information on evacuation behavior. <i>Applied Ergonomics</i> , 45(6), 1649-1659.	The study does not meet the intervention criteria for this review: The communication intervention in this study was driven by a simulated casualty rather than a responder.
Knuth, D., Szymczak, H., Kuectiekbalaban, P., & Schmidt, S. (2016). Social Media in Emergencies How Useful Can They Be. In J. Pielorz, R. Duro, & A. Preinerstorfer (Eds.), <i>Proceedings of the 2016 3rd International Conference on Information and Communication Technologies for Disaster Management</i> (pp. 22-28).	The study does not meet the outcome criteria for this review: The outcome in this study was perceived usefulness of social media in emergencies.
Kostygina, G. Y. (2008). Mitigating chernobyl's lingering threat: What messages might motivate Ukraine's radiation-exposed youth to seek cancer screening tests? <i>Dissertation Abstracts International Section A: Humanities and Social Sciences</i> , 69(1-A), 15.	The dissertation does not meet the population/context criteria for this review: The focus is on the impact of communication on "young adults aged 20-27 who lived in the areas affected by fallout when they were children" (Kostygina, 2008, p.36) so there is no assessment of communication at the time of the emergency.
Kwee-Meier, S. T., Mertens, A., & Schlick, C. M. (2017). Age-related differences in decision-making for digital escape route signage under strenuous emergency	The study does not meet the intervention criteria for this review: The study tested installations inherent in the structural design of the environment in which participants underwent emergency wayfinding, rather than signage established

Citation	Exclusion Justification
conditions of tilted passenger ships. <i>Applied Ergonomics</i> , 59(Pt A), 264-273.	or activated by emergency responders in response to an MCE.
Lamontagne, M., & Flynn, B. W. (2014). Communications in the Aftermath of a Major Earthquake: Bringing Science to Citizens to Promote Recovery. <i>Seismological Research Letters</i> , 85(2), 561-565. doi:10.1785/0220130118	The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.
Lemyre, L., Johnson, C., & Corneil, W. (2010). Psychosocial considerations for mass decontamination. <i>Radiation Protection Dosimetry</i> , 142(1), 17-23.	The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.
Leykin, D., Aharonson-Daniel, L., & Lahad, M. (2016). Leveraging Social Computing for Personalized Crisis Communication using Social Media. <i>PLoS currents</i> , 8.	The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.
Lightstone, S. N., Swencionis, C., & Cohen, H. W. (2005). The effect of bioterrorism messages on anxiety levels. <i>International Quarterly of Community Health Education</i> , 24(2), 111-122.	The study does not meet the outcome criteria for this review: There is no behavioural outcome (outcomes were limited to anxiety, pessimism regarding uncontrollable events, and bioterrorism knowledge)
Lin, C.-C., Siebeneck, L. K., Lindell, M. K., Prater, C. S., Wu, H.-C., & Huang, S.-K. (2014). Evacuees' information sources and reentry decision making in the aftermath of Hurricane Ike. <i>Natural Hazards</i> , 70(1), 865-882. doi:10.1007/s11069-013-0853-1	The study does not meet the population/context criteria for this review: The focus of the study is on behaviour in the aftermath/recovery phase of a disaster rather than peri-MCE behaviour.
Lindell, M. K., & Perry, R. W. (2012). The protective action decision model: Theoretical modifications and additional evidence. <i>Risk Analysis</i> , 32(4), 616-632.	The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.
Lindell, M. K., Prater, C. S., Gregg, C. E., Apatu, E. J. I., Huang, S.-K., & Wu, H. C. (2015). Households' immediate Responses to the 2009 American Samoa Earthquake and Tsunami. <i>International Journal of Disaster Risk Reduction</i> , 12, 328-340. doi:10.1016/j.ijdr.2015.03.003	The study does not meet the population/context criteria for this review: The focus was on communication with the wider public rather than casualties in an MCE.

Citation	Exclusion Justification
<p>Liu, B. F., Fraustino, J. D., & Jin, Y. (2015). How disaster information form, source, type, and prior disaster exposure affect public outcomes: Jumping on the social media bandwagon? <i>Journal of Applied Communication Research</i>, 43(1), 44-65.</p>	<p>The study does not meet the population/context criteria for this review: The focus was on communication with the wider public rather than casualties in an MCE.</p>
<p>Liu, B. F., Fraustino, J. D., & Jin, Y. (2016). Social media use during disasters: How information form and source influence intended behavioral responses. <i>Communication Research</i>, 43(5), 626-646.</p>	<p>The study does not meet the population/context criteria for this review: The focus was on communication with the wider public rather than casualties in an MCE.</p>
<p>Liu, B. F., Quinn, S. C., Egnoto, M., Freimuth, V., & Boonchaisri, N. (2017). Public Understanding of Medical Countermeasures. <i>Health Security</i>, 15(2), 194-206.</p>	<p>The study does not meet the population/context criteria for this review: The focus was on communication with the wider public rather than casualties in an MCE.</p>
<p>Liu, Q., Zhou, H., Zhou, H., Yang, Y., Yang, X., Yu, L., . . . Ma, X. (2011). Health behaviors of victims and related factors in Wenchuan earthquake resettlement sites. <i>Annals of Epidemiology</i>, 21(3), 221-229.</p>	<p>The study does not meet the intervention criteria for this review.</p>
<p>Ma, X., & Yates, J. (2014). Optimizing social media message dissemination problem for emergency communication. <i>Computers & Industrial Engineering</i>, 78, 107-126. doi:10.1016/j.cie.2014.09.016</p>	<p>The paper does not meet study type criteria for this review: There are no original data.</p>
<p>MacLeod, A. (2014). The impact of communication on human behaviour in times of crisis. <i>Journal of Business Continuity & Emergency Planning</i>, 8(2), 134-140.</p>	<p>The paper does not meet study type criteria for this review: There are no original data.</p>
<p>Maxwell, T. A. (2003). The public need to know: emergencies, government organizations, and public information policies. <i>Government Information Quarterly</i>, 20(3), 233-258. doi:10.1016/s0740-624x(03)00039-x</p>	<p>The study does not meet the population/context criteria for this review: This is a study on communication with the wider public during an emergency, rather than communication with casualties at treatment area.</p>
<p>McComas, K. A. (2006). Defining Moments in Risk Communication Research: 1996-2005. <i>Journal of Health Communication</i>, 11(1), 75-91.</p>	<p>The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.</p>

Citation	Exclusion Justification
<p>Miller, L. (2010). On-scene crisis intervention: Psychological guidelines and communication strategies for first responders. <i>International Journal of Emergency Mental Health</i>, 12(1), 11-19.</p>	<p>The paper does not meet study type criteria for this review: There are no original data.</p>
<p>Mulilis, J. P., & Duval, T. S. (1995). NEGATIVE THREAT APPEALS AND EARTHQUAKE PREPAREDNESS - A PERSON-RELATIVE-TO-EVENT (PRE) MODEL OF COPING WITH THREAT. <i>Journal of Applied Social Psychology</i>, 25(15), 1319-1339. doi:10.1111/j.1559-1816.1995.tb02620.x</p>	<p>The study does not meet the intervention criteria for this review: The study is about long-term communication and emergency preparedness.</p>
<p>Mulilis, J.-P., & Duval, T. (1997). The PrE model of coping and tornado preparedness: Moderating effects of responsibility. <i>Journal of Applied Social Psychology</i>, 27(19), 1750-1766.</p>	<p>The study does not meet the intervention criteria for this review: The study is about long-term communication and emergency preparedness.</p>
<p>Mustafa, D., Gioli, G., Qazi, S., Waraich, R., Rehman, A., & Zahoor, R. (2015). Gendering flood early warning systems: the case of Pakistan. <i>Environmental Hazards-Human and Policy Dimensions</i>, 14(4), 312-328. doi:10.1080/17477891.2015.1075859</p>	<p>The study does not meet the intervention criteria for this review: There was no assessment of the effect of communication on casualties at the treatment area of an incident.</p>
<p>Nakai, F., Hatayama, M., & Yamori, K. (2015). Integrating Computer Simulation and the Fieldwork to Discover Possible Alternatives for Tsunami Evacuation. In T. X. Bui & R. H. Sprague (Eds.), 2015 48th Hawaii International Conference on System Sciences (pp. 200-207).</p>	<p>The study does not meet the intervention criteria for this review: The interview investigation which informs the behaviour rules in this simulation do not include an assessment of communication with the affected population.</p>
<p>Olsson, P. A., & Regan, M. A. (2001). A comparison between actual and predicted evacuation times. <i>Safety Science</i>, 38(2), 139-145. doi:10.1016/s0925-7535(00)00064-3</p>	<p>The study does not meet the intervention criteria for this review: Whilst there were differences between the three buildings in terms of evacuation alarm (siren, pre-recorded PA, live directive PA), there is no assessment by the authors of the effect of evacuation alarm type on pre-movement time lag or evacuation time. I contacted the author to request clarification but received no response.</p>

Citation	Exclusion Justification
<p>Paul, B. K. (2012). Factors Affecting Evacuation Behavior: The Case of 2007 Cyclone Sidr, Bangladesh. <i>Professional Geographer</i>, 64(3), 401-414. doi:10.1080/00330124.2011.609780</p>	<p>The study does not meet the intervention criteria for this review: There is an assessment of characteristics of the message audience but no explicit assessment of the message intervention.</p>
<p>Pearce, J. M., Rubin, G. J., Amlôt, R., Wessely, S., & Rogers, M. B. (2013). Communicating public health advice after a chemical spill: results from national surveys in the United Kingdom and Poland.[Erratum appears in <i>Disaster Med Public Health Prep</i>. 2013 Feb;7(1):112]. <i>Disaster Medicine & Public Health Preparedness</i>, 7(1), 65-74.</p>	<p>The study does not meet the population/context criteria for this review: This is a study on communication with the wider public during an emergency, rather than communication with casualties at treatment area.</p>
<p>Pearce, J. M., Rubin, G. J., Selke, P., Amlôt, R., Mowbray, F., & Rogers, M. B. (2013). Communicating with the public following radiological terrorism: Results from a series of focus groups and national surveys in Britain and Germany. <i>Prehospital & Disaster Medicine</i>, 28(2), 110-119.</p>	<p>The study does not meet the population/context criteria for this review: This is a study on communication with the wider public during an emergency, rather than communication with casualties at treatment area.</p>
<p>Pescaroli, G., & Magni, M. (2015). Flood warnings in coastal areas: how do experience and information influence responses to alert services? <i>Natural Hazards and Earth System Sciences</i>, 15(4), 703-714. doi:10.5194/nhess-15-703-2015</p>	<p>The study does not meet the population/context criteria for this review.</p>
<p>Peters, G.-J. Y., Ruiter, R. A. C., & Kok, G. (2013). Threatening communication: a critical re-analysis and a revised meta-analytic test of fear appeal theory. <i>Health Psychology Review</i>, 7, S8-S31. doi:10.1080/17437199.2012.703527</p>	<p>The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.</p>
<p>Proulx, G. (1995). EVACUATION TIME AND MOVEMENT IN APARTMENT BUILDINGS. <i>Fire Safety Journal</i>, 24(3), 229-246. doi:10.1016/0379-7112(95)00023-m</p>	<p>The study does not meet the intervention criteria for this review.</p>
<p>Rickard, L. N., Schuldt, J. P., Eosco, G. M., Scherer, C. W., & Daziano, R. A. (2017). The Proof is in the Picture: The Influence of Imagery and Experience in Perceptions of Hurricane Messaging. <i>Weather Climate and</i></p>	<p>The study does not meet the population/context criteria for this review: The study context is the early warning phase of a disaster.</p>

Citation	Exclusion Justification
Society, 9(3), 471-485. doi:10.1175/wcas-d-16-0048.1	
Ripberger, J. T., Silva, C. L., Jenkins-Smith, H. C., & James, M. (2015). The Influence of Consequence-Based Messages on Public Responses to Tornado Warnings. <i>Bulletin of the American Meteorological Society</i> , 96(4), 577-590. doi:10.1175/bams-d-13-00213.1	The study does not meet the intervention criteria for this review: The study is about protection behaviour on receipt of a warning rather than behaviour during an emergency to which responders have been deployed.
Robinette, P., Li, W., Allen, R., Howard, A. M., Wagner, A. R., & Acm. (2016). Overtrust of Robots in Emergency Evacuation Scenarios.	The study does not meet the intervention criteria for this review.
Rogers, M. B., Amlôt, R., & Rubin, G. J. (2013). The impact of communication materials on public responses to a radiological dispersal device (RDD) attack. <i>Biosecurity & Bioterrorism</i> , 11(1), 49-58.	The study does not meet the population/context criteria for this review: This is a study on communication with the wider public during an emergency, rather than communication with casualties at treatment area.
Roy, C., Sarkar, S. K., Aberg, J., & Kovordanyi, R. (2015). The current cyclone early warning system in Bangladesh: Providers' and receivers' views. <i>International Journal of Disaster Risk Reduction</i> , 12, 285-299. doi:10.1016/j.ijdr.2015.02.004	The study does not meet the intervention criteria for this review: No explicit assessment of the effect of communication variables on behaviour. The authors did find a connection between evacuation warning compliance and lack of trust or understanding in warning messages but there is no analysis of the characteristics of the messages and how these characteristics contributed to lack of understanding or trust.
Rubin, G. J., Chowdhury, A. K., & Amlôt, R. (2012). How to communicate with the public about chemical, biological, radiological, or nuclear terrorism: a systematic review of the literature. <i>Biosecurity & Bioterrorism</i> , 10(4), 383-395.	The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.
Rundblad, G., Knapton, O., & Hunter, P. R. (2010). Communication, perception and behaviour during a natural disaster involving a 'Do Not Drink' and a subsequent 'Boil	The study does not meet the population/context criteria for this review. Respondents were not casualties in an MCE but residents of an area in which crisis communication was implemented.

Citation	Exclusion Justification
Water ¹ notice: a postal questionnaire study. BMC Public Health, 10, 641.	
Rundblad, G., Knapton, O., & Hunter, P. R. (2014). The causes and circumstances of drinking water incidents impact consumer behaviour: Comparison of a routine versus a natural disaster incident. International Journal of Environmental Research & Public Health [Electronic Resource], 11(11), 11915-11930.	The study does not meet the population/context criteria for this review. Respondents were not casualties in an MCE but residents of an area in which crisis communication was implemented.
Sadri, A. M., Ukkusuri, S. V., & Gladwin, H. (2017). The Role of Social Networks and Information Sources on Hurricane Evacuation Decision Making. Natural Hazards Review, 18(3). doi:10.1061/(asce)nh.1527-6996.0000244	The study does not meet the population/context criteria for this review.
Saha, S. K., & James, H. (2017). Reasons for non-compliance with cyclone evacuation orders in Bangladesh. International Journal of Disaster Risk Reduction, 21, 196-204. doi:10.1016/j.ijdrr.2016.12.009	The study does not meet the population/context criteria for this review.
Savoia, E., Lin, L., & Viswanath, K. (2013). Communications in public health emergency preparedness: a systematic review of the literature. Biosecurity & Bioterrorism, 11(3), 170-184.	The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.
Savoia, E., Stoto, M. A., Gupta, R., Wright, N., & Viswanath, K. (2015). Public response to the 2014 chemical spill in West Virginia: knowledge, opinions and behaviours. BMC Public Health, 15, 790.	The study does not meet the population/context criteria for this review: This is a study on communication with the wider public during an emergency, rather than communication with casualties at treatment area.
Sellnow, D. D., Lane, D. R., Sellnow, T. L., & Littlefield, R. S. (2017). The IDEA Model as a Best Practice for Effective Instructional Risk and Crisis Communication. Communication Studies, 68(5), 552-567. doi:10.1080/10510974.2017.1375535	The study does not meet the population/context criteria for this review.

