# Overhyped and Underresearched: What Explains Risk Perception of Malicious Hazards?

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by

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A hazard is a source of risk that can pose a threat to life. Across most cultures, human life is valued very highly, and societies are willing to pay a large amount to prevent people dying prematurely. There are some hazards, though, that societies seem to regard as particularly important to prevent to the extent that they are not only willing to pay considerably more to avert deaths caused by them but they are also willing to cede rights and liberties previously enjoyed in exchange for protection from them.

My research found that these hazards, which are characterised by violent acts committed by people against each other, constitute their own subset of hazards which I refer to as 'malicious' hazards. It further revealed that malicious hazards are characterised by high moral significance and low controllability. In addition, risk from this subset of hazards is overestimated, whereas risk from hazards in other categories are either underestimated or correctly estimated.

Considering the aspects of malicious hazards that separate them from other hazards, I

observed that they are the only type of hazard involving a consciously acting agent deliberately harming others, and that they are more angering than other types of hazards. I then independently manipulated the factors of agency belief and anger. My results showed that anger increased risk perception relative to controls participants, but that there was no effect of agency belief on risk perception.

In the General Discussion I emphasise the need to identify a valid agency belief manipulation and I conclude that because of anger's role in creating demand for often harmful risk mitigation measures, risk communication about malicious hazards should be tailored so as to minimise its potential to elicit anger.

**Keywords:** risk, hazards, anger, malicious, terrorism, crime, war, intent, agency, taxonomy.

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# Chapter 1 – Introduction

The threat of terrorism, in the last decade and a half, has proved to be very expensive. Some of the cost has been in the form of direct expenditure by airlines intended to minimise the threat. Niskanen (2006), for example, estimated that airport search procedures implemented by the Transport Security Administration in the United States cost around US $5 billion a year. The International Air Travel Association (2011) noted that airport security cost airlines worldwide $7.4 billion a year. But dwarfing these numbers are costs to the public purse and costs related to lost commercial opportunities, which include: reduced sale of air tickets due to fear of attacks (in the US, after passenger numbers had risen year-on-year for 18 of the previous 20 years, 2001 – the year during which the September 11th attacks took place – saw the largest percentage drop in passenger numbers since the year the World Bank's (2014) statistics database begins); reduced sale of air tickets due to passenger frustration with time-consuming airport security procedures; losses to airports caused by increases in the amount of time passengers have to spend clearing security (meaning a higher volume of passengers in the airport but not patronising airport shops or facilities); losses to taxpayers due to the additional expense of employing personnel to administer enhanced screening and profiling and compiling lists of passengers deemed a particularly high risk and checking passengers against those lists (a duty which, in the US, was previously discharged by airlines); cabin crew vetting and special training; a vast expansion of trained dog units; and, in the US, the expense of a Federal Air Marshal Service which has grown from 50 air marshals nationwide to 4,000 (an eighty-fold increase) since 2001 (Stewart & Mueller, 2013).

There are also costs indirectly related to aviation, such as loss of revenue generated by tourism. According to Bonham, Edmonds and Mak (2006), tourism-related sales in the

US dropped by $24 billion between 2000-2001. Tourism has recovered somewhat since then, but has not kept pace with the expansion of tourism worldwide, and the US's share of the tourism market dropped from 17% in 2000 to 12.4% in 2010 (US Travel Association, 2011). The US Travel Association projects that, based on the pre-attack trajectory, the September 11th attacks cost the US $606 billion in lost revenue. Antipathy towards flying in the wake of the terrorist attacks could also have cost non-aviation industry businesses revenue because of businesspeople refraining from taking flights that could have resulted in lucrative contracts with overseas, and possibly also distant domestic, firms and individuals.

Furthermore, terrorism's costs extend well beyond aviation. The US government created an entire new government department, the Department of Homeland Security (DHS), whose founding mission was combating terrorism (Department of Homeland Security, 2014). In 2002 the DHS was endowed with a budget of $19.5 billion. The budget for the DHS in 2013 was $59 billion, and has generally increased from year to year since its inception despite a return to pre-September 11th rates of terrorism (National Consortium for the Study of Terrorism and Responses to Terrorism, 2014). The financial impact also goes well beyond the US. The British government did not establish a new department, but the aggregated budget for relevant intelligence agencies in the decade after the attacks increased from £1 billion to £2 billion[1] (Intelligence and Security Committee, 2008). The combined budget of Australia's six intelligence agencies more than tripled from 2000-2010 (Cornall & Black, 2011). Even in countries not as closely allied to the US, such as Germany and France, security budgets have seen large increases since 2001 (Deutscher, 2009).

Perhaps the most pervasive worldwide costs directly associated with combating terrorism, though, are those associated with the global 'war on terror', declared by the North Atlantic Treaty Organisation (NATO) at the behest of the US and involving 28 nations

[1] Note that the figure quoted takes into account projected changes in expenditure from 2008-2010

belonging to NATO, and 4 other nations. Several military campaigns in disparate geographical regions have been fought, of which the most significant has been in Afghanistan. Ongoing since October 2001, the Afghan war has been fought off and on by 52 countries. Estimates of the financial cost for all participants in the war are not available, but it is estimated that by the end of 2010 the US's participation had cost it $299.6 billion[2] (Belasco, 2009), that by 2013 the war had cost the UK £37 billion (Ledwidge, 2013) and Australia $7.5 billion (Brissenden, 2013). Brück, De Groot and Schneider (2011) estimate that by the time they wrote their paper the Afghanistan war had cost Germany €17.1 billion. During 2010, France spent €450 million on their military presence in Afghanistan (Uludag, 2013). The threat of terrorism was also used as a pretext for US military action against Iraq. That war was fought by fewer parties, but for those involved it cost even more per annum than the war in Afghanistan.

If the purpose of spending such large sums is to save lives that would otherwise have been claimed by terrorism, that expenditure will not have succeeded in saving many lives, principally because terrorism kills a very small number of people. In the US (the country that has spent by far the most trying to alleviate the threat of terrorism), between 2001-2010 (i.e. including the statistical anomaly that was September 11th) far fewer than than 1 person in a million was been killed by terrorism (Institute for Economics & Peace, n.d.). Even worldwide, including 'high risk' countries such as Iraq, Iran, Israel and Pakistan, only 1 person in a million dies as a result of terrorist attacks (National Consortium for the Study of Terrorism and Responses to Terrorism, 2011). Economists use a measure called value of a statistical life (VSL, e.g. Lanoie, Pedro & Latour, 1995; Persson, Norinder, Hjalte & Gralén, 2001; Viscusi & Aldy, 2003) to gauge how much people and organisations are willing to pay to save one human life. The VSL measurement is usually applied to workplace,

[2] This figure incorporates a projection.

construction and manufacturing regulations and public health interventions, and according to Murphy and Topel (2005), the limit to how much society is willing to pay is around $6.3 million. Stewart and Mueller's (2008) study of spending by the US aimed at preventing terrorism revealed that the US is prepared to pay between $64 million and $600 million to save one terrorism-inflicted death.

As well as the VSL for would-be terrorism victims being at least 10 times higher than that of equally unfortunate victims of more mundane hazards, terrorism seems to be the only hazard that the US and many of her allies are willing to trade not only money, but *lives* to avert – 4,486 US military personnel have died in the US's invasion of Iraq and the other countries constituting the coalition against Iraq have lost a further 318 servicemen and women, while in Afghanistan the US has lost 2,364 members of the armed forces and her allies have lost a further 1,132 (iCasualties, 2015). Civilian deaths in both territories have totalled inordinately higher numbers, and while it is not known exactly how many have perished in the conflict, a recent survey of randomly sampled households in Iraq produced an estimate of 500,000 deaths (Hagopian et al, 2013). Estimates in Afghanistan, using a different methodology, are that approximately 21,500 civilian fatalities have been incurred.

The widespread fear of terrorism has not only resulted in the sacrifice of both American and foreign lives in the war – a frequently cited and ironic outcome of the airborne terrorist attacks is that in the nine months immediately following them road traffic increased three-fold. Since the incidence of fatalities on the road is much greater than that in the air, this shift in transportation habits produced a large increase in transportation-related deaths. Gigerenzer (2006) calculated that an estimated 1,595 Americans died due to driving in preference over flying, noting that figure was more than six times higher than the number of Americans carried in the hijacked planes.

Terrorism has also taken up a great deal of legislative time; almost every country has enacted some sort of anti-terrorism legislation (Mendoza, 2011). Since 2001, the US has enacted at least seven federal laws explicitly aimed at combating terrorism, while the UK parliament has passed a raft of anti-terrorism bills, many of them curtailing civil liberties. Most notable amongst these may be the Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism (PATRIOT) Act of 2001, which allowed for multiple infringements of privacy without judicial oversight and the UK's Anti-Terrorism Crime and Security Act of 2001, under which terror suspects were indefinitely detained without trial.

It is evident that the response to the September 11th attacks has been financially draining, erosive of civil liberties and in some cases life-threatening itself, but perhaps justified if, as some perceive, the terrorism attacks represented a qualitatively novel hazard (e.g. Slovic & Weber, 2002). This narrative asserts that the world was ambushed by a wholly alien threat, and its response can be attributed to the overwhelming shock resulting from it. Whilst there is no doubt that they constitute the most devastating individual set of co-ordinated simultaneous attacks in terms of their death toll and the amount of destruction of property, that they were extremely tragic, and that they have given rise to more domestic and international upheaval than any previous terrorist acts, terrorism is by no means a 'new' threat – and I would argue that the difference between these attacks and other attacks that preceded them is more quantitative than qualitative. Terrorism as a tactic for advancing political aims has existed for centuries, and the word was coined around the time of the French Revolution and applied to Robespierre, the revolutionary who spearheaded the 'terror' in France.

Terrorism, and repressive legislative responses, have been seen in South Africa under apartheid, Italy during the *Anni di Piombo* (Years of Lead), the UK during and after the

Troubles and the US, in the aftermath of the Oklahoma City bombings. But in none of the above cases was terrorism a major risk. In apartheid South Africa the paramilitary wing of the ANC inflicted a very small number of deaths, and the mortality rate associated with terrorism was less than 1 death out of every million. In the UK, even in 1974, the year in which the Provisional IRA carried out the most attacks, the mortality rate attributable to terrorism was similarly low. Over the whole duration of the *Anni di Piombo* in Italy, the death rate was less than 1 in a million. As for the US, the only year in which the mortality rate of terrorism exceeded 1 in a million was the statistical anomaly that was the September 11th attacks (Johnston, 2013). The US, as a country, has long been relatively devoid of any significant threat to life from terrorism. Evidently, the legislative hyperactivity in the aftermath of September 11th is not an isolated episode. Indeed, given the examples of similar governmental responses adumbrated above it could be argued that the reaction to September 11th was quite predictable.

It might be suggested that governmental response to terrorism reflects not (or not only) a genuine assessment of threat, but rather political necessities of remaining in power. However, an opinion poll taken nine months after the introduction of the PATRIOT Act revealed that a clear majority of the American public (85%) either supported the Act or believed it did not go far enough (Gallup, 2002a), as well as approved of the treatment of Guantanamo Bay prisoners (Gallup, 2002c). In the UK, analogous measures received similarly high levels of support.

Although terrorism is now the best example of the apparent mismatch between objective risk and subjective fear, it is not the only example of a hazard producing legislative reactions whose benefits are vastly outweighed by their costs. 'Common' crime is another case in which civil liberties, money and sometimes justice have been surrendered in response. For example, habitual offender laws – known colloquially as 'three strikes laws' –

have been introduced by more than half of US states and the US federal government. These laws differ in their particulars but they all mandate very long prison sentences for criminals that are convicted of three crimes of a certain severity. California passed a law mandating that those convicted of two felonies must be incarcerated for a minimum of 25 years on commission of a third crime of considerably less severity. This resulted in some sentences that attracted almost universal condemnation, one example being the case of Santos Reyes who, having previously been convicted of two acquisitive crimes (one of which was committed while he was a minor), was imprisoned for a minimum of 26 years for forging a driving test. Several Australian states have also adopted habitual offender laws for some offences, and New Zealand and the United Kingdom have implemented habitual offender laws for some offences with the proviso that exceptions can be made in exceptional circumstances.

As with the response to terrorism, these efforts to curtail crime are expensive. In California the average cost of incarcerating one inmate is placed at $47,102 (Legislative Analyst's Office, 2009), and it is estimated that by 2009 habitual offender laws had cost California $19.2 billion (California State Auditor, 2010). Worse, it has consistently been found that such laws exert little or no positive impact on crime rates (Doob & Webster, 2003; Stolzenberg & D'Alessio, 1997; Worrall, 2004), and have in some cases been associated with *increased* commission of serious crimes (Kovandzic, Sloan & Vieraitis, 2004; Marvell & Moody, 2001). Some researchers have attributed this effect to a perverse incentive created for those with two strikes to murder victims and witnesses to reduce the likelihood of their being caught. As with responses to terrorism, such laws are not merely the product of political pressure; most enjoy widespread public support. In addition to being ineffective, the willingness to pay to reduce homicide appears to exceed the VSL for

the average hazard considerably. Cohen, Rust, Steen and Tidd (2004) found in a survey study that US residents were willing to pay $9.7 million to avert one homicide death.

Another populist criminal justice initiative is 'Megan's Law', variants of which have been implemented in several US States and the UK, and which is currently under consideration by the US federal government. Again, there is considerable variation between different iterations of Megan's Law, but they generally provide for registration of convicted sex offenders with authorities and make publicly available certain sensitive information about them, such as their name, photo, address and details of their crime. Some territories create geographically defined 'Sex Offender-Free Zones', which convicted sex offenders are prohibited from entering. Megan's Law boasts large majorities in its support in the US (Levenson, Brannon, Fortney & Baker, 2007) and the UK (Market & Opinion Research International, 2000), despite being demonstrably ineffective in reducing the commission of first sex offences and the rate of sex crime recidivism (Petrosino & Petrosino, 1999; Schram & Darling Milloy, 1995; Zgoba, Witt, Dalessandro & Veysey, 2008). The financial cost of administering such programmes is comparatively modest relative to anti-terrorism and habitual offender laws, but the cost to the welfare of released sex offenders is incalculable. Levenson and Cotter (2004) found in Florida that a third of the sex offenders in their sample had been threatened or harassed by neighbours, 27% lost their job because their employer discovered their crime, and 5% had been assaulted on that basis.

The enactment of Megan's Law also seems to be a consequence of pervasive misunderstanding of the threat posed by sex offenders. Most (68%) of Levenson et al's (2007) participants believed that sex offences were becoming more prevalent when in fact, in the state in which the study was conducted, they had been dropping year-on-year for the past decade prior to the study (Florida Department of Law Enforcement, 2014). They believed that 58% of boys and 63% of girls are sexually abused by someone they know,

figures that are respectively eight times higher and two-and-a-half times higher than estimates derived from meta-analyses of adults self-reporting earlier child abuse (Pereda, Guilera, Forns & Gómez-Benito, 2009). And they thought that 74% of sex offenders re-offend, another widely held (Filler, 2002) but erroneous belief. In reality, a meta-analysis found that sex offenders are less likely to reoffend than the average criminal, with 13.4% reoffending within 4-5 years (Hanson & Bussiere, 1998).

Capital punishment is yet another measure whose punitiveness is arguably disproportionate to the hazard it addresses. As well as costing several times more to administer than life imprisonment (California Commission on the Fair Administration of Justice, 2008), by its very nature it carries the risk of terminating the life of a convict who is later exonerated and creates a perverse incentive for the courts to refrain from posthumously acquitting those condemned even where substantial evidence comes to light that undermines the original conviction, for fear of generating public outrage and compromising the credibility of the judicial system. Nevertheless, a majority of Americans support the death penalty (Gallup, 2014), and one of the key reasons is fear of crime (Holbert, Shah & Kwak, 2004; Kell & Vito, 2006; Langworthy & Whitehead, 1986). Research has also been undertaken in countries that have abolished the death penalty, and it too has shown that support for the death penalty is partly driven by concerns about the prevalence of crime (Hessing, Keijser & Elffers, 2003; Roberts & Indermaur, 2007) suggesting that support for this expensive and arguably iniquitous punishment can be predicted by perceptions of pervasive criminality across cultures and even where it is not officially sanctioned as a crime-fighting policy.

Another hazard that tends to attract acute responses is war. Special wartime powers are usually introduced when a country is at war, and they frequently compromise rights and liberties previously enjoyed by the citizenry (Rehnquist, 2007; Stone, 2003; Tushnet, 2003).

Some of these are necessary and proportionate, but others have been controversial. Defence Regulation 18B, for example, permitted the indefinite detention of anyone suspected by the British government of involvement with the enemy in World War II. This entailed the mass internment of large swathes of the British far right (some of whom were Nazi sympathisers) but also resulted in large numbers of Jewish refugees being detained on the misguided grounds that they originated from Nazi-governed countries and thus may be collaborating with them (London, 2001).

Other emergency powers have produced manifestly unfair results. Shortly after the bombing of Pearl Harbor, President Roosevelt authorised blanket internment of a large percentage of Japanese Americans who, as a result, lost their liberty for as much as 3 years, lost much of their property as they were unable to take it with them into the internment camps, and lost future opportunities as their children's educational needs were met with insufficient resources. The decision was taken amid suspicions Japanese Americans may be collaborating with Japan. However, those suspicions have been roundly acknowledged to have been unfounded – indeed, the government's Commission on Wartime Relocation and Internment of Civilians (1982) determined that there was no evidence that the Japanese contingent was any more guilty of abetting the enemy than any other demographic cross-section.

If a rational response to a hazard is one that is proportional to the threat it poses and is effective in reducing it, it is clear that individuals and societies have reacted irrationally to terrorism, crime, and war. The goal of this thesis is to consider whether these hazards (and perhaps others) share some psychological feature that explains why they receive more attention than is warranted.

There are, then, several questions that need to be answered. Firstly, do people, in fact, regard hazards as members of distinct categories and, if so, what are those categories

based on? Several attempts have been made in the past to categorise hazards (e.g. Starr, 1969; Slovic, Fischhoff, Lichtenstein & Roe, 1981; Douglas & Wildavsky, 1983), but only Johnson and Tversky (1983) explicitly recognised a category for malicious hazards (i.e. those hazards that entail a human agent deliberately inflicting a risk on one or more other persons), which they referred to as 'violent acts'. However, their classification process has not been replicated (nor has an attempt been made to replicate it) since then. Further, there has been (to the best of my knowledge) no research since then that makes predictions specific to malicious hazards.

Second, if it were the case that malicious hazards are perceived as an identifiably separate class of hazard, what specific characteristics do malicious hazards have that sets them apart, psychologically, from other hazards. All other things being equal, are malicious hazards perceived to be more likely than hazards in other categories? If they were, this could help to explain why so much energy is spent fighting them.

Third, if malicious hazards do attract incommensurate reactions, what psychological mechanism(s) explain this bias? A popular theory, particularly amongst criminologists, is that disproportionate media attention helps to account for the way the public perceives malicious hazards (e.g. Dowler, Fleming & Muzzatti, 2006; Heath & Gilbert, 1996; Peelo, Francis, Soothill, Pearson & Ackerley, 2004), but this account only pushes back the explanation one step. Newsworthy stories are those that editors believe elicit interest; why are malicious hazards of this type?

The thesis consists of two parts. In the first, I construct an updated 'hazard space' by soliciting freely-generated hazards from New Zealand students and then use several data reduction techniques to characterise the categories into which the hazards fall and the dimensions and features on which the categories differ. Based on these analyses, I confirm that terrorism, violent crime, and war, cluster together in the hazard space.

In the second part I consider two hypotheses to explain the overestimation of malicious hazards: (1) Malicious hazards are more emotionally evocative than other categories of hazard; and/or (2) Malicious hazards are seen to be the result of the actions of a culpable human agent other than the victim. I present results of two sets of studies that manipulate both factors. The results suggest that laboratory manipulated anger is sufficient to increase the hazards' perceived likelihood (regardless of category), but agency is not. Finally, in a General Discussion I conclude that whilst it would appear that anger is likely to be responsible for overestimation of malicious hazards, limitations to the human agency manipulation make the inference that perceptions of human agency are not responsible for overestimation unsafe. I discuss those limitations as well as others, I make suggestions for how my research might be improved and what research might follow on from it (including potential alternative means of manipulating human agency), and I discuss the practical implications of my research.

# Chapter 2 – Generation of a 21st century hazard space for a New Zealand population

The first goal of the current research, and a prerequisite for an examination of 'malicious hazards', is the development of a taxonomy of hazards and a psychological 'hazard space'. Hazards have been classified previously, but the categories are typically theoretically, not empirically, derived (e.g. Lichtenstein, Slovic, Fischhoff, Layman & Combs, 1978; Sjöberg, 1999; Fischhoff, Slovic, Lichtenstein, Read & Combs, 1978; Slovic, Kraus, Lappe, Letzel & Malmfors, 1989). Notable exceptions to this top-down approach include Johnson & Tversky (1983), who asked participants to list an unspecified number of hazards and then extracted the 18 modal hazards and McDaniels, Axelrod and Slovic (1995) who ran focus groups mainly consisting of environmental experts to compile a taxonomy of ecological hazards. However, several factors make these analyses limited for my purposes: 1) McDaniels et al's sample comprised environmental experts and concerned ecological hazards, whereas my goal is to generate a representative sample of hazards as understood by a lay population; 2) Johnson and Tversky's stimuli were generated over thirty years ago, and it is likely that the popular understanding of hazards has changed since then. Smoking and drinking alcohol, for example, have become considerably more widely recognised as serious health threats, which might explain why neither was included in Johnson and Tversky's stimulus list. By contrast, nuclear power holds a much lower profile as a hazard than previously as the memory of the Three Mile Island and Chernobyl meltdowns becomes ever more remote; 3) both the previous hazards lists were generated using US populations, and it is likely that what is perceived as hazardous varies cross-culturally. Natural hazards may seem particularly relevant to New Zealanders, for example, and terrorism less so. This research

presents an inviting opportunity to generate a list of hazards using a New Zealand population, and better still the same population (university students) that will be recruited as participants in most of the studies included in this thesis; and 4) Johnson and Tversky relied primarily on two tasks which I would not endorse as exploratory measures of hazard similarity. First, in a 'conditional prediction' task, participants were asked to imagine they learnt that a certain hazard (e.g. terrorism) caused more deaths than they had previously believed, and then asked whether they would correspondingly increase their risk estimates for a set of other hazards. This presumes that hazards that are psychologically related to each other will display co-varying risk perception. Although that assumption is reasonable in and of itself, it restricts the dimensions of similarity participants are likely to consider when judging hazard similarity because there may be other types of similarity that do not imply risk covariation (as an example participants might take the view that cleaning products are a similar hazard to drug misuse as both may cause death by introducing toxic substances to the body, but clearly the circumstances under which such deaths might arise would likely differ dramatically). A second measure of similarity, 'dimensional evaluation' involved participants rating hazards along several dimensions previously proposed by Fischhoff et al. (1978), a task more appropriate for confirmatory purposes than exploratory ones as by its nature the task presupposed that the dimensions put to participants for evaluation were the only possible candidates.

Thus, the current study was designed to create an unbiased set of events that New Zealanders find hazardous in the 21st century. Participants first freely generated a large set of hazards, from which 33 hazard categories were induced and coded. Next, several data reduction techniques were used to characterise the dimensions on which the 33 hazards varied. The number of 33 was chosen in order to strike a balance between the need to derive a relatively comprehensive list of hazards and the imperative not to place excessive

demands on participants in later studies who would be asked to judge the similarity between hazard pairings (the number of which would increase exponentially with every additional hazard derived).

## Study 1

### Method

#### Participants

Seventy participants, 61 of whom were female, took part in return for partial course credit for psychology papers at the University of Otago. Reflecting an undergraduate population, the sample had a mean age of 20.4 and the sample ranged from ages 18-52.

#### Materials

Hazards were collected in a questionnaire (Appendix A) created and administered with the survey software SurveyMonkey (http://surveymonkey.com). Participants were asked to 'name 20 distinct hazards that can potentially cause death'. Twenty dialog boxes followed for participants to list their hazards. Participants were required to fill in every box; if they did not, they were prompted to complete any empty boxes before being allowed to proceed.

#### Procedure

Participants completed the study online (in a location of their own choosing and in their own time), in conjunction with several other, unrelated procedures. After providing informed consent, all participants completed a standard demographics questionnaire (Appendix B), and then a series of questionnaires including the one relevant to this thesis.

After completing all items they were shown a screen thanking them for participation and providing a written debriefing on all procedures.

## Results

Participants listed a total of 1,400 hazards, from which I derived 33 hazard categories (these are listed in Table 1). Hazards had to conform to the following criteria to be categorised:

a) Hazards had to represent a source of risk (i.e. a disfavourable outcome) without being a disfavourable outcome themselves. For example, cold snaps would be a hazard according to this criterion, but hypothermia would not.

b) Hazards had to be identifiable as the last link in the causal chain before death. For example, electricity would be a hazard according to this criterion, but 'negligence' would not, even though the negligent installation of wiring can result in death.

c) Hazards had to be potentially applicable to all participants. For example, allergies, Huntington's disease, and childbirth were excluded under this criterion.

Two independent coders classified the responses in terms of 33 categories which were decided on after my examination of the responses (taking into account the criteria outlined above). Due to an error during transmission of the responses to the coders, 68 of the responses were not coded. The coders agreed 82.7% of the time, *Kappa = .81 ($p < .001$),*

*95% CI (.79, .83)* – well above the acceptable standard for agreement (Jarvenpaa, 1999; Li, Rao, Ragu-Nathan and Ragu-Nathan, 2005; Stemler and Tsai ,2008). Where coders classified responses as compatible with more than one hazard, I resolved the disagreement by making a casting vote myself.

Table 1

*Categories Used to Classify Responses*

| | | |
|---|---|---|
| Avalanche | Eating unhealthy food | Violent criminals |
| Boating | Electricity | Slippery surfaces |
| Cleaning products | Extreme sport | Smoking |
| Cold snaps | Extreme weather | Team sport |
| Crossing the road | Fighting | Taking drugs |
| Cycling | Fire | Terrorists |
| Domestic animals | Flying | Travelling by train |
| Drinking alcohol | Heat waves | Tsunami |
| Driving a car | Heights | Volcanic eruption |
| Swimming | Bacteria & Viruses | War |
| Earthquakes | Insects | Wild animals |

A substantial number of hazards were not classifiable under my criteria. Of these, most were illnesses or medical causes of death, although 18 participants listed 'guns', 10 participants listed 'animals', and several listed old age and suicide. A limited number were hazards in accordance with my criteria, but they were listed by very few participants. Overall, the proposed category structure captured most of the hazards that participants generated. Table 2 shows frequencies for hazards where there was agreement.

Table 2

*Hazard Frequencies where Coders Agreed*

| Hazard | Frequency (%) |
|---|---|
| Avalanche | 1.13 |
| Boating | 0.75 |
| Cleaning products | 0.15 |
| Cold snaps | 1.20 |
| Crossing the road | 0.45 |

| | |
|---|---|
| Cycling | 0.53 |
| Domestic animals | 0.08 |
| Drinking alcohol | 2.48 |
| Driving a car | 6.16 |
| Swimming | 4.80 |
| Earthquakes | 2.85 |
| Eating unhealthy food | 2.48 |
| Electricity | 2.10 |
| Extreme sport | 0.75 |
| Extreme weather | 3.60 |
| Fighting | 0.83 |
| Fire | 3.45 |
| Flying | 2.40 |
| Heat waves | 0.60 |
| Heights | 2.78 |
| Bacteria & Viruses | 2.70 |
| Insects | 0.53 |
| Violent criminals | 5.18 |
| Slippery surfaces | 0.45 |
| Smoking | 1.20 |
| Team sport | 0.08 |
| Taking drugs | 3.38 |
| Terrorists | 0.83 |
| Travelling by train | 0.90 |
| Tsunami | 1.95 |
| Volcanic eruption | 1.05 |
| War | 1.80 |
| Wild animals | 2.18 |
| Other | 20.95 |

## Study 2

Having created a list of New Zealand students' perceived hazards, I next used data reduction techniques to characterise the dimensions or higher order structures underlying them. Multidimensional scaling (MDS) is a type of analysis used to visualise the psychological dimensions on which stimuli differ (e.g. Bigand, Vieillard, Madurell, Marozeau & Dacquet, 2005; Hollins, Faldowski, Rao & Young, 1993; Robinson & Bennett, 1995). MDS transforms similarity or dissimilarity judgments[3] into a graphical representation, such that those similarities map as closely as possible onto distances in (normally Euclidean) space (Borg & Groenen, 2005; Kruskal, 1964). The dimensions of that space can then be interpreted by the experimenter (Torgerson, 1965),

MDS has been used in the past to examine hazards and risk. Cooley (1977) asked investors working in various professional roles to rate the similarity of 9 different investment options and found that their ratings differed principally with respect to the variability of the possible outcomes of the investments and the possibility of making a loss. Of more relevance in the current context, Vlek and Stallen (1981) asked participants to judge similarity between pairs of 26 hazards. The results of their MDS analysis suggested that the variation between hazards was best represented by just one dimension, which they identified as 'size of possible accident' (the number of people affected per event) and 'degree of decisional control' (exercised by those exposed to the hazard), asserting that the former correlates inversely with the latter. However, this unidimensional structure can be questioned on methodological grounds, as the researchers used a sorting task (rather than direct, paired similarity ratings), which required participants first establish a dimension of difference, then use it to sort all the remaining stimuli. Furthermore, it is arguable whether size of possible accident and degree of decisional control are necessarily inversely related.

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[3] There is no qualitative difference between similarity and dissimilarity MDS – their formulae are merely mirror images of each other. In the case of risk perception it makes more intuitive sense to ask participants for similarity judgements.

Indeed, violent criminals, one of the hazards of greatest interest in this thesis, tend to inflict damage on a relatively small scale. Individuals, by definition, have no decisional control over whether or not they are murdered. It therefore cannot justifiably be claimed that the extent of harm and decisional control are always inversely related.

The most directly relevant MDS examination of risk was conducted more than 30 years ago by Johnson and Tversky (1984), based on similarity ratings of 17 hazards that they had sourced from undergraduates a year earlier (Johnson & Tversky, 1983). The analysis revealed two dimensions, which the researchers identified as 'dread' (the extent to which the hazard elicits a fearful visceral reaction) and 'catastrophic potential' (the extent to which the hazard is likely to claim large numbers of victims when it occurs). As noted above, however, Johnson and Tversky's proximities were partly based on dimension evaluation data using evaluations that were imposed top-down on participants rather than inferred from data generated by participants. Here, that shortcoming is rectified – participants are asked to provide similarity ratings, and then those ratings are used to map out the hazard space.

## Method

### Participants

Sixty-nine participants, drawn from the same population as in Study 1, took part in exchange for partial course credit.

### Materials

The experiment was conducted in a large room equipped with 10 PCs, each separated by an opaque barrier that extended high enough to ensure the privacy of participants. Stimuli

were presented and responses collected via a custom written Javascript program, designed to gauge participants' similarity judgements of hazard pairings.

**Procedure**

The study was run as the first of a pair of unrelated procedures. Participants were run in groups of between 1 and 10. After giving informed consent, participants received the following instructions:

> A hazard is defined as a potential source of danger. In this study we are investigating how people perceive and think about a number of hazards that we have identified. You will be presented with many different pairs of hazards. Your job is simply to judge how similar each pair of hazards is. Make your judgments on a 1 to 9 scale, where 1 is the least similar and 9 is the most similar.
>
> There are many pairs to rate, so don't spend a lot of time on any one judgement. There are no right or wrong answers; we are just interested in your judgement. The entire task should take about 45 minutes.

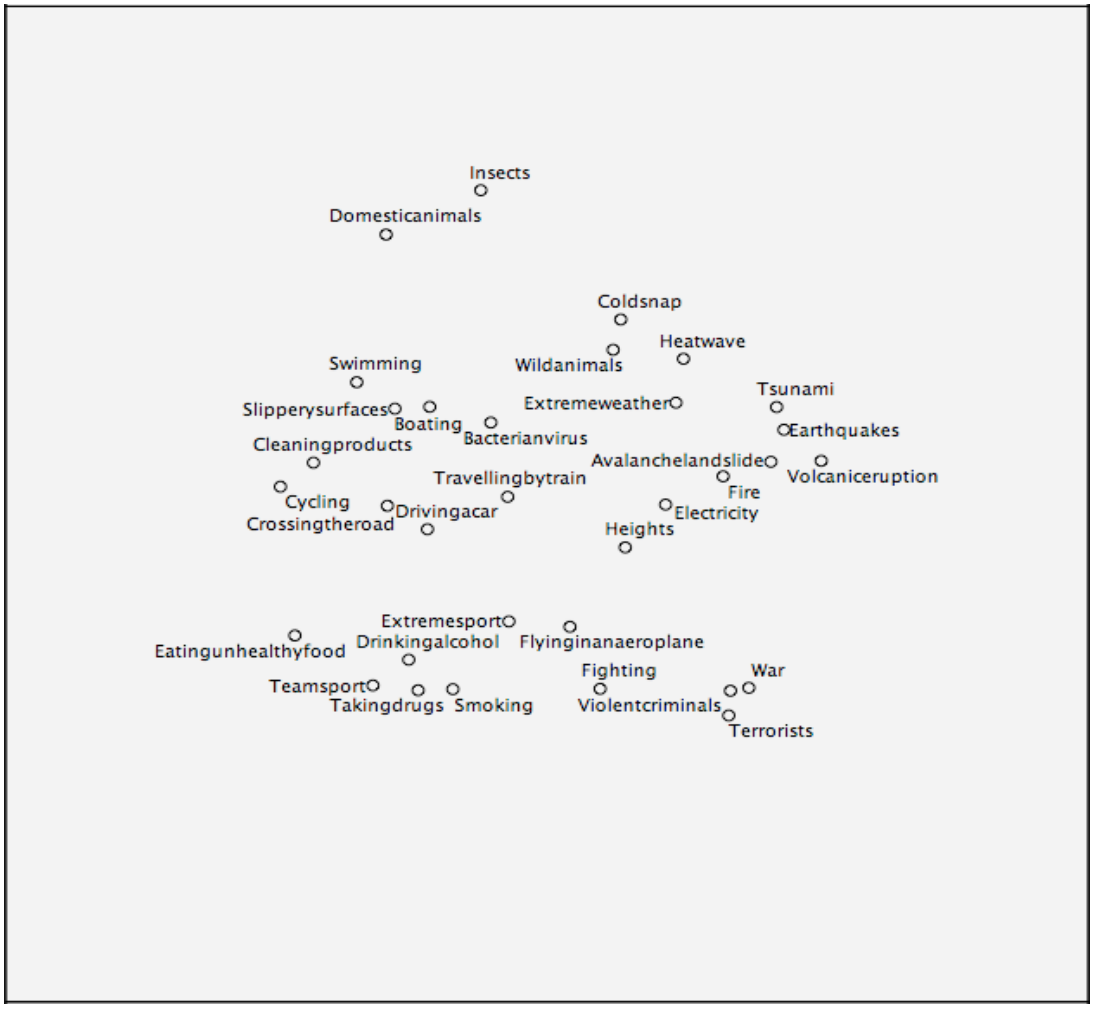
After signalling their understanding of the instructions with a button press, participants rated every possible combination of hazards ([33x32]/2 = 528). The order of presentation of hazard pairings was fully randomised. Each pair was presented at opposite sides of the screen (screen side was also randomised) above a 9-point Likert scale which was set out left to right, anchored at 1 ('least similar') and 9 ('most similar'). Participants

recorded their judgements by pressing the key corresponding to their similarity rating, after which the next pair appeared immediately.

## Results

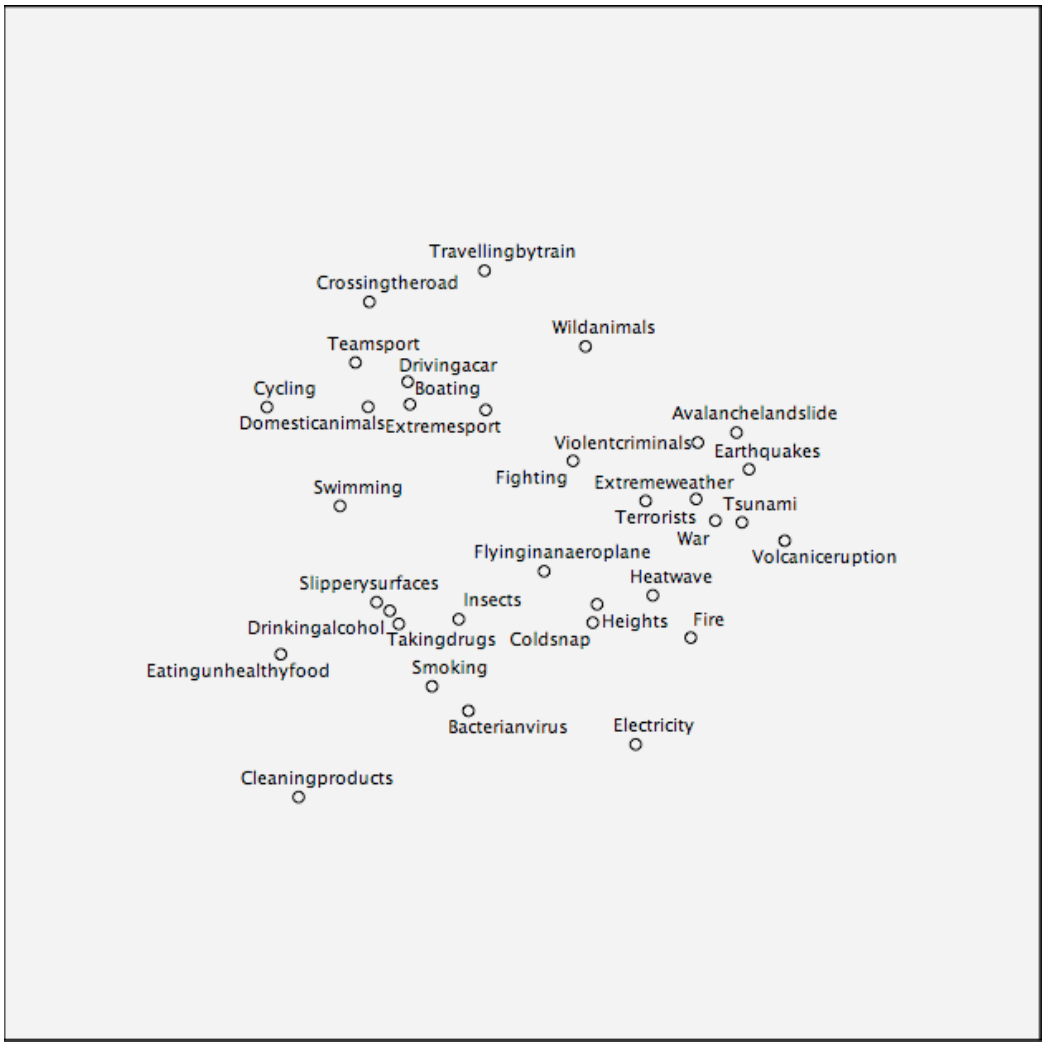
Consistency across raters was high (Cronbach's alpha = .97), well above the guideline standard of acceptability (George & Mallery, 2003), so ratings were aggregated across participants to calculate mean similarity scores between each hazard pairing. The mean similarities were submitted to analysis using PROXSCAL.

The Stress-1 statistic reflects how well the model accounts for variance. Lower stress values are indicative of better fit, and the value considered acceptable is contingent on the number of dimensions used to represent similarities. As the number of dimensions increases the stress value inevitably decreases, but the stress score needs to decrease sufficiently to justify including another dimension. A steep decline was observed as the dimensionality was increased from 1 to 3 dimensions, with only marginal improvements after that. Consequently, it was determined that a three-dimensional representation is most appropriate. The Stress-1 value, .197, is acceptable in accordance with Spence and Ogilvie's (1973) recommendations. The three dimensions are plotted in Figure 1.




Dimension 2

Dimension 1




Dimension 3

Dimension 1

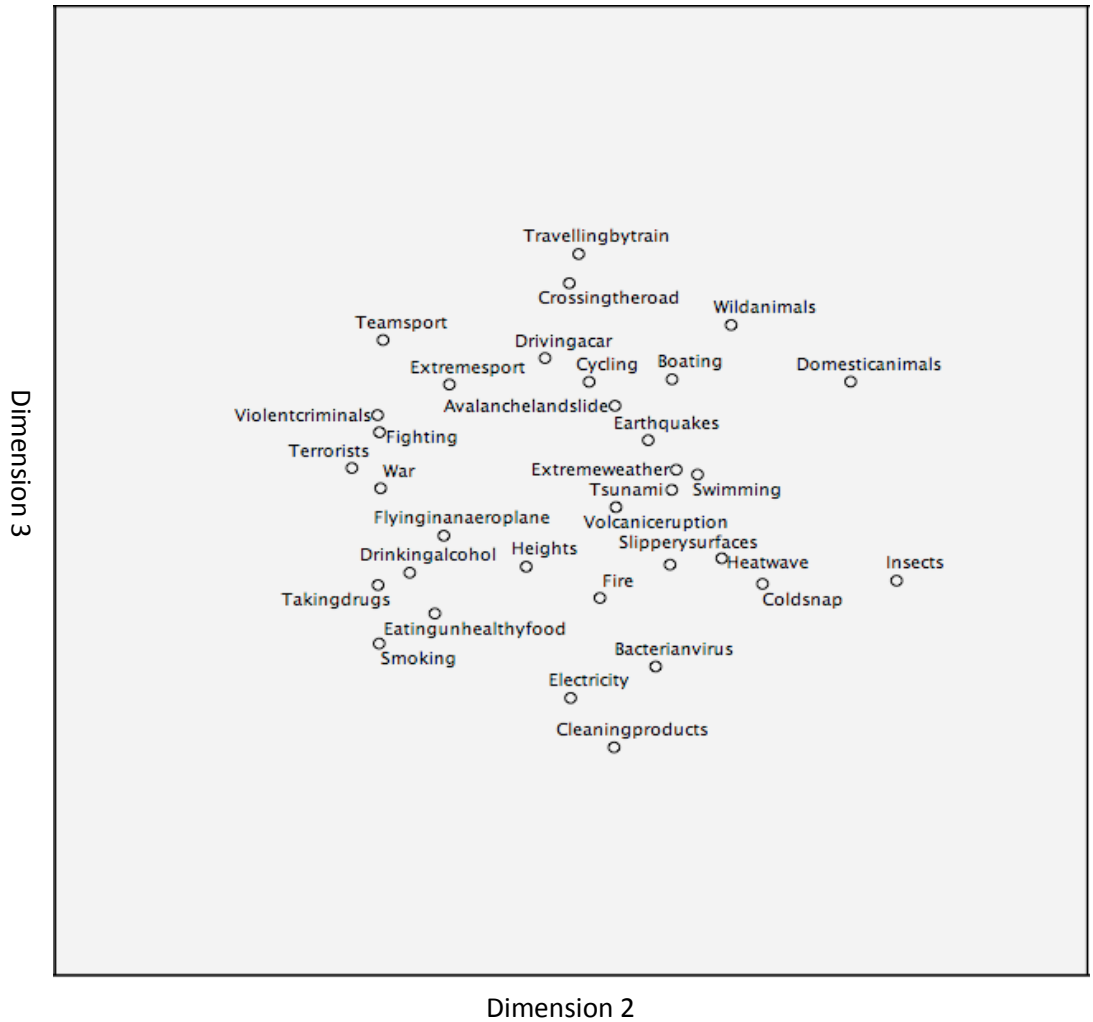



*Figure 1.* Dimensions from PROXSCAL analysis plotted against each other

Interpretation of stimulus dimensions in MDS is necessarily subjective, and it is worth visually inspecting the stimulus plots and speculating about their meaning. As seen in Figure 1, the first (and most subjectively important) dimension features cycling, cleaning products and eating unhealthy food at one extreme, and earthquakes, tsunamis and volcanic eruptions at the other.

This distinction bears some resemblance to Vlek and Stallen's (1981) harm/controllability dimension, but the presence of violent criminals and electricity close to natural disasters, and the distance between team sport and extreme sport (which both tend to cause at most one death per event) cast doubt on an interpretation in terms of magnitude of harm. More plausible was that the dimension represented controllability of hazards, although in that case it would be anomalous that cycling was considered to be considerably more controllable than driving a car.

Alternatively, Dimension 1 might reflect familiarity. A strength of familiarity as an explanation is that it would account for cycling being plotted at one extreme and driving, train travel and flying being plotted incrementally closer to the other pole. Only a minority of first and second year students drive (assuming they are representative of the general population of their age group; New Zealand Transport Agency, 2013), the passenger railway network of New Zealand is skeletal and geared towards tourism rather than transport and New Zealand's remote location means that at undergraduate age a lot of New Zealanders have not flown many times (if at all). The interpretation of familiarity, however, is not without its weaknesses. One would not expect undergraduates to be equally familiar with taking drugs and drinking alcohol, and it would also be surprising that wild animals were not plotted as one of the most unfamiliar hazards.

On Dimension 2, terrorists, violent criminals and war can be found at one pole and insects, domestic animals and cold snaps at the other. Notwithstanding the congregation of

all the malicious hazards at one extreme, the proximity assigned to team sport (close to that same extreme) argues against an interpretation of malicious intent. Furthermore, the proximities of other non-malicious hazards such as eating unhealthy food, drinking alcohol, smoking and taking drugs near that pole, and of two of the animal-related hazards at the other (with wild animals following very closely behind cold snaps) suggest a more parsimonious interpretation in terms of moral significance. Where this interpretation runs into difficulties is in explaining the differential proximities of hazards that appear to carry no moral implications (e.g., heights versus cold snaps). Also, if it is to be argued that team sport carries moral significance as a noble, character- and team-building pursuit, one might reasonably expect cycling to win moral approbation as a non-polluting method of transport and a form of regular exercise conducive to a healthy lifestyle. But that is a matter of subjective interpretation by the participants, and it is plausible that New Zealand's culture sets greater moral store by team co-operation than just exercise in general, and the likelihood that the majority of my hazards are morally neutral introduces noise that could account for differences in proximity between equally neutral hazards.

Dimension 3 finds cleaning products, electricity and bacteria and viruses at one extreme, and crossing the road, heights and travelling by train at the other. A possible difference between these groups relates to fear or vulnerability of victims prior to exposure, although travelling by train would be an anomaly. Another possibility is 'domesticity' – the degree to which the hazard affects victims in the confines of their own home. The proximity of cleaning products would be explained satisfactorily by this interpretation, as would those of the hazards at the other pole, but the similarity of the proximities of wild animals and domestic animals presents a rather glaring weakness. Other candidates include 'naturalness', as natural hazards such as avalanches and wild animals appear opposite electricity and cleaning products; and immediacy of death, as poisons (e.g., cleaning

products and eating unhealthy food) tend to inflict harm gradually over a longer period than heights and crossing the road.

## Study 3

To help with interpreting the dimensions, new participants were recruited to rate the hazards on 16 characteristics suggested by previous theory and by informal inspection of the MDS plots (see Tables 3 and 4 for operational definitions).

*Controllability, Dread, Immediacy, Severity of exposure, Voluntariness:* These are all cited by Jenkin (2006) as variables along which risk perception might vary in the context of the Psychometric Paradigm.

*Naturalness:* This is another Psychometric Paradigm variable that has been adduced by multiple researchers (Rozin; 2006; Siegrist, Stampfli, Kastenholz & Keller, 2008; Slovic, 1987).

*Deadliness, Familiarity, Inherent risk, Intrinsic badness:* These are all proposed as variables that might explain the proximities of hazards as plotted on dimension 1.

*Human involvement, Immorality, Maliciousness, Moral significance, Possibility of gain:* These are proposed as variables that might be represented by dimension 2.

*Domesticity:* This is the variable I believe best describes dimension 3.

These ratings were provided by two separate samples of participants.

## First sample

### Participants

Fifty-nine participants, of whom 29 were female, were recruited from a national student job centre; all were students at the University of Otago, studying a variety of disciplines. They were reimbursed $15 to cover their travel expenses.

### Materials

The same experimental booths were used as in Study 1. These were set up in the same manner as in Study 1. The 33 hazards previously generated provided the stimuli for this procedure. The task participants completed involved rating those hazards, using a Likert scale, on the characteristics enumerated above (this is described in further detail below).

### Procedure

The study was run in conjunction with two other, unrelated procedures. Participants were run in groups of up to 3, in individual experimental cubicles containing an iMac workstation on which all stimuli were presented and responses collected via custom written Superlab software (www.superlab.com). After giving informed consent, participants completed several other, unrelated procedures, before being given the following instructions:

> ‘This is a study of 'hazards'. A hazard is defined as a potential source of danger. When the danger actually occurs, that is known as a 'hazard event'.
>
> We are investigating how people perceive and think about a number of hazards that we have identified. You will be presented with a number of these hazards and

asked to judge them on various dimensions.

Read the definition of each dimension carefully, but don't spend a lot of time on any one judgement. There are no right or wrong answers; we are just interested in your judgement.'

Having read these instructions, participants then clicked through to the next page, which provided the definition of the first variable. There was a total of 12 variables altogether, and their identities and definitions are listed in Table 3. Participants rated all 33 hazards in random order on each variable before proceeding to the next variable. The variables were presented in one of six different orders (order did not influence results and will not be discussed further). One hazard was presented at a time, with the response scale below, anchored at 1 and 7. Participants recorded their responses by pressing the keyboard key that corresponded with their desired rating. After rating all hazards on all variables, participants completed another study before being thanked and debriefed about all tasks they had completed.

Table 3

*12 Variables Rated by First Cohort*

| Variable | Definition |
|---|---|
| Controllability | The extent to which a victim can control the severity of consequences due to exposure |
| Dread | The extent to which the effects of exposure are dreaded |
| Familiarity | The extent to which a hazard is known to the victim |

| | |
|---|---|
| Human Involvement | The extent to which people are involved in the hazard |
| Immorality | The extent to which the hazard is immoral |
| Intrinsic Badness | The extent to which the hazard is necessarily a negative thing |
| Maliciousness | The extent to which the hazard is inflicted on victims with the intention to harm them |
| Moral significance | The extent to which the hazard represents a moral issue (whether good or bad) |
| Naturalness | The extent to which a hazard is the product of nature rather than man-made/artificial |
| Possibility of gain | The extent to which something may be gained as a result of exposure to the hazard |
| Severity of effects | The extent to which the consequences of exposure are severe |
| Voluntariness | The extent to which exposure to the hazard is voluntary |

## Second sample

### Participants

Ninety-two participants (51 male, 40 female, 1 other) were recruited via Amazon's Mechanical Turk, a large community of 'workers' who volunteer for simple online tasks in exchange for token payment. Ages ranged from 17-59, and the mean age was 22.2.

### Procedure

The procedure for the second sample was identical to that of the first sample with the following exceptions: first, the study was run in isolation over the Internet, with informed consent and debriefing conducted online. Second, only four variables were used (see Table 4) and participants were provided with slightly amended instructions:

> This section of the questionnaire concerns the dimension of [variable]. [Variable] is here defined as [definition]. As an example, let's take construction sites. When rating the [variable] of construction sites, the question is '[exemplar question]'.
>
> The hazard you are being asked to judge will be displayed underneath the definition of [variable].'

Third, participants responded by clicking their mouse on a rating rather than entering a number into a response box, and the program permitted participants to change their rating before proceeding to the next one.

*Table 4*

*4 Variables Rated by Second Cohort*

| Variable | Definition | Exemplar question |
|---|---|---|
| Deadliness | The likely number of deaths per hazard event | If an accident occurred on a construction site (e.g. falling debris), how many people would that accident be likely to kill? |
| Domesticity | The extent to which the hazard affects people while they are at home | Do construction site accidents tend to affect people while they are at home? |
| Immediacy | The extent to which the | Do construction site accidents tend to |

| | | |
|---|---|---|
| | hazard event causes death straight away | cause death straight away? |
| Inherent Risk | The extent to which people potentially exposed to the hazard view it as inherently risky | If someone was working on a construction site, how much risk would they associate with the possibility of an accident occurring (e.g. falling debris)? |

## Results

Ratings of each hazard on each of the 16 variables were submitted to reliability analyses and all were found to be reliable (Table 5). To help interpret the dimensions extracted by the MDS analysis, hazard ratings on each variable were averaged across participants and then correlated, at the level of the hazard, with their coordinates on the three MDS dimensions. These correlations are also shown in Table 5.

It is apparent from Table 5 that multiple variables correlate significantly with dimensions 1 and 2. The variables that correlate most strongly with dimension 1, though, are controllability, dread, familiarity, inherent risk, immediacy and severity of exposure. In other words, dimension 1 appears to resemble a composite of hazards' perceived gravity and the perceived coping potential. These elements are strongly thematically linked (they are intrinsically inversely correlated). Thus dimension 1 could be seen as 'perceived impact'. Dimension 2 is correlated highly with variables of a moral theme – immorality and moral significance – consistent with the extreme locations of terrorism, violent criminals and war at one pole and insects and domestic animals at the other (non-morally significant) pole. Finally, dimension 3 is uniquely, and strongly, correlated with domesticity.

Table 5

*Variable Reliability and Intercorrelations*

| Variables | Cronbach's Alpha | Dimension 1 | Dimension 2 | Dimension 3 |
|---|---|---|---|---|
| Controllability | .97 | -.91*** | -.25 | .03 |
| Deadliness | .99 | .67*** | -.35* | -.22 |
| Domesticity | .99 | -.01 | .07 | -.73*** |
| Dread | .99 | .81*** | -.23 | -.26 |
| Familiarity | .93 | -.74*** | -.37* | -.07 |
| Human Involvement | .99 | -.19 | .14 | .11 |
| Immediacy | .99 | .75*** | -.19 | .19 |
| Immorality | .99 | -.008 | -.70*** | -.22 |
| Inherent Risk | .99 | .72*** | -.38* | -.17 |
| Intrinsic badness | .99 | .67*** | -.33† | -.32† |
| Maliciousness | .98 | .39* | -.49** | -.25 |
| Moral Significance | .98 | -.10 | -.74*** | .02 |
| Naturalness | .99 | .46** | .65*** | -.07 |
| Possibility of Gain | .98 | .69*** | -.08 | .27 |
| Severity of Exposure | .98 | .74*** | -.33† | -.24 |
| Voluntariness | .99 | -.10 | -.41* | .07 |

† p < .1, * p < .05, ** p < .01, *** < .001

However, because several of the 16 variables were also strongly correlated with each other, their ratings were factor analysed. In accordance with Velicer's (1976) Minimum Average Partial procedure, 2 factors were extracted. Factor scores are shown in Table 6. These factor scores were then correlated with the dimensions, and the results are shown in Table 7. It is evident that the first factor represents variables relating to perceived

impact and that the second factor represents moral variables. As expected, the first and second factors mapped closely on to the first and second dimensions. The third dimension is not explained by either of the factors as domesticity did not load strongly on to either one.

Table 6

*Loadings of Variables on to Factors*

| Variables | Factor 1 | Factor 2 |
|---|---|---|
| Controllability | -.72 | .64 |
| Deadliness | .89 | .04 |
| Domesticity | .31 | .06 |
| Dread | .99 | -.07 |
| Familiarity | -.60 | .62 |
| Human Involvement | -.25 | -.19 |
| Immediacy | .53 | -.23 |
| Immorality | .55 | .79 |
| Inherent Risk | .93 | .05 |
| Intrinsic badness | .97 | .13 |
| Maliciousness | .77 | .54 |
| Moral Significance | .44 | .86 |
| Naturalness | .28 | -.84 |
| Possibility of Gain | -.85 | .27 |
| Severity of Exposure | .98 | .04 |
| Voluntariness | -.19 | .29 |

Table 7

*Correlations of Factor Scores with Dimensions*

| Factor | MDS 1 | MDS 2 | MDS 3 |
|---|---|---|---|
| 1 | .76*** | -.30† | -.19 |
| 2 | -.43** | -.78*** | -.24 |

† p < .1, * p < .05, ** p < .01, *** < .001

In sum, a tentative look at the hazard space modelled by MDS reveals some overlap with previous analyses, but also notable differences, such as the possibility of a moral dimension. But the distribution of hazards in the space suggests that differences might be better represented discretely than continuously. It appears (particularly where the two most explanatory dimensions are plotted against each other) that hazards cluster together forming constellations of thematically similar hazards. Notably war, terrorism and violent criminals are plotted close to each other, but hazards such as earthquakes, tsunami and volcanic eruption (i.e. natural disasters) also cluster together as do driving a car, crossing the road and swimming (i.e. voluntary hazards) and smoking, taking drugs and drinking alcohol (i.e. 'vice' hazards).

Where hazards form discrete groups, a cluster analysis is a preferable type of descriptive analysis compared with MDS. Thus, the factor scores were submitted to a hierarchical cluster analysis. Distances between hazards were gauged as squared Euclidean distance. The results of the cluster analysis are graphically represented in Figure 2, in a 'dendogram'.

A dendrogram illustrates *how closely* the items within it are associated. To determine the closeness of two hazards, the two horizontal lines associated with the two hazards should be traced from left to right (including along vertical lines which allow horizontal lines to merge with each other) until a vertical line is reached which is common to both hazards. This vertical line will align with a point along the dendrogram's *x*-axis (which represents the hazard proximities rescaled such that 1 denotes high similarity and 25 denotes low similarity between hazards). This point defines the closeness of those two hazards by comparison with other hazard pairs. As an example, insects and cold snap can be connected at (but not before) the vertical line that heat wave, wild animals, extreme weather, slippery surfaces and heights hold in common, making their rescaled distance 4.