Citation	Exclusion Justification
<p>Sharma, U., Patwardhan, A., & Parthasarathy, D. (2009). Assessing adaptive capacity to tropical cyclones in the East coast of India: a pilot study of public response to cyclone warning information. <i>Climatic Change</i>, 94(1-2), 189-209. doi:10.1007/s10584-009-9552-z</p>	<p>The study does not meet the population/context criteria for this review.</p>
<p>Sharp, E. A., Thwaites, R., Curtis, A., & Millar, J. (2013). Factors affecting community-agency trust before, during and after a wildfire: an Australian case study. <i>Journal of Environmental Management</i>, 130, 10-19.</p>	<p>The study does not meet the outcome criteria for this review: The focus of the study was on participants' trust in authorities, which is an attitudinal outcome, and there was formal assessment of the impact of communication on reported behaviour.</p>
<p>Sherman-Morris, K., & Lea, A. M. (2016). An Exploratory Study of the Influence of Severe Weather Radar Broadcasts. <i>Journal of Operational Meteorology</i>, 4(8), 108-122. doi:10.15191/nwajom.2016.0408</p>	<p>The study does not meet the population/context criteria for this review.</p>
<p>Silver, A., & Matthews, L. (2017). The use of Facebook for information seeking, decision support, and self-organization following a significant disaster. <i>Information Communication & Society</i>, 20(11), 1680-1697. doi:10.1080/1369118x.2016.1253762</p>	<p>The study does not meet the population/context criteria for this review.</p>
<p>Spence, P. R., Lachlan, K. A., Westerman, D., Lin, X., Harris, C. J., Sellnow, T. L., & Sellnow-Richmond, D. D. (2017). Exemplification effects: responses to perceptions of risk. <i>Journal of Risk Research</i>, 20(5), 590-610. doi:10.1080/13669877.2015.1100658</p>	<p>The study does not meet the population/context criteria for this review.</p>
<p>Spence, P. R., Lachlan, K., Burke, J. M., & Seeger, M. W. (2009). Media use and information needs of the disabled during a natural disaster. Brennan, Virginia M [Ed] (2009) <i>Natural disasters and public health: Hurricanes Katrina, Rita, and Wilma</i> (pp 180-190) xi, 311 pp Baltimore, MD, US: Johns Hopkins University Press; US, 180-190.</p>	<p>The study does not meet the intervention criteria for this review.</p>

Citation	Exclusion Justification
<p>Strawderman, L., Salehi, A., Babski-Reeves, K., Thornton-Neaves, T., & Cosby, A. (2012). Reverse 911 as a Complementary Evacuation Warning System. <i>Natural Hazards Review</i>, 13(1), 65-73. doi:10.1061/(asce)nh.1527-6996.0000059</p>	<p>The study does not meet the population/context criteria for this review: The focus is on crisis warning communication rather than communication with casualties in an MCE.</p>
<p>Stubbe, H., van Emmerik, M., & Kerstholt, J. (2017). Helping behavior in a virtual crisis situation: Effects of safety awareness and crisis communication. <i>Journal of Risk Research</i>, 20(4), 433-444.</p>	<p>The study does not meet the population/context criteria for this review: Participants were bystanders rather than casualties.</p>
<p>Sugerman, D. E., Keir, J. M., Dee, D. L., Lipman, H., Waterman, S. H., Ginsberg, M., & Fishbein, D. B. (2012). Emergency health risk communication during the 2007 San Diego wildfires: Comprehension, compliance, and recall. <i>Journal of Health Communication</i>, 17(6), 698-712.</p>	<p>The study does not meet the population/context criteria for this review: The focus is on crisis warning communication rather than communication with casualties in an MCE.</p>
<p>Sullivan, H. T., Hakkinen, M. T., & Piechocinski, D. (2009). Improving Participation, Accessibility and Compliance for Campus-Wide Mobile Emergency Alerting Systems. In J. Loffler & M. Klann (Eds.), <i>Mobile Response</i> (Vol. 5424, pp. 32-40).</p>	<p>The paper does not meet study type criteria for this review: There are no original data.</p>
<p>Sutton, J., Gibson, C., Spiro, E. S., League, C., Fitzhugh, S. M., & Butts, C. T. (2015). What it takes to get passed on: Message content, style, and structure as predictors of retransmission in the Boston Marathon Bombing response. <i>PLoS ONE</i> Vol 10(8), Aug 2015, ArtID e0134452, 10(8).</p>	<p>The study does not meet the population/context criteria for this review: There is an assessment on the effect of aspects of tweets (e.g. thematic analysis of tweet content) originating from official accounts of message retransmission (re-tweeting) though this behaviour will have been measured in the wider public as well the affected public because there is no statement that retransmission measures were limited to the affected population/context</p>
<p>Sutton, J., Spiro, E. S., Johnson, B., Fitzhugh, S., Gibson, B., & Butts, C. T. (2014). Warning tweets: Serial transmission of messages during the warning phase of a disaster event.</p>	<p>The study does not meet the population/context criteria for this review: The authors specify that tweets from "non-locals...online observers or others with an interest in helping in some form" (p. 783)</p>

Citation	Exclusion Justification
Information, Communication & Society, 17(6), 765-787.	are also incorporated in the number of retweets measured.
Sutton, J., Vos, S. C., Wood, M. M., & Turner, M. (2018). Designing Effective Tsunami Messages: Examining the Role of Short Messages and Fear in Warning Response. <i>Weather Climate and Society</i> , 10(1), 75-87. doi:10.1175/wcas-d-17-0032.1	The study does not meet the population/context criteria for this review: The focus is on crisis warning communication rather than communication with casualties in an MCE.
Taylor-Clark, K. A., Viswanath, K., & Blendon, R. J. (2010). Communication inequalities during Public Health disasters: Katrina's wake. <i>Health Communication</i> , 25(3), 221-229.	The study does not meet the intervention criteria for this review.
The problem of panic. (1955). <i>Civil Defense Technical Bulletin</i> , TB-19-2, 8.	The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.
Tian, X., Zhao, G., Cao, D., Wang, D., & Wang, L. (2016). Health education and promotion at the site of an emergency: experience from the Chinese Wenchuan earthquake response. <i>Global Health Promotion</i> , 23(1), 15-26.	The study does not meet the intervention criteria for this review: The study is about long-term communication.
Vermeulen, K. (2014). Understanding Your Audience: How Psychologists Can Help Emergency Managers Improve Disaster Warning Compliance. <i>Journal of Homeland Security and Emergency Management</i> , 11(3), 309-315. doi:10.1515/jhsem-2014-0055	The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.
Verroen, S., Gutteling, J. M., & de Vries, P. W. (2013). Enhancing self-protective behavior: Efficacy beliefs and peer feedback in risk communication. <i>Risk Analysis</i> , 33(7), 1252-1264.	The study does not meet the population/context criteria for this review. Participants were not hypothetical casualties in an MCE but hypothetical residents of an area in which crisis communication was implemented.
Vilar, E., Rebelo, F., Noriega, P., Duarte, E., & Mayhorn, C. B. (2014). Effects of competing environmental variables and signage on route-choices in simulated everyday and emergency wayfinding situations. <i>Ergonomics</i> , 57(4), 511-524.	The study does not meet the intervention criteria for this review: The study tested installations inherent in the structural design of the environment in which participants underwent emergency wayfinding, rather than signage established

Citation	Exclusion Justification
	or activated by emergency responders in response to an MCE.
<p>Wei, R., Lo, V.-H., Lu, H.-Y., & Hou, H.-Y. (2015). Examining multiple behavioral effects of third-person perception: Evidence from the news about Fukushima nuclear crisis in Taiwan. <i>Chinese Journal of Communication</i>, 8(1), 95-111. doi:10.1080/17544750.2014.972422</p>	<p>The study does not meet the population/context criteria for this review.</p>
<p>Williams, D. J., & Noyes, J. M. (2007). How does our perception of risk influence decision-making? Implications for the design of risk information. <i>Theoretical Issues in Ergonomics Science</i>, 8(1), 1-35.</p>	<p>The study is a review and therefore does not meet the study type criteria for this review. Citations were searched.</p>
<p>Wilson, N., McIntyre, M., McDonald, M., Tanner, H., Hart, K., Tomlinson, R., . . . Bibby, S. (2005). Communication and health protection issues arising from a flooding emergency. <i>Prehospital & Disaster Medicine</i>, 20(3), 193-196.</p>	<p>The study does not meet the intervention criteria for this review: There is no explicit assessment of the effect of communication variables on behaviour.</p>
<p>Wong, D. J., Jones, E., & Rubin, G. J. (2018). Mobile text alerts are an effective way of communicating emergency information to adolescents: Results from focus groups with 12-to 18-year-olds. <i>Journal of Contingencies and Crisis Management</i>, 26(1), 183-192. doi:10.1111/1468-5973.12185</p>	<p>The study does not meet the population/context criteria for this review.</p>
<p>Yen, M. Y., Wu, T. S., Chiu, A. W., Wong, W. W., Wang, P. E., Chan, T. C., & King, C. C. (2009). Taipei's use of a multi-channel mass risk communication program to rapidly reverse an epidemic of highly communicable disease. <i>PLoS ONE [Electronic Resource]</i>, 4(11), e7962.</p>	<p>The study does not meet the population/context criteria for this review.</p>
<p>Zhu, D., Xie, X., & Gan, Y. (2011). Information source and valence: How information credibility influences earthquake risk perception. <i>Journal of Environmental</i></p>	<p>The study does not meet the outcome criteria for this review: There is no behavioural outcome</p>

Citation	Exclusion Justification
Psychology, 31(2), 129-136. doi:10.1016/j.jenvp.2010.09.005	
Zimmerman, R., & Sherman, M. F. (2011). To leave an area after disaster: How evacuees from the WTC buildings left the WTC area following the attacks. Risk Analysis, 31(5), 787-804.	The study does not meet the intervention criteria for this review: There is no explicit assessment of the effect of communication variables on behaviour.

Appendix C: Text from recruitment email that participants received prior to first responder interview study (Chapter 4)

We are a group of researchers from Public Health England and King's College London who are conducting a series of interviews with responders on communication during emergency mass casualty decontamination. This study is being conducted as part of the principal investigator's PhD project. The study is part of a project funded by the Department of Health. The study has been approved by the Psychiatry, Nursing and Midwifery Research Ethics Subcommittee at King's College London (reference number: LRS-15/16-3406).

We are writing to you because you have been trained in decontamination procedures, e.g. IOR, for CBRN or HazMat incidents.

The study consists of an interview (maximum duration of one hour) in which we will discuss any training and real-life experience that you may have regarding casualty management, specifically communication, during decontamination operations. We anticipate that information about your experiences will help us understand and improve communication strategies for agencies involved in mass casualty decontamination.

Participation is voluntary. All information will be kept completely confidential. Whilst your employer is aware that staff in your organisation are taking part in this study, no participants will be personally identified.

Please read the attached information sheet for more information about this research. If you would like to take part in this study, please complete the attached consent form and return it to charles.symons@kcl.ac.uk.

If you have any questions, please email charles.symons@kcl.ac.uk.

Appendix D: Discussion guide for first responder interview study (Chapter 4)

One interviewer conducted all of the interviews and used this schedule for all interviews so that the data collection method was consistent. Comments in italics are instructions for the interviewer which were not read aloud.

The following was a guide for discussion. Not all questions were presented to all interviewees, only the relevant questions were asked –based on interviewees’ responses. Answers to questions in this schedule may be volunteered without prompting, in which case it would not be necessary for the question to be asked. For example, if an interviewee responds to one of the initial questions with a question about what they would say when asking casualties to disrobe, it would not be necessary to ask the questions on this guide about disrobing. When asking what responders say to casualties, the interviewer prompted for specific examples of what they would say or what they have said to casualties.

Introduction to interview

The recording device is currently switched off. Before I outline the purpose of this interview, please could you confirm that you are not in a public place and that there is no one in earshot? If you are in a public place, please confirm that you are happy to continue with the interview. *Wait for clarification*

My name is Charles Symons and I am the principal investigator for this project. I am a PhD student based at King’s College London and Public Health England and this project is funded by the Department of Health Policy Research Programme.

Please confirm that you have read the information sheet and signed the consent form
Wait for clarification

Please confirm that you are free for the next hour to take part in this interview? *Wait for clarification*

During the interview I’m going to be asking you questions about what you would say to casualties who need to be decontaminated in an incident involving contamination, such as a chemical incident. We’ll be focusing on the Initial Operational Response procedures and things you would say to casualties during this type of response. We won’t focus on decontamination in purpose-built units such as MD1 units. We are interested in how you would engage with casualties in an operational capacity based on your training and your experiences. The interview shouldn’t take more than an hour. Just to reassure you, this isn’t a test and we are not after any “right” answer. We just want to find out what really happens on the ground. Do you have any questions before we get started? *Proceed if there are no questions*

I am about to switch on the recording device.

- *Start recording*

We are recording.

- *State the following information at the start of the recording:*
 - *Study title*
 - *Date and time*
 - *Researcher name*
 - *Participant's unique ID number*

Experience

- Before we go into specifics, I want to know more about your experiences in CBRN and HazMat and which type of emergency service organisation you work for. *[Expand acronyms if prompted]*.
- Have you been part of a response team for an incident where one or more casualties had to be decontaminated in some way, e.g. evacuation, clothing removal, dry decontamination, improvised wet decontamination or MD1 showering?
 - How long ago was the last incident to which you responded?
 - What type of incident was it? What was the contaminant?
 - What decontamination protocol or protocols did you follow? What steps did you take?
 - To how many incidents involving some kind of decontamination, approximately, have you responded in your career to date?
- Have you received training in CBRN or HazMat decontamination?
 - Have you specifically received training in IOR?
 - Did this training involve guidance on how to communicate with casualties?
- Does your service have a guide/script for what to say to casualties and are you trained to follow the guide to the letter?

Arrival at scene

- When you arrive on scene, having established that IOR needs to be followed, could you describe how you would go about communicating with casualties?
 - How do you talk to casualties who need to be decontaminated? Do you approach them and start speaking or is there someone in the team who communicates from a distance?
 - How do you decide who speaks to casualties?
- Does your organisation provide you with equipment/materials/technology for communicating with casualties?
- Can you think of anything –any kind of equipment, technology etc. -that would make it easier to communicate with casualties?
- What is the first thing you say to casualties? And what effect does it usually have?
 - Thinking back to the incident you previously described, what did you say to casualties when you arrived on the scene in the last incident? And what effect did it have?

Disrobing

- Have you ever had to instruct a casualty to remove contaminated clothing?
 - Did they have to remove the clothing themselves or was the clothing removed by responders?
 - If they had to remove the clothing themselves, what did you say to them? And what happened when you said it?
 - Is that typical of what you would say in an incident where casualties are required to remove their clothing?

- Did they have any questions and, if so, how did you respond to these questions?
- Have casualties ever refused to disrobe and, if so, what did you say to them?
- Do you have anything that you carry on the vehicle that could be used to make it easier for casualties to disrobe?
 - Do these provisions include instructions for casualties?

Dry decontamination

- Are you trained to carry out dry decontamination with absorbent materials and have you ever had to carry out dry decontamination in a real incident?
 - Are casualties required to perform dry decontamination themselves? Do they use the absorbent materials or do you apply the absorbent materials to them?
 - Can you talk me through what you said to casualties in the last incident where casualties had to carry out dry decontamination on themselves?
 - How typical is that of what you would normally say in an incident involving dry decontamination?
 - What effect did it have when you said that? Did they co-operate? Did they have further questions and, if so, how did you answer their questions?

Improvised wet decontamination

- Are you trained to carry out improvised wet decontamination? And can you talk me through any incidents you can recall where you used improvised wet decontamination? How did you do wet decontamination?
 - Can you talk me through what you said to casualties in the last incident where casualties had to undergo improvised wet decontamination? And how typical is that of what you would normally say in an incident involving wet decontamination?
 - What effect did it have when you said that? Did they co-operate? Did they have further questions and, if so, how did you answer their questions?

Asking casualties to remain in place

- Have you ever been in a situation where casualties had to wait a long time for specialist resources, like MD1 units, to arrive?
 - What do you normally say to casualties when you need them to remain where they are for an unknown amount of time?
- Have casualties ever refused to co-operate or threatened to leave the scene and, if so, what did you say to them?
 - What effect did it have when you said that?
- *[If they have not had to communicate with a noncompliant casualty]* What do you expect you would say to a casualty who is not co-operating?

Summary

- Based on what we've discussed today, this is how I would imagine you would approach a casualty from start to finish in a real incident *[Run through notes in*

the order written on template appended to this document]. Please let me know if this is an accurate reflection of how you communicate with casualties and if I've missed anything or if there's anything you would add.

- In my PhD, I am going to developing and testing a new strategy for talking to casualties about decon. Is there anything you think would be particularly useful or interesting to include in that?

This marks the end of the interview. Thank you for your time.

Appendix E: Ethical approval for first responder interview study (Chapter 4)

Research Ethics
Office

Franklin Wilkins Building
5.9 Waterloo Bridge Wing
Waterloo Road
London SE1 9NH
Telephone 020 7848 4020/4070/4077
rec@kcl.ac.uk



Charles Symons

3 August 2016

Dear Charles

LRS-15/16-3406 - Interview study of responders' use of communication during mass casualty decontamination

I am pleased to inform you that full approval for your project has been granted by the PNM Research Ethics Panel

- Ethical approval is granted for a period of **three years** from 3 August 2016 . You will not receive a reminder that your approval is about to lapse. It is your responsibility to apply for an extension prior to the project lapsing.
- You should report any untoward events or unforeseen ethical problems to the panel Chair, via the Research Ethics Office, within a week of occurrence.
- Information about the panel may be accessed at:
<http://www.kcl.ac.uk/innovation/research/support/ethics/committees/ssh/reps/index.aspx>

If you wish to change your project or request an extension of approval, please complete and submit a Modification Request to crec-lowrisk@kcl.ac.uk. Please quote your ethics reference number, found at the top of this letter, in all correspondence with the Research Ethics Office. Details of how to complete a modification request can be found at:

<http://www.kcl.ac.uk/innovation/research/support/ethics/applications/modifications.aspx>

All research should be conducted in accordance with the King's College London *Guidelines on Good Practice in Academic Research* available at:

<http://www.kcl.ac.uk/college/policyzone/assets/files/research/good%20practice%20SEPT%2009%20FINAL.pdf>

Please note that we may, for auditing purposes, contact you to ascertain the status of your research.