This can be contrasted with the closeness of insects and avalanche, two hazards whose first vertical line in common is beyond that shared by insects and cold snaps, also encompassing volcanic eruption, tsunami and earthquakes. This vertical line aligns with 9 on the *x*-axis, and hence the rescaled distance between insects and cycling is 9.

In this way, the hazards are arranged into clusters. Reading the dendrogram from right to left, the first vertical lines one encounters have offshoots that represent the most broadly applicable clusters. One of these clusters includes drinking alcohol, taking drugs, smoking, unhealthy food, fighting, violent criminals, war and terrorists (rescaled proximity of 9), and the other cluster is comprised of all the other hazards (rescaled proximity of 17). This second cluster sub-divides at the vertical line used in the second example in the paragraph above (rescaled proximity of 9), and at the line common to cleaning products, domestic animals, cycling, travelling by train, team sport, swimming, crossing the road, flying, driving a car, extreme sport, electricity, boating (rescaled proximity of 3). The first cluster sub-divides at the line common to violent criminals, war and terrorism (rescaled proximity of 1) and the line common to drinking alcohol, taking drugs, smoking, eating unhealthy food and fighting (rescaled proximity of 3). In some cases, further subdivisions can be made beyond these but, as with factor analysis, refining data into more fragments increases the descriptive accuracy of those fragments and reduces their utility. For that reason I have limited my interpretation to the first four factors.

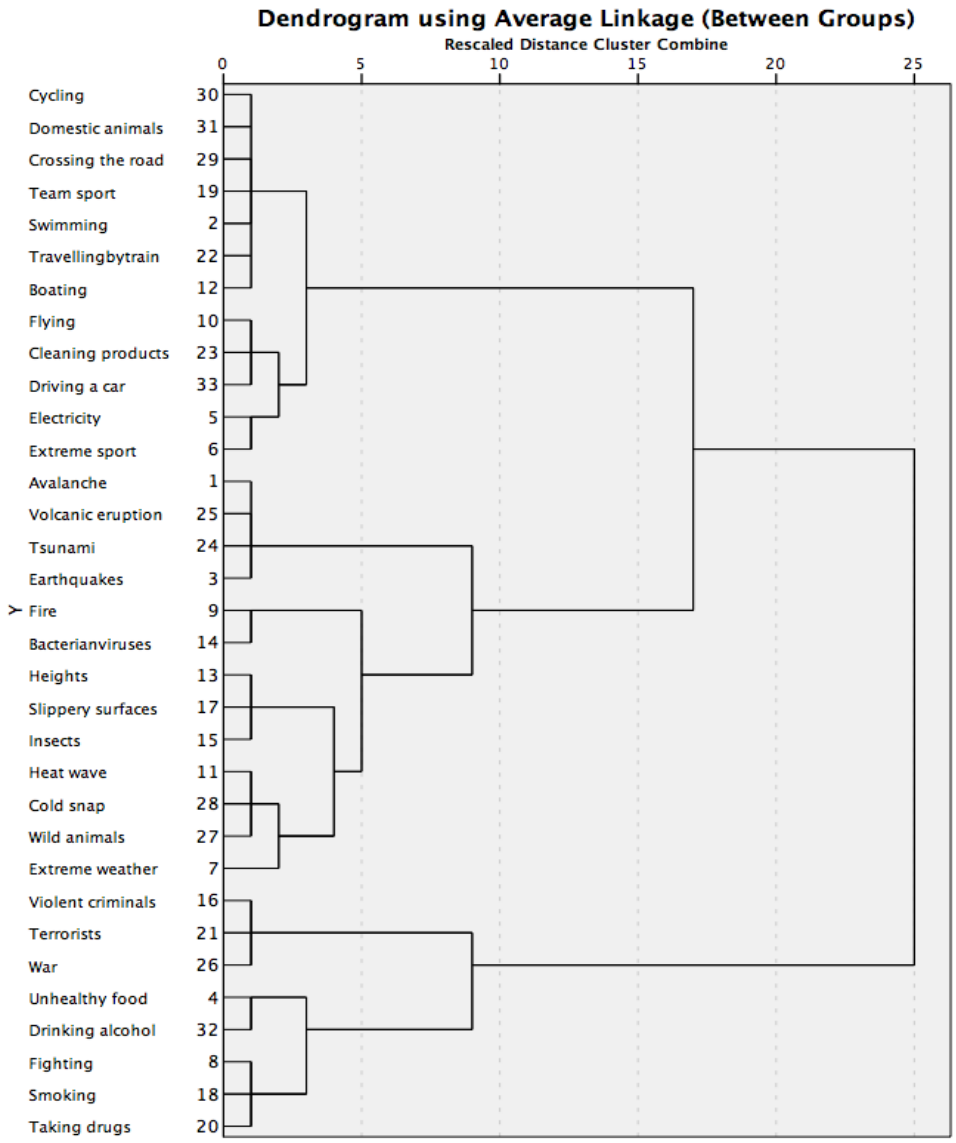



*Figure 2.* Dendrogram illustrating clustering of hazards

In this dendrogram, the numbers immediately to the right of the hazards should be ignored – they only represent the order in which hazards were set out in the data file; the order of presentation in this study was randomised, so order is not a factor in this study.

## Discussion

This chapter presents three studies: a hazard generation study, a stimulus similarity

judgement study and a variable evaluation study. Replicating previous work in a modern and novel context, New Zealanders generated hundreds of hazards, which were then reduced to 33 hazard categories. Based on new participants' paired similarity ratings, MDS was used to map their psychological proximity, a process yielding three major dimensions. Yet another group of participants rated the hazards on a set of plausible and theoretically-derived variables, which suggested that the most important dimension could be explained by controllability, and was also strongly correlated with a host of other variables that collectively represent the degree to which hazards are believed to be both seriously destructive and difficult to cope with.

In this way dimension 1 actually encompasses the characteristics of both Fischhoff et al's (1978) dimensions. Unlike that study, however, the current study suggests that these dimensions are not orthogonal. This is perhaps unsurprising, as Fischhoff et al's dimensions themselves had two attributes in common with each other (dread and catastrophic potential). The area in which their dimensions differed was that one emphasised familiarity and the other focussed on deadliness. The reason that familiarity did not emerge as its own factor in the current MDS analysis may be a result of the different types of hazards used in the analysis. In particular, in keeping with the most prominent contemporary issues, many of their hazards were of a novel technological nature (such as food preservatives, pesticides and nuclear power). The relative lack of hazards of this sort from my hazard list is perhaps symptomatic of a society in which threats from technological advancements are not feared as much as they used to be.

With respect to MDS dimension 2, I suggested that it represented moral significance. The findings of Study 3 corroborate that claim as the largest correlation was with moral significance. Immorality and naturalness were also (slightly less) strongly correlated with dimension 2. The importance of a moral dimension, which has not been identified in

previous MDS analyses of hazard space, may be partly explained by the comparative preponderance of overtly moral hazards on my list, which serves to highlight the importance of sourcing a relevant, up-to-date taxonomy. There is good reason to suspect that moral hazards have become more salient over the years. In 1983 (the year Johnson and Tversky sourced their hazards), 32.1% of US adults smoked (Centers for Disease Control and Prevention, 2013). Since then, the percentage of smokers in the developed world in general has declined, and by 2011 (the year I sourced my hazards), 19.0% of US adults smoked (Centers for Disease Control and Prevention, 2012) and the percentage of NZ adult smokers was 18% (Ministry of Health, 2012). A drop in alcohol consumption has also been observed – in 1983 the US consumed 10.2 litres per capita (Schoenborn, 1986) compared with 8.6 litres in 2011. In the same year, NZ consumed 9.5 litres (Statistics New Zealand, 2012). This decline in these particular types of risky behaviour hints at more pervasive awareness of the health risks they entail. In further support of my belief that these indulgences have increasingly come to be viewed as health risks, it should be noted that research has generally found that those who engage in smoking and drink on a more frequent basis (of which there are now proportionally fewer than in 1983) tend to perceive them to be less risky (Dillard, Midboe & Klein, McCoy et al, 1992; Weinstein, 1998; Weinstein, Marcus & Moser, 2005). The third and final dimension was found to correlate highly with domesticity, and none of the other dimensions.

In sum, the MDS analysis suggests that controllability and moral significance are the most heavily weighted aspects of the hazards among my participants. However, I observed from the arrangement of the hazards in the Euclidean spaces plotted by MDS that the hazards are better seen as members of distinct clusters than locations along continua, and so I supplemented the MDS analysis with a cluster analysis based on participants' ratings on the sixteen candidate variables. This analysis identified four clusters of hazards: natural

disasters (these will henceforth be referred to as 'natural' hazards), hazards that individuals or societies voluntarily accept exposure to in exchange for some other perceived benefit (these will be referred to as 'useful' hazards), hazards that individuals voluntarily accept in exchange for a benefit but which are widely perceived to be immoral (these will be referred to as 'immoral' hazards), and hazards that are deliberately inflicted on unwilling victims (these will be called 'malicious' hazards). These four clusters were generated by the subdivision of two overarching clusters. Reading the dendrogram items from top-to-bottom, items from Cycling through Extreme Sport are 'useful' hazards, those from Avalanche through Extreme Weather are 'natural' hazards, those from violent criminals through war are 'malicious' hazards and those from unhealthy food through taking drugs are 'immoral' hazards. Examination of the hazard proximities showed that the overarching clusters were driven by differences in moral significance and that the subdivision of those clusters was driven by controllability. Whereas natural and useful hazards are both defined by low moral significance, the former are considered to have relatively low controllability and the latter are perceived to be relatively controllable.

The morally significant cluster also sub-divides into a high controllability cluster and a low controllability cluster, with the high controllability cluster including hazards that could be interpreted as useful hazards were it not for the apparent likelihood that society does not willingly accept them, and tends to take a disapproving view of individuals that choose to expose themselves to them. Thus, even though some individuals may perceive there to be some social, cathartic or self-gratifying benefit to hazards such as smoking or eating unhealthily, they cannot be classified as useful and appear to form their own discrete group. They therefore earn their 'immoral' label. The low controllability sub-cluster comprises hazards that are morally significant and not accepted voluntarily either by society or individuals. Exposure to these hazards is inflicted by intentionally acting agents

whose purpose is to cause harm. It is these malicious hazards that are of particular interest in this thesis.

It has been argued above that malicious hazards are routinely treated differently to other hazards that threaten humanity – that they receive incommensurate media and political attention, that more legislation is devoted to, and more money is spent on, combating them and somewhat paradoxically more lives are sacrificed in bids to stymie them (e.g. Cohen et al, 2004; Lanoie et al,1995). Evidence cited from opinion polling appears to suggest that public opinion whole-heartedly supports efforts to quell malicious hazards. A possible reason for this could be simply that the public perceives that these are the type of hazard that authorities have the most capacity to tackle. However, this argument does not stand up to scrutiny. Useful hazards, some of which amount to practical necessities of day-to-day life, can in many cases be attenuated through regulation. But while some such regulation does exist, the policy debate is primarily conducted between politicians and academics, and on the occasions when the public's wider attention is engaged, the public sometimes opposes regulation (e.g. legislating for mandatory use of seat belts; Schenck, Runyan & Earp, 1985; legislating for minimum pricing for alcohol; Lonsdale, Hardcastle & Hagger, 2012) and often fails to take simple precautions on an individual level (Pashby, 1979; Slovic, Fischhoff & Lichtenstein, 1978). Furthermore, some research tentatively hints at a heightened perception of the threat of these hazards (Johnson, 2009). Opinion polling in the US found that the bulk of the public believed crime had risen over the previous 20 years, even though official statistics showed that exactly the reverse was true (Yougov, 2014a), and the same finding has been obtained in UK polling (Duffy, Wake, Burrows & Bremner, 2008). This could be explained by a general tendency of people to adopt a pessimistic stance, but research exploring other hazards has tended to find that participants err on the side of optimism (Leiserowitz, 2006; Yougov, 2014b). If it is true that malicious hazards

attract especial pessimism, what exactly is it about malicious hazards that is responsible for this perceptual disparity?

# Chapter 3 – Risk perception

Having established the validity of 'malicious hazards' as a category, and also that this is the same class of hazards to which western countries have routinely overreacted, the remainder of the thesis is concerned with why this is the case. One account is that *risk perception* drives policy attitudes, that people support policies intended to avert malicious hazards to the extent they believe those policies will prove effective in reducing their prevalence. It follows, then, that where people consider malicious hazards to be more common, they will perceive greater need to do something about them, and hence support risk mitigation.

As intuitive as this account is, it is not the only one. Another is that the desire to fight crime, terrorism or hostile international powers derives from a perceived moral obligation – where crime and terrorism are concerned, the moral obligation is to secure a form of redress for the victims of criminals or terrorists, to penalise offenders so as to compel them to make amends and to deter similar transgressions, to affirm the moral authority of the law and to maintain the public's confidence in its ability to express its collective repudiation of miscreants. Apropos war, some may perceive a moral obligation to attack a country acting in a way that is contrary to the values they hold, hoping to humiliate or depose its leader and assert the moral superiority of their own country's values. Of course, there is still likely to be a limit to how much expense people will be prepared to spare in order to accomplish their moral goals, but the point is that support for tougher sentencing for criminals or broader surveillance powers to fight terrorism is independent of perceived risk, because it is the principle that counts.

There is indeed support for this explanation. Tyler & Boeckmann (1997) issued surveys consisting of individual difference inventories measuring crime-related concerns, concerns about social conditions and social values. The crime-related concerns inventory

contained items concerned with personal risk perception (e.g. 'I worry about being robbed or assaulted in my own neighbourhood at night') and items that approximated general risk perception (e.g. 'The crime problem in California is serious'). The social conditions inventory addressed concerns about societal decay, a deficit in social cohesion and chaotic heterogeneity. Its items were of a distinctly moral character (e.g. 'There is a lot of agreement about what is right and wrong'; 'With so many different types of people in California it is hard to know if others would help you if you were in trouble') and the social values inventory comprised items that tapped fundamental, core social and political attitudes, in particular, authoritarianism (e.g. 'Obedience and respect for authority are the most important virtues children should learn'), dogmatism (e.g. 'Of all the different philosophies which exist in the world there is probably only one which is correct') and liberalism (an example of a liberalism question was the extent to which participants would support multilingual education). Participants were also questioned about their support for California's three strikes law (discussed in Chapter 1), punitive criminal justice measures more generally and support for the abolition of civil rights that criminal suspects benefit from. Each of these three dependent variables was then regressed on the three inventories measuring beliefs and attitudes. It was found that the factor most predictive of support for all three policies was social values. Social values are stable, enduring and internal (Caprara, Schwartz, Capanna, Vecchione & Barbaranelli, 2006; Rokeach, 1973; Sears & Funk, 1999), and any attempt to influence public support for certain policies by correcting risk perception would not be expected to have any impact on the portion of support for these policies that is accounted for by them.

Other research has also supported the role of morally driven support in risk mitigation policies (Green, Staerklé & Sears, 2006; King & Maruna, 2009; Tyler & Weber, 1982). However, it is still apparent that concern about crime and its prevalence plays a part

- Dowler (2003), Pfeiffer, Windzio & Kleimann (2005) and Roberts & Indermaur (2007) all found that beliefs and concerns about crime predict support for punitive policies, and the papers previously cited as supporting a greater role for social values nonetheless acknowledged that crime-related concerns accounted for a significant minority of the variance. Crucially, crime-related concerns are also mutable, as evidenced by studies reporting successful efforts to correct health-related risk perception (Kreuter & Stretcher, 1995; Siero, Kok & Pruyn, 1984), technological risk perception (Arvai, 2003; Bord & O'Connor, 1990; Frewer, Howard & Shepherd, 1996) and risk perception of natural hazards (Keller, Siegrist & Gutscher, 2006; Paton, Smith, Daly & Johnston, 2008). This stands in contrast to social and political values, which are relatively permanent (Braithwaite, 1998; Johnson, 2001; Lindsay & Knox, 1984) . It may be, therefore, that to influence the resources expended on battling relatively uncommon hazards, the most viable method would be to target the risk perception mechanism.

Further supporting this contention, it appears not only to be possible to influence people's risk perception (and in so doing their attitudes towards risk mitigation policies), but also to modify people's risk-related behaviours. It has been shown, for example, that interventions that alter risk perception are able to modify vaccination uptake (Chapman & Coups, 2006; Madhaven, Rosenbluth, Amonkar, Fernandes & Borker, 2003; Zimmerman et al, 2003), cancer and heart disease screening uptake (Ahmad, Cameron & Stewart, 2005; Hutchison et al, 1998; Rimer et al, 2002), driving behaviour (Perkins, Linkenbach, Lewis & Neighbors, 2010; Rundmo & Iversen, 2004; Wang, Rau & Salvendy, 2015) and smoking behaviour (Armitage, Harris. Hepton & Napper, 2008; Borrelli, Hayes, Dunsiger & Fava, 2010; Smerecnik, Grispen & Quaak, 2011). These, of course, are all examples of risk communications that augment participants' risk perception and thus induce them to take evasive or protective action. But risk researchers and policymakers have also succeeded in

diminishing risk perception and increasing acceptance of hazards for which the public's risk perception is inflated, such as genetically modified food (Lusk et al, 2004; Steur, Buysse, Feng & Gellynck, 2013; Rousu, Huffman, Shogren & Tegene, 2007), water fluoridation (Chun, You, Ju & Son, 2015; Mork & Griffin, 2015) and nuclear power plants (Bickerstaff, Lorenzoni, Pidgeon, Poortinga & Simmons, 2008; Ieong et al, 2014). Should it emerge that malicious hazards are overestimated relative to other hazards, similar approaches to risk communication might prove effective for increasing the accuracy of risk perception and reducing support for counterproductive spending and policy.

Before commencing a discussion about risk perception research, it helps first to specifically define risk perception, especially as there are now multiple fields of study that fall under the overarching category of 'risk analysis'. These include risk assessment (the study of how to objectively quantify risk; Risk assessment, 2015), risk management (how to minimise risk and deal with its consequences; Risk management, 2015), risk communication (how best to communicate information about risk; Lang, Fewtrell & Bartram, 2001), risk-taking behaviour (the study of people's propensity to take risks; Trimpop, 1994) and risk preferences (people's attitudes towards taking risks; Pandey, 2013). 'Risk perception', in contrast, is the study of how we subjectively gauge risk (Slovic, 1987). It could be said, therefore, that risk assessment and risk perception are two sides of the same coin, but the former takes an actuarial approach and the latter takes a psychological one.

It may seem that compared to related fields, risk perception is rather theoretical; that may be so, but not at the expense of practical application. Knowledge acquired in risk perception research facilitates and interacts with other areas. It is an integral component of risk communication; measuring risk perception may help to determine whether it is necessary to communicate risk information at all. In the 1970s, for example, such research

determined that nuclear power was perceived to be highly risky (Fischhoff et al, 1978; Otway, Maurer & Thomas, 1978; Slovic, Fischhoff & Lichtenstein, 1979). The associated public opposition to nuclear power came as a surprise to nuclear experts, who deemed it to be in fact relatively safe. Subsequently, researchers theorised about how to communicate risk information about nuclear power so as to bridge the gap between professional and lay understanding of it (e.g. Keeney & von Winterfeldt, 1986; Van der Pligt & Midden, 1990).

There is also an important relationship between risk-taking behaviour and risk perception. Intuitively, one would assume that those who perceive more risk will probably take fewer chances – in a normative risk-return analysis, increasing risk makes a bargain less appealing (e.g. Borelli, Hayes, Dunsiger & Fava, 2010; Harris, Jenkins & Glaser, 2006; Rundmo & Iversen, 2004). The same can be said of risk perception's relationship with risk preferences (Klos, Weber & Weber, 2005; Soane & Chmiel, 2005; Weber & Millman, 1997). In spite of that, there seem to be several caveats. Some research does not find a relationship between risk perception and risk-taking behaviour in adolescents (Kern et al, 2014; Ulleberg & Rundmo, 2003), or even finds that the correlation is reversed (Johnson, McCaul & Klein, 2002). Some samples of tourists have also been found not to show the usual correlation (Lepp & Gibson, 2008. As Lepp & Gibson's results suggest, individual differences in personality serve as a moderator – those inclined more towards sensation-seeking may willingly embrace risks that most would prefer to avoid, or be less sensitive to changes in perceived risk (Arria, Caldeira, Vincent, O'Grady & Wish, 2008; Foster, Shenesey & Goff, 2009; Zuckerman, Ball & Black, 1990). Some have questioned the direction of the putative relationship (e.g. Ulleberg & Rundmo, 2003). These exceptions notwithstanding, it is generally the case that higher risk perception predicts less risk-taking behaviour, although further research on the relationship is needed.

Although the notion of risk perception had been acknowledged previously, in

relation to game theory in international relations (Quandt, 1961) and risk taking behaviour (Slovic, 1964), the first analysis of factors that control risk perception appears to have been authored by Starr (1969). As a starting point, Starr gathered data on the average benefit of an array of hazards and the average risk carried by them. The former was determined by the average amount of money spent on activities by participants or by the average increment to participants' annual income delivered by hazards. The latter, risk, was taken to be equivalent to the number of fatalities per hour of exposure to hazards. These data were then plotted against each other, and Starr drew conclusions based on two important assumptions. The first was that economical behaviour of participants and hazards is a valid proxy for ascertaining risk preferences – implicitly, the more money that is spent on a hazard, the higher the level of acceptance that hazard enjoys. The second assumption was that fatalities and spending in relation to hazards is sufficiently consistent over time as to allow the use of historic records to predict future trends. Of Starr's conclusions, the most relevant to this thesis is that the public was willing to accept a level of risk 1000 times greater in exchange for the same benefit where exposure to the hazard was voluntary.

Whilst this provided a valuable insight into the sort of biases at play where risk perception is concerned, Starr's results must be put into perspective. Both of his assumptions were questionable. The notion that benefit can be measured in monetary terms is at best reductive, and at worst misleading. We now know that purchasing decisions are often made on the basis of flimsy criteria. For example, it has been shown that when presented with two identical offers, with the exception that one is presented as having been discounted from an earlier reference price, participants are significantly more likely to accept the purportedly discounted offer (Urbany, Bearden & Weilbaker, 1988; Lichtenstein, Burton & Karson, 1991). Tversky & Kahneman (1981) demonstrated that participants were more likely to agree to forego a discount than agree to pay a surcharge, despite the final

price being the same. In a similar vein, participants proved to make different decisions in two different conditions of the same gambling task based only on the wording of the question (De Martino, Kumaran, Seymour & Dolan, 2006). In its most naked form, this point can be illustrated by the gambling behaviour displayed by most gamblers of placing bets on long-shots which, despite offering attractive odds, deliver a lower expected value than favourites (Snowberg & Wolfers, 2007).

In each of these instances, it can be argued that to pass judgements on rationality based on measurable quantitative factors ignores the role of emotion – in other words, if buying the same item for the same price but with a discount from a previous price affords the purchaser more positive affect, the decision is in fact rational. This argument has some merit (although in some cases purchasers still make purchasing decisions they consciously disagree with. Note, for example, that a large number of smokers voice the desire to stop; Boyle et al, 2000; Siahpush, Yong, Borland, Reid & Hammond, 2009), but in this instance it misses the point. If Urbany et al's participants had been presented with the two quantitatively identical offers side by side, any positive affect they may have derived from achieving a saving would have been erased by the knowledge that in the reference price offer the initial price was too high in the first place. And this highlights the real deficiency in Starr's reasoning, and indeed a well-documented cause of market failure in general – that individuals are frequently uninformed about relevant aspects of consumer decisions they take, and that as a result their decisions are not necessarily optimal (Cason & Gangadharan, 2002; Eggers & Fischhoff, 2004; Giannakas, 2002). In fact, even if consumers were privy to all relevant information, depending on the complexity of the decision, there is a good chance they would not be able to optimally utilise it (Kahneman, Slovic & Tversky, 1982).

Starr's second assumption about the temporal stability of risk perception over time might also be questionable, because it appears that preferences can change quite

substantially in the course of a relatively short period. In the decade following publication of Starr's (1969) paper, revenue from air travel in the US nearly doubled (United States Department of Transportation, n.d.) and UK passenger numbers more than doubled (Department for Transport, 2013). A similar seismic change can be observed in smoking habits, where nearly half the number of cigarettes were available for sale in the UK in 2006 than in 1996 (Health & Social Care Information Centre, 2012). Indeed, smoking also provides a good example of the inadequacies of Starr's market-reliant paradigm – the number of cigarettes available for sale decreased in the decade preceding 2006, (i.e. the number of smokers dropped) and following a decade of steadily escalating public health decisions to restrict the practice and marketing of smoking and educate the public about the dangers resulting from it, the number of people who attributed aggravated risk of developing a variety of medical conditions to smoking increased (Lader, 2007). However, over the same period the inflation-adjusted cost of cigarettes has increased substantially (Tobacco Manufacturers' Association, 2014) leading Starr's reasoning to yield the conclusion that the public's acceptance of the risk posed by smoking in 2006 was greater than in 1996 (because the amount spent per smoker has increased). This flies in the face of evidence that suggests the public is more aware of the risks of smoking and less accepting of them (e.g. Cummings & Proctor, 2014; Lader, 2007).

Even if it were not for these weaknesses in Starr's assumptions, his methodology by its very nature was limiting as it only permitted meaningful comparisons where voluntary hazards are concerned. Involuntary hazards generally have no benefits at all, but to say that society therefore considers them all to be equally unacceptable is unhelpful – in reality, the public may wish to spend more money, or take more of some other type of evasive action, to stave off the risk of some involuntary hazards than others.

The next notable attempt at a comprehensive framework to explain risk perception

came from Fischhoff et al. (1978), who argued that a stated preferences approach, in which participants were asked to express their attitudes towards risk, was preferable to revealed preferences. Furthermore, stated preferences address some of the shortcomings of the revealed preferences approach (i.e. allowing for subjective measures of social benefit that are not only monetary and not making epistemological presumptions about the nature of risk perception). In the Fischhoff et al. (1978) study, separate participant groups were asked to rate the societal benefits and perceived risk of the same set of hazards (e.g. Contraceptives, Nuclear Power, Police work). All participants were also asked to rate the acceptability of the current level of risk (it was made clear to participants that rating a hazard as unacceptably risky implied that more money needed to be spent on, or more restrictions applied to, the hazard in question) and rated hazards on 9 dimensions hypothesised to account for risk perception.

Several findings emerged. Acceptability of current level of risk was measured by way of a 'risk adjustment factor', where an adjustment factor of 1 indicated the current risk was acceptable, lower than 1 denoted that even if the current risk were higher it would still be acceptable and higher meant that the current risk levels needed to be reduced. The results illustrated that almost all hazards were deemed to present excessive risk. This revelation thoroughly undermines the premise central to the revealed preferences approach, which simply assumes that a society's interactions with hazards reflect an optimised equilibrium.

Further challenging the revealed preferences approach, Fischhoff et al. (1978) observed an *inverse* correlation between perceived risk and perceived benefit, suggesting that their participants did not appreciate the existence of a trade-off between risk and return (Bali & Peng, 2006; Brandt & Kang, 2004; Ludvigson & Ng, 2007). This also conflicts with attempts to understand risk perception in rational economic terms. Instead, Slovic and

colleagues introduce the notion of 'affect heuristics' (Alhakami & Slovic, 1994; Slovic, Finucane, Peters & MacGregor, 2007), which stipulates that instead of giving proportional weight to pros and cons when evaluating targets, people tend instead to form a global impression of the targets, either by retrieving previously formed evaluations or by retrieving related memories and the affective connotations attached to them (Epstein, 1994), and then rendering affect-congruent judgements. Although the affect heuristic had not been named at the time, Slovic et al, 2007 argued that it is the mechanism behind the long-established Halo Effect (Thorndike, 1920). In terms of risk perception, this means that when asked to render judgements participants will retrieve the most accessible information about the hazard from memory and if any of that information is affectively resonant (e.g. 'Vaccinations save millions of lives' or 'Food preservatives do no-one any good') an impression of the hazard will be formed which will then be used to inform judgements about all aspects of it.

As mentioned previously Fischhoff et al. (1978) gathered ratings on Likert scales for 9 dimensions which had been hypothesised either by the authors or in previous literature to control perception of risk. Recall that their factor analysis revealed that the 9 dimensions loaded on to 2 factors: one was severity of exposure and the other included most of the other dimensions, but especially familiarity and controllability. This finding was used at the time to explain the public furore about nuclear power (which frustrated policy makers at the time who deemed it relatively innocuous), and Slovic (2002) has since used the same paradigm to explain the recent consternation terrorism has evoked. Slovic (2004) drew an explicit parallel between the two, arguing that terrorism 'hits all the same risk perception hot buttons' (p.15) as nuclear power, though it is not clear that this parallel is warranted. Although they may appear to possess comparable catastrophic potential and be similarly uncontrollable, nuclear power was a genuinely new and poorly understood hazard in 1978

– the world's first nuclear plant was opened in 1954, and nuclear power only started to gather serious momentum in the 1980s – whereas terrorism has been around in various forms for thousands of years (see Chapter 1).

Despite some weaknesses in their two-factor model's ability to explain the last decade's hyperactive concern about terrorism, Slovic et al's (1978) work, which they termed the 'Psychometric Paradigm' contributed a lot to our understanding of risk perception. It highlighted where the public's perspective is normatively rational and where it appears not to be. In doing so it also highlighted that it cannot be assumed that the public has optimised the balance between risk and benefit and introduced the dimension evaluation methodology. Perhaps most importantly, it began to address the role affect plays, though in a very limited way. The two factors in their two-factor model comprise a blend of informational, cognitive and affective content. The implication, though, is that the affective component of the factors is a response to cognitive appraisals. Furthermore, there is really only one emotion incorporated into the model – fear. It is of course helpful to know that certain hazards are regarded as more terrifying than others, but it would also be interesting to know whether other emotions affect risk perception too, and similarly whether affect only influences risk perception when the source of the arousal was the hazard itself or whether affect exerts a more general, pervasive influence on risk perception.

Both these lines of enquiry were taken up by Johnson & Tversky (1983), who examined the causal role of affect by inducing negative mood by informing participants, via newspaper-style stories, about a death arising from one of three different causes – leukaemia, fire or homicide. A control group read news stories about neutral subjects. Participants then went on to indicate their level of anxiety towards a pre-determined range of hazards, including the hazards referenced in the stories, and give risk estimations about them. The results revealed, to the authors' surprise, that experimental participants

expressed *higher* levels of anxiety towards, and gave higher risk estimates for *all* hazards, irrespective of similarity to the subject of the death story initially read. This suggests that the affective disposition of hazards themselves only represents part of the picture and that emotion does not simply impact upon risk perception as a component of the same mechanism through which beliefs about hazards do. Indeed, Johnson & Tversky's (1984) conditional prediction task, in which participants were informed that the frequency of one hazard was higher than they had previously believed and then given the chance to adjust their estimates of the frequency of other hazards, demonstrated the context-specific operation of receiving information *about* a hazard, which is here contrasted with the global effect of being affectively primed *by* a hazard.

Although the primary purpose of the stories was to induce depressive affect, one cannot be certain whether the effect of augmenting risk perception was caused by depressive affect or anxious affect, as these emotions covary (Ellsworth & Smith, 1988; Siemer, 2001; Siemer, Mauss & Gross, 2007), and the results from the anxiety scale confirm that participants were experiencing anxiety after reading the stories. It is also not clear whether affect was responsible for the effect; there remains the possibility that reading the stories caused participants to form the belief that the world is a generally more dangerous place than they had previously thought, and that their subsequent risk estimates were driven by this cognitive extrapolation and not by affect. However, both of these qualms were addressed by a follow-up experiment in which the authors presented a news story recounting the sad, but not dangerous, situation of a young man. This story was presented alongside the crime story from the earlier study. Results indicated that both stories increased risk estimates in equal measure, and that, again, the similarity of the hazard being estimated did not impact upon the effect of the mood induction. A final experiment including a happiness manipulation illustrated that happiness and depressive mood exerted

opposite effects on risk perception, pointing towards a mood congruency effect.

Notwithstanding the consistency of Johnson & Tversky's (1983) ability to amplify risk perception by inducing negative affect, closer inspection of their data reveals that their effect was largely carried by non-malicious hazards. If anything, the results suggest that risk perception of malicious hazards specifically is more influenced by the informational significance of the stories than by mood, relative to other types of hazard. As well as giving support to the view that malicious hazards are treated differently, this indicates either that their risk judgements are not heavily driven by affect, at least not by depressive affect. The finding that those experiencing negative affect made generally more pessimistic judgements was observed more recently by Gasper & Clore (2000), but again the wording of the negative mood induction was intended to induce sad mood, and none of the hazards estimated post-induction were malicious.

Keltner, Ellsworth & Edwards (1993) took the important step of distinguishing between negatively valenced emotions, inducing both anger and sadness. Their research, though, was focussed on the interpretation of the causes of hazards after the fact rather than the likelihood of their occurring. DeSteno, Petty, Wegener & Rucker (2000), however, proposed a framework that could satisfactorily explain Johnson & Tversky's (1983) results. Having noted Keltner et al.'s finding that anger-induced participants were more likely to construe hazards as having been caused by other people's misdeeds, DeSteno et al. reasoned that by extension anger-induced participants would perceive hazards caused by others' misdeeds as more likely. Their results did indeed show that angry participants believed angering events were more likely relative to sad events when compared with sadness-induced participants, and proposed two possible mechanisms: 'ease-of-retrieval' and 'emotion-as-information'. The first posits that when we are in an affective state, events that are affectively congruent with that state become more easily accessible. This was

probed by prompting participants with a series of day-to-day angering events and asking them to press a button when they were able to recall an instance of a given event occurring (either to themselves or to others). No significant differences between anger- and sadness-induced participants emerged. The second mechanism, emotion-as-information, suggests instead that when affectively aroused, we use the biases associated with our specific emotional state to inform our perceptions of the world. This explanation was probed using Likert scales, on which participants conveyed their agreement with statements about what emotions they felt the world gave rise to. This time, anger-induced participants were significantly more likely to find the world an angering place than sad participants, supporting the emotion-as-information hypothesis. This is important, because if emotion imposed its effect on risk perception via enhanced recall of mood congruent events, it is unlikely that anger could have the opposite effect of reducing risk perception. But the inference that the world is an angry place is just one type of information that can be drawn from anger, leaving open the possibility that if people use anger to inform their judgement under other circumstances, it might influence risk perception differently.

Lerner & Keltner (2001) obtained further evidence of the differential effects of negative emotions. Drawing on Smith & Ellsworth's (1985) insights, Lerner and Keltner proposed that the specific effects of emotions depend on the cognitive appraisals associated with them. Cognitive appraisals are evaluations made by perceivers about their environment along various theoretically defined dimensions: in Lerner and Keltner's case, pleasantness, anticipated effort, certainty, attentional activity, self-other responsibility/control and situational control. Different combinations of evaluations, it is suggested, produce different emotions. As an example, consider a long wait in a waiting room, containing no reading materials or other form of stimulation, for a doctor's appointment. Such a situation would be appraised as low in pleasantness, low in attentional

activity and low in anticipated effort, theoretically producing boredom. But if the situation is changed so that the obstacle to seeing the doctor is not a passive wait, but instead a series of long and difficult forms to fill in, the pleasantness of the situation would probably still be low, but it would command a higher level of attentional activity and anticipated effort, producing frustration. Similarly, whilst both fear and anger are appraised as unpleasant, Ellsworth & Smith (1988) found that the former is characterised by uncertainty and situational control whereas anger is distinguished by certainty and individual control (i.e. the belief that the perceiver is in control of the situation).

DeSteno et al. (2000) had already demonstrated that the idiosyncratic effects of emotions on risk perception extend beyond differences in valence, and Lerner & Keltner (2001) expanded on the mechanism behind them. They suggested that not only do appraisals of situations determine which specific emotion will be elicited, but they will also continue to influence cognition and colour the way subsequent situations are perceived even when the subsequent situations are immaterial to the initial source of the appraisals. These latent effects of appraisals have been dubbed 'appraisal tendencies' (p.147). The notion is essentially a refinement of the emotion-as-information hypothesis, as it extends the information derived from affect beyond a general inference that the world is prone to eliciting the emotion being experienced, to an inference that the appraisals that elicited the emotion more generally hold true. As regards anger and fear, their contrary appraisals along the certainty and individual control dimensions were theorised to lead to different risk preferences – angry people ought to be inclined towards risk-seeking preferences as they should feel fortified by beliefs about their control over the situation and the situation's certainty, while fearful people ought to be inclined in the opposite direction.

These predictions were tested using Tversky & Kahneman's (1981) 'Asian Disease Problem', in which participants are presented with a moral dilemma that forces them to

choose between two alternative programmes to combat a hypothetical pandemic. One programme is deemed risky, as it incorporates an element of random chance that determines either the total success or total failure of the treatment. The other programme is deemed certain – there is no element of chance because the treatment guarantees that a certain number of people will be cured and a certain number will die. Rather than experimentally manipulating fear and anger, the authors required participants to fill in questionnaires from which their dispositional tendencies towards fear and anger were gauged. Regression analyses confirmed that, as expected, higher anger scores predicted risk-seeking and higher fear-scores predicted risk-aversion.

Risk preferences are not necessarily the same as risk perception, and the effect could have been carried by the appraisals of control that affect preferences without impacting upon perception, but a further study by Lerner & Keltner (2001) revealed that anger was predictive of more optimistic risk perceptions in relation to a set of positive and negative life events and fear was predictive of pessimism. That study also assessed dispositional happiness of participants and found that happiness was predictive of optimism to much the same extent as anger. This is notable as anger and happiness share the cognitive appraisal of high certainty and individual control but differ with respect to valence. These findings imply that valence is not the critical factor in predicting risk perception in this context. Foreseeing that findings based on pre-existing individual differences are vulnerable to the usual criticisms about causality (e.g. chronically angry people may be exposed to fewer threats than fearful people), Lerner & Keltner experimentally manipulated mood, asking participants to write down several things that evoked the target emotion in them, and also to describe in some detail the one that they found most evocative. Once again, results showed effects in opposite directions depending on whether participants were in the fear or anger condition.

The findings of DeSteno et al. (2000) and Lerner & Keltner (2001) complement each other, although they present somewhat conflicting interpretations of the emotion-as-information hypothesis. DeSteno et al. propose that the only information an emotion supplies is that the world is prone to causing that self-same emotion, whereas Lerner & Keltner claim that information also takes the form of extrapolations based on what appraisals first elicited the emotion. In addition, both may be limited, for the present purposes by their lack of attention to deadly hazards. Perhaps prosaic life events are more prone to affective influence because participants are better able to empathise with the victim involved, or more able to imagine them affecting themselves. It also must be noted that neither of the studies included a control condition, so it cannot be known whether the observed effects are accounted for by fear, by anger or by both.

Lerner, Gonzalez, Small & Fischhoff (2003) addressed most of these issues in a study that was, coincidentally, the first to specifically theorise about and empirically test risk perception in relation to terrorism. Their study was conducted at two time points, each separated by about two months. The first time point (T1) was on 20th September 2001, nine days after the infamous terrorist attacks in New York, so the whole study was carried out at an opportune moment to gauge the impact of emotional reactions to them. At T1, participants were simply issued with scales intended to measure dispositional levels of anxiety and vengefulness (these were respectively assumed to be proxies for fear and anger). At T2, participants were randomly assigned to receive an anger or a fear mood induction. In these inductions, they were specifically asked to focus on the characteristics of the recent terrorist atrocities that evoked the target emotion, and write them down. Following that, to reinforce the induction, they were also presented with a photo and played an audio track that had previously proved successful in eliciting anger or fear. Participants then completed the risk perception exercise. This included three scales, one concerning

predictions about the fortunes of the US where terrorism is concerned, one inquiring into the probability that the average American will be the victim of terrorism or take precautionary measures against it, and one inquiring whether the participant himself would be such a victim. Finally, as a manipulation check, participants reported how angry and fearful they had felt during the erstwhile mood inductions.

The results revealed that participants in the fear condition generated significantly higher scores on all of these scales. This substantiates Lerner & Keltner's (2001) results, but arguably conflicts with DeSteno et al.'s (2000), because of the latters' contention that angry participants are prone to perceiving greater risk. In the case of this study, almost all of the items did concern angering hazards, yet they received lower ratings under angry affect than fearful affect. Although the authors claimed that anger and fear were independently responsible for their respective effects, the evidence for this conclusion (based on the null effect of covarying the mood manipulation check data), was weak so it is best to see Lerner et al.'s (2003) results as indicative and not definitive.

There is also the further complication that while all the scales were orientated towards risk perception in relation to terrorism, the first scale asked for predictions about the US's efficacy in waging the war on terror, and thus confidence in one's country and beliefs about the threats it faces were conflated. Evidence now exists suggesting that anger can inflate people's self-belief (Gambetti & Giusberti, 2014; Hemenover & Zhang, 2004; Lee, Park & Lee, 2012). It would seem unjustified to assume that the same mechanism that amplifies optimism about one's own prospects of success when engaging in active confrontation also minimises perceptions of the threat from the enemy's active confrontations. The other two scales were also composite measures, this time comprising items that measured risk perception along with items that measured risk preferences (half of each). Although those constructs do tend to correlate, multiple examples can, and have,

been cited of where they diverge. In addition, it has been noted that, rather unsurprisingly, anger is related to more risky behaviour (Fessler, Pillsworth & Flamson, 2004; Gambetti & Giusberti, 2009; Raghunathan & Pham, 1999) while fear has been linked to generally more cautious behaviour (Morman, 2000; Witte, Berkowitz, Cameron & KcKeon, 1998; Yaoshan, Wei & Yongjuan, 2011). In further support of the theoretical and functional distinction between risk perception and risk preferences, Rader, May & Goodrum (2007) found that although risk perception is highly predictive of fear of crime, it is not directly predictive of defensive or avoidance behaviours, whereas fear of crime is, a position endorsed by Miceli, Sotgiu & Settanni (2008) too (but see Gerrard, Gibbons & Bushman, 1996; McCusker, Stoddard, Zapka, Zorn & Mayer, 1989). The most apposite conclusion to draw is that the relationship between risk perception and risk preferences is complex, and assumptions that they are one and the same thing are unwarranted.

Other research has since been carried out in the vein of Lerner & Keltner's (2001) appraisal-tendency framework (ATF). Foo (2011), for example, applied the ATF to investment decisions, using the same induction procedure as Lerner & Keltner (2001). However, in Foo's study four emotions were induced – happiness, anger, fear and hope. The authors hypothesised that hope would have a similar effect to fear because the two share appraisals of low certainty and high situational control with fear. Mood indeed had an effect, but surprisingly the differences were due to the hope condition, in which participants perceived more risk than in the anger and happiness conditions. Fear-induced participants also perceived more risk than participants in those conditions, but the effect did not reach significance. Nonetheless, the research largely vindicated Lerner & Keltner (2001). It found that anger and happiness result in similar risk perception, and the effect of hope seems to corroborate their more sophisticated version of the emotion-as-information hypothesis. DeSteno et al's (2000) contention that information conferred by emotion manifests itself as

a bias towards seeing the world as congruent with that emotion does not accord with the finding that hope-induced participants perceive more risk; if the world was a hopeful place, one would expect people to perceive a greater likelihood of success. Note, though, that even if this study had found a significant effect of anger, the lack of a control group would render the difference hard to interpret.

Another innovative study was run by Shavit, Shahrabani, Benzion & Rosenboim (2013). Theirs was a natural experiment conducted in the wake of a forest fire in Israel. National media coverage had portrayed the authorities' response to the fire as being inept, and it was thus suspected that the issue had aroused considerable anger amongst Israelis. Data were collected only one week after the forest fire, so the authors also hypothesised that those close to the area where it took place would still be experiencing heightened fear. Thus two pseudo-experimental groups were formed – those who lived close to the fire and those who lived far away. Emotion self-reports revealed that those closer to the fire were more afraid of it than those further away, although both groups reported similar levels of anger. The ensuing risk perception questionnaire contained questions about six hazards, one of which was about fires and two of which were malicious hazards. Participants nearer to the fire, as predicted, did show higher risk perception, and not only in relation to fires. This is not remotely surprising; since participants in both groups were experiencing anger in similar measure, the observed effect of location was reflective of the cumulative effect of anger and fear, and does not give any clues about the influence of anger on that effect. However, further analyses revealed that fear and anger were both significantly positively correlated with most of the items on the risk questionnaire (including the two malicious hazards), albeit fear more so. Although it is not possible to infer causation from this finding, it does contradict Lerner & Keltner's study, which used very similar dependent variables. Shavit et al's correlational finding suggests that Lerner et al's (2003) results may have

merely reflected the differential effect sizes of anger and fear rather than a qualitative difference between them. If it is the case that what Shavit et al. (2013) observed was a cumulative effect, that would add more weight to the importance of researching perception of malicious hazards which, much like the forest fires in Israel, may give rise to fearful and angry affect.

So far, much of the uncertainty about what role anger plays in risk perception surrounds the endemic lack of studies including a control group, or any other way of ascertaining what drives the difference between anger and fear. There does appear, though, to be one published study that did feature control participants. Lu, Xie & Zhang (2013) induced emotion by asking participants to read narratives in which a driving-related situation was portrayed either in an angering or a frightening way. In the neutral condition, participants read a pallid passage of text about the university's library. Subsequently participants answered a risk perception questionnaire comprising three questions about the perceived likelihood of accidents caused by running a red light, speeding, and drink driving (it was not specified whether they were fatal or not). The hazards were therefore not malicious as such, but all involved recklessness and an attitude of indifference towards the welfare of others, and so they might reasonably be seen as quasi-malicious. As predicted, anger-induced participants perceived significantly less risk than neutral participants, who perceived significantly less risk than fear-induced participants. Lu et al.'s (2013) study therefore represents the strongest evidence yet in favour of the ATF as an explanation of risk perception and against DeSteno et al's (2000) version of the emotion-as-information hypothesis. Nonetheless, being the only paper that satisfactorily demonstrates an optimism-biasing effect of angry affect compared with neutral affect, Lu et al. requires replication.

Taking the corpus of research as a whole, the effect of manipulating emotion on non-

malicious hazards seems to be consistent. Johnson & Tversky (1983) demonstrated that sad participants perceived more risk of such hazards than happy participants, an effect that has since been replicated by Drače & Ric (2012), Gasper & Clore (2000) and DeSteno et al. (2000). By contrast, the effect of emotion on perception of malicious hazards is more enigmatic, hindered by the failure of research to include control conditions. The only paper that convincingly makes the case that anger lowers risk perception is Lu et al's (2013), and other research appears to conflict with their results, most notably DeSteno et al. (2000) but also Shavit et al. (2013).

The picture is also somewhat inconsistent with regard to the relative effects of other emotions. When fear has been compared with any other emotion (with the exception of hope), it has produced inflated risk perception (Lerner et al, 2003; Shavit et al, 2013). We also have evidence from DeSteno et al. (2000) that anger gives rise to higher risk perception of malicious hazards than sadness. Together, the findings could point to an emotion hierarchy with regard to risk perception, with fear at the apex, followed by anger, and with sadness producing the most optimistic risk perception. This hypothesis would in fact comport with the ATF – anger and fear both comprise appraisals of high anticipated effort, high perceived obstacles and low pleasantness. This combination of appraisals is suggestive of a threat, so, in keeping with the emotion-as-information hypothesis, higher risk perception ought to result. Another appraisal potentially weighing in on risk perception is human agency, high levels of which are associated with anger, heightening risk perception of malicious hazards in particular. But increased feelings of control bestowed by anger may serve to counterbalance the effect caused by the other appraisals, partially offsetting it. Sadness, on the other hand, entails attributions of less anticipated effort than the other two emotions, which suggests that a threat is absent or no longer relevant. DeSteno's (2000) simplified version of the emotion-as-information hypothesis also explains this hierarchy

satisfactorily, but research such as Foo's (2011) and Lu et al.'s (2013) seems to argue against it. Either way, Lerner & Keltner's (2001) description of the ATF states explicitly that anger ought to lower risk perception, not merely relative to fear but in absolute terms.

But neither Lerner et al. (2003) nor DeSteno et al. (2000) are able to explain the phenomenon of heightened risk perception of malicious hazards in a real world context – Lerner et al. cannot because they conclude that anger *reduces* risk perception, and DeSteno et al's (2000) mood congruency effect would be equally applicable to hazards affectively characterised by emotions other than anger (e.g. if tornados were a saddening hazard, it is expected that thinking about tornados and judging their risk would be a saddening experience – thus the perceived risk of tornados would be inflated). In fact, from an affective standpoint, risk perception of malicious hazards is best explained by the alternative interpretation of the ATF outlined above. Malicious hazards may be angering and anger appraisals tend to invoke a threat, which ought to augment risk perception relative to non-angering hazards.

The discussion thus far has focused on affective influences on risk perception of malicious hazards. But it would be constructive also to consider the literature from a cognitive perspective. Regrettably (and ironically, given the cognitive origins of the field) such research is rather more scarce. Examples of cognitive approaches to risk perception include: Fischhoff et al's (1978), psychometric paradigm (and similarly, Brun, 1992), Kahneman & Tversky's (1979) application of Prospect Theory; Tversky & Kahneman's (1983) use of the representativeness heuristic; Folkes's (1988) use of the availability heuristic; and Sjöberg's (2000), extension of the psychometric paradigm (to 25 dimensions). These approaches are all cognitive in the sense that they invoke target beliefs or globally applicable processing biases to explain risk perception. The psychometric paradigm, for example, offers severity of exposure and familiarity to account for the

perception of terrorism and war, whereas prospect theory might explain risk perception of those hazards in terms of the non-linearity of probability weighting, causing the over-weighting of normatively small probabilities. The representativeness heuristic hints that malicious hazards may appear more likely because terrorism, homicide and war seem like more plausible ways of dying than travelling in trains or extreme weather. The availability heuristic points to hysterical news coverage of malicious hazards as a factor (Frost, Frank & Maibach, 1997; Lawrence & Mueller, 2003; Marsh, 1991), although, as I argued previously, this explanation is philosophically dubious because of the circular logic it employs.

Although no cognitive account has yet provided a comprehensive or satisfying account of risk perception, some research has provided intriguing clues. Belief in a just world (BJW; Lerner, 1970), for example, is a cognitive bias in which people are inclined to assume that others (and sometimes themselves) receive outcomes that correspond with their moral worthiness. As such, it has been used to explain derogation of impoverished people and victims of rape and domestic violence (Carmody & Washington, 2001; Montada, 1998; Reichle, Schneider & Montada, 1998). In a nutshell, the plight of innocent victims is hypothesised to threaten the worldview of people who endorse BJW, and the resulting conflict is resolved by altering beliefs about these victims by attributing responsibility for their circumstances to them. Although BJW has obvious undesirable, anti-social implications, numerous studies have found that those who endorse it benefited from more positive psychological outcomes (Dzuka & Dalbert, 2007; Foster & Tsarfati, 2005; Tomaka & Blascovich, 1994), sometimes even when they themselves have endured the adverse circumstances (Otto, Boos, Dalbert, Schöps & Hoyer, 2006; Wu et al, 2011; Xie, Liu & Gan, 2010).

Lambert, Burroughs & Nguyen's (1999) research investigated individual differences in BJW and right-wing authoritarianism (RWA), and how they relate to risk perception.

People high in RWA are a particularly relevant contingent where risk perception is concerned, as RWA is a set of beliefs characterised by strict, inflexible values that place a heavy emphasis on adherence to the moral standards and behaviour endorsed by the dominant group in society (Adorno, Frenkel-Brunswick, Levinson & Sanford, 1950). The corollary of these beliefs is a suspicion towards those who deviate from endorsed norms, who are accordingly seen as a threat. The fear that the sense of security afforded by conformity might be compromised causes right-wing authoritarians to view the world as a dangerous place, so they tend to perceive higher levels of risk than people lower on this trait (Altemeyer, 1988). In Lambert et al's study, participants' RWA was gauged using Altemeyer's RWA scale, and then divided into low authoritarians and high authoritarians. BJW was also ascertained, using Dalbert, Montada & Schmitt's (1987) BJW scale. Two months later, participants were asked both about the likelihood of hazards affecting them, and the likelihood of the hazards affecting others. Results indicated that among those participants classified as high in RWA, BJW was negatively correlated with risk perception. The researchers concluded that for individuals high in RWA, BJW has a buffering effect - it is used as a coping device to help such people reconcile their belief that there are deplorable people in the world with their need to feel safe and secure.

Concerns about causality aside, what is particularly interesting is that there was little difference between self and other risk estimates. It seems from these results that those high in RWA and BJW do not only use the latter to mitigate concern for their own safety, they also use it to minimise the threats others face. This may be because those high in RWA derive their sense of security in part from feeling as though they are members of a safe society, and that harm suffered by others vicariously poses a threat to them (as a portent of societal breakdown), or it may be because people high in BJW believe exposure to hazards is controllable and so when presented with a questionnaire that requests likelihood

estimates in percentage terms they return low percentage estimates because they do not construe victimhood as a matter of random chance.

But is there reason to believe this effect would be amplified where malicious hazards are concerned? None of Lambert et al.'s (1999) hazards were malicious, but given the tendency of right-wing authoritarians to dislike and distrust certain segments of society that they deem degenerate and dangerous, and given Lambert et al's finding that BJW is a particularly important predictor of risk perception when RWA is high, there is good reason to suspect that they would judge malicious hazards particularly likely.

There is another insight to draw from Lambert et al's research. Most hazards afford two general attributions when they result in injury or death: 'it was the fault of the deceased' and 'it was the fault of external circumstances'). Malicious hazards, however, afford a third: 'it was the fault of someone else'. The availability of a third option may reduce the likelihood of blaming the victim, either because more potential causes dilute the confidence in any individual one (the 'discounting' principle; Kelley, 1972), or, more interestingly, because people might find causal explanations involving a deliberate perpetrator more satisfying.

In fact, the attribution literature offers good reason to suspect they are more satisfying. This notion can be traced back to Heider (1958), who conjectured that perceivers aim to establish personal causality because it confers greatest capacity to predict what will happen in the future (perhaps because whereas it is a helpful heuristic to assume that people's dispositions and resultant actions will likely be consistent over time, random environmental vagaries offer no such insight). Jones & Davis (1965) agreed that intentionality is a crucial part of the attribution process, and argued that when attempting to make attributions, the first question perceivers consider is whether an intentional act was involved. In a well-known test of this hypothesis, Jones & Harris (1967) asked

participants to read out essays in favour of or opposing Fidel Castro to other participants, who were informed that the substance of the essay was not chosen by the readers but rather by a coin toss. In spite of knowing that the readers' personal opinions could not have influenced which essay they read, readers of pro-Castro essays were still rated as more pro-Castro than readers of anti-Castro essays. This was an early substantiation of Heider's thesis, and the predilection to make internal, or 'correspondent' attributions over external attributions.

Subsequent research probed what factors predict correspondent inferences, frequently in the context of hazards. Several studies confirm that when the consequences of a hazardous event are described in more severe terms (Schroeder & Linder, 1976; Shaver, 1970; Ugwuegbu & Hendrick, 1984) and when the valence of the consequences is negative, correspondent inferences were more likely (Kanekar & Pinto, 1991; Shaw & Skolnick, 1971). Other research has found that perceivers will render defensive attributions such that when they perceive themselves as more similar to a potentially culpable individual they will attribute less responsibility to them (Chaikin & Darley, 1973; Shaver, 1970; Shaw & McMartin, 1977); and when the outcome of an event is mutable internal attributions are more likely (Williams, Lees-Haley & Price, 1996). All of these potentially illuminate the sort of hazards for which personal responsibility is likely to be imputed, and it would appear that all malicious hazards are just that sort.

Indeed, some evidence suggests that ambiguously attributable adverse incidents are more likely to be attributed to personal factors than situational ones. Morris, Moore & Sim (1999) recounted to their participants a vignette about a lawnmower factory where construction practices had recently changed so that lawnmowers no longer arrived at workstations with predictable regularity. As a consequence, employees sometimes found themselves adopting the risky practice of working on two lawnmowers simultaneously.

Eventually, participants were told, this resulted in an accident in which a lawnmower fell, causing damage to expensive instruments and lost productivity to the company. The scenario was specifically designed so that an environmental factor (the ergonomics of the production line set-up) was subjectively more causal than an internal factor (the negligence of the employees). In spite of that, when asked to generate counterfactuals (i.e. scenarios in which the accident would not have happened), two separate samples of participants preferred counterfactuals in which the workers had behaved differently to counterfactuals where the production line had been configured less dangerously. These findings supplement the previously adduced evidence that people are likely to be held personally culpable for their actions, and that they tend to identify human factors as the causes of negative events to a greater extent than they ought to.