We wish you every success with your research.

Best wishes,

PNM Research Ethics Panel REP Reviewers

Appendix F: Participant information sheet for first responder interview study (Chapter 4)

INFORMATION SHEET FOR PARTICIPANTS

REC Reference Number: LRS-15/16-3406

Interview study of responders' use of communication during mass casualty decontamination

We are a group of researchers from Public Health England (PHE) and King's College London (KCL) who are conducting a series of interviews with responders on communication during emergency mass casualty decontamination for incidents involving the release of hazardous Chemical, Biological, Radiological or Nuclear (CBRN) material. This study is being conducted as part of the principal investigator's PhD project. We would like to invite you to take part in an interview in which we will discuss any training and experience you may have in communicating with casualties during emergency decontamination.

What is the purpose of the study?

This research is being conducted to better understand the processes by which emergency responders currently communicate information to casualties during emergency decontamination. Information about your experiences will help us to understand and improve communication strategies for mass casualty decontamination.

Why have I been invited to take part?

You have been invited to take part because you may have received training in the management of casualties during emergency decontamination.

What will happen to me if I take part?

If you decide you would like to take part, you will be asked to complete, sign, and return the consent form which accompanies this information sheet. Once we receive the completed consent form, we will contact you to arrange the interview for a date and time which is convenient for you.

The interview will last no longer than one hour. The interview will either take place in person at PHE, Porton Down (near Salisbury) or over the telephone (the contact number will be provided). The interview will be recorded on an audio device and you will be notified when the recording device is switched on. On completion of the interview, the audio recording will be transferred to a restricted access folder on encrypted PHE servers. The recording will be completely

removed from the recording device itself. Only the immediate research team will have access to the folder in which the recording is stored. The recording will be transcribed by the principal investigator, a member of the research team, or an external agency (a confidentiality agreement will be in place between the third party transcribing agency and the research team to ensure confidentiality of any potentially identifiable data). Interview transcripts will be stored on a restricted access folder on encrypted PHE servers.

The transcript of your interview may be available to other researchers who are affiliated with the research team. No personally identifiable information will be available to these researchers.

What are the possible benefits and risks of taking part?

There are no anticipated risks associated with taking part in this study. We do not expect that you will experience any direct benefits from taking part in this study. However, we hope you will find the experience of participating in the study interesting and the outcomes of this study will be used to inform guidance for emergency responders.

Will my taking part be kept confidential?

Audio recordings and transcripts of interviews will be kept in a restricted access folder on encrypted PHE servers. No identifying details, e.g. consent forms with your name on it, will be kept alongside either audio recordings or transcripts so you will not be recognised from them. At no point in the interview will you be identified by name. You will be given a pseudonym within the transcript and will not be named at any point during the write-up. Any potential identifying details (e.g. age) will not be used in the write-up. We will be publishing direct quotes from participants, but none that could identify who said them. Your data will be archived for up to 7 years and may be used in subsequent research. Whilst your employer is aware that staff in your organisation are taking part in this study, no participants will be personally identified.

Do I have to take part?

No. Participation is entirely voluntary. It is up to you to decide whether or not you would like to take part. We recommend you take a minimum of 24 hours to consider the information in this document before completing the consent form. Taking part will have no bearing on your employment. If you decide to take part you will still be free to withdraw your data without providing a reason. On completion of the interview, you are free to withdraw your responses without providing a reason by contacting the research team using the contact details at the end of this document. However, data withdrawal requests can only be fulfilled if the request is made before the data have been analysed. If the study causes any distress, you can contact the research team using the contact details at the end of this document for further advice and information.

How is the project being funded?

This project is part of a PhD studentship funded by the Department of Health Policy Research Programme.

What will happen to the results of the study?

The results of the study will be published in the principal investigator's PhD thesis. Results will also be published in an internal report submitted to the Department of Health, which funds this study. Outcomes from this study may also be used in academic journals and in oral and poster presentations at academic and industry conferences and internal workshops. Quotations from your interview may be used illustratively but it will not be possible to identify interviewees from quotes. You will be provided with a summary of the results on completion of the study.

Who should I contact for further information?

If you have any questions or require more information about this study, please contact me using the following contact details:

Charles Symons
Department of Psychological Medicine,
Weston Education Centre,
Cutcombe Road,
London SE5 9RJ
charles.symons@kcl.ac.uk

What if I have further questions, or if something goes wrong?

If this study has harmed you in any way or if you wish to make a complaint about the conduct of the study you can contact King's College London using the details below for further advice and information:

Dr James Rubin
Department of Psychological Medicine,
Weston Education Centre,
Cutcombe Road,
London SE5 9RJ
gideon.rubin@kcl.ac.uk
020 7848 5684

Thank you for reading this information sheet and for considering taking part in this research. Please keep a copy of this information sheet for your records.

Appendix G: Participant consent form for first responder interview study (Chapter 4)

Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research.

Title of Study: Interview study of responders' use of communication during mass casualty decontamination

King's College Research Ethics Committee Ref: *LRS-15/16-3406*

Thank you for considering taking part in this research. The person organising the research must explain the project to you before you agree to take part. If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

If you agree with each of the statements below, please check the adjacent grey box by left-clicking the box then changing the default value from 'not checked' to 'checked'.

I confirm that I understand that by checking each box I am consenting to this element of the study. I understand that it will be assumed that unchecked boxes mean that I DO NOT consent to that part of the study. I understand that by not giving consent for any one element I may be deemed ineligible for the study.

- 1. I confirm that I have read and understood the information sheet dated 19/07/2016 (version 1.1) for the above study. I have had the opportunity to consider the information and to ask questions. If I have asked questions, they have been answered satisfactorily.**

- 2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason. Furthermore, I understand that I will be able to withdraw my data up to the point at which the data have been analysed.**

- 3. I consent to the processing of my personal information for the purposes explained to me. I understand that such information will be handled in accordance with the terms of the UK Data Protection Act 1998.**

4. I understand that my information may be subject to review by responsible individuals from the College for monitoring and audit purposes.
5. I understand that confidentiality and anonymity will be maintained and it will not be possible to identify me in any publications.
6. I consent to my interview being audio recorded.
7. I understand that my responses will be used in an internal report to the Department of Health and in the principal investigator's PhD thesis and may be included in publications in academic journals and in oral and written presentations at academic and industry workshops and conferences.
8. I understand that the recording of my interview may be transcribed by a third party agency but that a confidentiality agreement will be in place between the transcribing company and the research team to ensure confidentiality of any potentially identifiable data.
9. I understand that the transcript of my interview may be analysed in subsequent, related studies but no personally identifiable information will be available to the researchers running these studies

Please enter your full name and today's date (dd/mm/yyyy) below then return this form electronically to charles.symons@kcl.ac.uk

Name:

Date:

Appendix H: Covering letter sent to Technical Advisory Group consisting of emergency response policy and toxicology experts who reviewed the expert model influence diagram (Chapter 5)

Hi all,

I'm a PhD student attached to Work Package 7 of the PHOENIX project. The aim of WP7 is to determine an optimum communication messaging intervention to be used by the first responder on scene during IOR and then test it in intervention trials.

As part of the intervention development stage, I am interviewing participants recruited from lay populations (specifically, people with no pre-existing expertise in skin toxicology, CBRN, or decontamination) and discussing their knowledge of chemical contamination. The purpose of these interviews is to identify trends in participants' thought processes and to identify a non-expert mental model of the subject that will inform the communication intervention. In order to plot a non-expert mental model, I need to begin with an initial visual representation of decontamination which I will later annotate with the results of the interview study. To that end, I have drafted the attached influenced diagram.

I would really appreciate it if you could review the attached diagram, focusing only on the text (I anticipate the design will change when I change the wording following this review process). After looking at the wording in the diagram, please could you let me know:

1. Is it an accurate representation of the current status of UK decontamination guidelines for chemical incidents?
2. Is the information accurate from a toxicological standpoint?
3. Are there any glaring omissions from a practitioner/policy or toxicological standpoint (for example, I do not devote much space to respiratory exposure in this draft)?
4. Any other feedback

Once there's feedback available, I will amend the diagram and re-circulate for final approval.

Appendix I: Discussion guide for non-expert mental models interview study (Chapter 5)

The following is a guide for discussion. Not all questions will be presented to all interviewees, only the relevant questions will be asked –based on interviewees’ responses. Answers to questions in this schedule may be volunteered without prompting, in which case it would not be necessary for the question to be asked. After every assertion, ask how (if relevant) and why. Comments in italics are instructions for the interviewer and are not to be read aloud.

Introduction to interview

The recording device is currently switched off. If you are in a public place or there is anyone in earshot, please let me know if you are happy to continue with the interview.
Wait for clarification

My name is Charles Symons and I am the principal investigator for this project. I am a PhD student based at King’s College London and Public Health England and this project is funded by the Department of Health Policy Research Programme.

I have received your consent form. Just to reiterate, you are under no obligation to participate and you are free to withdraw from the interview at any time without having to provide any reason. During the interview I’m going to be asking you questions about your understanding of chemical contamination. Please answer questions honestly. This is not a test and I am not interested in right or wrong answers. I want to know what and how you currently think about this subject. This will help me to understand people’s actual thought processes about the subject, as opposed to how we would expect people to think about the subject.

Some of the questions I ask may sound like unnecessary questions but it is important that I ask these questions because it will help me to understand how you think about the subject rather than what you think. To that end, I will often ask you follow-up questions when you answer a question. This is to make sure I don’t miss anything about your thought process.

During the course of the interview, please do not refer to any personally identifiable information, for example your name or address.

Do you have any questions before we get started? *Proceed if there are no questions*

I am about to switch on the recording device.

- *Start recording*

We are recording.

- *State the following information at the start of the recording:*

- *Study title*
- *Date and time*
- *Researcher name*
- *Participant's unique ID number*

Demographic Questions

- Before we begin, I have some demographic questions. If there are any demographic questions you do not want to answer, please respond with "prefer not to say"

- Can I ask for your age?
- What is your gender identity?
- What is your highest education qualification achieved to date? If you are currently enrolled on a course, what qualification is it?
Probe for subject if the qualification is undergraduate degree or higher
- What is your current occupation?
- What is your nationality and first language?
- How would you describe your ethnic group or background?

Options

White

1. *English / Welsh / Scottish / Northern Irish / British*
2. *Irish*
3. *Gypsy or Irish Traveller*
4. *Any other White background, please describe*

Mixed / Multiple ethnic groups

5. *White and Black Caribbean*
6. *White and Black African*
7. *White and Asian*
8. *Any other Mixed / Multiple ethnic background, please describe*

Asian / Asian British

9. *Indian*
10. *Pakistani*

11. *Bangladeshi*

12. *Chinese*

13. *Any other Asian background, please describe*

Black / African / Caribbean / Black British

14. *African*

15. *Caribbean*

16. *Any other Black / African / Caribbean background, please describe*

Other ethnic group

17. *Arab*

18. *Any other ethnic group, please describe*

- Do you have a religion?

Options

1. *No religion*

2. *Christian (including Church of England, Catholic, Protestant and all other Christian denominations)*

3. *Buddhist*

4. *Hindu*

5. *Jewish*

6. *Muslim*

7. *Sikh*

8. *Any other religion, please describe*

- Tell me what you already know about chemical contamination
 - Can you think of any examples of chemical substances that may be hazardous to your health?
 - How do you know if you have a chemical on you?
 - Why do you think that?
 - How would [*perceived effect*] happen?
 - Are you familiar with chemical warfare agents and toxic industrial chemicals and what do you know about them?
 - What happens when you are exposed to a hazardous chemical?
 - What happens in the long-term?
 - If you don't get an immediate effect, do you have anything to worry about?
 - Is there anything else you know about chemical contamination that you have not already mentioned?

I am now going to read you a scenario and I would like you to imagine that you are in this situation: You are standing in the middle of a queue for an automated ticket machine at a crowded train station. The weather is mild with no wind or rain. You are travelling alone and you have never been to this station before. Suddenly, you hear the following announcement on an overhead speaker: "Due

to a reported emergency, all passengers must leave the station immediately. Go to the nearest exit.” You join the crowd of people walking towards the nearest exit. You hear the announcement again: “Due to a reported emergency, all passengers must leave the station immediately. Go to the nearest exit.” You follow the crowd outside the station. You are now standing on a street among roughly 100 people. In the distance, you can see a police van with blue lights flashing.

- What would you be thinking at this point?
 - Why would you be thinking that?
 - Anything else?

- What is the first thing you would do at this point?
 - Why would you do that?/Why is that?
 - What would happen if you did that?
 - What if the authorities (for example police, firefighters, ambulance crew) did not allow you to do that?
 - Anything else?

- If no one told you and all the people around you that you had all been exposed to a hazardous chemical, do you think you would know whether you have been exposed to a hazardous chemical in this scenario?
 - How would you know?
 - In what way would you be contaminated?
 - What do you think would happen to you if you were contaminated?
 - Why do you think that?
 - What would you do if you thought that?
 - What effect would that have?
 - Anything else?

- Assuming you knew for certain that you and the people around you had been exposed to a hazardous chemical because of *[perceived indication]* or you could hear and see other people *[perceived indication]* or you were informed by the authorities that you are contaminated, what is the first thing you would do?
 - Why would you do that?
 - How would you do that?
 - What effect would that have?
 - Would it matter who told you that you were contaminated or the manner in which they tell you?
 - What if the authorities (for example police, firefighters, ambulance crew) did not allow you to do that?
 - Is there anything that would make it harder for you to do that?
 - **What else would you do?**
 - What if it was on your skin?
 - What else would you do if you knew your skin had been exposed?

Only ask the following questions if the participant has not already addressed them without prompting and they have been given the opportunity to raise it without prompting

- If you were told by the authorities to remain in place until further notice, what would you do?
 - Why would you do that?
 - What would happen if you did that?
 - Is there anything that would make it harder for you to do that?

- Would you remove any clothing if you knew that you had been exposed to a hazardous chemical?
 - Why would you do that?
 - How much clothing would you remove, assuming you were wearing two layers of upper body clothing?
 - Talk me through how you would remove your clothing to protect yourself from contamination
 - Why would you do it that way?
 - If it were dangerous to remove the clothing by lifting it over your head, talk me through how you would remove it
 - Is there anything you can think of that would make it harder for you to remove clothing?
 - What if you were told by the authorities to remove clothing?
 - Does it matter who tells you?

- If there were absorbent materials available, for example tissue paper or cloths, would you use those to protect yourself?
 - What kind of absorbent materials would you use?
 - Why would you use them?
 - Talk me through how you would use [*stated materials*] in this situation
 - Why would you do it that way?
 - How would that protect you?
 - Is there anything you can think of that would make it harder for you to use absorbent materials?
 - What if you were told by the authorities to use absorbent materials on exposed skin?
 - Does it matter who tells you?

- If there was water available, for example bottles of water or fire hoses that were spraying water, would you wash yourself?
 - Why would you wash yourself?
 - Why would you use water instead of using dry materials?
 - Talk me through how you would wash yourself?
 - Why would you do it that way?
 - How would that protection you?
 - Is there anything you can think of that would make it harder for you to wash yourself?
 - What if you were told by the authorities to wash yourself?
 - Does it matter who tells you?

- Assuming everything that we have discussed has taken place, what would you do next?
 - Why would you do that?
 - Is there anything that would make it harder for you to do that?
 - Anything else?

- If, after everything we have discussed has taken place, you were told by the authorities to remain in place until further notice, what would you do?
 - Why would you do that?
 - Is there anything that would make it harder for you to do that?
 - What if you were told you were waiting for decontamination facilities to arrive?

- Thinking back to the scenario, if, after leaving the train station, you were to leave and go home, what would the consequences be if you had been exposed to a hazardous chemical?
 - What would the consequences be for you?
 - What would the consequences be for others?

- Thinking back to the scenario, if, after leaving the train station, you were to leave and go to an emergency department, what would the consequences be if you had been exposed to a hazardous chemical?
 - What would the consequences be for you?
 - What would the consequences be for others?