A justifiable criticism of Morris et al. (1999) is that the human factor in the vignette appears to be the proximal cause (i.e. the last component of the causal chain prior to the accident), and other counterfactual research has found that people are more inclined to mutate the proximal cause (Byrne, Segura, Culhane, Tasso & Berrocal, 2000; Miller & Gunasegaram, 1990; Segura, Fernandez-Berrocal & Byrne, 2002). Thus temporal sequence and human agency are confounded. McClure, Hilton & Sutton (2007), however, utilised a between-subjects design where in one condition human agency was the proximal cause of a fire and in the other condition it was the distal cause. Three vignettes were presented to participants, and there were two versions of each vignette. In one version the distal cause was a voluntary action (e.g. a youth deliberately setting fire to a shrub) and the proximal cause was an environmental fluke (e.g. a piece of glass focusing the sun, causing a shrub to catch fire), and in the other version these were reversed. At the end of the vignettes participants were told that an adverse consequence occurred, and they were then asked to rate the importance of the distal and proximal causes, the voluntariness of each cause (as a

manipulation check), the 'goodness' of each cause as an explanation, the social preventability of each cause, and the increase in probability of the adverse consequence as a result of the distal and proximal causes. The results revealed that voluntary causes were rated as more important, explanatory, preventable and more accountable for augmenting the likelihood of hazards, and perceived voluntariness and social preventability mediated the effects. The effects on explanatory goodness and probability are particularly relevant in the current context, as both could potentially account for higher risk estimates for malicious hazards – if people see intentional acts as better explanations of adverse consequences in retrospect, they may also find them easier to envisage as causes of death in general.

It is also possible that, if people believe in retrospect that intentional acts played a greater part in increasing the probability of a mishap, they are likely to think that, all else being equal, more deaths result from intentional acts. The statement that adverse consequences are more likely to be explained by intentional acts can be thought of as a conditional. It does not logically follow that intentional acts are more likely to cause adverse consequences than unintentional acts – an alternative interpretation would be that there are simply more intentional acts in total than unintentional acts. However, research has tended to show that conditional statements are often interpreted as biconditional statements. In the Wason Selection Task (Wason, 1966; WST), participants were presented with 2 cards showing letters ('A' and 'D') and 2 cards showing numbers ('4' and '7'), told that all cards show a letter on one side and a number on the other side, and asked to test the rule that 'if a card has a vowel on one side, then it has an even number on the other side' (Johnson-Laird & Wason, 1970; p. 135) by turning over probative cards. It was found that participants most frequently chose either 'A' alone, or 'A' and '4', when in fact the only probative cards are 'A' and '7'. Wason inferred from this that participants were fallaciously attempting to confirm the rule instead of falsifying it.

Johnson-Laird & Byrne (2002), however, pointed out that instead of participants misapplying logic to test the rule, they may have actually misinterpreted the rule. If the rule had instead been 'if, *and only if*, a card has a vowel on one side, does it have an even number on the other side', then turning over '4' would have tested the rule. Wagner-Egger (2007) investigated this possibility by presenting participants with the classic WST and a modified version (counterbalanced). In the modified version, instead of telling participants the rule and then asking them to choose which cards to turn over to test it, the experimenter showed the cards to participants individually and asked each time to indicate whether it was possible to discern from the visible side of the card what was on the other side. In this way it was possible to ascertain whether participants were making biconditional inferences from the rule, and the results showed that participants did tend to interpret the WST rule biconditionally, and that biconditional interpretation was strongly associated with selections of the 'A' and '4' cards. This finding reflects those of Cummins, Lubard, Alksnis & Rist (1991), Sherman, McMullen & Gavanski (1992) and Valiña, Seone, Ferraces & Martin (1999), all of whom found that under some circumstances participants were prone to interpreting conditional statements as biconditionals. It is thus reasonable to posit that the belief that adverse consequences have intentional antecedents may lead to the inference that intentional acts are likely to cause adverse consequences.

A bias towards intentional accounts of malicious hazards could be cognitive or motivational (McClure et al. favoured the latter). From a motivational perspective, for instance, Sedikides, Campbell, Reeder & Elliot (1998) suggested that people tend to employ self-serving biases, attributing failure in a task to others' dispositional weaknesses as a means of comparative self-enhancement. Applying that principle to McClure et al's (2007) findings, participants were offered a clearly identifiable individual to derogate, so according to Sedikides et al. it is to be expected that they would take that opportunity. On the other

hand, in studies like Johnson & Tversky's (1983), there was no identifiable individual to blame, just an opportunity to judge that people (including the participant themselves) are globally untrustworthy. Jellison & Green (1981) offered a similar rationale for the correspondence bias, arguing that internal attributions 'allow [people] to block others' attempts to escape from responsibility and allow [people] to justify punishments and retribution' (p.648), as did Heider (1958), who claimed that people make internal attributions to gain a sense of control over their environment.

There are also cognitive factors in the correspondence bias. Gilbert, Pelham & Krull (1988) ran a study similar to Jones & Harris (1967) in which participants were instructed to write and then read out a pro- or anti-abortion speech to other participants, who then rated their attitudes to abortion. However, half of the participants had been instructed, prior to hearing the speech, that afterwards they would be asked to write a speech of their own, thus placing them under cognitive load. It emerged that whether or not participants were under cognitive load, there was an effect of the content of the essay on perceived actual opinions of the readers (as in Jones & Harris). But there was also a significant interaction between essay content and cognitive load, such that those participants placed under cognitive load displayed an accentuated correspondence bias. The researchers concluded that when making attributions, participants initially gravitated towards more internal attributions but then, when sufficiently motivated, adjusted that attribution if cognitive resources permit. Thus, it may be that perceivers favour human causes and either fail to sufficiently adjust them or are not motivated to adjust them. In both cases, participants asked to determine how many deaths are caused by human causes versus situational causes would be expected to exaggerate the former.

Pennington & Hastie (1992) offer another reason why perceivers might be biased toward agentic explanations of malicious hazards: such explanations might provide a more

coherent and easily processed storyline. The researchers presented participants with substantively identical evidence in the case of a defendant charged with a hit-and-run offence. Evidence from 4 witnesses (3 whose evidence pointed towards a certain verdict, 1 whose evidence dissented) about 4 evidential issues was presented, but in the 'story' condition the witnesses appeared once each and addressed the 4 evidential issues prior to the next witness taking the stand and doing the same. In the 'issue' condition, the issues were addressed sequentially, so that each witness appeared four separate times and the story was disjointed. They found that in the story condition, participants were more likely to render a verdict consistent with the preponderance of the evidence, indicating that they found story-framed evidence more persuasive. Reeder (2009) also recognised the connection between dispositional inferences and the narrative satisfaction of a story: 'A good story, of course, implies a goal or motive behind the events' (p.4). It is likely that explaining ambiguous consequences in terms of intentional actions offers more insight into goals or motives than circumstantial vagaries would. If the observation that people prefer to explain adverse consequences with satisfying stories extends to abstract or anticipated adverse consequences, this would also serve to augment risk perception of malicious hazards.

In summary, this chapter offers two types of explanation for why risk perception of malicious hazards might be uniquely amplified. The affective explanation posits that malicious hazards are particularly angering, and anger biases perceivers towards inferences consistent with the appraisals associated with that emotion. The appraisals most relevant to risk perception are those of low pleasantness (a hazard is dangerous and danger is unpleasant), high perceived obstacles (hazards are an obstacle to the perceiver's goal of safety) and high anticipated effort (a hazard constitutes a good reason to expend effort to avoid it). These appraisals lead perceivers to the inference that a threat is present, and

hence their perceived risk of malicious hazards increases. The cognitive account, on the other hand, holds that malicious hazards are perceived to be disproportionately likely due to a cognitive or motivational bias in favour of using human agency to account for adverse consequences (or indeed consequences in general). Malicious hazards are particularly likely to be interpreted as explicable in terms of human agency (because they are, by definition, caused by human perpetrators). Alternatively, or supplementarily, human agency accounts are inherently more cognitively fluent, and therefore subjectively more likely. Research on conditional statements suggests that people are prone to confusing them for biconditionals, thus the finding that people tend to attribute negative events to human agency indicates they may also believe that intentional acts are particularly likely to result in negative consequences, increasing perceived risk of malicious hazards.

# Chapter 4 – Emotion and risk perception

There are two largely separate research traditions (affective and cognitive) both of which could have a bearing on risk perception of malicious hazards. As regards affect, a substantial body of research has already investigated its influence on risk perception, occasionally including that of malicious hazards. The research, though, is inconclusive. One of the core predictions of the Appraisal Tendency Framework (ATF), that sadness and anger ought to have opposing effects, has not been satisfactorily demonstrated. It does appear that for non-malicious hazards sadness results in more pessimistic risk perception – this much was demonstrated by DeSteno et al. (2000) and Drače & Ric (2012) – but it is not clear that the same effect applies to malicious hazards, or that angry participants display lower risk perception relative to controls. The purpose of the studies in this chapter was to test the effects of anger and sadness on malicious and non-malicious hazard perception. I predicted that due to the cognitive appraisals associated with anger, anger-induced participants would display higher risk perception than participants in a neutral emotional state, and that, in line with the emotion-as-information hypothesis, this effect would be particularly marked for malicious hazards.

Furthermore, to the extent that malicious hazards are particularly angering in themselves, an external anger manipulation may be particularly influential. There is reason to believe that they are: unlike most hazards, malicious hazards involve the deliberate actions of someone intending to harm someone else. In the vast majority of cases, this would be construed as unfair (even in war, civilian fatalities are typically seen as unfair), a recognised psychological precursor to anger (Berkowitz & Harmon-Jones, 2004). To verify

this assumption, a pre-test was conducted to examine the degree to which the four categories of hazards (derived in Chapter 2) are seen as causing anger.

## Anger pre-test

### Method

#### Participants

One-hundred-and-twenty-two University of Otago students took part in exchange for NZ$10 to cover their travel expenses. Demographic data were not collected.

#### Design

There was 1 within-subjects factor, which was hazard category (natural, useful, immoral, malicious). The dependent variable was anger rating, which was measured on a Likert scale.

#### Materials

The study was run in a block with studies from two other researchers. My study entailed an anger questionnaire, which participants were given pens to fill in. The other researchers used a mixture of computer tasks and pen and paper tasks, but their studies took place later in the procedure than mine and will hence not be further discussed.

#### Procedure

The study was run in conjunction with two other, unrelated procedures. Participants were run in individual light and sound-attenuated experimental cubicles, on paper. After

providing informed consent, they were given written instructions, which first defined a hazard as 'a potentially threatening event.' They were directed to a list of hazards below and asked to 'imagine, in each case, that you have learned that the hazard has caused someone's death.' They were asked to rate how angry this knowledge would make them using a seven point scale anchored at 1 (Not angry at all) and 7 (Very angry).

The list contained all 33 hazards in alphabetical order, with response scales next to each one. Participants rated them at their own pace and contacted the experimenter upon completion. After taking part in the other studies, they were thanked and debriefed.

## Results

Hazard ratings were averaged within each category to form four scores per participant, which were submitted to a repeated measures ANOVA. Mauchly's Test of Sphericity suggested the assumption of sphericity had been violated $\chi^2(5) = .37$, $p < .001$, so the Greenhouse-Geisser correction was applied. The ANOVA was significant $F(2.17, 262.43) = 152.49$, $p < .001$. Post-hoc tests with Fisher's LSD further probed the differences between each level of the independent variable, and revealed a significant difference between malicious (M = 6.17, *SD* = 1.28) and immoral (*M* = 5.14, *SD* = 1.48) hazards ($p < .001$), between immoral and useful (M = 4.30, *SD* = 1.11) hazards ($p < .001$), and between useful and natural hazards (*M* = 3.60, *SD* = 1.34) hazards ($p < .001$).

## Discussion

The results confirm that malicious hazards are more angering than other hazard categories. They also validate the distinct hazard categories, all of which significantly differed from each other in how angering their constituent hazards were rated. It is also notable that the

hazards of primary interest to this thesis, as well as attracting large amounts of spending and public attention, are also the most angering.

Having validated the assumption that malicious hazards are at least believed to be more angering than other types of hazard, the next step was to test whether anger increases risk perception independent of the hazard itself, and whether malicious hazards in particular are judged to be particularly likely when the perceiver is angry. An experiment testing these hypotheses required the induction of emotion, and thus necessitated a choice as to which mood induction procedure (MIP) to use. The MIPs that have been most prevalent in prior risk perception research involve imagination, pictures, and stories intended to elicit the target emotion(s). Picture and story MIPs have the particular disadvantage of often being culturally and temporally specific. The picture MIP used by Lerner et al. (2003), for example, depicted jubilant celebrations of the September 11th attacks in Arab world countries which, whilst undoubtedly angering to most participants, probably would not retain the same potency in New Zealand 11 years later. DeSteno et al. (2000) gave participants magazine stories detailing anti-American protests in Iraq – again, not as applicable to a New Zealand sample. Notice also that a problem both these examples suffer from is that they overtly relate to a particular type of hazard, thus potentially confounding affective and informational priming for some rated hazards but not others. The imagination MIP, in contrast, has the advantage of allowing participants to decide for themselves what sort of stimulus angers or saddens them and then uses that stimulus to help realise the targeted affective state. It elegantly customises the stimulus for each participant.

I elected to use a specific type of imagination MIP, the autobiographical MIP (Erber & Erber, 1994; Forgas, Laham & Vargas, 2005; Lanys, 2014), in which participants are asked to recall a life event that evoked the target emotion. The benefit this has over the

imagination MIP is that most participants probably will not have experienced events that resemble the list hazards, so the chances of informational content (as opposed to affect) during priming exerting an influence on risk perception later on ought to be mitigated.

Another challenge in designing the study is that there is no universally accepted measure of risk perception. Fischhoff et al's (1978) seminal paper used a ranking task in which participants selected the least risky hazard and then assigned ratios to the other hazards relating to how risky they were in comparison. Johnson & Tversky's (1983) gave participants a reference hazard, told them how many Americans died because of it, and then asked them to estimate how many people died because of the other hazards. Lerner & Keltner (2001), Fischhoff et al. (2003) and Lu et al. (2013) all used Likert-type scales and Foo (2011) used a semantic differentials scale. For simplicity, I opted for the Likert scales; consistent with Preston & Colman (2000), and the predominant psychometric orthodoxy (Allen & Seaman, 2007; Preston & Colman, 2000; Weng, 2004), it was determined that 7-point scales strike the right balance between reliability and validity.

## Study 4

### Method

#### Participants

Seventy female and 32 male participants took part in return for NZ$15 travel reimbursement. The experiment was open to students and those who graduated within the last year, but the majority of those who applied were students and the sample therefore reflects that demographic cross-section; the mean age was 22.5 with a range of 17-49. Participants were run in groups of up to 9.

**Materials**

State mood was rated on a series of 7-point Likert scales, always in the order anger, sadness, disgust, happiness, fear and surprise (Appendix C). Participants were asked to 'indicate the extent to which you are experiencing the following emotions **at this moment**, where 1 is "very slightly or not at all" and 7 is "extremely" ' (emphasis in original). These six emotions were chosen on the grounds that they are the six 'basic' emotions proposed in Ekman's (1992) influential paper. A risk questionnaire was used to gauge risk perception in which all 33 list hazards were presented to participants who then rated their likelihood of being harmed by each one on a 7-point Likert scale, anchored at 1 (not at all likely) and 7 (very likely).

**Procedure**

The experiment was run in a classroom with three rows of unseparated desks. After giving informed consent, participants completed a mood measure before being instructed to 'try to recall one specific life event during which you have felt angry, wronged, outraged, or violated, and write about it in as much as detail as you can.' The sadness MIP instead asked for an event in which the participant felt 'lonely, sad, rejected, or hurt'. In a third, control condition, participants were asked to recall 'what you did yesterday'.

Participants wrote at their own pace and, when finished, were given a second mood scale, followed by the risk questionnaire, and then a third mood scale. The study was run in conjunction with another, unrelated procedure (order counterbalanced).

**Results**

Mood ratings were analysed in a mood condition (anger, sadness, control) x self-reported emotion (anger, sadness, disgust, happiness, fear, surprise) x time (T1, T2, T3) mixed

models ANOVA, with the last two factors treated as repeated measures.). The ANOVA showed a significant three-way interaction $F(13.25, 562.99) = 7.479$, $p < .001$. Separate two-way ANOVAs with condition and self-reported emotion as factors were run using data from each time point, and these showed that at T1 condition and self-reported emotion did not interact $F(5.87, 284.76) = 1.427$, $p > .1$, at T2 they did interact $F(6.70, 288.19) = 5.812$, $p < .001$ and at T3 they did not $F(6.75, 333.89) = 1.604$, $p > .1$. Further ANOVAs were run using mean self-report emotion scores at T2 for each item individually. The anger ANOVA was significant $F(2, 89) = 11.78$, $p < .001$. Post-hoc tests with Tukey's HSD revealed significant differences in anger between the anger and sadness conditions ($p = .003$) and the anger and neutral conditions ($p < .001$). The sadness ANOVA was significant $F(2, 89) = 9.12$, $p < .001$, and post-hoc tests showed a significant difference between anger and neutral ($p = .003$) and sadness and neutral ($p < .001$). The disgust ANOVA was also significant $F(2, 89) = 11.83$, $p < .001$, and post-hoc tests found differences between the anger and sadness conditions ($p = .002$) and the anger and neutral conditions ($p < .001$). None of the other ANOVAs were significant. Emotion scores at T2 are in Figure 3.

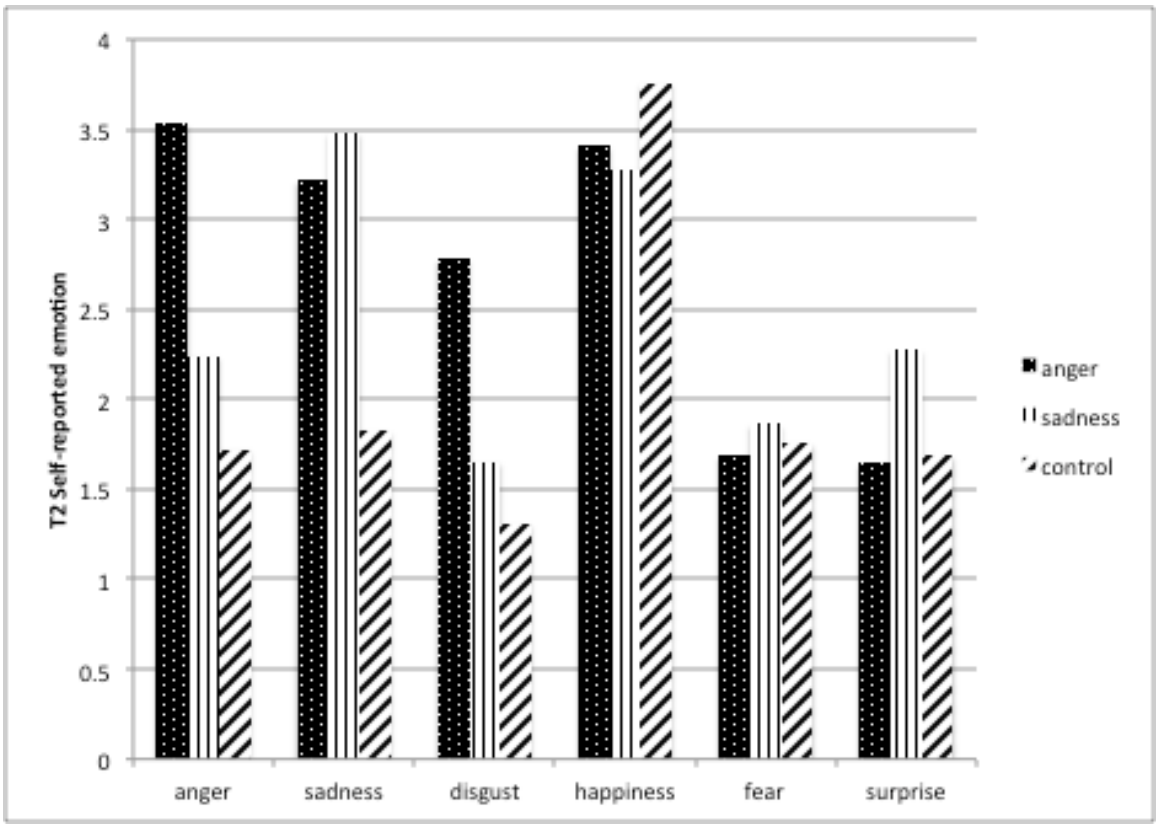



*Figure 3.* Self-reported emotion by condition at T2 (immediately following the MIP) in Study 4

Mean risk scores were calculated by averaging participants' risk ratings within the malicious and non-malicious categories. In this and future analyses reported in this thesis, wherever the means of a dependent risk perception measure were compared and the factor of interest was manipulated between subjects, the Shapiro-Wilk test was run on each cell to ascertain whether data significantly deviated from normality. Unless stated otherwise the Shapiro-Wilk statistic was not significant ($p > .05$). In the present study, Shapiro-Wilk was significant for the neutral condition ($p = 0.009$), indicating that assumptions of normality relied on by parametric tests were violated. Consequently, the mean risk scores calculated were rank transformed in accordance with Conover and Iman (1981) prior to submission to a condition by hazard type (malicious, non-malicious) ANOVA, where the latter was a

repeated measures factor. There were no significant effects, however. Means appear in Figure 4.

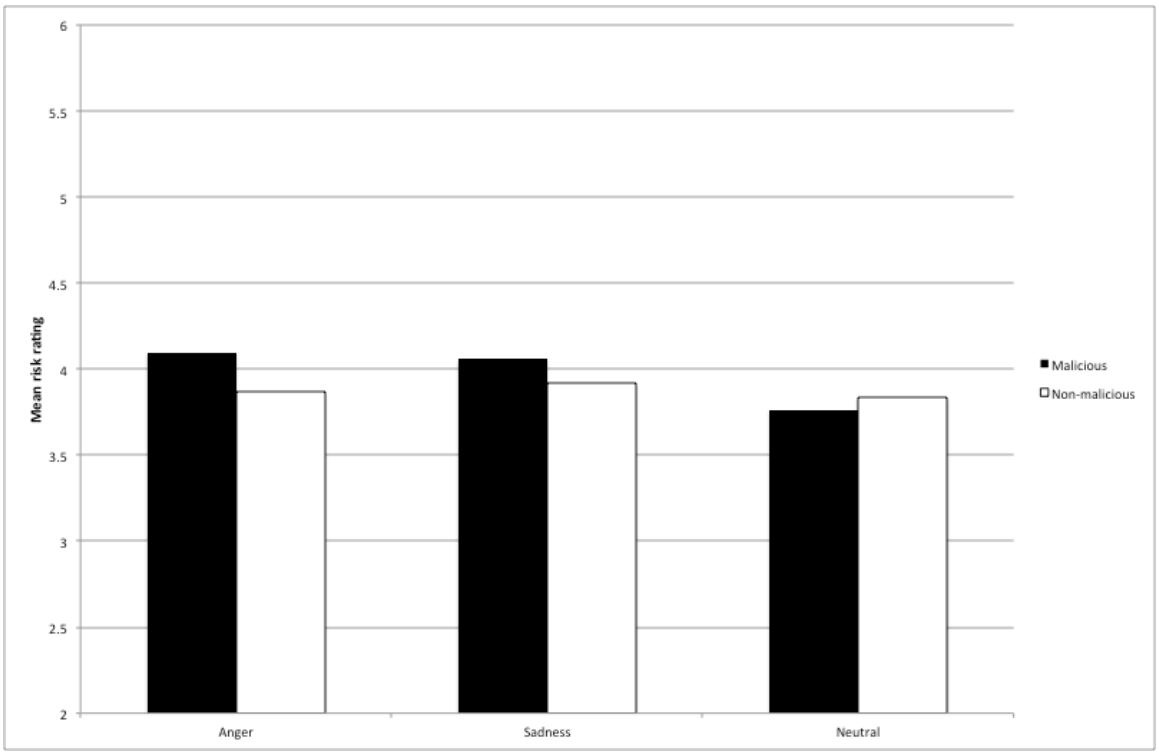



*Figure 4.* Mean risk ratings by condition and hazard type in Study 4

The data were probed further by correlating risk ratings with self-reported emotion at T1. If one accepts that trait emotion is highly correlated with state emotion at a given time point (a proposition to which extensive evidence lends support, and across several different types of affect; e.g. Deffenbacher et al, 1996; Koray et al, 2003; Watson & Clark, 1999), correlational analysis of fear, happiness and anger at T1 with mean risk ratings could be seen as a crude replication of Lerner & Keltner (2001), who found that the latter was negatively correlated with risk perception but the former was positively correlated. Correlations are shown in Table 8.

Table 8

*Spearman's Rank Correlations between T1 Self-report Emotion Ratings and Risk Ratings for Malicious and Non-malicious Hazards*

| T1 affect | Non-malicious | Malicious | Mean |
|---|---|---|---|
| Anger | .15 | -.003 | .13 |
| Sadness | .17† | .10 | .17† |
| Disgust | .21* | .07 | .200* |
| Happiness | -.200* | -.04 | -.19† |
| Fear | .23* | -.020 | .20* |
| Surprise | .28* | .08 | .26* |

† p < .1, * p < .05, ** p < .01, *** < .001

It is shown that where the correlation between fear and mean risk ratings was significant and the correlation between happiness and mean risk ratings was marginally significant, the correlation between anger and mean risk ratings was not. Indeed, not only did the anger correlation fail to reach significance, it did not even trend in the direction observed by Lerner & Keltner (2001).

## Discussion

The purpose of this study was to test the hypotheses that anger increases risk perception and that emotion and hazard type interact. The results obtained in this study show that there was no effect of emotion induction on risk perception, and self-reported emotion at T2 suggests that the emotion manipulations did work. Notwithstanding that, by the end of the experiment, at T3 there were no longer differences in emotion across experimental conditions, placing the efficacy of the manipulation in some doubt.

Although only one other study used a similar MIP in the context of risk perception research (Gasper & Clore, 2000), other researchers (e.g. Erber & Erber, 1994; Forgas et al,

2005) have successfully utilised it to induce emotion in other situations, albeit rarely to induce anger. In the present study the anger MIP was more effective at inducing sadness in the long term than anger (and almost equally effective in the short term), so it is plausible that the autobiographical MIP is simply a poor instrument for anger induction. But why would it be less effective for anger than other emotions?

One possible reason is that recalled events in one's own life will inevitably be in the past – and if asked to single out one event that was especially angering, there is a good chance it will be some distance in the past. But there is a difference between an event that *made* someone angry, and an event that *is still capable* of making them angry. Caruso (2010) found that participants were less angry about a seemingly unfair action perpetrated by a corporation that they were told happened last month than one they were told was due to happen in a month. This is consistent with Levine & Pizarro's (2004) observation that whereas anger helps people to stay focused on achieving a goal that has been obstructed and affirm their ire against those they hold responsible for obstructing it, sadness 'is experienced when people believe that goal failure is irrevocable' (p. 543). This has obvious relevance to recalling angering events. If a person was angry a year ago when she received a parking ticket that she thought was unfair, but after exhausting her appeals she eventually had to acquiesce and pay the fine, there is scant chance of her getting her money back now, so she won't be able to experience anger as intensely as she did at the time.

A more general problem with the autobiographical MIP, especially in the present study, is its requirement that participants impart profound, private information. Although all manifestations of the autobiographical MIP implicitly demand participants' confidence in the experimenter, in this version the participants' belief that their stories would be read by a stranger was made more salient by the fact they were surrounded by other strangers (the participants) and they could actually see the stranger (the experimenter) who was going to

read their accounts. Despite efforts to assure participants of the confidentiality they would be afforded, the possibility that participants did not feel sufficiently secure to record their most heartfelt recollections, and thus chose to write down less evocative memories instead, cannot be dismissed. This is especially true in light of participants' answers in informal post-experimental interviews, where a sizeable minority reported feeling somewhat inhibited.

Another possible limitation of the present study is the dependent measure. Likert scales were chosen because of their ease of use and prevalence in previous studies (Fischhoff et al, 2003; Foo, 2011; Lerner & Keltner, 2001; Lu et al, 2013), but all those previous studies used much shorter questionnaires. A concern is that with a 33-item questionnaire with no subscales, participants might treat the questionnaire as a ranking exercise, with the outcome that rather than rendering risk judgements in an absolute sense, participants rate hazards' riskiness relative to other hazards on the questionnaire.

A more fundamental problem may have been the wording of the dependent measure. Participants were asked to 'rate the likelihood of the following hazards', but that wording left considerable scope for interpretation. If asked to rate the likelihood of an avalanche, does that mean the likelihood of an avalanche happening to the participant, or does it just mean an avalanche in general? And over what time frame? Today? In the next year? Furthermore, when applied to certain hazards, the wording resulted in questions such as 'rate the likelihood of boating', leaving uncertainty as to whether the experimenter wanted to know the likelihood of someone going boating or the likelihood of a boating-related hazard occurring.

An alternative method of measuring risk was provided by Johnson & Tversky (1983), discussed above. They told participants that in the United States every year 50,000 people die due to motor vehicle accidents, and asked them to estimate how people died

each year in the United States due to the other hazards on their list. This approach has definite advantages over the approach previously applied. The phrasing of the question eliminates much of the ambiguity of the wording in the current study. Requiring estimates of the actual number of deaths also brings a sort of ecological validity to the measure, framing the question as one that has a (relatively) objective answer. A concern, however, is that ratings within a specific timeframe will be subject to year-to-year variability. An even more promising paradigm was utilised by DeSteno et al. (2000), who presented participants with denominators for each of their hazards and then asked them to supply the numerator (e.g., 'Of the 40,000 people who commute to work in downtown Columbus, how many will be late for a meeting today because they are stuck in traffic?'). Although the hazards used by DeSteno et al. tended not to be fatal, it is easy to see how their questions could be adapted to apply to the current paradigm.

Study 5 was designed to address these methodological limitations. A new dependent measure was used, deaths per 1,000,000 people over a lifetime. Not only is 1,000,000 people a more suitable denominator for extremely improbable hazards but the number is also consistent with the *micromort* (*μmt*), a unit introduced by Howard (1980) and promulgated as a standardised, accessible way of communicating measured risk to lay audiences to help them make informed decisions about which risks to expose themselves to. A micromort is defined as a one-in-a-million chance of death, and can be expressed in multiple contexts. The risk for car accidents, for example, has been expressed as *μmt*/year (Howard, 1989) and *μmt*/mile (Spiegelhalter, 2009), the risk associated with general anaesthetics has been conveyed as *μmt*/anaesthetic procedure (Turnbull, 2011), the risk of death from air pollution in New York or Boston has been cited in *μmt*/days spent in one of those cities (Roebuck, 2012) and the risk from smoking has been expressed in *μmt*/cigarette (Walker et al, 2014).

Study 5 also used a different, presumably more powerful manipulation of emotion. The autobiographical MIP, used in Study 4, can be thought of as highly participant-directed because participants are free to activate stimuli that will induce the target emotion (Gerrards-Hesse & Spies, 1994). The advantage of this type of MIP (and the reason the autobiographical MIP was chosen in the first place) is that participants are likely to know better than the experimenter what will make them angry or sad. However, knowing what will make them angry does not guarantee that they will select an angering event to recall. In fact given that people seek to maintain positive affective states and avert negative ones (e.g. Erber & Tesser, 1992; Raghunathan & Pham, 1999; Zeelenberg, 1999), they may intentionally select a less angering event to avoid the unpleasant arousal. In addition, as noted above, recalling angering events that can no longer be remedied may not induce anger as it is usually understood.

'Guided' MIPs avoid some of these concerns. There are, according to Gerrards-Hesse & Spies (1994), three types of guided stimulus generation MIPs – the Music, Film/Story and Velten MIPs, all accompanied by explicit instructions to try to experience the target emotion. Of these, the Velten procedure is most suitable for my purposes.

Emmett Velten (1968) designed and introduced the Velten MIP. It was originally intended for therapeutic use, and it relies on two factors to induce emotion. Firstly, like certain versions of the Music and Film/Story MIPs it relies on participants' complicity in inducing a mood state. Secondly, it presents a sequence of statements that are evocative of the target emotion (e.g. 'I'm not very alert; I feel listless and vaguely sad'; 'I know good and well that I can achieve the goals I set'). Participants read these and attempt to engage with and experience the feelings they conjure up. Velten MIP has seen extensive use. It has also been found to be an effective MIP. Larsen & Sinnett (1991) ran a meta-analysis of studies employing the Velten MIP – they aggregated effect sizes derived from the elated and

depressive versions of it and found the resulting effect size to be large *(d = .76)*. In a later meta-analysis, Westermann, Spies, Stahl & Hesse (1996) reported that not only was the Velten MIP by far the most frequently used but that it was also successful inducing both elated and depressive effect, and particularly effective with depressive mood *(d = 1.21)*.

Velten himself did not develop an MIP for anger, but Engebretson, Sirota, Niaura, Edwards & Brown (1999) compiled a series of 50 statements with angry connotations, in the same style as Velten (1968), and presented them to participants, along with the original depressive Velten MIP, in counterbalanced order. Both versions proved capable of eliciting the target moods, and a comparison between the two showed that the anger version produced even larger changes in the target emotion than the depressed version and boasted a large effect size *(d = .76)*. Both versions also benefited from good specificity – most of the emotions that data were collected on but that were not the target emotion showed no appreciable change from the pre-induction baseline.

It is true that the Velten MIP is vulnerable to experimenter demand, perhaps more so than autobiographical MIPs. Evidently though, this is a criticism that Velten (1968) anticipated, by including a 'demand characteristics conditions' in which participants were instructed to 'remember to act… elated/depressed' (p. 475). Participants in these conditions did not report corresponding emotions to the same extent as those in standard experimental conditions, suggesting that even if participants were motivated to confirm the hypotheses they would be unaware of how to do this. The question of demand characteristics was also addressed by Larsen & Sinnett's (1991) meta-analysis. As well as reporting the overall effect size of the Velten MIP, the authors also divided the data according to whether participants were furnished with an honest account of the experiment (as in the original Velten MIP) or whether a deceptive cover story was used, and whether self-report or behavioural measures were employed to measure affect. Although effect sizes

were larger in conditions favouring experimenter demand (i.e. with no cover story and using emotion self-reports), the researchers found medium effect sizes in all four conditions ($d$ >= .5).

Study 5, then, was intended to be a conceptual replication of Study 4. The means of manipulating mood were changed from the autobiographical MIP to the Velten MIP and the dependent measure changed from a series of Likert scales that participants used to answer a very vague and variously interpretable question to a standardised frequency estimation task in which participants answered a very specific question. There was also a further change to the experiment – having decided to gather data using a specifically framed question, I wanted to enhance the specificity of the question by identifying a geographical area for participants to make their estimations about. As a consequence, two questionnaires were administered: one where participants estimated deaths out of a million in New Zealand and one where they estimated deaths out of a million in the world. Geographical area is relevant because personal risk is usually estimated to be significantly lower than risk to people in general (i.e. 'general risk'; Sjöberg, 2003), and simultaneously more accurate (as general risk tends to be overestimated; Rothman, Klein & Weinstein, 1996). Manipulating geographical area acts as a proxy for personal versus general risk as it changes the proximity of the hazard relative to the perceiver, allowing for a test of potential interaction effects.

# Study 5

## Method

### Participants

95 participants took part in return for partial course credit for psychology papers at the University of Otago, of which 65 were female and the remainder were male. Reflecting an undergraduate population, the sample had a mean age of 20.2 and ranged from ages 17-41.

### Design

This experiment featured one between-subjects factor with three levels. Participants were assigned to groups such that a roughly equal sample took part in each condition, anger ($N$ = 31), sadness ($N$ = 32) and control ($N$ = 32). The dependent variables were state affect and risk frequency estimates.

### Materials

The experiment was conducted in individual experimental booths. Participants were supplied with pens to complete the written components of the study, which included a demographics questionnaire (asking the same questions as in Study 1), the self-report state emotion questionnaire adapted from Tiedens (2001) which was issued three times, the world and New Zealand versions of the frequency estimation questionnaire (see Appendix D) and the Marlowe-Crowne Social Desirability Scale (MCSDS; Crowne & Marlowe, 1960). The MCSDS contained questions intended to gauge participants' inclination towards giving socially desirable answers such as 'I'm always willing to admit it when I make a mistake' and (reverse-coded) and 'I am sometimes irritated by people who ask favours of me' (other

items are enumerated in Appendix E) to which participants answered 'yes' or 'no'. The Velten MIPs and the neutral procedure were run on Apple Macintosh computers.

**Procedure**

After giving informed consent, participants completed the demographics questionnaire and the first self-report emotion questionnaire. Participants were told that they would be reading a series of sentences, and that in each case they should 'imagine what the sentence is saying' and (in the anger and sadness conditions) 'try as much as possible to get into the mood suggested by the sentence.' In the neutral condition the last phrase was replace by 'to try as much as possible to understand the sentence.'

After reading these instructions participants were presented with statements appropriate to their experimental condition. The sadness and neutral condtions utilised the same statements as in Velten's (1968) original paper, whereas the anger condition used Engebretson et al's (1999) stimuli. The anger, sadness and neutral conditions consisted of 50, 58 and 60 statements respectively. Statements were always presented in the same order, and participants were required to spend a minimum of 20 seconds reading each statement before proceeding to the next one. After 20 seconds had elapsed a message appeared beneath the current statement informing participants that they could now proceed by clicking their mouse on a 'continue' button.

Once all statements had been presented and the self-report emotion questionnaire completed, participants contacted the experimenter who presented them with the New Zealand and world versions of the frequency estimation questionnaire, in counterbalanced order. In both cases, participants were asked, 'Out of every 1,000,000 deaths in New Zealand [the world] how many are attributable to the following causes? Your answers need

**NOT** add up to 1,000,000.' Participants wrote their estimates next to each of the 33 hazard types.

Finally, participants completed the third mood measure, and then the MCSDS, before being debriefed.

## Results

State mood ratings were analysed in a mood condition (anger, sadness, control) x self-report emotion (anger, sadness, disgust, happiness, fear, surprise) x time (T1, T2, T3) mixed model ANCOVA, with the last two factors treated as repeated measures and MCSDS score as a covariate. The ANCOVA showed a significant three-way interaction $F(15.19, 675.99) = 4.88$, $p > .001$. Separate two-way ANCOVAs with condition and self-report emotion as factors were run using data from each time point, and these showed that at T1 condition and self-report emotion did not interact $F(7.70, 342.70) = .822$, $p > .1$, at T2 they did interact $F(7.11, 319.94) = 5.159$, $p < .001$ and at T3 they did not interact $F(7.48, 336.79) = 1.369$, $p > .1$. Separate ANOVAs tested for differences in self-reported emotion at T2. The anger ANOVA was significant $F(2, 94) = 9.82$, $p < .001$ and post-hoc tests using Tukey's HSD revealed a significant difference between the anger and sadness conditions ($p = .001$) and the anger and neutral conditions ($p = .001$). The sadness ANOVA was significant $F(2, 94) = 5.49$, $p = .006$ and this was accounted for by a significant difference between the sadness and neutral conditions ($p = .006$) and a marginally significant difference between the anger and neutral conditions ($p = .052$). The disgust ANOVA was also significant $F(2, 94) = 6.94$, p = .002, and post-hoc tests revealed a significant difference between the anger and neutral conditions ($p = .003$) and the sadness and neutral conditions ($p = .010$). None of the other ANOVAs reached significance. Emotion scores at T2 are in Figure 5.

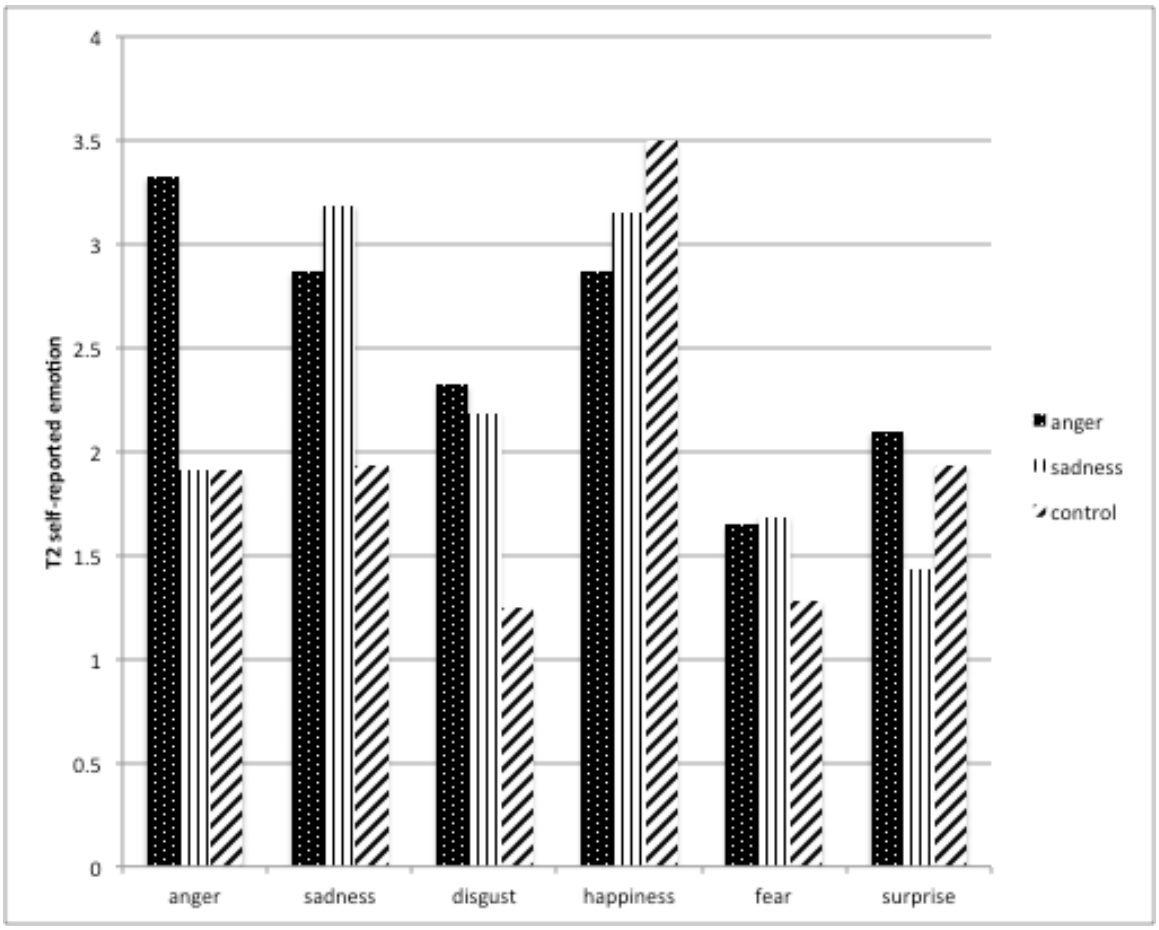



*Figure 5.* Self-reported emotion by condition at T2 (immediately following the MIP) in Study 5

New Zealand and World risk estimates were highly correlated with each other, $r$ (95) = .79, $p < .001$, so responses were averaged to form a single estimate for each hazard, which was log-transformed (after recoding all estimates below 1, to 1) before analysis. A 2-way ANOVA with mood condition (anger, sadness, neutral) as a between-subjects factor and hazard type (malicious/non-malicious) as a within-subjects factor revealed a significant main effect of hazard type such that non-malicious hazards were perceived to have significantly higher frequencies than malicious hazards $F(1, 92) = 30.728$, $p < .001$ and a marginally significant effect of condition $F(2, 92) = 2.874$, $p = .062$. The main effect of condition was further explored by subjecting the data to Fisher's LSD. This showed a

significant difference between the anger and neutral conditions (p = .029) and a marginally significant difference between the anger and sadness conditions (*p* = .059). Means are shown in Figure 6. There was no interaction.

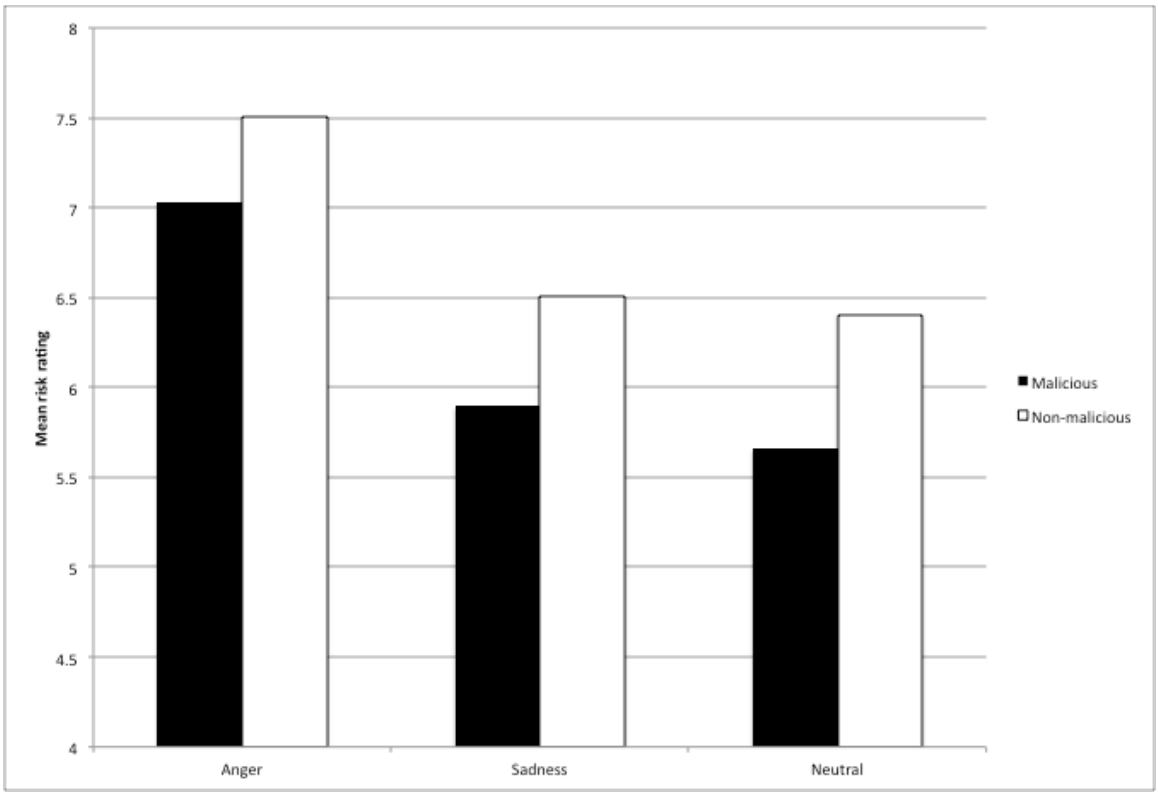



*Figure 6.* Mean log-transformed frequency estimates by condition and hazard type in Study 5

The self-report emotion questionnaire was also issued to participants after completion of the frequency estimation questionnaire to investigate a potential bi-directional relationship between emotion and risk perception. Although there was a correlation between risk estimates and T3 anger *rs*(94) = .306, *p* = .003, that finding could easily be explained away as a byproduct of covariation between T2 anger and T3 anger. Consequently the correlation was run again with T2 anger partialled out, and the result was that risk estimates and T3 anger were no longer significantly correlated *rs*(91) = .078, *p* > .1.

This could be interpreted as evidence that the mere act of rating hazards as risky is not in itself sufficient to elicit anger, but from another perspective it could be argued that using T2 anger as the baseline is misleading as the risk estimation task may have elicited anger but the resultant anger increase could have been offset by decay of the anger aroused by the Velten MIP. To resolve the uncertainty, the partial correlation was run again but this time only data from the neutral condition was submitted. Once again the test was not significant $rs(28) = -.05$, $p > .1$, quashing the possibility that the risk estimation task itself induced emotion.

## Discussion

To begin with, the Velten MIP appears to have largely accomplished its aim. Although it did not succeed in independently eliciting anger (without accompanying sadness), this does not particularly matter – sadness was induced in roughly equal measure in the anger and sadness conditions, so an observed effect in the anger condition implies an effect of anger over and above whatever effect sadness might have. The performance of the Velten MIP was also superior to that of the autobiographical MIP for other reasons. Firstly, disgust was no longer inimically confounded with emotion induction, which gives confidence in the effect of anger on risk perception. Secondly, although the experimental MIPs resulted in general decreases in happiness they did so comparably, whereas previously the sadness condition had resulted in larger decreases in happiness potentially exposing results to an alternative explanation. Finally, the anger manipulation (at least) seems to have elicited more enduring anger. The results show that after completion of the frequency estimation task anger-induced participants still reported more anger than neutral participants (although the difference no longer reached significance).

The headline finding of this experiment was that anger increased risk perception relative to neutral. Furthermore, anger exerted the same effect irrespective of the affective disposition of the hazard. The emotion effect, however, runs contrary to almost all recent literature, and in particular findings reported by DeSteno et al. (2000) and Lerner et al. (2003). One potentially important point of difference between the current studies and Lerner et al's (2003), who found that anger did not enhance risk perception (relative to fear), is the nature of the MIP. Participants in that study were asked to record aspects of the September 11th attacks that made them angry versus fearful. It is not hard to imagine how the content of the aspects recalled might have differed. There is a wide array of potentially angering factors – these could include the temerity of foreign terrorists hijacking US aircraft and crashing them into totemic American landmarks, the sense that airport security had failed to detect and forestall the attacks and feelings of indignation that there exist people in the world who so hate the country Americans love. Fear-inducing factors, on the other hand, necessarily entail inferences about the ominous significance of the attacks – thoughts about whether national icons that projected national pride could be protected against capricious attacks, or whether Americans could ever truly feel safe again in aeroplanes, in foreign countries or on their own soil. For this reason, the informational content of the MIP could have impacted upon risk perception, independent of emotion. This possibility is further supported by the fact that the risk perception questions were predominantly concerned with terrorism and not other hazards.

Furthermore, Lerner et al's (2003) risk perception measures were quite different to those used in the current study. As well as being dominated by terrorism-related themes, they also explicitly required that participants judge future risk. In other words, their dependent measures could be seen as risk *prediction* measures. Unlike MIPs that require appraisals of the past, Lerner et al's MIP, carried out in the aftermath of the September 11th

attacks, may have led to situational appraisals of high effort and high personal control. They were then asked questions pertaining indirectly to the US's ability to successfully combat the terrorist threat it faced. In that context, it is unsurprising that participants estimated risk more optimistically – given their cognitive appraisals, they may have even thought it unpatriotic not to. In fact, the reported negative correlations between trait anger and risk perception was really a correlation between vengefulness and risk perception. The authors used the Desire for Vengeance scale and desire for revenge, by its very nature, entails a general tendency to take action to redress a perceived injustice. Again, it is to be expected that those who are inclined towards revenge are more likely to believe they will succeed in getting it, and low risk predictions can be seen as a proxy for success in exacting revenge. By contrast with Lerner et al's risk prediction measure, the current measure did not assign any temporal frame to the risk question, leaving it in more abstract terms. This may have removed or attenuated the element of participants' perceived ability to deal with risk and thus changed how anger impacted on risk perception.

DeSteno et al. (2000) induced anger via a story MIP – participants were presented with an article detailing an angering event – and although their finding that saddening hazards were perceived to be less risky by angry participants than sad ones is consistent with Lerner's results, their finding that angering hazards are seen as more risky by angry participants is not.

It may, however, be possible to reconcile DeSteno et al's and Lerner et al's (2003) findings – the risk questions DeSteno et al. asked required participants to predict the risk posed to other people and not themselves. Angry people appraise that an adverse event has occurred and that they are equipped to overcome the setback – thus anger brings with it feelings of empowerment, which ought to reduce the sense of self-vulnerability. But personal empowerment does not necessarily generalise to feelings of empowerment on

behalf of other people. It may be noted that in Lerner et al. anger exerted a similar effect on personal and general risk estimates, but this may have been caused by differences between Lerner et al's and DeSteno et al's general risk measure. The latter asked questions such as 'of the 2,000,000 people in the US who will buy a used car this year, how many will intentionally be sold a 'lemon' by a dishonest car dealer?'' – the wording was abstract and detached. This contrasts with Lerner et al's questions about general risk, which took the form 'What is the probability that the average American will be hurt in a terror attack within the next 12 months?'. The key difference is that DeSteno et al's general risk questions specified a large sample of people that participants were not necessarily a member of and were not likely to identify with, whereas Lerner et al. called on participants to imagine the average American and give a percentage likelihood of suffering from hazards. Many participants are likely to have thought of themselves as average Americans, and at the time their study was run Americans were freshly galvanised by the September 11th attacks resulting in a heightened sense of national unity (Li & Brewer, 2004). Under the conditions Americans' identities as individuals and Americans were likely fused to a considerable extent, potentially obscuring any interaction between hazard proximity and induced anger.

However, while DeSteno et al.'s (2000) and Lerner et al's (2003) results are not mutually incompatible, it is difficult to make sense of the current results in the context of DeSteno et al's. The MIPs are conceptually similar and both studies required abstract risk estimates to be made using natural frequencies. One important difference was that DeSteno et al. mainly gathered risk predictions and the present study did not specify a time frame. Although the forward temporal orientation of DeSteno et al's wording could serve as an explanation for why estimates for sad hazards were lower in angry participants (if feelings of empowerment did in fact generalise to other people in society) in their study but not mine, this argument ought to apply equally to angering hazards (this was how I accounted

for the discrepancy between Lerner et al's results and mine). Of course, DeSteno et al. used an emotion-as-information account to explain why anger and sadness produced opposing effects depending on the affective disposition of the hazard, but this is also not reconcilable with my data, which show no hint of an interaction between emotion condition and affective disposition of hazard.

There are, however, two areas where the present study also differed from DeSteno et al. (2000). One area was the type of hazard used. The current study used 'deadly' hazards (which was the basis on which they were originally generated by participants), whereas DeSteno et al's hazards were chiefly mundane inconveniences that participants could well have been exposed to previously themselves, or at the very least could easily envisage themselves falling victim to. This could provide participants with a frame of affective reference – remembering how they felt when they were sold a defective used car, for example – that enabled participants to put their induced emotion to instructive use. The emotion-as-information hypothesis holds that angry/sad people, when asked about the likelihood of an angering/saddening event, think to themselves 'this is exactly the sort of thing that *would* happen'. No-one has ever previously experienced death, and nor can death be readily imagined as there are no authoritative accounts of what it is like. This may limit the informational capacity of emotion.

The other difference between my study and DeSteno et al's (2000) is the length and form of the risk measure. In the current study, the measure consisted of a list of hazards conveyed in the smallest possible number of words needed to identify them. DeSteno et al. presented participants with only eight hazards – four saddening and four angering – and they were each described using full sentences. Some hazards, such as the used car hazard above, used words intended to emphasise the affective disposition of the hazard, such as 'intentionally'. In this way it could be argued that DeSteno et al's paradigm made affective

disposition more salient – participants were encouraged to take more time processing the hazards when contrasted with my paradigm where they were simply handed a list of 33 hazards.

The prior research that my results best resemble is probably Johnson & Tversky (1983). The authors used a very similar dependent measure to mine (17 list hazards were presented and participants were asked to estimate their natural frequencies), and their measure more closely resembled a measure of general risk than personal risk. Further, although Lerner and Keltner (2001) argued that Johnson and Tversky (and other researchers) overlooked the nuances that other dimensions of cognitive appraisal beyond valence bring to emotion differentiation, the latter did in fact use stories likely to arouse emotions similar in valence but distinct on other dimensions. For example, in their third experiment, the authors presented one group of participants with the street crime story from their earlier studies and another group with a story that was sad, but unrelated to risk. The results showed that the angering and sad stories achieved almost identical increases in risk estimates. Although it was not their intention, they had inadvertently provided evidence that anger augments risk perception. However, their findings are somewhat questionable because hazard-related MIP content and affective MIP content were confounded (this is symptomatic of the fact that they were not researching differences between anger and sadness induction).

Despite employing comparable methodologies and obtaining similar findings apropos anger, Johnson & Tversky's (1983) findings with respect to sadness differed from the current results. First, it should be noted that Johnson & Tversky's angering story generally augmented risk considerably more than the sad stories that had been utilised. Second, it is possible that sadness was not responsible for the effect of the sad story. Again, reflecting Johnson & Tversky's conflation of negatively-valenced emotions, the

manipulation check only measured general negativity of affect. It is also stated in their paper that the sad stories they used were intended to elicit anxiety. Anxiety and fear closely resemble each other, and it is already understood that fear augments risk perception. Thus the lack of specificity inherent in story MIPs is compounded by the fact that their data offer no means for anxiety to be controlled for statistically. For this reason, I advocate the present study as a more definitive comparison of sadness-induced participants' risk perception with neutral participants'.

In summary, my findings suggest that when anger is induced with an effective MIP suitable to the task, it has the effect of increasing participants' risk perception irrespective of the affective significance of the hazard they are judging. This effect cannot be dismissed as a by-product of demand characteristics. By contrast, when sadness is induced, no effect on risk perception is observed. These findings can be used to explain the apparent overestimation of malicious hazards that drives societies to commit vast resources to tackling them as malicious hazards are angering. When people hear about deaths caused by malicious hazards they are likely to experience anger arousal, and when forming views as to what policies should be adopted to mitigate against malicious hazards, participants may either be angry in the moment or may retrieve beliefs about the nature of malicious hazards that were formed under angry affect. As a result, they perceive greater risk and support more expensive risk mitigation strategies.

# Chapter 5 – Perception of agency and risk perception

The previous chapter examined the impact of anger on risk perception, providing evidence that the relationship is more complex than previously supposed: anger can, at least in some conditions, increase rather than decrease risk perception. In principle, this provides one mechanism by which malicious hazards attract incommensurate concern and resources: this is the class of events most likely to create anger.