- Before we end the interview, is there anything on the subject of chemical contamination, hazardous chemicals, or decontamination that you are aware of or that has occurred to you during the course of this discussion that we have not already discussed?

Interview terminated

End recording

Appendix J: Ethical approval for non-expert mental models interview study (Chapter 5)

Research Ethics
Office

Franklin Wilkins Building
5.9 Waterloo Bridge Wing
Waterloo Road
London SE1 9NH
Telephone 020 7848 4020/4070/4077
rec@kcl.ac.uk



Charles Symons

19 April 2017

Dear Charles

LRS-16/17-4476 - Interview study to understand public perceptions of chemical contamination

Thank you for submitting your application for the above project. I am pleased to inform you that your application has now be approved with the proviso specified below:

1. Please submit a modification request, through REMAS, for the modifications proposed on the second page of your covering letter.

All changes must be made before data collection commences. The Committee does not need to see evidence of these changes, however supervisors are responsible for ensuring that students implement any requested changes before data collection commences.

Ethical approval has been granted for a period of **three years** from 19 April 2017 . You will not be sent a reminder when your approval has lapsed and if you require an extension you should complete a modification request, details of which can be found here:

<http://www.kcl.ac.uk/innovation/research/support/ethics/applications/modifications.aspx>

Please ensure that you follow the guidelines for good research practice as laid out in UKRIO's Code of Practice for research:

<http://www.kcl.ac.uk/innovation/research/support/conduct/cop/index.aspx>

Any unforeseen ethical problems arising during the course of the project should be reported to the panel Chair, via the Research Ethics Office.

Please note that we may, for the purposes of audit, contact you to ascertain the status of your research.

We wish you every success with your research.

Yours sincerely,
Mr James Patterson

Senior Research Ethics Officer

For and on behalf of:

PNM Research Ethics Panel REP Reviewer

21 April 2017

Dear Charles,

Reference Number: RESCMR-16/17-4476

Study Title: Interview study to understand public perceptions of chemical contamination

Modification Review Outcome: Full Approval

Thank you for submitting a modification request for the above study. This is a letter to confirm that your request has now been granted Full Approval.

If you have any questions regarding your application please contact the Research Ethics Office at rec@kcl.ac.uk.
Kind regards,

Mr James Patterson
Senior Research Ethics Officer
on behalf of
PNM Research Ethics Panel

Appendix K: Recruitment advertisement for non-expert mental models interview study (Chapter 5)

Advertisement for use for recruitment of volunteers for study ref: LRS-16/17-4476 approved by Psychiatry, Nursing & Midwifery Research Ethics Subcommittee. This project contributes to the College's role in conducting research, and teaching research methods. You are under no obligation to reply to this email, however if you choose to, participation in this research is voluntary and you may withdraw at any time

Overview: We are seeking volunteers to participate in an interview about chemical contamination. We are only interviewing people who do **not** have expertise or professional experience in decontamination or hazardous chemicals. Interviews will take no longer than one hour. Participants will be compensated for their time with a £10 online gift voucher.

To improve how emergency responders communicate with casualties during hazardous chemical incidents, we are conducting one-on-one interviews with members of the public to learn about current perceptions about the risks of exposure to hazardous chemicals, such as chemical warfare agents and toxic industrial chemicals. The insights gained from this interview study will contribute to communication strategies that will be tested as part of a Department of Health funded project on mass casualty decontamination.

This study is being conducted as part of a Department of Health funded PhD project at King's College London and Public Health England.

To take part in the study, you must be at least 18 years old and speak fluent English and have **no** professional experience or expertise in the areas we are looking at (e.g. skin toxicology, Chemical, Biological, Radiological and Nuclear incidents, or decontamination).

The study consists of an interview (maximum duration of one hour), which can be carried out in person or remotely via phone or Skype. The interview will be audio recorded. Audio recordings and transcripts of interviews will be kept in a restricted access folder on encrypted PHE servers. At no point in the interview will you be identified by name. You will be given a pseudonym within the transcript and will not be named at any point during the write-up. Any potential identifying details will not be used in the write-up.

Participation is voluntary. All information will be kept completely confidential. You will be reimbursed for your time with a £10 online gift voucher. If you decide to take part you will still be free to withdraw your data without providing a reason.

The results of the study will be published in a PhD thesis. Results will also be published in an internal report submitted to the Department of Health. Outcomes from this study may also be used in academic journals and in oral and poster presentations at academic and industry conferences and internal workshops. Quotations from your interview may be used illustratively but it will not be possible to identify interviewees from quotes.

If you are interested in participating or you require further information, please email [**charles.symons@kcl.ac.uk**](mailto:charles.symons@kcl.ac.uk).

Appendix L: Participant information sheet for non-expert mental models interview study (Chapter 5)

INFORMATION SHEET FOR PARTICIPANTS

REC Reference Number: LRS-16/17-4476

Interview study to understand public perceptions of chemical contamination

We would like to invite you to participate in this research project. Before you decide whether you want to take part, it is important for you to understand why the research is being done and what your participation will involve. Please take time to read the following information carefully. Ask us if there is anything that is not clear or if you would like more information.

What is the purpose of the study?

To improve how emergency responders communicate with casualties during hazardous chemical incidents, we are conducting one-on-one interviews with members of the public to learn about current perceptions about the risks of exposure to hazardous chemicals, such as chemical warfare agents and toxic industrial chemicals. The insights gained from this interview study will contribute to communication strategies that will be tested as part of a Department of Health funded project on mass casualty decontamination.

Why have I been invited to take part?

To take part in the study, you must be at least 18 years old and speak fluent English and have **no** professional experience or expertise in the areas we are looking at (e.g. skin toxicology, Chemical, Biological, Radiological and Nuclear incidents, or decontamination).

Do I have to take part?

No. Participation is entirely voluntary. It is up to you to decide whether or not you would like to take part. We recommend you take a minimum of 24 hours to consider the information in this document before completing the consent form. If you decide to take part you will still be free to withdraw your data without providing a reason. On completion of the interview, you are free to withdraw your responses without providing a reason by contacting the research team using the contact details at the end of this document. However, data withdrawal requests can only be fulfilled if the request is made before the data have been analysed. In practice, this means you will need to tell

us before 1st September 2017. If the study causes any distress, you can contact the research team using the contact details at the end of this document for further advice and information.

What will happen to me if I take part?

If you decide you would like to take part, you will be asked to complete, sign, and return the consent form which accompanies this information sheet. Once we receive the completed consent form, we will contact you to arrange the interview for a date and time which is convenient for you.

The interview will last no longer than one hour and you will be asked what you currently understand about the risks of chemical contamination and what steps can be taken to reduce these risks. The interview will either be conducted in person at Public Health England (PHE), Porton Down (near Salisbury) or King's College London or it will be conducted over telephone/online. The interview will be recorded and you will be notified when the recording begins. On completion of the interview, the audio recording will be transferred to a restricted access folder on encrypted PHE servers. The recording will be completely removed from the recording device itself. Only the immediate research team will have access to the folder in which the recording is stored. The recording will be transcribed by the principal investigator, a member of the research team, or an external agency (a confidentiality agreement will be in place between the third party transcribing agency and the research team to ensure confidentiality of any potentially identifiable data). Interview transcripts will be stored on a restricted access folder on encrypted PHE servers.

The transcript of your interview may be available to other researchers who are affiliated with the research team. No personally identifiable information will be available to these researchers.

You will be reimbursed £10 online gift vouchers for your time.

What are the possible benefits and risks of taking part?

There are no anticipated risks associated with taking part in this study. We do not expect that you will experience any direct benefits from taking part in this study. However, we hope you will find the experience of participating in the study interesting and the outcomes of this study will be used to inform interventions designed to protect public health in the aftermath of a hazardous chemical release. All participants will have access to a copy of our final report.

Will my taking part be kept confidential?

Audio recordings and transcripts of interviews will be kept in a restricted access folder on encrypted PHE servers. No identifying details, e.g. consent forms with your name on it, will be kept alongside either audio recordings or transcripts so you will not be recognised from them. At no point in the interview will you be identified by name. You

will be given a pseudonym within the transcript and will not be named at any point during the write-up. Any potential identifying details will not be used in the write-up. We will be publishing direct quotes from participants, but none that could identify who said them. Your data will be archived for up to 10 years and may be used in subsequent research.

How is the project being funded?

This project is part of a PhD studentship funded by the Department of Health Policy Research Programme.

What will happen to the results of the study?

The results of the study will be published in the principal investigator's PhD thesis. Results will also be published in an internal report submitted to the Department of Health, which funds this study. Outcomes from this study may also be used in academic journals and in oral and poster presentations at academic and industry conferences and internal workshops. Quotations from your interview may be used illustratively but it will not be possible to identify interviewees from quotes. You will be provided with a summary of the results on completion of the study.

Who should I contact for further information?

If you have any questions or require more information about this study, please contact me using the following contact details:

Charles Symons

Department of Psychological Medicine,

Weston Education Centre,

Cutcombe Road,

London SE5 9RJ

charles.symons@kcl.ac.uk

What if I have further questions, or if something goes wrong?

If this study has harmed you in any way or if you wish to make a complaint about the conduct of the study you can contact King's College London using the details below for further advice and information:

Dr James Rubin

Department of Psychological Medicine,

Weston Education Centre,

Cutcombe Road,

London SE5 9RJ

gideon.rubin@kcl.ac.uk

020 7848 5684

Thank you for reading this information sheet and for considering taking part in this research.

Appendix M: Participant consent form for non-expert mental models interview study (Chapter 5)

Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research.

Title of Study: Interview study to understand public perceptions of chemical contamination

King's College Research Ethics Committee Ref: LRS-16/17-4476

Thank you for considering taking part in this research. The person organising the research must explain the project to you before you agree to take part. If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

If you agree with each of the statements below, please check the adjacent grey box by left-clicking the box then changing the default value from 'not checked' to 'checked'.

I confirm that I understand that by checking each box I am consenting to this element of the study. I understand that it will be assumed that unchecked boxes mean that I DO NOT consent to that part of the study. I understand that by not giving consent for any one element I may be deemed ineligible for the study.

10. I confirm that I have read and understood the information sheet dated 13/07/2017 (version 1.2) for the above study. I have had the opportunity to consider the information and to ask questions. I have had the opportunity to consider the information and asked questions which have been answered satisfactorily.

11. I understand that I will be able to withdraw my data until 1st September 2017.

12. I consent to the processing of my personal information for the purposes explained to me. I understand that such information will be handled in accordance with the terms of the UK Data Protection Act 1998.

13. I understand that my information may be subject to review by responsible individuals from the College for monitoring and audit purposes.

14. I understand that confidentiality and anonymity will be maintained and it will not be possible to identify me in any publications.

15. I consent to my interview being audio recorded.

16. I understand that my responses will be used in an internal report to the Department of Health and in the principal investigator's PhD thesis and may be included in publications in academic journals and in oral and written presentations at academic and industry workshops and conferences.

17. I understand that the recording of my interview may be transcribed by a third party agency but that a confidentiality agreement will be in place between the transcribing company and the research team to ensure confidentiality of any potentially identifiable data.

18. I understand that the transcript of my interview may be analysed in subsequent, related studies but no personally identifiable information will be available to the researchers running these studies

Please enter your full name and today's date (dd/mm/yyyy) below then return this form electronically to charles.symons@kcl.ac.uk

Name:

Date:

Appendix N: Recruitment advertisement for pilot study (Chapter 7)

Advertisement for use for recruitment of volunteers for study ref: LRS-17/18-7875 approved by Psychiatry, Nursing & Midwifery Research Ethics Subcommittee. This project contributes to the College's role in conducting research, and teaching research methods. You are under no obligation to reply to this email, however if you choose to, participation in this research is voluntary and you may withdraw at any time

Overview: We are seeking volunteers aged 18 years or over who are fluent in written English to participate in a pilot test of interventions and measures designed for use in a planned randomised controlled trial. The survey will take no longer than 30 minutes to complete. Participants will be reimbursed for their time with a £10 online gift voucher.

To develop materials for a planned randomised controlled trial on the effect of communication by emergency responders on expected behaviour in a chemical incident, I am inviting volunteers to take part in a pilot study. The study consists of a survey in which you will be asked questions about your perceptions of a message that could be broadcast by a member of the emergency services during a chemical incident.

This study is being conducted as part of a Department of Health & Social Care funded PhD project at King's College London and Public Health England.

To take part in the study, you must be at least 18 years old, fluent in written English, and you must be either a university student or a university graduate.

Participation is voluntary. All information will be kept completely confidential. You will be reimbursed for your time with a £10 online gift voucher. If you decide to take part you will still be free to withdraw your data without providing a reason.

The results of the study will be published in a PhD thesis. Results will also be published in an internal report submitted to the Department of Health & Social Care. Outcomes from this study may also be used in academic journals and in oral and poster presentations at academic and industry conferences and internal workshops.

If you are interested in participating or you require further information, please email [**charles.symons@kcl.ac.uk**](mailto:charles.symons@kcl.ac.uk) with the subject heading "Pilot Test".

Appendix O: Ethical approval for pilot study (Chapter 7)

Research Ethics
Office

Franklin Wilkins Building
5.9 Waterloo Bridge Wing
Waterloo Road
London SE1 9NH
Telephone 020 7848 4020/4070/4077
rec@kcl.ac.uk



Charles Symons

18 July 2018

Dear Charles,

LRS-17/18-7875 - Online survey to assess interventions and measures to be used in a study on the effect of communication on behaviour during chemical incidents

Thank you for submitting your application for the above project. I am pleased to inform you that your application has now be approved with the proviso specified below:

1. Information Sheet: Provide more information about the purpose of the study in lay language.

All changes must be made before data collection commences. The Committee does not need to see evidence of these changes, however supervisors are responsible for ensuring that students implement any requested changes before data collection commences.

Ethical approval has been granted for a period of **three years** from 18 July 2018. You will not be sent a reminder when your approval has lapsed and if you require an extension you should complete a modification request, details of which can be found here:

<http://www.kcl.ac.uk/innovation/research/support/ethics/applications/modifications.aspx>

Please ensure that you follow the guidelines for good research practice as laid out in UKRIO's Code of Practice for research:

<http://www.kcl.ac.uk/innovation/research/support/conduct/cop/index.aspx>

Any unforeseen ethical problems arising during the course of the project should be reported to the panel Chair, via the Research Ethics Office.

Please note that we may, for the purposes of audit, contact you to ascertain the status of your research.

We wish you every success with your research.

Yours sincerely,
Mr James Patterson

Senior Research Ethics Officer

For and on behalf of:
PNM Research Ethics Panel

23/08/2018

Dear Charles,

Reference Number: RESCM-17/18-7875

Study Title: Online survey to assess interventions and measures to be used in a study on the effect of communication on behaviour during chemical incidents

Modification Review Outcome: Full Approval

Thank you for submitting a modification request for the above study. This is a letter to confirm that your request has now been granted Full Approval.

If you have any questions regarding your application please contact the Research Ethics Office at rec@kcl.ac.uk.

Kind regards
Mr James Patterson
Senior Research Ethics Officer
on behalf of
PNM Research Ethics Panel

Appendix P: Online survey containing information sheet, consent form, instructions, scenario, outcome measures, and debrief in pilot study (Chapter 7)

PARTICIPANT INFORMATION SHEET

Online survey to assess interventions and measures to be used in a study on the effect of communication on behaviour during chemical incidents

I would like to invite you to participate in this research project which forms part of my PhD research. Before you decide whether you want to take part, it is important for you to understand why the research is being done and what your participation will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask me if there is anything that is not clear or if you would like more information.

What is the purpose of the study?

The purpose of the study is to test perceptions of materials to be used in a subsequent study on the effect of different communication methods on behaviour in a chemical incident. In this study, I am testing how people would feel after hearing a message delivered by a police officer during a hypothetical incident. Perceptions about messages in this test will be used to either confirm or re-write messages to be used in the study.

Why have I been invited to take part?

You are being invited to participate in this study because you are likely to meet the criteria for taking part in this study. To participate, you must be at least 18 years old, fluent in written English, and you must be either a university student or a university graduate.

What will happen if I take part?

If you decide you would like to take part, email charles.symons@kcl.ac.uk with the subject heading "Pilot Test" and I will email you the link to the online survey. The email will contain a unique code for you to enter when attempting the survey. Please note that you will not be reimbursed for your time if you enter a number other than the one in the email that I sent to you. A code in an email forward by me would not be valid for reimbursement.

The survey will last no longer than 30 minutes. You will be asked questions about: your perceptions of a message that could be broadcast by a member of the emergency services during a chemical incident. The reliability of all responses to each set of questions will also be tested to see if the measures used in this test could be applied to the subsequent study. On completion of the survey by all participants, your responses will be downloaded from the survey tool to an encrypted Public Health England server. Your responses will be stored in a folder on this server that is only accessible by me.

Do I have to take part?

Participation is completely voluntary. You should only take part if you want to and choosing not to take part will not disadvantage you in anyway. Once you have read the information sheet, please contact us if you have any questions that will help you make a decision about taking part. If you decide to take part we will ask you to indicate your consent on the first page of the online survey.

Incentives

You will be reimbursed £10 in online gift vouchers for your time. Please note that this is subject to you fully completing the survey. Reimbursement is also contingent on you entering, when prompted, the code will have been sent to you from the email account, charles.symons@kcl.ac.uk.

What are the possible risks of taking part?

There are no anticipated risks associated with taking part in this study.

What are the possible benefits of taking part?

We hope you will find the experience of participating in the study interesting and the outcomes of this study will be used to inform interventions designed to protect public health in the aftermath of a major incident.

Data handling and confidentiality

Your data will be processed in accordance with the General Data Protection Regulation 2016 (GDPR). No identifying details, i.e. email address will be kept alongside your responses to questions. Your data will be archived in a restricted access folder on encrypted Public Health England servers for up to 10 years. At the end of the survey you will be asked to enter an email address purely so that I can email you the gift code as reimbursement for your time. The email address will be stored in a separate folder from the file that contains your responses to survey questions. A copy of the email I send you containing the online gift code will be retained for financial auditing purposes

and stored in a separate folder from your responses to survey questions. This means that it will not be possible to identify you from your responses to the survey.

Data Protection Statement

The data controller for this project will be King's College London (KCL). The University will process your personal data for the purpose of the research outlined above. The legal basis for processing your personal data for research purposes under GDPR is a 'task in the public interest' You can provide your consent for the use of your personal data in this study by checking the statements at the bottom of the first page of the survey.

You have the right to access information held about you. Your right of access can be exercised in accordance with the General Data Protection Regulation. You also have other rights including rights of correction, erasure, objection, and data portability. When you begin the survey, you will be provided with a unique identifying number that you will need to quote so that I can identify which responses are yours. Questions, comments and requests about your personal data can also be sent to the King's College London Data Protection Officer Mr Albert Chan infocompliance@kcl.ac.uk. If you wish to lodge a complaint with the Information Commissioner's Office, please visit www.ico.org.uk.

What if I change my mind about taking part?

You are free to withdraw at any point of the study just by closing your browser. Withdrawing from the study will not affect you in any way. After submitting your responses, you are able to withdraw your data until 1st October by emailing charles.symons@kcl.ac.uk or by calling 01980 616960 and quoting the unique code that will have been emailed to you. After 1st October 2018, withdrawal of your data will no longer be possible because analysis of the data will have already been used to inform the methods used in the subsequent study. Please note that all data will be anonymous by this point in time as your email address will have been removed from the data set and stored in a separate restricted access encrypted server folder.

If you choose to withdraw from the study before 1st October 2018, we will not retain the information you have given thus far aside from the copy of the email sent to you with the online gift code which, as stated before, will be retained for financial auditing purposes.

How is the project being funded?

This study is part of a PhD project funded by the Department of Health & Social Care Policy Research Programme.

What will happen to the results of the study?

The results of the study will be published in the principal investigator's PhD thesis. Results will also be published in an internal report submitted to the Department of Health & Social Care, which funds this study. Outcomes from this study may also be used in academic journals and in oral and poster presentations at academic and industry conferences and internal workshops. Please note that it will not be possible to identify your individual responses to the survey.

Who should I contact for further information?

If you have any questions or require more information about this study, please contact me using the following contact details:

Charles Symons

Department of Psychological Medicine,

Weston Education Centre,

Cutcombe Road, London SE5 9RJ charles.symons@kcl.ac.uk

What if I have further questions, or if something goes wrong?

If this study has harmed you in any way or if you wish to make a complaint about the conduct of the study you can contact King's College London using the details below for further advice and information:

Dr James Rubin

Department of Psychological Medicine,

Weston Education Centre,

Cutcombe Road, London SE5 9RJ gideon.rubin@kcl.ac.uk

020 7848 5684

Thank you for reading this information sheet and for considering taking part in this research.

PARTICIPANT ONLINE CONSENT FORM

Thank you for considering taking part in this research. The person organising the research must explain the project to you before you agree to take part. If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to join in.

Clicking the circle next to each statement indicates agreement with the statement

I confirm that I understand that by clicking each box I am consenting to this element of the study. I understand that it will be assumed that unclicked boxes mean that I DO NOT consent to that part of the study. I understand that by not giving consent for any one element I may be deemed ineligible for the study.

I confirm that I have read and understood the above information. I have had the opportunity to consider the information and asked questions which have been answered to my satisfaction.

I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason, up until 1st October 2018.

I consent to the processing of my personal information for the purposes explained to me in the Information Sheet. I understand that such information will be handled in accordance with the terms of the General Data Protection Regulation.

I understand that my information may be subject to review by responsible individuals from the College for monitoring and audit purposes.

I understand that confidentiality and anonymity will be maintained and it will not be possible to identify me in any research outputs.

I agree that the research team may use my data for future research and understand that any such use of identifiable data would be reviewed and approved by a research ethics committee. (In such cases, as with this project, my data would/would not be identifiable in any report).

I understand that I must not take part if I fall under the exclusion criteria as detailed in the above information.

I understand that confidentiality and anonymity will be maintained and it will not be possible to identify me in any publications.

I understand that my responses will be used in an internal report to the Department of Health & Social Care and in the principal investigator's PhD thesis and may be included in publications in academic journals and in oral and written presentations at academic and industry workshops and conferences but it will not be possible to identify my individual responses to questions.

I understand that my email address will only be used for the purposes of sending a reimbursement gift code and will be stored separately from my responses to all other questions at the conclusion of the study.

I understand that reimbursement for taking part in this study is contingent on reaching the end of the survey and submitting my responses by clicking "Done" on the last page of the survey and on entering a unique code on the next page that was emailed directly to me from the email account, charles.symons@kcl.ac.uk or charles.symons@phe.gov.uk.

INSTRUCTIONS FOR ENTERING UNIQUE CODE AND REQUESTING DATA DELETION

Please enter the unique code from the email that contained the link to this survey

If you wish for your data to be deleted before 1st October 2018, please contact the researcher using the information below. You will need to keep a record of your unique code as you would need to quote this code in order for your responses to be deleted.

Email: charles.symons@kcl.ac.uk

The survey can only be completed in one session so please ensure that there are no distractions and that you do not close the survey unless you wish to withdraw. Please note that you do not have to complete the survey but you will only be reimbursed for your time if you reach the end of the survey and submit your responses.

SCENARIO AND MESSAGING INTERVENTION

Please read the following scenario. Try to imagine that you were involved in the incident and think about how you might feel and act in this type of situation.

Imagine you are waiting in a crowded lecture theatre for a lecture to begin. You hear a fire alarm. You and your fellow students walk out of the room and walk outside the building. Roughly 20 university staff and students are gathered outside. You are now standing among them. You see a police van parked nearby and there are rolls of blue tissue paper on the ground.

You hear the following announcement on a megaphone:

[Participant randomly allocated to receive one of the six messages displayed in Table 6-5 (condition label stored in dataset but not displayed to participant)]

OUTCOME MEASURES

Think about how you would feel after hearing that message.

Based only on the information in the message delivered by the police officer, to what extent would you agree or disagree with each of the following statements?

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
If I was exposed to the chemical released in this incident it is likely that I would become seriously ill	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would feel anxious about being exposed to the chemical released in this incident	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I didn't take preventative action, it is likely that I would be exposed to the	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

chemical released in
this incident

It is likely that I had
been exposed to the
chemical released in
this incident

Staying where I am
and
following instructions
would help to protect
me if I had been
exposed to the
chemical

Removing
the clothing that I am
wearing would help to
protect me if I had
been
exposed to the
chemical

Blotting then rubbing
my skin with tissue
paper would help to
protect me if I had
been exposed to the
chemical

I would be able to
follow all instructions
in this incident

Now think about the police officer who was talking on the megaphone. Please answer the following questions about how you felt about the police officer in this scenario.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I imagined the police officer to be respectful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I imagined the police officer to be fair	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I imagined the police officer to be open about the actions they were taking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I imagined the police officer to be trustworthy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If this situation had been real, I would have felt a sense of unity with the police officer responding to the incident	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If this situation had been real, I would have identified with the police officer responding to the incident	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Was there anything that the police officer said that you didn't understand or that they should have said differently? Also, are there any reasons as to why you answered particular questions a certain way?

PARTICIPANT DEBRIEF

The outcomes of this survey will be used to inform the development of a communication intervention that I will test in an experiment. The intervention is designed for use by first responders (e.g. police) in the early phase of a chemical incident. In the experiment I will assess the intervention using a video based on the scenario that you read in this test.

The objective of this test was to check that messages that were written to address certain information would have their intended effect. For example the message, "The chemical is on your clothing. So the more clothing you remove, the more chemical you'll remove." was designed to heighten people's perceptions of the effectiveness of clothing removal at reducing the risk of chemical contamination of the skin. Previous studies on decontamination have indicated that clothing removal followed by application of absorbent material to skin is an effective method of reducing the extent of chemical contamination until decontamination showers are available.

If participants who take part in the experiment are aware of the true nature of the study then their responses are likely to be biased. Therefore your discretion about the aims of this study would be really helpful.

As reimbursement for your time, you will be emailed an online gift code to the value of £10 as well as instructions on how to access the shopping portal. Please enter your email address below for this purpose. On completion of the study, your email address will be removed from the data set and stored in a separate folder on the encrypted server so it will not be possible to identify you from your responses. Email:

Appendix Q: Immersive video production outline (Chapter 8)

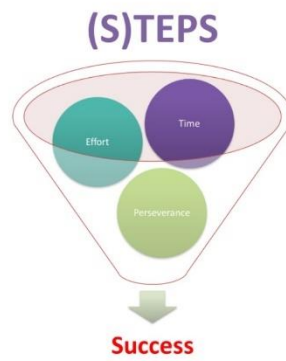
The sequences outlined below, which were set within the context of the scenario outlined in Section 6.2.1 of this thesis, were recorded by Dependable Productions (dependableproductions.com) on 27th September 2018 with a cast of 18.

Bold text indicates that the visual or audio is to be added in post-production.

Sequence	Visuals	Audio/Script	Time
1: Lecture Theatre	<p>Students are seated in the lecture theatre.</p> <p>The lecturer is standing on the stage and delivering a non subject-specific Microsoft PowerPoint presentation (Figure Q-1).</p> <p>Following the alarm cue, the students stand up and file out of the lecture theatre in an orderly manner, following the lecturer.</p>	<p><i>[The lecturer presents three powerpoint slides (script for each slide in Figure Q-1). Partway through the presentation of the third slide, a fire alarm sounds]</i></p> <p>Lecturer: “Um, we’re not expecting a drill so I think we should evacuate. Let’s all move to the, um, fire escape, the nearest one, at the front of the building. Just leave your stuff here for now though...”</p>	00:00 – 00:50
2: Evacuation from lecture theatre to outdoor muster point	<p>Students and lecturer walk from lecture theatre to the building reception to outside the front of the building. A university warden donned in a blue tabard holds the door open for the lecturer and students and joins them outside.</p>	<p><i>[Alarm continues]</i></p> <p>Improvised dialogue among students</p>	00:50 – 01:50

Sequence	Visuals	Audio/Script	Time
3: Outdoor Muster point	<p>Casualties walk towards rolls of white tissue paper that are being thrown onto the ground by a police officer.</p> <p>There is a police van in the distance.</p> <p>The police officer goes to the police van to retrieve a handheld loudhailer then begins speaking into the loudhailer.</p> <p>While the police officer is speaking, the casualties look concerned. They examine their skin. They exchange concerned glances with one another.</p> <p>At the conclusion of the communication intervention, the visuals fade to black. Graphics instruct the viewer to inform researcher that the video has concluded.</p>	<p><i>[Alarm continues in background]</i></p> <p>Police officer: Keep walking, over towards my voice... Come toward me...</p> <p>Lecturer: Everyone, this way</p> <p>Police officer: Come towards the paper I am throwing... Please come towards the paper I am throwing...</p> <p><i>[At 02:22, the police officer delivers the communication intervention (one of six possible messages)]</i></p>	<p>01:50 - ~05:00 (exact end time dependent on condition)</p>

Slide 1



Before I go into specifics on the course structure, I found this online and, it's a bit vague but the S in the acronym is for "Students". And if you put lots of effort in and time and perseverance, you'll find that you all do really well on this course. It's as simple as that. Now moving on to the next slide...

Slide 2

Image of Pythagorean cup

Now by the end of the lecture, this will make sense. I won't spend too long on this but what I will say for now is that this cup was designed so that the volume of wine, as it rises to a certain level, the wine is drawn out and empties from the bottom of the cup but we're gonna come back to that soon.

Slide 3

Image of notepad and pen

Some of the assignments will be relatively straightforward but *[CUE FIRE ALARM]* understandably there'll be...

Figure Q-1 Microsoft PowerPoint slides and accompanying speech for lecture delivered to students at the beginning of the video.

Appendix R: Communication interventions tested in RCT (Chapter 8) arranged by condition

Table R-1 All six messages tested in the RCT, arranged according to threat and efficacy condition, and duration of each message (maximum percentage duration difference = 7.02%).

IV1: Threat	IV2: Efficacy	
	Efficacy	No Efficacy (Control)
High	<p><i>[Duration = 165 seconds; Word count = 399]</i></p> <p>This is the police. Please listen carefully.</p> <p>We've been informed that a harmful chemical was released in one of the lecture theatres. We are still investigating what type of chemical it is but, based on what we know, the risk to the public is high.</p> <p>It can sometimes take a while to feel the effects. You might feel fine right now but still be affected. The chemical may cause painful skin burns and may even be fatal. People who come into contact with you could be exposed to the chemical.</p> <p>We train for this type of incident regularly. We are working with the ambulance crews to resolve the situation. We're waiting on equipment to arrive so that we can set up a shower for you. The equipment should be here in 20 minutes.</p> <p>There are things you can do right now that will remove the chemical from your skin. Staying here and following our instructions is the best thing you can do right now to protect yourselves.</p> <p>In a moment, we are going to ask you to do the following things. Please listen carefully.</p> <p>Most of the chemical is on your clothing. So the more clothing you remove, the more chemical you'll prevent from getting onto your skin or into your lungs.</p>	<p><i>[Duration = 171 seconds; Word count = 401]</i></p> <p>This is the police. Please listen carefully.</p> <p>We've been informed that a harmful chemical was released in one of the lecture theatres. We are still investigating what type of chemical it is but, based on what we know, the risk to the public is high.</p> <p>It can sometimes take a while to feel the effects. You might feel fine right now but still be affected. The chemical may cause painful skin burns and may even be fatal. People who come into contact with you could be exposed to the chemical.</p> <p>We train for this type of incident regularly. We are working with the ambulance crews to resolve the situation. We're waiting on equipment to arrive so that we can set up a shower for you. The equipment should be here in 20 minutes.</p> <p>We are still currently looking into the cause of the incident. We are also looking into the source of the chemical and the precise time when the incident was reported.</p> <p>In a moment, we are going to ask you to do the following things. Please listen carefully.</p> <p>If you have just arrived, please stay where you are and listen out for updates. We are currently investigating this incident. We will be giving you some instructions in a moment. Please listen.</p>

IV1: Threat	IV2: Efficacy	
	Efficacy	No Efficacy (Control)
	<p>We will ask you to carefully remove as much clothing as you can, down to your underwear. Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head. If you have to lift it over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face.</p> <p>A decontamination shower is on the way. Brushing the skin with dry paper is a safe and effective way to remove some of the chemical from your skin before showering.</p> <p>We will ask you to use the tissue paper on the ground to brush your skin. Start by brushing your hands and then use a new piece of paper to brush your face. Repeat this process from your neck down to your toes.</p> <p>If anyone requires assistance, please ask someone next to you.</p> <p>After using the tissue paper, going through a decontamination shower is the best way to ensure that you are thoroughly cleaned.</p> <p>A shower is on its way here now. Please remain where you are and start removing your clothing...</p>	<p>We will ask you to carefully remove as much clothing as you can, down to your underwear. Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head. If you have to lift it over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face.</p> <p>A decontamination shower is on the way. We are investigating what type of chemical this is and the cause of the incident. Remain where you are and listen out for further instructions.</p> <p>We will ask you to use the tissue paper on the ground to brush your skin. Start by brushing your hands and then use a new piece of paper to brush your face. Repeat this process from your neck down to your toes.</p> <p>If anyone requires assistance, please ask someone next to you.</p> <p>Listen out for further updates. We are looking into the situation to find out more about what has happened here.</p> <p>A shower is on its way here now. Please remain where you are and start removing your clothing...</p>
Low	<p><i>[Duration = 172 seconds; Word count = 396]</i></p> <p>This is the police. Please listen carefully.</p> <p>We've been informed that a chemical may have been released in one of the lecture theatres. We are still investigating what type of chemical it is but, based on what we know, the risk to the public is low.</p> <p>Had you been exposed to the substance, you would have felt some symptoms by now. You will probably be fine but we will still need to take some precautions. The instructions we are about to give you are a precaution.</p> <p>We train for this type of incident regularly. We are working with the ambulance crews to resolve the situation. We're waiting on equipment</p>	<p><i>[Duration = 172 seconds; Word count = 397]</i></p> <p>This is the police. Please listen carefully.</p> <p>We've been informed that a chemical may have been released in one of the lecture theatres. We are still investigating what type of chemical it is but, based on what we know, the risk to the public is low.</p> <p>Had you been exposed to the substance, you would have felt some symptoms by now. You will probably be fine but we will still need to take some precautions. The instructions we are about to give you are a precaution.</p> <p>We train for this type of incident regularly. We are working with the ambulance crews to resolve the situation. We're waiting on equipment</p>