However, the possibility that anger drives risk perception does not rule out other mechanisms. As discussed in Chapter 4, malicious hazards are distinct in another way: they are also the hazards most likely to involve human agents. Perceptions of human agency may give rise to higher risk perception because people tend to attribute negative events to human causes (due to attribution bias), and tend also to assume reverse causality (i.e. that human causes are particularly likely to lead to negative events compared with situational causes).

From a cognitive evolutionary standpoint, one account of attribution bias has it that the bias exists because for the entirety of mankind's history, people have had to make decisions about which other people they wish to accept as allies (Haselton & Nettle, 2006). Accepting an ally has always entailed adopting a trusting attitude towards them, and inevitably those who benefit from the trust of another are in a stronger position to inflict damage on them than those they are wary of. As people, we have of course always required the companionship of others to survive and prosper, but whereas selecting one bad ally can potentially be fatal, it is unlikely that any good ally is likely to be required to save our lives. When determining whether or not someone's actions reflect their stable disposition, the costs of a false negative are potentially higher than the costs of a false positive. It is easy to

see how this applies to detecting whether a death was caused by a malicious agent or another factor – we have an adaptive reason to be inclined towards ascribing deaths to intentionally acting agents 'just in case' – so that we can act to prevent that agent from harming us. This appears to hinge on there being an identifiable agent, but it may also be that when judging risk perceivers take the precaution of overestimating malicious hazards because of the same mechanism that helps us avoid unwise social alliances.

Then there are the motivational accounts of correspondence bias. One of these is that we are intrinsically motivated to achieve a sense of control over our world and how we interact with it (Gilbert & Malone, 1995). This invokes the same mechanism as Lerner's (1970) Just World phenomenon, depicting cognition as a motivated tool to satisfy primitive needs. Making dispositional attributions enables us to predict (accurately or inaccurately) the future actions of an actor that situational attributions do not allow. Hence, if someone's actions led to someone else's death, we can infer that because of their dangerous disposition they may also cause our death, and act accordingly. It is doubtful, however, whether this reasoning would cohere when we are trying to explain an ambiguously caused fatality rather than the reasons behind someone's actions. If we do not know whether or not anyone's actions caused the fatality, the resolution derived from surmising that they did (i.e. making a dispositional attribution) can only be to adopt a more guarded attitude towards everyone. This is much less practicable than being wary of one individual. As a consequence this motivational explanation probably would not predict augmented risk perception of malicious hazards (unless one ascribes ambiguously caused deaths to a hazard strongly associated with a certain group in society – an example might be terrorism – in which case making the dispositional attribution could result in heightened suspicion of that group).

Another motivational account of attribution bias is that attributions are motivated by self-interest. According to this account, we are particularly inclined to make dispositional

attributions when appraising others' negative behaviour (Snyder, Stephan & Rosenfield, 1976). We do this because by derogating others, we comparatively elevate ourselves. So upon discovering that someone's actions led to someone else's death, we are motivated to cite their personal failings as the reason why that happened and on discovering that someone else died due to an unknown cause we are inclined to search for someone to derogate which may mean blaming them for the death. Furthermore, even without having a specific death to explain, it may serve our self-enhancement motivation well to believe that deaths, when they do occur, are caused by other people of less worth than ourselves.

People may also be motivated to make dispositional attributions to justify meting out punishment (Jellison & Green, 1981). Goldberg, Lerner & Tetlock (1999) induced anger by showing participants a video in which the negligence of an antagonist ends up harming an innocent person. The repercussions of the antagonist's actions were manipulated such that they were either punished for their transgressions, not punished, or whether or not justice was served was left deliberately ambiguous. All three manipulations left participants feeling equally angry, but participants in the condition where the antagonist was not punished then went on to exhibit significantly more punitive attitudes to antagonists in a series of unrelated vignettes than participants who saw justice dispensed satisfactorily to the initial miscreant. This research suggests that when an injustice is perceived to have occurred, punishment fulfils some sort of cathartic function, and because the enactment of punishment is accounted for by more than the misdeeds of the person being punished, it would be reasonable to infer that when the cause of an untimely (i.e. unjust) death is being diagnosed, people actively search for someone to punish as a means of channelling their indignance about the death. This could also explain overestimation of malicious hazards – whilst all untimely deaths may be in some way unjust, people may foresee that only ones

deliberately caused by someone are punishable, and hence a motivation to overestimate the proportion of punishable deaths may exist.

Finally, it appears that dispositional attributions are simply easier to make – Gilbert et al. (1988) found that, whereas participants under no cognitive load were sometimes able to make situational inferences, those under cognitive load almost always resorted to dispositional attributions. In a similar vein, Pennington & Hastie (1992) found that mock jurors found stories attributing observations to human actions easier to understand and explanatorily more satisfying. It could also be possible, therefore, that people find it easier to envisage the consequences of deliberate human actions than situational factors.

In practice, evidence exists to support all of these explanations for attribution bias, even though some appear to be mutually contradictory. For example, although Snyder et al's (1976) data corroborated the view that attributions are self-serving, Augoustinos (1990) found that dispositional attributions were preferred regardless of whether the actor succeeded or failed. In spite of Haselton & Nettle's (2006) argument that there are evolutionary benefits to making dispositional attributions and Gilbert et al's (1988) demonstration that we find it easier to make them, some researchers have advocated an exception to the bias where deception is involved (e.g. Andrews, 2001), and some studies show that when a deception motive exists, the correspondence bias disappears (e.g. Fein, 1996); others cite the correspondence bias as one of the reasons why people find it so difficult to detect deception (e.g. O'Sullivan, 2003), arguing that we are so used to assuming that others' behaviour corresponds with their true motives and beliefs that we frequently apply the heuristic in situations where this is not the case.

There are, then, a variety of reasons why attribution biases exist, and the literature showing that conditionals are often mistaken for biconditionals suggests that the biases may also apply in reverse. If people are biased to see hazards as caused by agents, they may

well be biased to see agentic (i.e., malicious) hazards as more likely than nonagentic ones. If so, then perceivers should judge hazards (whether malicious or not) as more likely to occur when they are primed to think of them in terms of agentic causes.

Priming was introduced to psychology by Meyer & Schvaneveldt (1971), who showed that, when presented with pairs of real or invented words next to each other and asked to declare whether the words were both real, participants were able to respond correctly faster when the real words were semantically linked to each other. This was interpreted as evidence that reading a word cognitively activates related words, and that when participants read the related words they are therefore able to confirm more quickly that they are indeed words.

Priming tasks involving words have shown that memory works by encoding meaning rather than recording exact samples of stimuli and then impartially retrieving them when required (e.g. Roediger & McDermott, 1995; Thapar & McDermott, 2001), but for a priming paradigm to be useful in manipulating hazard attributability the priming effect will need to extend beyond semantics and impact on beliefs and judgement as well. In a classic study, Srull & Wyer (1979) had an experimenter ask participants to choose which 3 words out of a set of 4 words could be arranged to form a sentence. The sets of words were orchestrated such that only one typw of sentence could be formed and that sentence, dependent on condition, carried an affective subtext or was affectively neutral. Where affective undertones were present, the sentences connoted hostility or kindness (examples given were 'leg, break, arm, his' and 'the, hug, boy, kiss'), also depending on the condition. Then later on, in an ostensibly unconnected task, participants read a passage in which the narrator related, in journal form, his interactions with an acquaintance called Donald who behaved in an ambiguously hostile or kind way. They then went on to rate their overall impression of Donald along 6 dimensions, 3 of which were related to hostility and 3 were a

function of kindness, and to judge how hostile or kind the behaviours Donald exhibited in the narrative were. It emerged that participants in the affectively connotative conditions were more likely to credit Donald with the primed affective characteristic than control participants and more likely to perceive his actions as congruous with that characteristic.

Particularly relevant to the current questions, Keltner, Ellsworth & Edwards (1993) primed participants to think in terms of situational or agentic causes. The authors tested the hypothesis that anger and sadness differentially affect social perception such that the former leads to agentic attributions of negative events, whereas the latter leads to situational attributions of negative events. After finding some initial support for this hypothesis, they set out to show that it was the emotional arousal itself, and not the constituent cognitive appraisals it entails, that was responsible for their earlier effect. They did this by having participants read a priming story and imagine the events happening to them. The story took the form of a diary entry written in the second person, and it described relatively prosaic, non-emotionally involved events that might occur in the life of a university student. In one condition the events were depicted as the outcome of human impetus (e.g. 'You wake up at 6.53 a.m.'; 'You wander into the shower… and rid yourself of yesterday's heat and humidity'); in the other they were the result of situational influences (e.g. 'The early morning light wakes you up at 6.53 a.m.'; 'the water streaming full blast over your body sweeps away yesterday's heat and humidity'). Participants then estimated the likelihood of 13 (mainly non-fatal) events (about half of which were positive and half negative), all of which were accompanied by causal explanations either imputing human agency (e.g. 'You miss an important flight because you had a bad cab driver') or situational factors (e.g. 'You are injured in an accident due to icy roads'). In keeping with their hypothesis that affect drives differing probability estimation of differently caused hazards, there was no significant effect of the attribution manipulation.

Although Keltner et al.'s study casts doubt on the attributional explanation of malicious hazards, there are several reasons to remain skeptical of their results. One of those is that the stories were rather pallid, presumably due to the authors' stated intention to keep them affectively neutral, and colourless prose is unlikely to engage readers (Hidi, 2001). Furthermore, the prime was very subtle, and the researchers gathered no data that could attest to whether priming had actually been achieved. We do know from the pilot study that, when asked, participants were able to recall whether the events had been described in terms of human or situational causality, but there is no way of knowing whether participants were sufficiently engaged by the story to establish a general association between events occurring and people making them occur. The authors also did not distinguish between first person causality and third party causality, with the effect that many of the events in the human causality story were actions initiated by the protagonist (who the participants imagined to be themselves) but all of the items on the probability estimation task involved a third party either helping or harming the participants. The association between me getting out of bed and someone else causing me to miss a flight is tenuous at best.

Finally, Keltner et al.'s procedure could have been strengthened by not merely priming a type of causal attribution generally, but also by creating an association between causality and the events being estimated. In order for priming to be effective in influencing judgement, primed attributes must be relatively more accessible than alternative attributes at the time judgements are rendered (Higgins & Brendl, 1995). The literature reveals that presenting stimuli that were earlier featured in a priming phase facilitates access to stimuli the priming phase had associated them with. In a study of verbal priming effects, Graf & Schacter (1985) taught participants associations between pairs of words by inviting them to

form sentences involving both of the words. At the conclusion of this learning phase, participants were presented with one of two dependent measures (contingent on the group they had been randomly assigned to). There was an explicit measure where participants were given a word stem derived from a previously studied word, and asked to complete the word stem so as to form that word. Presented alongside the word stem was a cue word that had either previously been paired with the target word or had not (a within-subjects factor). More pertinent to my proposed research, there was an implicit measure where cue words and word stems were presented as in the explicit measure, only participants were not told that the task intended to test memory – instead they were asked to complete the stem with the first word that came to mind, and that the cue word might help them think of a stem completion. Irrespective of which dependent measure was used, the outcome was the same: when a stem completion was cued with a word it had previously been paired with, participants were more likely to complete the stem to form a previously studied word. The significance of this is that priming is not confined to pre-existing associations in the mind of the perceiver, activated in the case of Meyer & Schvaneveldt (1971) and Roediger & McDermott (1995) by proximity in semantic networks – rather it can exert a contextual effect. In Graf & Schacter, the mere act of placing words in sentences may have helped participants to encode them (as in Craik & Tulving, 1975), but on top of that effect a context-specific facilitation effect was in evidence. Whereas Meyer & Schvaneveldt tapped an existing association between 'bread' and 'butter', Graf & Schacter forged a new one between 'shirt' and 'window'.

Analogously, to explore whether the perception that an agent (other than the victim themselves) is in some way responsible for an adverse outcome, has an effect on risk perception, Study 6 manipulated the tendency to attribute hazards to agentic causes. Drawing on Keltner et al's (1993) use of a story to prime agency, I composed two scenarios

for each of the natural and useful hazards in my list[4]. In all cases one of the scenarios was framed so as to lead participants to attribute responsibility to a negligent agent whose actions supposedly caused the death of one or more victims. The other scenarios absolved all potential human parties of responsibility, and attributed the death(s) to bad luck. Like Keltner et al, I aimed to make the content of the scenarios emotionally bland (to avoid confounding agentic perceptions with affect) and, both as a manipulation check and as a valuable source of data to later correlate with risk estimates, participants were asked to judge where the responsibility for the fatalities described in the scenarios lay. As an improvement on Keltner et al's design, these judgements were requested immediately after every scenario. If agentic hazards are seen as more likely, then participants primed to associate list hazards with human agency should display higher risk perception than those who learn to associate the hazards with situational causality.

## Study 6

### Method

#### Participants

110 undergraduate students participated in the study, of which 76 were female. Ages ranged from 18 to 39, and the mean age was 20.1.

#### Materials

Mood and risk estimates were measured using the same questionnaires described in Study 5, except that only items pertaining to hazards described in the scenarios were included.

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4 There was no scenario for cleaning products as it proved difficult to write a convincing story that did not implicate the manufacturer of the product

Agency was primed by varying the content of hazard scenarios. The following exemplar illustrates how the content differed between the **human agency** and the *situational factors* conditions:

> On 12th June 1998, on a beach in Miami, United States, a swimmer drowned after finding the tide too strong to swim against. **The swimmer attempted to attract the attention of the lifeguards, but apparently they weren't paying attention**/*The swimmer attracted the attention of the lifeguards, but they weren't able to rescue the swimmer in time.*

The full battery of scenarios can be found in Appendix F.

**Procedure**

Participants were run in groups of up to 10 in a large experimental room, at individual desks. After giving informed consent, participants were given a questionnaire packet containing a demographics form, one of the two versions of the scenarios task, and a second emotion questionnaire. Immediately beneath each scenario, participants were asked, 'To what extent do you feel the deceased were responsible for their fate?' Participants responded on a 7-point Likert scale anchored at 1 (not very responsible) and 7 (very responsible).

After reading and rating all 24 scenarios, and rating their mood a second time, they completed both the New Zealand and World versions of the frequency estimation questionnaire (order counterbalanced).

Finally, participants completed two additional, unrelated studies, before being debriefed.

**Results**

Self-report emotion ratings were analysed in a priming condition (human agency, situational factors) x self-report emotion (anger, sadness, disgust, happiness, fear, surprise) x time (T1, T2, T3) mixed model ANOVA, with the last two factors treated as repeated measures. The ANOVA showed a significant three-way interaction $F(15.57, 379.95) = 4.06$, $p < .001$. Separate two-way ANOVAs with condition and mood item as factors were run using data from each time point, and these showed that at T1 condition and mood did not interact $F(3.99, 405.51) = 1.03$, $p > .1$, at T2 they did interact $F(16.04, 535.34) = 3.15$, $p = .024$ and at T3 there was also an interaction $F(21.84, 416.93) = 5.45$, $p = .002$. Six t-tests compared self-reported emotion at T2 for each item. The happiness t-test was significant $t(105) = 2.00$, $p = .048$ and the disgust t-test was marginally significant $t(105) = 1.91$, $p = .059$. Emotion at T2 is shown in Figure 7.

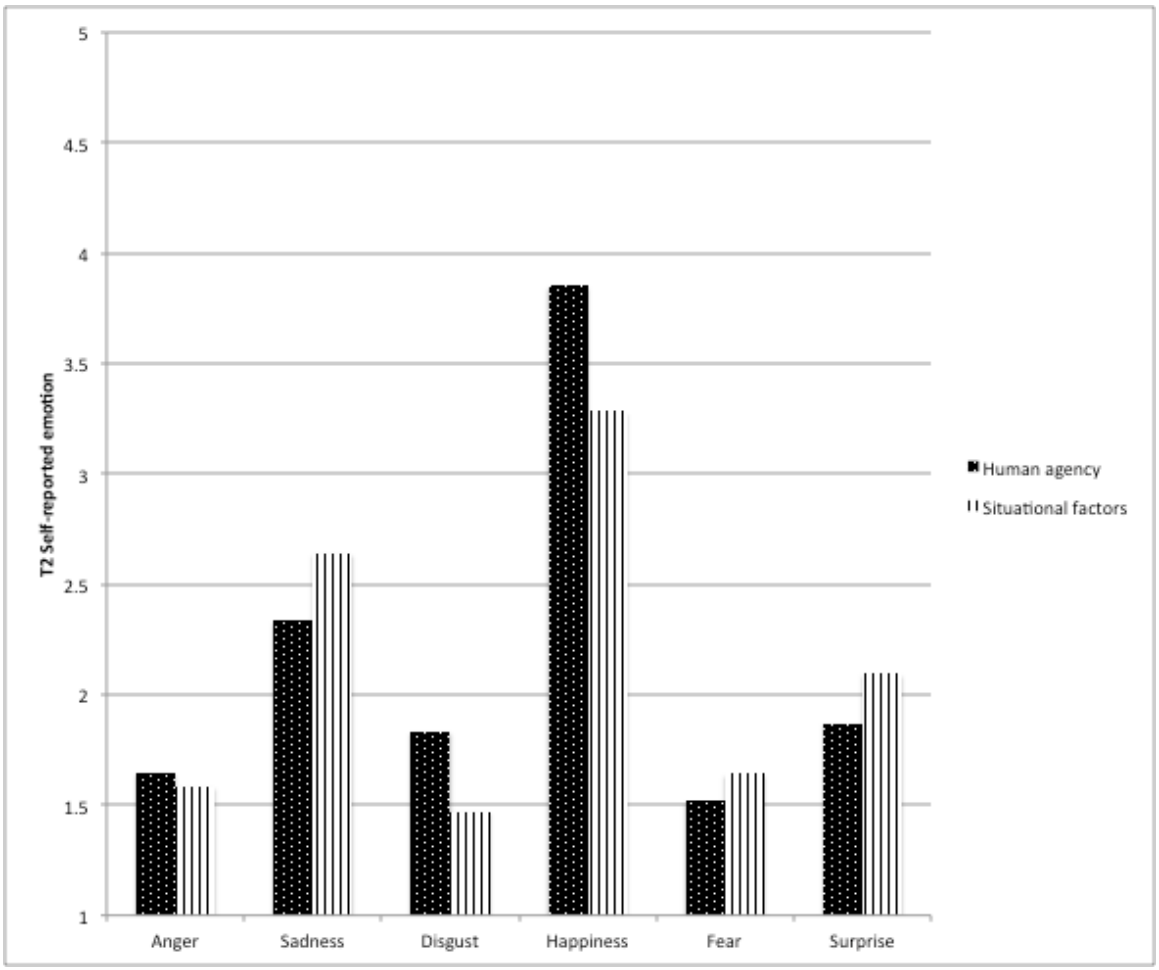


*Figure 7.* Self-reported emotion by condition at T2 (immediately following the scenarios priming task) in Study 6

The other important manipulation check was on participants' interpretation of the scenarios. After reading each one, participants assigned a value to how blameworthy the deceased themselves were. The assumption behind this manipulation check was that the more culpable participants believed other people were for the fatalities, the less blame they would attach to the victims. Consequently it was anticipated that in the situational factors condition participants would hold the deceased to be significantly more responsible for their own deaths. This was tested by averaging the 24 deceased fault ratings delivered by each participant across hazards, leaving only one fault rating per participant. An

independent samples t-test with condition as the factor confirmed that fault ratings in the human agency condition were significantly lower than in the situational factors condition $t(108) = -4.31$, $p < .001$.

Risk perception was analysed as in Study 5. New Zealand and world risk estimates were highly correlated, and the correlation was significant $rs(111) = .76$, $p < .001$. Log-transformed estimates were averaged across the 24 hazards, leaving one data point per version of the frequency estimation questionnaire, per participant. Order differences were investigated with a t-test, which proved non-significant $t(109) = -.60$, $p > .1$. Estimates were also collapsed across context and order.

The main hypothesis that priming would affect risk perception was tested by submitting risk estimates to a one-way ANCOVA with the condition as the factor and T2 self-reported emotion as a covariate (to control for undesired changes in mood caused by the priming manipulation). It proved non-significant $F(1, 107) = .79$, $p > .1$. Means are shown in Figure 8.

As a test of the relationship between attribution and risk perception, independent of experimental condition, two measures were correlated. The correlation was not significant, however, $r(110) = .059$, $p > .1$.

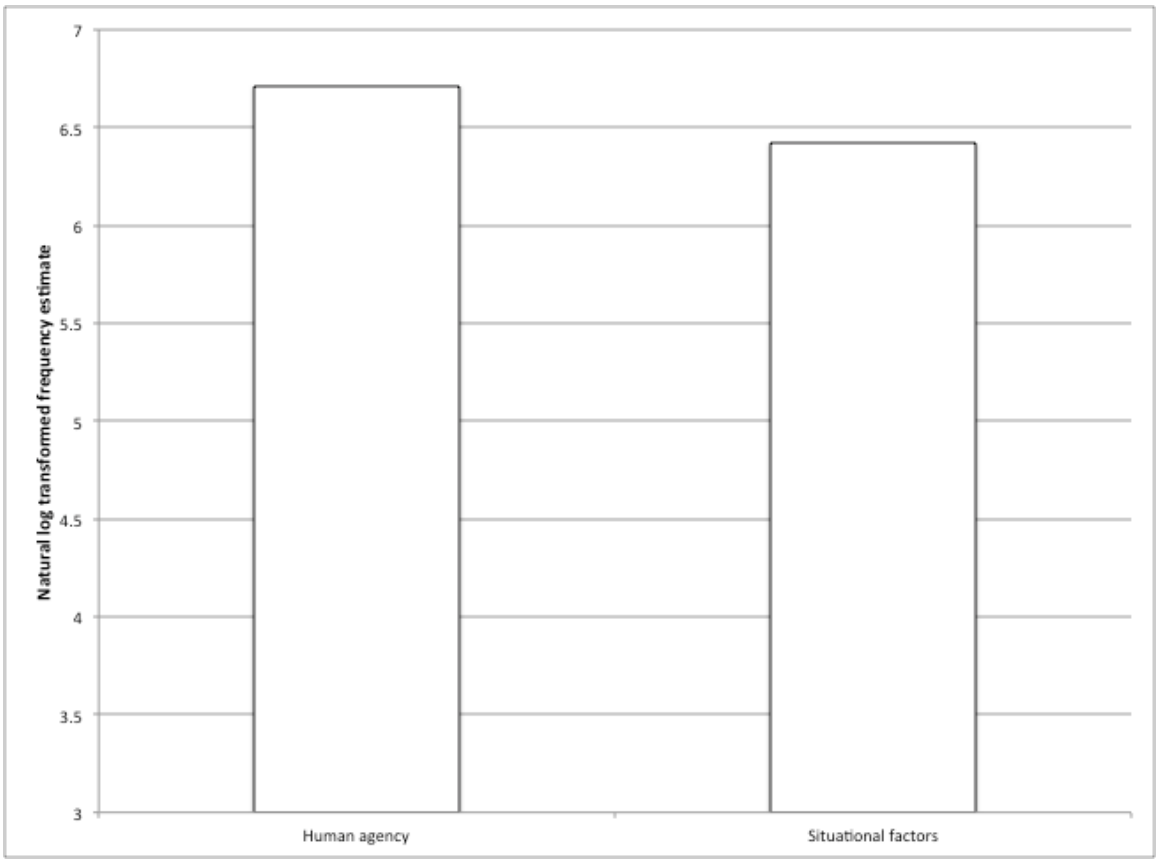


*Figure 8.* Mean log-transformed frequency estimates by condition in Study 6

**Discussion**

Differences in self-reported emotion at T2 were noted – these were an unintended byproduct of the priming manipulation. However, T2 emotion was controlled for when the main hypothesis was tested, justifying the claim that the reported null effect was not caused by the confounding of priming and affect.

In spite of the changes made to Keltner et al's (1993) rather more subtle procedure, there was no effect of attribution priming on risk perception. Although the manipulation check confirmed differences in attributions about the scenarios, there is no way to be certain that the same attributional tendencies generalised to the target hazards. However, it

is hard to conceive of a more explicit and unambiguous procedure for causing that link to be made. Of course, the argument can be made that the explicitness of the procedure was what prevented it from working (due to participants' awareness of the source of the association and resultant effortful correction), but Keltner et al's procedure gave participants little chance to decipher the hypothesis, and also failed to obtain any effect of priming.

Furthermore, correlating responsibility ratings with risk estimates revealed no relationship, though there are some notable limitations with this analysis. In practice, three attributions were possible about each scenario event: the victim caused their own suffering; someone else caused the victim's suffering; or nobody caused the victim's suffering (i.e., it was situationally caused). Thus, the proxy for the agency manipulation, the victim's responsibility for an event, does not distinguish between other agency and situational causes. Another possibility is that a true negative correlation between responsibility and risk estimates was masked by a positive correlation between victim blaming and general risk perception, perhaps because those who have had direct or indirect contact with people who have suffered misfortunes develop a rehearsed tendency to blame them for it. This would be consistent with Gracia & Tomás's (2014) finding that those exposed to intimate partner violence against women are more likely to deem women partially responsible for it. The lack of specificity offered by the manipulation check represents an area where the present study could be improved.

Another interesting nuance unaddressed by this study is whether agency perceptions interact with emotion. Even if there is no effect of agency when affect is neutral, anger might facilitate agency perception, or vice versa. Whether or not such an interaction occurs hinges on the reason why Study 5's anger induction produced the effect it did. If the state of being angry simply causes people to perceive that the world is a more dangerous place due to the cognitive appraisals accompanying anger, there is no particular reason to

expect an interaction with agency perception. On the other hand, if the emotion-as-information account holds, an interaction is to be expected; adverse events caused by other people are (presumably) more angering than the average adverse event. A similar mechanism would be that anger arousal causes people to selectively attend to those aspects of hazards that are most angering (e.g. human agency) and then uses those to reinforce the rationale behind their affect, propagating and amplifying anger effects.

To explore these possibilities, I replicated Study 6 in the context of an anger manipulation. If anger facilitates the perception of agency (and in turn, risk), then risk perception should be highest in the anger-agency condition than in any other cells.

## Study 7

### Method

#### Participants

A total of 128 participants took part in exchange for partial course credit, of which 85 were female. They were sourced from the Psychology Department participant pool, and were thus all 100- and 200-level psychology undergraduate students. Ages ranged from 18-30, and the mean age was 22.0 years.

#### Materials

The study was conducted in individual experimental booths equipped with a writing desk and a computer workstation. Materials included a demographics questionnaire, the self-report emotion questionnaire, a modified version of the scenarios task in which participants were asked to attribute responsibility to 'The deceased', 'Other person(s)/organization(s)'

and 'Bad luck/the circumstances' using percentages (instead of rating the deceased's responsibility on a Likert scale; see Appendix F) and both versions of the risk frequency estimation questionnaire. The modified version of the scenarios task gave every causal factor equal exposure, was less subject to experimenter demand, and did not assume that lower other person causality ratings necessarily imply higher bad luck causality (or vice versa). Mood was manipulated via the anger and neutral versions of the Velten MIP, described in Study 5.

**Procedure**

After giving informed consent, participants were given the demographics form and the first self-report emotion questionnaire, followed by the Velten MIP, a second emotion questionnaire, the scenarios task, a third emotion questionnaire, the New Zealand and World versions of the hazard estimations (counterbalanced), and, finally, a fourth emotion questionnaire. All participants were then thanked and debriefed.

## Results

State mood ratings were analysed in a priming condition (human agency, situational factors) x mood condition (anger, neutral) x time (T1, T2, T3, T4) x self-reported emotion (anger, sadness disgust, happiness, fear surprise) ANOVA, with the last two treated as within-subjects factors. There were main effects of time $F(2.36, 1079.78) = 15.00$, $p < .001$, mood $F(2.91, 1079.78) = 56.98$, $p < .001$ and self-reported emotion $F(1, 118) = 5.8$, $p = .018$, 2-way interactions between self-reported emotion and time $F(2.36, 1079.78) = 6.16$, $p = .001$ and between self-reported emotion and mood $F(2.91, 1079.89) = 5.528$, $p = .001$ and a 3-way interaction between self-reported emotion, time and mood $F(9.15, 1079.78) = 4.97$, $p < .001$.

Mood was further investigated by submitting scores at T2 and T3 to separate t-tests (with emotion as the factor) for each item. The T2 t-tests for anger $t(110.58) = 4.67$, $p < .001$, sadness $t(95.21) = 6.39$, $p < .001$ and disgust $t(83.07) = 4.62$, $p < .001$ were significant, and the fear $t(104.47) = 1.92$, $p = .058$ and surprise $t(122) = -1.97$, $p =. 051$ t-tests were marginally significant. The T3 t-tests for anger $t(118.16) = 2.71$, $p = .008$, sadness $t(125) = 2.33$, $p = .022$ and disgust $t(114.60) = 2.32$, $p = .022$ were also significant. Self-reported emotion scores at T2 and T3 are shown in Figures 9 and 10 respectively.