IV1: Threat	IV2: Efficacy	
	Efficacy	No Efficacy (Control)
	<p>to arrive so that we can set up a shower for you. The equipment should be here in 20 minutes.</p> <p>There are things you can do right now that would remove the chemical from your skin. Staying here and following our instructions is the best precaution you can take right now to protect yourselves.</p> <p>In a moment, we are going to ask you to do the following things. Please listen carefully.</p> <p>Most of the chemical would be on your clothing. So the more clothing you remove, the more chemical you'd prevent from getting onto your skin or into your lungs.</p> <p>We will ask you to carefully remove as much clothing as you can, down to your underwear. Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head. If you have to lift it over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face.</p> <p>A decontamination shower is on the way. Brushing the skin with dry paper is a safe and effective way to remove some of the chemical from your skin before showering.</p> <p>We will ask you to use the tissue paper on the ground to brush your skin. Start by brushing your hands and then use a new piece of paper to brush your face. Repeat this process from your neck down to your toes.</p> <p>If anyone requires assistance, please ask someone next to you.</p> <p>After using the tissue paper, going through a decontamination shower is the best way to ensure that you are thoroughly cleaned.</p> <p>A shower is on its way here now. Please remain where you are and start removing your clothing...</p>	<p>to arrive so that we can set up a shower for you. The equipment should be here in 20 minutes.</p> <p>We are still currently looking into the cause of the incident. We are also looking into the source of the chemical and the precise time when the incident was reported.</p> <p>In a moment, we are going to ask you to do the following things. Please listen carefully.</p> <p>If you have just arrived, please stay where you are and listen out for updates. We are currently investigating this incident. We will be giving you some instructions in a moment. Please listen.</p> <p>We will ask you to carefully remove as much clothing as you can, down to your underwear. Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head. If you have to lift it over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face.</p> <p>A decontamination shower is on the way. We are investigating what type of chemical this is and the cause of the incident. Remain where you are and listen out for further instructions.</p> <p>We will ask you to use the tissue paper on the ground to brush your skin. Start by brushing your hands and then use a new piece of paper to brush your face. Repeat this process from your neck down to your toes.</p> <p>If anyone requires assistance, please ask someone next to you.</p> <p>Listen out for further updates. We are looking into the situation to find out more about what has happened here.</p> <p>A shower is on its way here now. Please remain where you are and start removing your clothing...</p>
Neutral (Control)	<i>[Duration = 176 seconds; Word count = 393]</i>	<i>[Duration = 177 seconds; Word count = 394]</i>

IV1: Threat	IV2: Efficacy	
	Efficacy	No Efficacy (Control)
	<p>This is the police. Please listen carefully.</p> <p>We've been informed that a chemical may have been released in one of the lecture theatres. We are still investigating what type of chemical it is, where the chemical would have originated, and what time it would have been released.</p> <p>Please stay where you are and listen for updates. If you have just arrived, please remain where you are. We will update you when we know more about the situation. Listen out for updates and instructions.</p> <p>We train for this type of incident regularly. We are working with the ambulance crews to resolve the situation. We're waiting on equipment to arrive so that we can set up a shower for you. The equipment should be here in 20 minutes.</p> <p>There are things you can do right now that would remove the chemical from your skin. Staying here and following our instructions is the best precaution you can take right now to protect yourselves.</p> <p>In a moment, we are going to ask you to do the following things. Please listen carefully.</p> <p>Most of the chemical would be on your clothing. So the more clothing you remove, the more chemical you'd prevent from getting onto your skin or into your lungs.</p> <p>We will ask you to carefully remove as much clothing as you can, down to your underwear. Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head. If you have to lift it over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face.</p> <p>A decontamination shower is on the way. Brushing the skin with dry paper is a safe and effective way to remove some of the chemical from your skin before showering.</p>	<p>This is the police. Please listen carefully.</p> <p>We've been informed that a chemical may have been released in one of the lecture theatres. We are still investigating what type of chemical it is, where the chemical would have originated, and what time it would have been released.</p> <p>Please stay where you are and listen for updates. If you have just arrived, please remain where you are. We will update you when we know more about the situation. Listen out for updates and instructions.</p> <p>We train for this type of incident regularly. We are working with the ambulance crews to resolve the situation. We're waiting on equipment to arrive so that we can set up a shower for you. The equipment should be here in 20 minutes.</p> <p>We are still currently looking into the cause of the incident. We are also looking into the source of the chemical and the precise time when the incident was reported.</p> <p>In a moment, we are going to ask you to do the following things. Please listen carefully.</p> <p>If you have just arrived, please stay where you are and listen out for updates. We are currently investigating this incident. We will be giving you some instructions in a moment. Please listen.</p> <p>We will ask you to carefully remove as much clothing as you can, down to your underwear. Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head. If you have to lift it over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face.</p> <p>A decontamination shower is on the way. We are investigating what type of chemical this is and the cause of the incident. Remain where you are and listen out for further instructions.</p>

IV1: Threat	IV2: Efficacy	
	Efficacy	No Efficacy (Control)
	<p>We will ask you to use the tissue paper on the ground to brush your skin. Start by brushing your hands and then use a new piece of paper to brush your face. Repeat this process from your neck down to your toes.</p> <p>If anyone requires assistance, please ask someone next to you.</p> <p>After using the tissue paper, going through a decontamination shower is the best way to ensure that you are thoroughly cleaned.</p> <p>A shower is on its way here now. Please remain where you are and start removing your clothing...</p>	<p>We will ask you to use the tissue paper on the ground to brush your skin. Start by brushing your hands and then use a new piece of paper to brush your face. Repeat this process from your neck down to your toes.</p> <p>If anyone requires assistance, please ask someone next to you.</p> <p>Listen out for further updates. We are looking into the situation to find out more about what has happened here.</p> <p>A shower is on its way here now. Please remain where you are and start removing your clothing...</p>

Table R-2 All six messages tested in the RCT, arranged according to threat and efficacy condition, with differences between conditions indicated by formatting.

Bold font denotes statements that differ according to Threat condition

Italicised font denotes statements that differ according to Efficacy condition

IV1: Threat	IV2: Efficacy	
	Efficacy	No Efficacy (Control)
High	<p>This is the police. Please listen carefully.</p> <p>We've been informed that a harmful chemical was released in one of the lecture theatres. We are still investigating what type of chemical it is but, based on what we know, the risk to the public is high.</p> <p>It can sometimes take a while to feel the effects. You might feel fine right now but still be affected. The chemical may cause painful skin burns and may even be fatal. People who come into contact with you could be exposed to the chemical.</p>	<p>This is the police. Please listen carefully.</p> <p>We've been informed that a harmful chemical was released in one of the lecture theatres. We are still investigating what type of chemical it is but, based on what we know, the risk to the public is high.</p> <p>It can sometimes take a while to feel the effects. You might feel fine right now but still be affected. The chemical may cause painful skin burns and may even be fatal. People who come into contact with you could be exposed to the chemical.</p>

IV1: Threat	IV2: Efficacy	
	Efficacy	No Efficacy (Control)
	<p>We train for this type of incident regularly. We are working with the ambulance crews to resolve the situation. We're waiting on equipment to arrive so that we can set up a shower for you. The equipment should be here in 20 minutes.</p> <p><i>There are things you can do right now that will remove the chemical from your skin. Staying here and following our instructions is the best thing you can do right now to protect yourselves.</i></p> <p>In a moment, we are going to ask you to do the following things. Please listen carefully.</p> <p><i>Most of the chemical is on your clothing. So the more clothing you remove, the more chemical you'll prevent from getting onto your skin or into your lungs.</i></p> <p>We will ask you to carefully remove as much clothing as you can, down to your underwear. Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head. If you have to lift it over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face.</p> <p><i>A decontamination shower is on the way. Brushing the skin with dry paper is a safe and effective way to remove some of the chemical from your skin before showering.</i></p> <p>We will ask you to use the tissue paper on the ground to brush your skin. Start by brushing your hands and then use a new piece of paper to brush your face. Repeat this process from your neck down to your toes.</p> <p>If anyone requires assistance, please ask someone next to you.</p> <p><i>After using the tissue paper, going through a decontamination shower is the best way to ensure that you are thoroughly cleaned.</i></p> <p>A shower is on its way here now. Please remain where you are and start removing your clothing...</p>	<p>We train for this type of incident regularly. We are working with the ambulance crews to resolve the situation. We're waiting on equipment to arrive so that we can set up a shower for you. The equipment should be here in 20 minutes.</p> <p><i>We are still currently looking into the cause of the incident. We are also looking into the source of the chemical and the precise time when the incident was reported.</i></p> <p>In a moment, we are going to ask you to do the following things. Please listen carefully.</p> <p><i>If you have just arrived, please stay where you are and listen out for updates. We are currently investigating this incident. We will be giving you some instructions in a moment. Please listen.</i></p> <p>We will ask you to carefully remove as much clothing as you can, down to your underwear. Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head. If you have to lift it over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face.</p> <p><i>A decontamination shower is on the way. We are investigating what type of chemical this is and the cause of the incident. Remain where you are and listen out for further instructions.</i></p> <p>We will ask you to use the tissue paper on the ground to brush your skin. Start by brushing your hands and then use a new piece of paper to brush your face. Repeat this process from your neck down to your toes.</p> <p>If anyone requires assistance, please ask someone next to you.</p> <p><i>Listen out for further updates. We are looking into the situation to find out more about what has happened here.</i></p>

IV1: Threat	IV2: Efficacy	
	Efficacy	No Efficacy (Control)
		A shower is on its way here now. Please remain where you are and start removing your clothing...
Low	<p>This is the police. Please listen carefully.</p> <p>We've been informed that a chemical may have been released in one of the lecture theatres. We are still investigating what type of chemical it is but, based on what we know, the risk to the public is low.</p> <p>Had you been exposed to the substance, you would have felt some symptoms by now. You will probably be fine but we will still need to take some precautions. The instructions we are about to give you are a precaution.</p> <p>We train for this type of incident regularly. We are working with the ambulance crews to resolve the situation. We're waiting on equipment to arrive so that we can set up a shower for you. The equipment should be here in 20 minutes.</p> <p><i>There are things you can do right now that would remove the chemical from your skin. Staying here and following our instructions is the best precaution you can take right now to protect yourselves.</i></p> <p>In a moment, we are going to ask you to do the following things. Please listen carefully.</p> <p><i>Most of the chemical would be on your clothing. So the more clothing you remove, the more chemical you'd prevent from getting onto your skin or into your lungs.</i></p> <p>We will ask you to carefully remove as much clothing as you can, down to your underwear. Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head. If you have to lift it over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face.</p>	<p>This is the police. Please listen carefully.</p> <p>We've been informed that a chemical may have been released in one of the lecture theatres. We are still investigating what type of chemical it is but, based on what we know, the risk to the public is low.</p> <p>Had you been exposed to the substance, you would have felt some symptoms by now. You will probably be fine but we will still need to take some precautions. The instructions we are about to give you are a precaution.</p> <p>We train for this type of incident regularly. We are working with the ambulance crews to resolve the situation. We're waiting on equipment to arrive so that we can set up a shower for you. The equipment should be here in 20 minutes.</p> <p><i>We are still currently looking into the cause of the incident. We are also looking into the source of the chemical and the precise time when the incident was reported.</i></p> <p>In a moment, we are going to ask you to do the following things. Please listen carefully.</p> <p><i>If you have just arrived, please stay where you are and listen out for updates. We are currently investigating this incident. We will be giving you some instructions in a moment. Please listen.</i></p> <p>We will ask you to carefully remove as much clothing as you can, down to your underwear. Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head. If you have to lift it over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face.</p>

IV1: Threat	IV2: Efficacy	
	Efficacy	No Efficacy (Control)
	<p><i>A decontamination shower is on the way. Brushing the skin with dry paper is a safe and effective way to remove some of the chemical from your skin before showering.</i></p> <p>We will ask you to use the tissue paper on the ground to brush your skin. Start by brushing your hands and then use a new piece of paper to brush your face. Repeat this process from your neck down to your toes.</p> <p>If anyone requires assistance, please ask someone next to you.</p> <p><i>After using the tissue paper, going through a decontamination shower is the best way to ensure that you are thoroughly cleaned.</i></p> <p>A shower is on its way here now. Please remain where you are and start removing your clothing...</p>	<p><i>A decontamination shower is on the way. We are investigating what type of chemical this is and the cause of the incident. Remain where you are and listen out for further instructions.</i></p> <p>We will ask you to use the tissue paper on the ground to brush your skin. Start by brushing your hands and then use a new piece of paper to brush your face. Repeat this process from your neck down to your toes.</p> <p>If anyone requires assistance, please ask someone next to you.</p> <p><i>Listen out for further updates. We are looking into the situation to find out more about what has happened here.</i></p> <p>A shower is on its way here now. Please remain where you are and start removing your clothing...</p>
Neutral (Control)	<p>This is the police. Please listen carefully.</p> <p>We've been informed that a chemical may have been released in one of the lecture theatres. We are still investigating what type of chemical it is, where the chemical would have originated, and what time it would have been released.</p> <p>Please stay where you are and listen for updates. If you have just arrived, please remain where you are. We will update you when we know more about the situation. Listen out for updates and instructions.</p> <p>We train for this type of incident regularly. We are working with the ambulance crews to resolve the situation. We're waiting on equipment to arrive so that we can set up a shower for you. The equipment should be here in 20 minutes.</p> <p><i>There are things you can do right now that would remove the chemical from your skin. Staying here and following our instructions is the best precaution you can take right now to protect yourselves.</i></p>	<p>This is the police. Please listen carefully.</p> <p>We've been informed that a chemical may have been released in one of the lecture theatres. We are still investigating what type of chemical it is, where the chemical would have originated, and what time it would have been released.</p> <p>Please stay where you are and listen for updates. If you have just arrived, please remain where you are. We will update you when we know more about the situation. Listen out for updates and instructions.</p> <p>We train for this type of incident regularly. We are working with the ambulance crews to resolve the situation. We're waiting on equipment to arrive so that we can set up a shower for you. The equipment should be here in 20 minutes.</p> <p><i>We are still currently looking into the cause of the incident. We are also looking into the source of the chemical and the precise time when the incident was reported.</i></p>

IV1: Threat	IV2: Efficacy	
	Efficacy	No Efficacy (Control)
	<p>In a moment, we are going to ask you to do the following things. Please listen carefully.</p> <p><i>Most of the chemical would be on your clothing. So the more clothing you remove, the more chemical you'd prevent from getting onto your skin or into your lungs.</i></p> <p>We will ask you to carefully remove as much clothing as you can, down to your underwear. Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head. If you have to lift it over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face.</p> <p><i>A decontamination shower is on the way. Brushing the skin with dry paper is a safe and effective way to remove some of the chemical from your skin before showering.</i></p> <p>We will ask you to use the tissue paper on the ground to brush your skin. Start by brushing your hands and then use a new piece of paper to brush your face. Repeat this process from your neck down to your toes.</p> <p>If anyone requires assistance, please ask someone next to you.</p> <p><i>After using the tissue paper, going through a decontamination shower is the best way to ensure that you are thoroughly cleaned.</i></p> <p>A shower is on its way here now. Please remain where you are and start removing your clothing...</p>	<p>In a moment, we are going to ask you to do the following things. Please listen carefully.</p> <p><i>If you have just arrived, please stay where you are and listen out for updates. We are currently investigating this incident. We will be giving you some instructions in a moment. Please listen.</i></p> <p>We will ask you to carefully remove as much clothing as you can, down to your underwear. Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head. If you have to lift it over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face.</p> <p><i>A decontamination shower is on the way. We are investigating what type of chemical this is and the cause of the incident. Remain where you are and listen out for further instructions.</i></p> <p>We will ask you to use the tissue paper on the ground to brush your skin. Start by brushing your hands and then use a new piece of paper to brush your face. Repeat this process from your neck down to your toes.</p> <p>If anyone requires assistance, please ask someone next to you.</p> <p><i>Listen out for further updates. We are looking into the situation to find out more about what has happened here.</i></p> <p>A shower is on its way here now. Please remain where you are and start removing your clothing...</p>

Appendix S: Survey containing instructions to participants and outcome measures

Instructions

You are about to watch an immersive video of an emergency scenario.

Please remain seated until the headset is removed.

On completion of the video, it is important that you do not tell the researcher what you heard during the video.

The researcher will be outside the room during the presentation of the video. When it is time to inform that the researcher that the video has ended, please raise your hand.

Please listen carefully during the video as you will be asked questions about what you hear.

When you are ready to begin the video, please let the researcher know.

[After reading instructions, participant watches immersive video then returns to the web-based survey]

Behavioural expectation measures

Think about what you would do if the scenario carried on from the point that the video stopped. Imagine you are still standing outside.

For each of the following statements, please select an option that best represents how you would feel in that moment.

Please answer honestly.

I would remain where I am until the shower arrives

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

I would **try** to remain where I am until the shower arrives

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

I would **want** to remain where I am until the shower arrives

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

I would remove my clothing, down to my underwear

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

I would **try** to remove my clothing, down to my underwear

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

I would **want** to remove my clothing, down to my underwear

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

I would brush my skin with the tissue paper

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

I would **try** to brush my skin with the tissue paper

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

I would **want** to brush my skin with the tissue paper

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

I would go straight to the nearest hospital without following any of the police officer's instructions

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)

- Strongly agree (7)

I would **try** to go straight to the nearest hospital without following any of the police officer's instructions

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

I would **want** to go straight to the nearest hospital without following any of the police officer's instructions

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

I would leave the area without following any of the police officer's instructions

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

I would **try** to leave the area without following any of the police officer's instructions

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

I would **want** to leave the area without following any of the police officer's instructions

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)

- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

I would seek further information before taking any action

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

I would **try** to seek further information before taking any action

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

I would **want** to seek further information before taking any action

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

Anxiety measures (STAI-6)

For each of the statements below, please select an option that best describes how you would feel by the end of the scenario shown in the video

	Not at all (1)	Somewhat (2)	Moderately (3)	Very much (4)
I would feel calm	•	•	•	•
I would be tense	•	•	•	•
I would feel upset	•	•	•	•
I would be relaxed	•	•	•	•
I would feel content	•	•	•	•
I would be worried	•	•	•	•

Threat susceptibility measures

Based on what you heard in the video, how likely or unlikely is it that you had been exposed to the chemical?

- Extremely unlikely (1)
- Moderately unlikely (2)
- Slightly unlikely (3)
- Neither likely nor unlikely (4)
- Slightly likely (5)
- Moderately likely (6)
- Extremely likely (7)

Based on what you heard in the video, to what extent do you agree or disagree with the following statements?

I was at risk for being exposed to the chemical

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

It is possible that I had been exposed to the chemical

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

Threat severity measures

If I don't take protective action, I am likely to become seriously ill

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

If I don't take protective action, there will be severe consequences for my health

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

If I don't take protective action, the chemical will cause me serious problems

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

Response efficacy measures

Staying where I am and following instructions would help to protect me if I had been exposed to the chemical

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

Removing the clothing that I am wearing would help to protect me if I had been exposed to the chemical

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

Brushing my skin with tissue paper would help to protect me if I had been exposed to the chemical

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

Self-efficacy measures

To what extent do you agree or disagree with the following statements about how you would feel at this point in the scenario?

It would be possible for me to follow all of the instructions that I heard

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

If I wanted to, I am confident that I would be able to follow all of the instructions that I heard

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

I can easily follow all of the instructions that I heard

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

Response cost measures

It would be embarrassing for me to remove my clothing in this situation

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

I would be concerned about removing my clothing in front of the other people in this situation

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

Trust measures

The next questions are about the police officer who was talking to you in the video

How open do you think the police officer was with information regarding the chemical?

- Not at all open (1)
- Somewhat open (2)
- Open (3)
- Very open (4)

How honest do you think the police officer was with information regarding the chemical?

- Not at all honest (1)
- Somewhat honest (2)
- Honest (3)
- Very honest (4)

How competent do you believe the police officer was in handling the emergency?

- Not at all competent (1)
- Somewhat competent (2)
- Competent (3)
- Very competent (4)

How committed do you believe the police officer was to protecting you from the chemical?

- Not at all committed (1)
- Somewhat committed (2)
- Committed (3)
- Very committed (4)

How much caring and concern do you think the police officer has shown about people who might be affected by the chemical?

- Not at all caring (1)
- Somewhat caring (2)
- Caring (3)
- Very caring (4)

How much do you believe that the police officer's actions in response to the emergency are in your personal best interest?

- Not at all (1)
- To some extent (2)
- In my best interest (3)
- Absolutely in my best interest (4)

How much do you believe the police officer will protect you from the chemical?

- Not at all (1)
- Somewhat (2)
- Yes, will protect me (3)
- Absolutely will protect me (4)

Stimulus check measures

To what extent do you agree or disagree with the following statements about the immersive video that you watched during this study?

I felt emotionally engaged with the video

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

The video accurately resembled how I would imagine a real chemical incident to be

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

Demographic questions

What is your age in years?

At birth were you described as...

- Female (1)
- Male (2)
- Intersex (3)
- I prefer not to say (4)

Which of the following describes how you think of yourself?

- Female (1)
- Male (2)
- In another way (please specify) (3)

Which of these options best describes your current status?

- Full-time employed (1)
- Part-time employed (2)
- Self-employed (full or part-time) (3)
- Full-time education at college or university (4)
- Unemployed (5)
- Retired from paid work (6)
- On a government supported training programme (7)
- Employed (full or part-time) and on long-term leave (8)
- Other (please specify) (9)

What is your highest educational qualification achieved to date?

If you are currently working towards a qualification, please select this option from the list below

- GCSE or equivalent (1)
- A-Level, AS-Level, or equivalent (2)
- Professional qualification (3)
- Trade apprenticeship (4)
- Undergraduate degree (5)
- Postgraduate degree or higher (6)
- Other UK qualification (please specify) (7)

- Other non-UK qualification (please specify) (8)

How would you describe your national identity?

- English (1)
- Welsh (2)
- Scottish (3)
- Northern Irish (4)
- British (5)
- Other (please specify) (6)

Before participating in this study, had you heard any information about the study, besides the information in the information sheet or information provided by the researcher?

- No (1)
- Yes, Please briefly specify: (2)

Appendix T: Ethical approval for RCT (Chapter 8)

Research Ethics
Office

Franklin Wilkins Building
5.9 Waterloo Bridge Wing
Waterloo Road
London SE1 9NH
Telephone 020 7848 4020/4070/4077
rec@kcl.ac.uk



Mr Charles Symons

20 September 2018

Dear Charles,

Reference Number: HR-17/18-8399

Study Title: Effect of communication on willingness to adhere to initial
decontamination protocols in a virtual chemical incident: RCT

Review Outcome: Approval with Provisos

Thank you for submitting your application for the above project. I am pleased to inform you that your application has now be approved with the proviso specified below:

1. Participant debrief document: Please consider whether the reference to 'medium risk' is appropriate.

All changes must be made before data collection commences. The Committee does not need to see evidence of these changes, however supervisors are responsible for ensuring that students implement any requested changes before data collection commences.

Please ensure that you follow all relevant guidance as laid out in the King's College London Guidelines on Good Practice in Academic Research (<http://www.kcl.ac.uk/college/policyzone/index.php?id=247>).

For your information, ethical approval has been granted for 3 years from 20 September 2018. If you need approval beyond this point, you will need to apply for an extension at least two weeks before this. You will be required to explain the reasons for the extension. However, you will not need to submit a full reapplication unless the protocol has changed. If you have been granted approval for only 12 months, you will not be sent a reminder when it is due to lapse.

Ethical approval is required to cover the data-collection phase of the study. This will be until the date specified in this letter. However, you do not need ethical approval to cover subsequent data analysis or publication of the results.

For secondary data-analysis, ethical approval is applicable to the data that is sensitive or identifies participants. Approval is applicable to period in which such data is accessed or evaluated.

Please note you are required to adhere to all research data/records management and storage procedures agreed to as part of your application. This will be expected even after the completion of the study.

If you do not start the project within three months of this letter please contact the Research Ethics Office.

Please note that you will be required to obtain approval to modify the study. This also encompasses extensions to periods of approval. Please refer to the URL below for further guidance about the process:

<https://internal.kcl.ac.uk/innovation/research/ethics/applications/modifications.aspx>

Please would you also note that we may, for the purposes of audit, contact you from time to time to ascertain the status of your research.

If you have any query about any aspect of this ethical approval, please contact your panel/committee administrator in the first instance (<https://internal.kcl.ac.uk/innovation/research/ethics/contact.aspx>)

We wish you every success with this work.

Yours sincerely,

Mr James Patterson
Senior Research Ethics Officer

For and on behalf of

Mr Chris Webb, Joint Interim Chair

PNM Research Ethics Subcommittee

03/10/2018

Dear Charles,

Reference Number: RESCM-18/19-8399

Study Title: Effect of communication on willingness to adhere to initial decontamination protocols in a virtual chemical incident: RCT

Modification Review Outcome: Full Approval

Thank you for submitting a modification request for the above study. This is a letter to confirm that your request has now been granted Full Approval.

If you have any questions regarding your application please contact the Research Ethics Office at rec@kcl.ac.uk.

Kind regards
Mr James Patterson
Senior Research Ethics Officer
on behalf of
PNM Research Ethics Subcommittee

Appendix U: Recruitment advertisement for RCT (Chapter 8)

RE: Participants wanted for experiment to test the effect of communication on behaviour in a simulated emergency

I am running an experiment to test different types of communication in terms of their effect on how people would behave in an emergency.

The experiment should take no longer than 1 hour to complete. During the experiment, you will watch a video of an emergency situation through a virtual reality headset then answer questions about what you would have done during the situation.

The study takes place at Public Health England South West, 2 Rivergate, Temple Quay, Bristol.

Participation is voluntary. All information will be kept completely confidential. You will be reimbursed for your time with £30.

To take part in the study, you must be at least 18 years old and fluent in written and spoken English. Unfortunately, you will be unable to participate in this study if you have any hearing impairments, active ear infections, or visual impairments that cannot be corrected with glasses or contact lenses. You will also be unable to participate if you have any professional experience or expertise in the area of emergency response and/or toxicology.

This study is being conducted as part of a Department of Health & Social Care funded PhD project. The study has been approved by the Psychiatry, Nursing and Midwifery Research Ethics Subcommittee at King's College London (reference number: HR-17/18-8399).

Please read the attached information sheet for more information about this research. If you would like to take part in this study or if you have any questions, please email charles.symons@kcl.ac.uk with the subject heading, "Emergency Study".

If you don't want to take part in this research, please feel free to just delete this email - I won't contact you about this again.

Appendix V: Participant information sheet for RCT (Chapter 8)

INFORMATION SHEET FOR PARTICIPANTS

Ethical Clearance Reference Number: HR-17/18-8399

YOU WILL BE GIVEN A COPY OF THIS INFORMATION SHEET

Experiment to test the effect of communication on behaviour in a simulated emergency

Invitation Paragraph

I would like to invite you to participate in this research project which forms part of my PhD research. This study was approved by the King's College London Psychiatry, Nursing & Midwifery Research Ethics Committee (Ref: HR-17/18-8399).

Before you decide whether you want to take part, it is important for you to understand why the research is being done and what your participation will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask me if there is anything that is not clear or if you would like more information.

What is the purpose of the study?

The purpose of the study is to test different types of communication in terms of their effect on how people would behave in an emergency.

Why have I been invited to take part?

You are being invited to participate in this study because you are likely to meet the criteria for taking part in this study. To participate, you must be at least 18 years old and fluent in written and spoken English.

You will be unable to participate in this study if any of the following apply to you:

- Hearing impairments;
- Active ear infections;
- Visual impairments that cannot be corrected with glasses or contact lenses;
- Professional experience or expertise in emergency response and/or toxicology.

Before deciding to participate, please consult your GP and present them with this information sheet if any of the following apply to you:

- You are pregnant;

- You have a pre-existing binocular vision disorder;
- You have a heart condition;
- You previously have had a seizure, loss of awareness, or other symptom linked to an epileptic condition.

What will happen if I take part?

If you decide you would like to take part, email charles.symons@kcl.ac.uk with the subject heading "Emergency Study" and I will email you to arrange a date and time to participate. The study takes place at PHE South West, 2 Rivergate, Temple Quays, Bristol, BS1 6EH. I will provide directions and arrange for site access prior to your arrival.

The study will take no longer than 1 hour. During the study, you will wear a virtual reality headset through which you will watch a brief video of an emergency. After watching the video, you will be asked questions about what you think you would have done and how you think you would have felt during the emergency. You will also be asked some demographic questions. On completion of the study, your responses to questions will be stored on encrypted Public Health England servers in a folder that is only accessible by my research team and me.

Do I have to take part?

Participation is completely voluntary. You should only take part if you want to and choosing not to take part will not disadvantage you in anyway. Once you have read the information sheet, please contact us if you have any questions that will help you make a decision about taking part. If you decide to take part we will ask you to indicate your consent on the first page of the online survey.

For Health & Safety reasons, we will be required to reschedule your participation if, on the day, you feel over-tired or unwell (including cold, flu, headaches, migraines, and earaches) or if you are under the influence of drugs (including alcohol but **not** including nicotine, caffeine, and prescribed medication) or under emotional stress and anxiety.

Incentives

You will be reimbursed £30 for your time. Reimbursement will be paid via an expenses claim form. Please note that there will be a delay of **at least one month** between completing the study and receiving reimbursement to allow time for the processing of the expenses claim form.

What are the possible risks of taking part?

Given that the video depicts an emergency situation, there may be references to potentially upsetting subject matter. But no injuries will be shown.

What are the possible benefits of taking part?

We hope you will find the experience of participating in the study interesting and the outcomes of this study will be used to inform interventions designed to protect public health in the aftermath of a major incident.

Data handling and confidentiality

Your data will be processed in accordance with the General Data Protection Regulation 2016 (GDPR). No identifying details, i.e. email address will be stored alongside your responses to questions. Your data will be archived in a restricted access folder on encrypted Public Health England servers for up to 10 years.

Data Protection Statement

The data controller for this project will be King's College London (KCL). The University will process your personal data for the purpose of the research outlined above. The legal basis for processing your personal data for research purposes under GDPR is a 'task in the public interest' You can provide your consent for the use of your personal data in this study by checking the statements at the bottom of the first page of the survey.

You have the right to access information held about you. Your right of access can be exercised in accordance with the General Data Protection Regulation. You also have other rights including rights of correction, erasure, objection, and data portability. When you begin the survey, you will be provided with a unique identifying number that you will need to quote so that I can identify which responses are yours. Questions, comments and requests about your personal data can also be sent to the King's College London Data Protection Officer Mr Albert Chan info-compliance@kcl.ac.uk. If you wish to lodge a complaint with the Information Commissioner's Office, please visit www.ico.org.uk.

What if I change my mind about taking part?

You are free to withdraw at any point of the study. After completing the study, you are able to withdraw your data until 1st February 2019 by emailing charles.symons@kcl.ac.uk or by calling 01980 616960 and quoting the unique code that will have been assigned to you when you participated. After 1st February 2019, withdrawal of your data will no longer be possible because analysis of the data will have already been completed and the final report written. Please note that all data will be anonymous by this point in time

If you choose to withdraw from the study before 1st February 2019, we will not retain the information you have given thus far aside from your consent form and the form to confirm that you received the vouchers.

How is the project being funded?

This study is part of a PhD project funded by the Department of Health & Social Care Policy Research Programme.

What will happen to the results of the study?

The results of the study will be published in the principal investigator's PhD thesis. Results will also be published in an internal report submitted to the Department of Health & Social Care, which funds this study. Outcomes from this study may also be used in academic journals and in oral and poster presentations at academic and industry conferences and internal workshops. Please note that it will not be possible to identify your individual responses to questions. You will remain anonymous.

Who should I contact for further information?

If you have any questions or require more information about this study, please contact me using the following contact details:

Charles Symons
Department of Psychological Medicine,
Weston Education Centre,
Cutcombe Road,
London SE5 9RJ
charles.symons@kcl.ac.uk

What if I have further questions, or if something goes wrong?

If this study has harmed you in any way or if you wish to make a complaint about the conduct of the study you can contact King's College London using the details below for further advice and information:

Dr James Rubin
Department of Psychological Medicine,
Weston Education Centre,
Cutcombe Road,
London SE5 9RJ
gideon.rubin@kcl.ac.uk
020 7848 5684

Thank you for reading this information sheet and for considering taking part in this research.

Appendix W: Participant consent form for RCT (Chapter 8)

[An electronic version of this consent form was used in the study to avoid the risks associated with transporting and storing personal information in hard copy]

Title of Study: Experiment to test the effect of communication on behaviour in a simulated emergency

King's College Research Ethics Committee Ref: HR-17/18-8399

Thank you for considering taking part in this research. The person organising the research must explain the project to you before you agree to take part. If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

I confirm that I understand that by ticking/initialling each box I am consenting to this element of the study. I understand that it will be assumed that unticked/initialled boxes mean that I DO NOT consent to that part of the study. I understand that by not giving consent for any one element I may be deemed ineligible for the study.

1. I confirm that I have read and understood the information sheet dated 23/10/2018 v1.1 for the above study. I have had the opportunity to consider the information and asked questions which have been answered to my satisfaction.
2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason, up until 1st February 2019.
3. I consent to the processing of my personal information for the purposes explained to me in the Information Sheet. I understand that such information will be handled in accordance with the terms of the General Data Protection Regulation.
4. I understand that my information may be subject to review by responsible individuals from the College for monitoring and audit purposes.
5. I understand that confidentiality and anonymity will be maintained and it will not be possible to identify me in any research outputs.
6. I understand that I must not take part if I fall under the exclusion criteria as detailed in the information sheet and explained to me by the researcher.

7. I understand that there will be a minimum of one month between completing this study and receiving reimbursement.

Name of Participant

Date

Name of Researcher

Date

Appendix X: Participant debrief for RCT (Chapter 8)

DEBRIEF FOR PARTICIPANTS

Ethical Clearance Reference Number: HR-17/18-8399

Experiment to test the effect of communication on behaviour in a simulated emergency

Thank you for taking the time to participate in this study and contribute to this research.

The aim of this study was to test the effect of different types of messages on the behaviour of casualties at the scene of a chemical incident.

When you watched the video, you will have heard one of six messages delivered by a voice actor who was portraying a police officer. The messages varied in content. Some of the messages emphasised the danger, some either didn't emphasise the danger or downplayed it. Some of the messages included information about how effective the instructions would be in protecting you from the chemical whilst others just consisted of instructions and updates on actions responders were taking. My prediction, based on previous research, is that a message in which the danger of chemical contamination **and** the effectiveness self-protective actions are both emphasised would make people more likely to imagine themselves following instructions, rather than taking alternative courses of action, such as leaving the scene and going home.

Large-scale attacks involving hazardous materials, including harmful chemicals, are a low probability, high impact risk to the UK public. Harmful chemicals do not always result in immediate symptoms. In the unlikely event that you are affected, there are steps you can take to protect yourself and others around you. Try to remember the steps outlined in the guidance on the next page.

If you have experienced any distress as a result of taking part in this study or if you wish to make a complaint about the conduct of the study you can contact King's College London using the details below for further advice and information:

Dr James Rubin
Department of Psychological Medicine,
Weston Education Centre,
Cutcombe Road,
London SE5 9RJ
gideon.rubin@kcl.ac.uk
020 7848 5684

Appendix Y: Draft IOR scripts

Presented below are the latest drafts (version 0.4) of IOR scripts to be disseminated by the UK Home Office National Resilience Policy Team to frontline responders and control room operators, following further testing in exercises (as outlined in Appendix Z). The scripts are arranged according to the type of chemical release scenario in which they would be used. All text, aside from italicised text and capitalised text in parenthesis, is to be spoken by the communicator.

Communicating at the scene when there are no signs or symptoms of chemical exposure but a chemical release is suspected or confirmed

[MOVE CASUALTIES TO PLACE OF SAFETY AWAY FROM HOT ZONE]

- *[If hot zone is within a building, activate fire alarm and continuously repeat this message while casualties are evacuating the building]* This is the... *[State emergency service]* Keep following the sound of my voice. Walk towards the tissue paper on the ground.
- *[If hot zone is in an outdoor location]* This is the... *[State emergency service]* There is a suspected toxic chemical leak in this area. Please follow me to a place of safety, away from the chemical.

[CONTAINMENT]

- This is the... *[State emergency service]*. Please listen to me *[repeat if necessary]*.
- Raise your hand if you can understand me.
- Those with your hands up make sure those around you that can't hear or understand follow my instructions. We are investigating a possible chemical leak.
 - *[If you are a non-medical officer]* We are working with *[State co-operating **health/medical** organisation, e.g. local paramedic organisation]*

- For your safety you need to stay with us.
- It is important you don't leave until we say it is safe to do so. If you leave now, you could put yourself and anyone who comes into contact with you at risk.
- We are working to make sure you receive the care that you need. A decontamination shower is on the way here.
- Staying here and following our instructions is the best thing you can do right now to protect yourself and others.

[IF CASUALTIES APPEAR TO BE WALKING AWAY OR CHECKING THEIR PHONES]

- We've been informed that a harmful chemical has been released in this area.
- We are still investigating what type of chemical it is, but based on what we know, the risk to the public is high.
- It can sometimes take a while to feel the effects. You might feel fine right now but still be affected.
- People who come into contact with you could be exposed to the chemical.
- It is really important that you stay here and follow my instructions, as this will protect you and others.
- Do not touch your face. Do not eat, drink, smoke, or use your phone. Keep your hands away from your face.

[FOR DISROBE AND DECONTAMINATION INSTRUCTIONS]

- To stop the chemical going through your skin [*pat arms*] or into your lungs [*pat chest area*] you need to be decontaminated. Showering facilities are on the way and will be here in [*estimated number of minutes until interim shower arrives*].
- In the meantime, most of the chemical will be on your clothing. Follow my instructions carefully to remove the contaminated clothing from your skin.
- Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head [*use actions*].
- If you have to lift any clothing over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face as you lift it [*use actions*]

- Remove as much clothing as you can, down to your underwear. In *[estimated number of minutes until disrobe packs arrive]*, we will provide you with clean gowns to wear to keep you warm and covered up. Leave your clothes and possessions on the ground. They will also be decontaminated. It's more important to get you cleaned up.
- Help anyone who requires assistance.
- After removing the clothing, brushing your skin with clean, dry material is a safe and effective way to remove more of the chemical from your skin. The shower is on its way.
- In the meantime, use the *[available dry material]* on the ground to brush your skin and absorb any chemical. Listen carefully to our instructions on how to brush from the top down.
- Use a new piece of *[available dry material]* to brush each area of your body. Do not reuse any of the *[available dry material]*. Once you've used a piece, place it in one of the yellow sacks on the ground.
 1. Brush your hands first.
 2. Use a new piece to brush your hair [use actions].
 3. Blow your nose.
 4. Use a new piece to brush your face and neck [use actions]. Brush any chemical away from your eyes and mouth.
 5. Use a new piece to brush your left shoulder and arm and then repeat for your right shoulder and arm [use actions].
 6. Use a new piece to brush your chest, stomach and back [use actions].
 7. Use a new piece to brush your left leg and foot and then repeat for your right leg and foot [use actions].
 8. Help anyone who requires assistance by brushing their skin from the top down.

[PRIOR TO INTERIM DECONTAMINATION SHOWER]

- You will need to go through a shower to completely remove the chemical. We are setting up the shower now. Please stay where you are.

Communicating at the scene when there are signs or symptoms of caustic chemical exposure

[APPLY NEAREST CLEAN WATER TO CASUALTIES' FACES]

[FOR DISROBE AND DECONTAMINATION INSTRUCTIONS]

- We are investigating what kind of chemical this is but the priority is to completely remove it from you.
- We have applied as much water as we can to your exposed skin.
- To stop the chemical going through your skin *[pat arms]* you need to be completely showered. Water is available here so please don't leave,
- In the meantime, most of the chemical left on you will be on your clothing. Follow my instructions carefully to remove the clothing from your skin. Do not lift any clothing over your head.
- Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head *[use actions]*. If clothing is stuck to skin, do not attempt to remove it yet.
- Remove as much clothing as you can, down to your underwear. In *[estimated number of minutes until disrobe packs arrive]*, we will provide you with clean gowns to wear to keep you warm and covered up. Leave your clothes and possessions on the ground. They will also be decontaminated. It's more important to get you cleaned up.
- Help anyone who requires assistance.
- Now pour water over your skin to flush away the chemical. *[State where the available water is, e.g. bottles of water]*.

- Pour as much water as you can over yourself, starting with your face. Tilt your head back and pour as much water as you can over your face. Make sure you completely flush your eyes.
- You will need to go through a shower to totally remove the chemical. A shower is on its way here now.
- Help anyone who needs help.
- Stay where you are. Keep applying water.

[PRIOR TO INTERIM DECONTAMINATION SHOWER]

- You will need to go through a shower to completely remove the chemical. We are setting up the shower now. Please stay where you are.

Communicating at the scene when there are signs or symptoms of non-caustic chemical exposure

[MOVE CASUALTIES TO PLACE OF SAFETY AWAY FROM HOT ZONE]

- *[If hot zone is within a building, activate fire alarm and continuously repeat this message while casualties are evacuating the building]* This is the... *[State emergency service]* Keep following the sound of my voice. Walk towards the tissue paper on the ground.
- *[If hot zone is in an outdoor location]* This is the... *[State emergency service]* There is a toxic chemical leak in this area. Please follow me to a place of safety, away from the chemical.

[CONTAINMENT]

- This is the... *[State emergency service]*. Please listen to me *[repeat if necessary]*.
- Raise your hand if you can understand me.

- Those with your hands up make sure those around you that can't hear or understand follow my instructions. We are investigating a chemical leak.
- For your safety you need to stay with us.
- It is important you don't leave until we say it is safe to do so. If you leave now, you could put yourself and anyone who comes into contact with you at risk.
- We are working to make sure you receive the care that you need. A decontamination shower is on the way here.
- Staying here and following our instructions is the best thing you can do right now to protect yourself and others.
- Do not touch your face. Do not eat, drink, smoke, or use your phone. Keep your hands away from your face.

[I/O DISROBE AND DECONTAMINATION INSTRUCTIONS]

- To stop the chemical going through your skin [*pat arms*] or into your lungs [*pat chest area*] you need to be decontaminated. Showering facilities are on the way and will be here in [*estimated number of minutes until interim shower arrives*].
- In the meantime, most of the chemical will be on your clothing. Follow my instructions carefully to remove the contaminated clothing from your skin.
- Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head [*use actions*].
- If you have to lift any clothing over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face as you lift it [*use actions*]
- Remove as much clothing as you can, down to your underwear. In [*estimated number of minutes until disrobe packs arrive*], we will provide you with clean gowns to wear to keep you warm and covered up. Leave your clothes and possessions on the ground. They will also be decontaminated. It's more important to get you cleaned up.
- Help anyone who requires assistance.
- After removing the clothing, brushing your skin with clean, dry material is a safe and effective way to remove more of the chemical from your skin. The shower is on its way.

- In the meantime, use the *[available dry material]* on the ground to brush your skin and absorb any chemical. Listen carefully to our instructions on how to brush from the top down.
- Use a new piece of *[available dry material]* to brush each area of your body. Do not reuse any of the *[available dry material]*. Once you've used a piece, place it in one of the the yellow sacks on the ground.
 1. Brush your hands first.
 2. Use a new piece to brush your hair [use actions].
 3. Blow your nose.
 4. Use a new piece to brush your face and neck [use actions]. Brush any chemical away from your eyes and mouth.
 5. Use a new piece to brush your left shoulder and arm and then repeat for your right shoulder and arm [use actions].
 6. Use a new piece to brush your chest, stomach and back [use actions].
 7. Use a new piece to brush your left leg and foot and then repeat for your right leg and foot [use actions].
 8. Help anyone who requires assistance by brushing their skin from the top down.

[PRIOR TO INTERIM DECONTAMINATION SHOWER]

- You will need to go through a shower to completely remove the chemical. We are setting up the shower now. Please stay where you are.

Communicating from the control room

1. Do you feel any pain right now, like a burning pain on your skin? [If Yes, skip to Point 3; If No, skip to Point 2]

2. Does anyone around you look like they're in pain? Are they coughing or being sick or are their eyes stinging? [If Yes, skip to Point 3; If No, skip to Point 4]
3. It's likely that you have been exposed to a harmful chemical.
4. Help is on the way.
 - Listen to me. I'm going to give you some instructions. Please pass these on to people around you.
 - Move away from the area that you are now. Remain with anyone else who has been exposed and move at least 30 metres away. Move uphill if possible and move in the direction from which the wind is blowing. You should feel the wind in your face as you're walking.
 - Then remain where you are and wait for emergency services to arrive. They will be bringing showering facilities so you can wash the chemical off your skin.
 - You must wait to be treated. If you leave, you could put yourself and others, including your friends and family, at risk.
 - You may feel fine now, but may still be affected.
 - In the meantime, if the chemical is on you, most of it will be on your clothing. Follow my instructions carefully to remove the contaminated clothing from your skin to stop the chemical going through your skin or into your lungs
 - Make sure the people around you copy what you do. Put me on speakerphone so you and I can both guide them through this.
 - Do not let the clothing touch your face. Tear or cut clothing away from the body instead of lifting it over your head.
 - If you have to lift any clothing over your head then hold your breath, close your eyes and mouth, and hold the clothing away from your face as you lift it.
 - Remove as much clothing as you can, down to your underwear. When the showering facilities arrive, you will be provided with clean gowns to wear to keep you warm and covered up. Leave your clothes and possessions on the ground. They will also be decontaminated. It's more important to get you cleaned up.
 - Make sure anyone who needs assistance gets the help they need.

- Actions for (a) no signs and symptoms ["No" to 1 and 2] and,
- (b) where there are signs and symptoms ["Yes" to either 1 or 2]

[(a) IF CHEMICAL IS NON-CAUSTIC]

- A shower is on its way to you. You have removed contaminated clothing from your skin. Right now, the best way to keep removing the chemical is to brush skin and hair with clean dry material. Can you see any dry material around you, like tissue paper? Does anyone around you have dry material?
- *[If they confirm that they have dry material, find out what they are using then refer to it for the following statements]*
- Follow my instructions carefully. Keep me on speakerphone and make sure everyone around you copies what you are doing. When you follow my instructions, use a new piece on each area of your body. Do not reuse any of the *[material]*. Once you've used a piece, leave it on the ground.
- 1. Brush your hands first.
- 2. Use a new piece to brush your hair.
- 3. Blow your nose.
- 4. Use a new piece to brush your face and neck. Brush any chemical away from your eyes and mouth.
- 5. Use a new piece to brush your left shoulder and arm and then repeat for your right shoulder and arm.
- 6. Use a new piece to brush your chest, stomach and back.
- 7. Use a new piece to brush your left leg and foot and then repeat for your right leg and foot.
- 8. Help anyone who requires assistance by brushing their skin from the top down.

[PRIOR TO INTERIM DECONTAMINATION SHOWER]

- You will need to go through a shower to completely remove the chemical. The shower is on its way. Please remain where you are.

[(b) IF CHEMICAL IS CAUSTIC]

- Is there any water around? Bottles of water or a tap? Find water.
- Now pour water over your skin to flush away the chemical.
- Pour as much water as you can over yourself, starting with your face. Tilt your head back if possible and pour as much water as you can over your face. Make sure you completely flush your eyes.
- You will need to go through a shower to totally remove the chemical. A shower is on its way to you.
- Help anyone who needs help.
- Stay where you are until the shower gets there. Keep applying water. Apply as much water as you can.

Appendix Z: Letter from stakeholder



Dr Bob Speel
Head of National Resilience Policy Team
National Resilience and Fire Programmes
2 Marsham Street London SW1P 4DF
Bob.speel@homeoffice.gov.uk
0207 035 3532

Charles Symons
King's College London
Department of Psychological Medicine
Weston Education Centre
Cutcombe Road
London SE5 9RJ

24 May 2019

Dear Charles

Re: Your contribution to Initial Operational Response Script Development

I am writing this letter to thank you for your contributions to the ongoing development of Initial Operational Response (IOR) decontamination scripts. We plan to disseminate the final, tested versions of the scripts to emergency response organisations, whereupon they will be used by frontline responders and control room operators communicating with casualties during the initial response to chemical incidents, including mass casualty incidents. It is anticipated that this tool will assist responders with the task of implementing IOR decontamination.

You developed the early drafts of scripts, based on the outcomes of your PhD research, which has been funded by the Department of Health and Social Care Policy Research Programme, and is sponsored by King's College London and Public Health England. The scripts are currently being further developed by our colleagues in the emergency response field to ensure maximum usability. I would like to thank you for your involvement to date.

Yours sincerely

Bob Speel
Head of National Resilience Policy Team