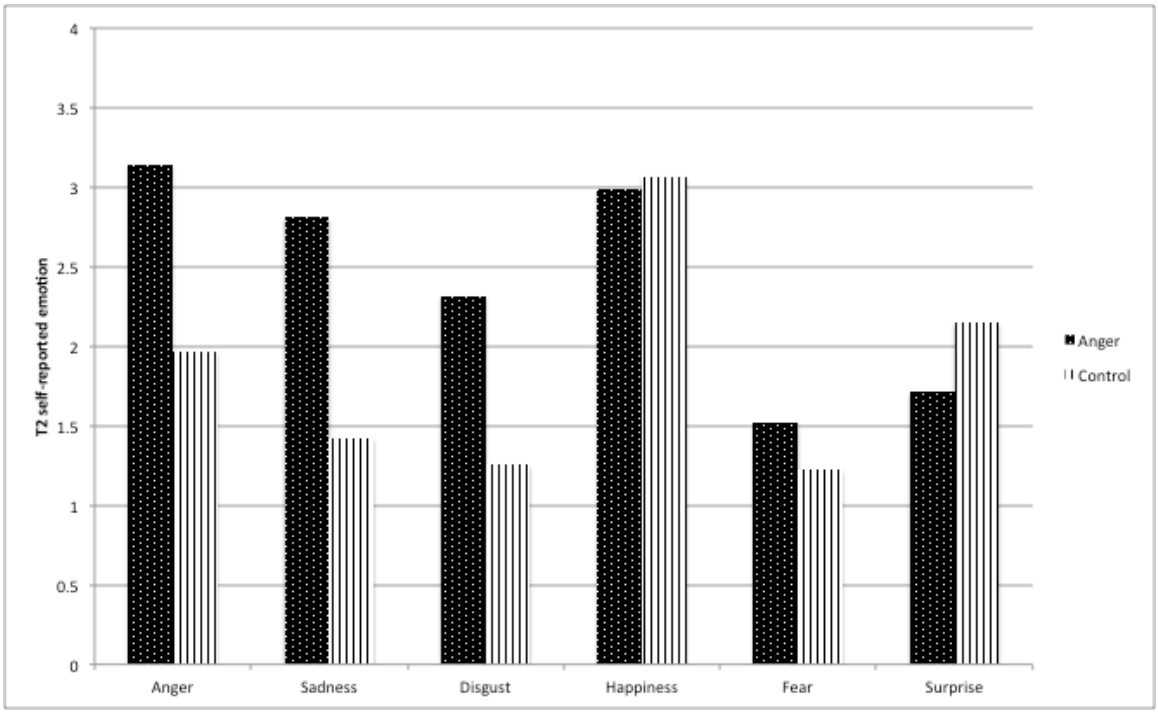


*Figure 9.* Self-reported emotion by condition at T2 (immediately following the MIP) in Study 7

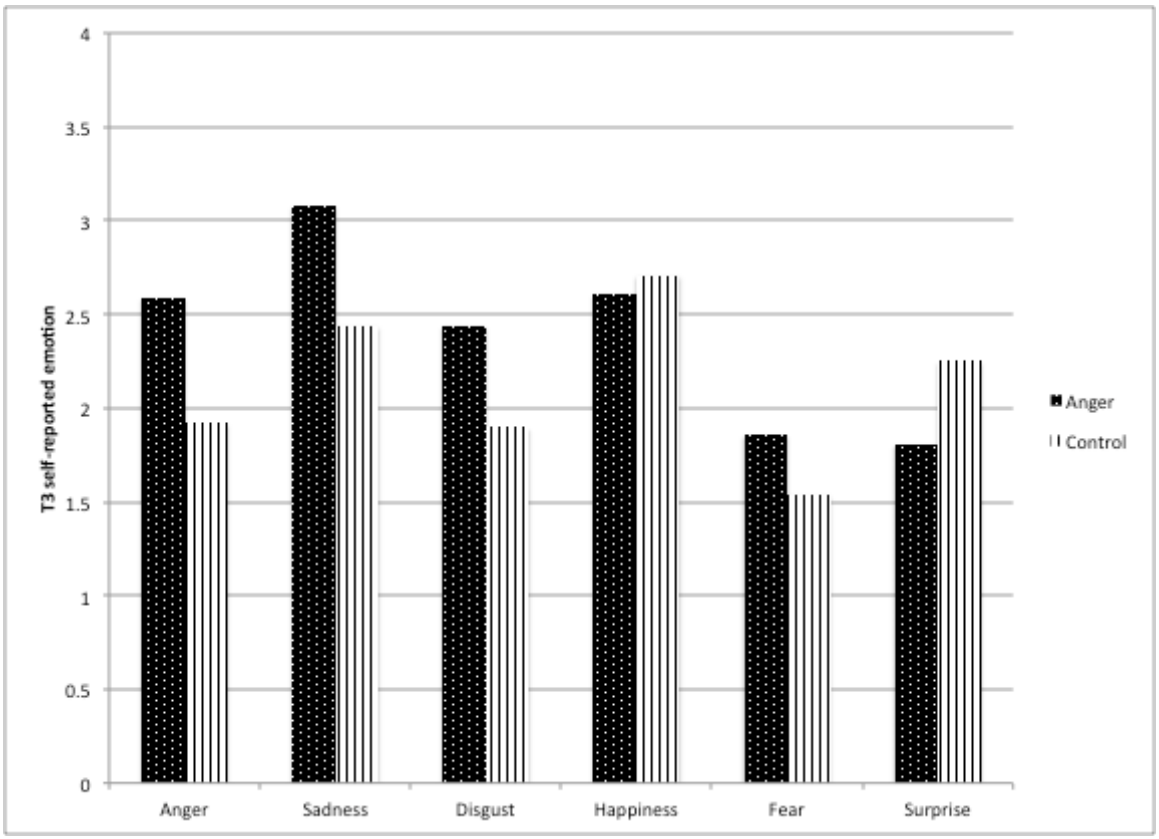


*Figure 10.* Self-reported emotion by condition at T3 (immediately following scenarios priming task) in Study 7

Responsibility ratings, aggregated across all 24 hazards, were analysed in an attribution (others/circumstances) x priming condition ANOVA. A significant interaction emerged $F(1, 126) = 191.268, p < .001$ in the expected configuration, confirming that the content of the scenarios had been construed as hoped.

New Zealand and world risk estimates were found to be highly correlated $rs(128) = .78$, so data were collapsed across geographical context. Risk estimates were then subjected to natural logarithmic transformation and submitted to a two-way ANOVA with priming and emotion as factors; there were no significant effects. Means are shown in Figure 11.

Correlations were also run between risk estimates and attributions of responsibility to the deceased, others and bad luck. There was no correlation between risk estimates and

deceased responsibility *rs(128) = -.072*, *p > .1* but there was a significant positive correlation with other responsibility *rs(128) = .17, p = .049* and a significant negative correlation with bad luck attributions *rs(128) = -.18, p = .045*.

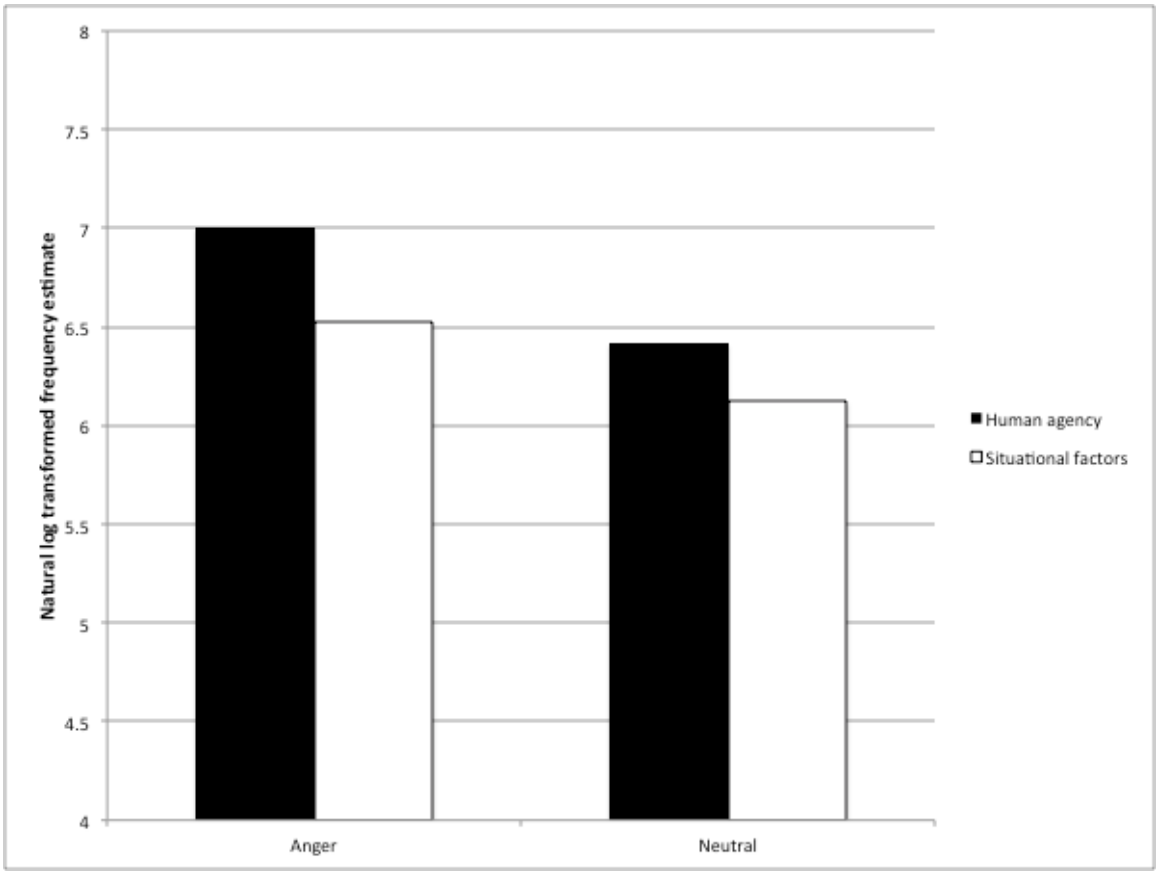


*Figure 11.* Mean log-transformed frequency estimates by condition in Study 7

**Discussion**

There are several observations to be made from this study. Most crucially, there was no interaction between agency priming and emotion induction, thus providing no support for the hypothesis that anger might facilitate the perception of agency. As in Study 6, there was also no main effect of priming on risk perception, providing stronger evidence against the hypothesised role of agency as an account of malicious hazards' overestimation.

Although the priming manipulation had no effect, there was a significant (albeit weak) correlation between risk perception and attribution to other agents and to situational factors. This could be interpreted as evidence that propensity to attribute events to human factors and propensity to perceive high risk are related, or that they covary, independent of the effects of the priming manipulation. At the very least the results represent an endorsement of the more precise means of measuring attributions employed in this study compared with Study 6.

Aside from the lack of an effect of priming, the null effect of emotion on risk perception raises questions about the conclusions of Study 5. However, there are also methodological reasons to question the comparability of the two studies. Jeon, Yim & Walker (2011), in another study entailing a mood induction, observed that participants' self-reports of anger collected immediately after the MIP were nearly twice as high as self-reports of anger gathered after a 24-minute experimental procedure (involving a relatively neutral driving task). In the present study, the scenario rating task (which, on the evidence of Study 6 is also relatively affectively neutral) lasted approximately 15 minutes on average, giving the anger earlier elicited plenty of time to decay prior to the risk estimation task. Empirically, it is also apparent from the self-reports that anger levels had declined by T3. Although a significant difference in anger remained between the two conditions, the effect size was considerably lower at T3 than T2 ($\eta^2 = .055$ v. $\eta^2 = .152$), and the effect size of anger on risk perception in Study 5 was fairly small already ($\eta^2 = .07$). It is therefore conceivable that the residual anger experienced after the scenarios task was not enough to generate a significant effect of anger on risk perception. Note as well that despite the failure to replicate the finding of Study 5, the trend with respect to emotion was still in the predicted direction.

## Meta-analysis

To better estimate the size of the Velten mood effects, I conducted a meta-analysis of Studies 5 and 7, along with an additional study, run for a different purpose, with similar independent and dependent variables. The additional study involved 32 undergraduate participants from the same population as Studies 5 and 7 (23 female, age range 18-53, mean 21.97). Like those studies, the new study included angry and neutral conditions, after which participants answered the hazard frequency questionnaire, with no geographical locality specified. The only difference was that normative data for one hazard (driving) was provided as a reference point (as in Johnson & Tversky, 1983).

### Statistical methods

Effect sizes were calculated for each included study (in the case of Study 7 two effect sizes were calculated, one for participants in the human agency condition and another for participants in the situational factors condition). All studies used the same dependent measure, which collected continuous data, hence Cohen's *d* was computed by subtracting the neutral condition means from the anger condition means and then dividing the resulting value by the pooled standard deviation. This was done for each experiment, meaning a total of four *d* statistics were calculated. To reflect that the studies were not comprised of identically sized samples and their data possessed differential variability, weights were applied to the effect sizes. Upper and lower 95% confidence intervals were computed for each effect, and from these an effect size for the meta-analysis was calculated. The meta-analysis was run using fixed and random effects models, but because heterogeneity was relatively low the outcome was the same regardless.

**Results and discussion**

Data important to the way the meta-analysis results were computed are displayed in Table 9. Difference in means refers to the outcome of subtracting the mean of the neutral group from that of the anger group, the pooled *SD* refers to the standard deviation after data were collapsed across the two conditions and the confidence intervals by study show (unsurprisingly) that the only study whose data permit the inference that anger augmented risk perception with 95% confidence was Study 7, where frequency estimation immediately followed mood induction. The weighted effect size was *d = .32*.

Table 9

*Data Used to Compute Meta-analysis Confidence Intervals*

| Study | N | Difference in means | Pooled SD | Weighting | Unweighted effect size (d) | 95% Confidence Intervals | p-value |
|---|---|---|---|---|---|---|---|
| Study 5 | 63 | 1.16 | 2.15 | 32.9% | 0.54 | 0.08, 2.24 | 0.036 |
| Study 7 (human agency) | 64 | 0.40 | 2.42 | 26.4% | 0.17 | -0.81, 1.61 | 0.51 |
| Study 7 (situational factors) | 64 | 0.59 | 2.37 | 27.5% | 0.25 | -0.60, 1.77 | 0.36 |
| Unreported Study | 32 | 0.56 | 2.43 | 13.0% | 0.23 | -1.20, 2.31 | 0.52 |

Figure 12 is a forest plot where the four effects are represented individually by the horizontal lines and collectively by the horizontally orientated diamond. The extremes of the lines represent the lower and upper limits of the 95% confidence interval, and the square in the middle of it depicts the difference in means. The size of the square is

determined by the weightings of the studies, the most influential study (Study 5) being given the largest square. The *x*-axis is labelled 'LNMicromorts' which means the mean natural log of the number of micromorts per million. The diamond represents the estimated effect size, and the horizontal ends of the diamond represent the lower and upper limits of the CI. The mean weighted difference in means was 0.72 (which is also the thickest part of the diamond). The confidence intervals generated by the meta-analysis were 0.12 (lower limit) and 1.33 (upper limit). The meta-analysis also returned a *z*-value of 2.33, and a *p*-value of 0.020. It therefore supported the hypothesis that anger increases risk perception relative to neutral. The weighted effect size was 0.32 which, according to Cohen's (1988) guidelines, is a small effect. However, effect size magnitudes are only sensibly seen in the context of similar research. The two studies that elucidated the theory behind affect as a factor in risk perception also found small effect sizes. DeSteno et al's (2000) interaction between induced mood (anger, sadness) and affective disposition of hazard (angering, saddening) had an effect size of $d = 0.23$. Fischhoff et al's (2003) effect of fear over anger on risk perception was also $d = 0.23$. In this context, the effect size observed across my affective experiments is in line with expectations in this field of research.

It should be noted that effect sizes differed considerably between the four samples. This is because the studies are not interchangeable, being run in accordance with different procedures. Specifically Studies 7 and 9 entailed an appreciable time delay between the end of the MIP and the administration of the frequency estimation questionnaire. This may explain why their effect sizes are lower. It cannot defensibly be claimed, on the basis of this meta-analysis, that an anger effect is observable even with a delay between induction and risk perception measurement because the meta-analysis's overall finding that an effect of anger exists is carried largely by Study 5 (which entailed no such delay). However, the findings argue against the notion that Study 5's results were a type 1 error as, after the

inclusion of the other samples the confidence interval becomes *more* indicative of a genuine effect of anger on risk perception. In summary, this meta-analysis allows confidence in asserting that anger increases risk perception, at least when the former is manipulated and the latter is measured in accordance with the procedure of Study 5.

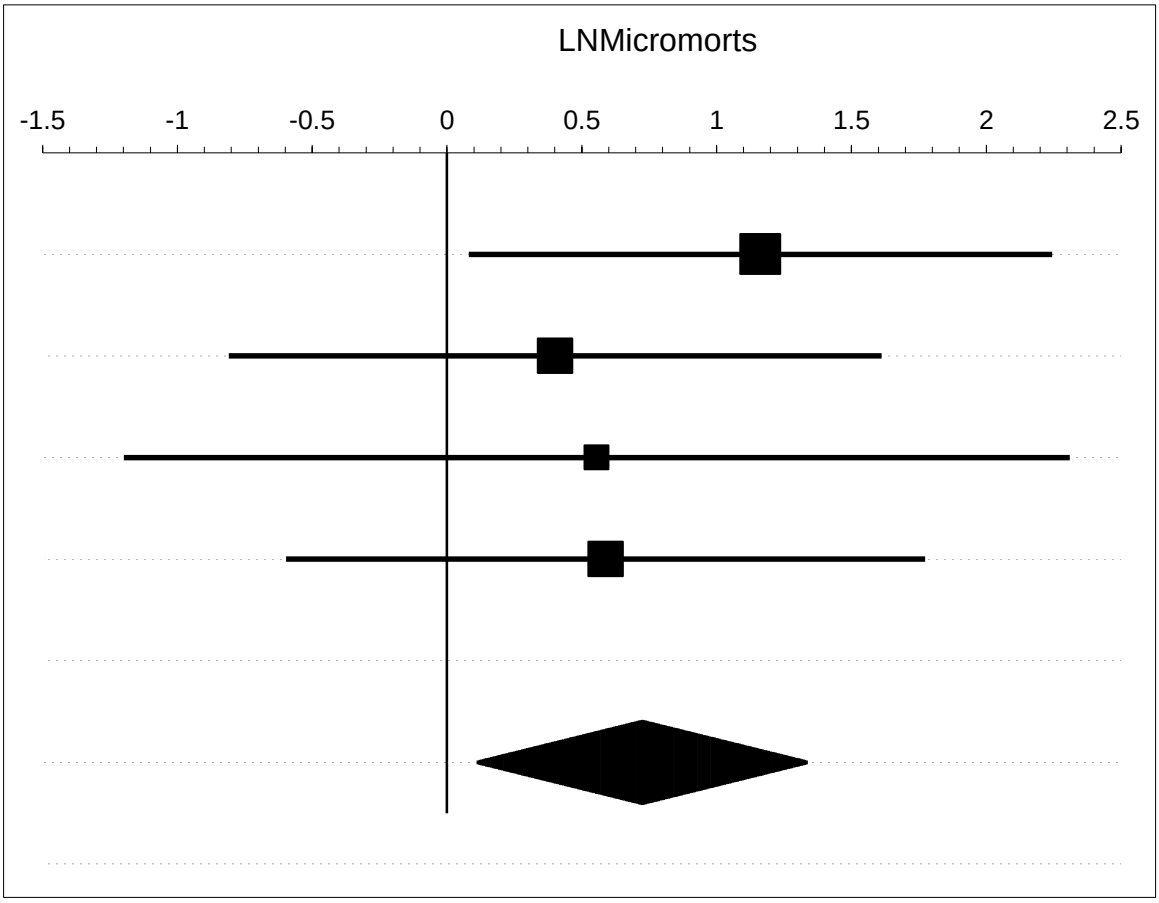


*Figure 12.* Forest plot showing confidence intervals in meta-analysis of four pairs of participant samples who had either been induced with angry or neutral mood

# Chapter 6 – General discussion

Many western societies appear to have a fixation with certain types of hazard – particularly those involving violent acts. These hazards are characterised by the disproportionate amount of money governments are prepared to spend to prevent deaths caused by them, the amount of legislation passed purporting to combat them (and in particular the tendency of that legislation to remove rights previously enjoyed by citizens so as to better protect them from malicious hazards) and the apparently high levels of popular support such spending and legislation can lay claim to (e.g. Gallup 2002a; Gallup 2002c). Ironically, these same hazards do not constitute particularly serious threats when account is taken of the relatively small number of people that are normatively subject to them. Not only that, but there are also considerable losses incurred by attending particularly keenly to these hazards. The concession of civil liberties could be considered a loss *a priori*, but it also leads to other undesirable consequences such as stoking resentment in sectors of the population disproportionately affected by having their (formerly enjoyed) rights infringed and fomenting societal divisions and the social problems associated with them. It is also linked with the expenditure of public finances to combat malicious hazards, which manifests itself in other ways as well (such as the establishment of new government departments whose purpose it is to stave off malicious threats). The loss incurred by this expenditure is that it diverts public funds from other areas where they might otherwise be put to better use. The purpose of this thesis was to explore the nature of these hazards and to test possible mechanisms accounting for the disproportionate attention they receive.

As a first step, in Chapter 2, I generated a reasonably exhaustive list of hazards based on those commonly listed by participants as potential causes of death. By sourcing

my stimulus list from the population from which future experimental samples would be drawn, I optimised the likelihood the hazards were both understood by, and relevant to, future participants. From participants' free responses, I derived 33 hazard types, which were further subjected to several dimension reduction techniques. Multidimensional scaling suggested that participants thought of hazards along three dimensions, and that the two most important ones were described by familiarity and moral significance; the hazards of particular interest – terrorism, violent crime, and war – clustered together in a space representative of high moral significance and low controllability.

To gather convergent evidence for this interpretation, I subjected the 33 types of hazards to a cluster analysis based on ratings of independent participants on a range of hazard characteristics. The cluster analysis sorted the hazards into two overarching clusters, one made up of hazards high in moral significance and the other made up of hazards low in moral significance, and then refined those two overarching clusters into two sub-clusters each, defined by their controllability. The results validated my inferences about the meanings of the dimensions of the MDS and supported the existence of four distinct clusters of hazards, each characterised by different permutations of controllability and moral significance. I termed the cluster of hazards characterised by high moral significance and low controllability – which include the very hazards individuals and governments appear to fear so distinctively – 'malicious hazards'. This category of hazards has tended not to figure in previous research on risk perception. Johnson & Tversky (1983) did include all three of the hazards that comprise my malicious hazards category, *and* identified them as members of a distinct cluster, but they did so for the purpose of designing informationally similar/dissimilar MIPs, and did not theorise specifically about differential effects of affect on them. The finding reported in this thesis, that malicious hazards are seen as both morally

significant and uncontrollable (by contrast with other hazards) has also not been uncovered previously.

Having made the case that malicious hazards make up an identifiable category of hazards I considered, in Chapter 3, what aspects of malicious hazards might explain the amount of legislative time and public finances they attract. I considered two mechanisms through which these factors could exert their effect on public interest in malicious hazards. One of those was that attempts to tackle malicious hazards are motivated by non-consequentialist morality – specifically that some people are inclined towards the belief that where an individual or organization intentionally inflicts harm against people a moral duty exists to secure retribution against them. I acknowledged the likely importance of symbolic moral imperatives in predicting support for the manner of policies and public spending adumbrated in the introduction, but expressed the concern that research linking authoritarian and dogmatic personality types and social values to support for counterproductive policies and spending would be largely descriptive in nature because personality and social values are constructs which are notably stable traits. It was noted, on the other hand, that risk perception is more malleable and furthermore that its influence on support for policies related to malicious hazards is sufficiently important as to justify research into what factors influence it.

I then considered two factors that malicious hazards appear to share, which could account for inflated estimates of the likelihood: the degree of anger malicious hazards tend to arouse; and the cognitive understanding that a malicious human agent is responsible for exposure to the hazard.

On this subject, I brought up Fischhoff et al's (1978) pioneering Psychometric Paradigm which sought to explain risk perception in terms of attributes people generally attach to hazards. Much as I did in Study 3, they suggested a (different but overlapping)

range of attributes that hazards might have to participants, and found that those loaded on to two factors: severity of exposure and familiarity. They further suggested that hazards that were high on the former and low on the latter were particularly likely to inspire high risk perception, and later Slovic (2004) attempted to explain the phenomenon of overly pessimistic risk perception of terrorism by claiming that terrorism was both highly unfamiliar and very severe in the event of exposure. I did not find that explanation wholly convincing since people are not particularly unfamiliar with terrorism – it has occurred often throughout history and is a frequent and high-profile subject of news bulletins. I acknowledged the contribution the Psychometric Paradigm has made to risk perception research, but criticised its relative neglect of affect as a factor in risk perception. It is also worth drawing attention to the fact that the outcome of my hazard pairing similarity and dimension evaluation tasks was that participants differentiated hazards along a different dimension to Fischhoff et al's (moral significance replaced familiarity), and that this was most likely symptomatic of my use of different hazards to those authors (Fischhoff et al's hazard list was dominated by useful hazards, with a few immoral hazards and no natural or malicious hazards).

A number of researchers have taken an interest in affect as a predictor of risk perception. Johnson & Tversky (1983), for example, found that depressive affect increases risk perception and positive affect decreases it, although it was not clear whether their results generalise to malicious hazards. DeSteno et al. (2000) and Lerner et al. (2003) are particularly relevant, the former proposing that incidental affect influences risk perception to the extent that it is congruent with the type of affect associated with the hazard being judged, and the latter proposing that anger reduces risk perception irrespective of the affective disposition of the hazard. Again, though, the applicability of these analyses to malicious hazards is not clear. Furthermore, Lerner et al's study included no control

condition, so the only hypothesis tested in the form of a true experiment was that angry participants perceive less risk than fearful participants which, given the nature of fear, is scarcely surprising.

I then continued to consider evidence of how cognition, and agency in particular, might affect risk perception, and pointed to the long-established preference observers seem to have for attributing other people's actions dispositionally (Jones & Harris, 1967). I queried whether the principle that there is a preference to explain behaviour dispositionally might be extended to events whose cause is unknown and answered that it can be, citing Morris et al's (1999) finding that an ambiguously caused workplace accident was blamed on human error with greater frequency than it was attributed to environmental factors and McClure et al. (2007), who found that when offered an environmental cause or a human cause to explain an adverse event, participants favoured the human cause as an explanation. I also cited evidence that people are prone towards generalising conditional arguments to biconditional arguments (Johnson-Laird & Byrne, 2002; Wagner-Egger, 2007), and argued that for that reason, as well as deeming ambiguously caused events to be more likely to have been caused by human factors, people might also believe that events caused by human factors are more likely to happen

The remainder of the thesis tested each of these hypotheses in turn. Four studies (including one not reported in detail) tested the effects of anger on risk perception, and although not all simple effects were strong or statistically significant, a meta-analysis indicated that they were real: anger, compared to neutral affect, appears to increase the perceived likelihood of hazards, malicious or not. Because malicious hazards are themselves anger inducing, this finding can partially explain why they are judged as more likely to occur, and ultimately why individuals and institutions are particularly disposed to tackle them.

This finding however, appears to contradict both Lerner's and DeSteno's results, cited above. Both studies, though, differ in important ways from the studies reported here. In Lerner's case: 1) participants were judging future risk, which anger appraisals may have caused them to judge differently to time non-specific risk, 2) the study was conducted shortly after the September 11th attacks on the US, a time that Americans believed called for public displays of unity and fortitude creating a motivation to estimate the risk of terrorism optimistically, and 3) the mood induction was informationally relevant to the risk perception questions, and could have later infused their answers distorting the true effect of anger. In DeSteno's case 1) stimuli involved no fatal hazards, and therefore participants would have had no affective, experiential frame of reference to relate to them; and 2) risk questions were presented as short vignettes, which may have encouraged participants to focus more on the characteristics specific to the hazards they were being asked about. In spite of these disparities between my research and Lerner et al's and DeSteno et al's, I believe my procedure made a better controlled attempt to isolate the effects of anger on perception of deadly hazards because my MIP was distinctly unrelated to risk (hence there was no risk of stimuli from the MIP influencing risk perception via a mechanism other than affect), my dependent measure was relatively affectively neutral and unlike DeSteno et al. and Lerner et al. I included a control condition. My results pointed to a predominant effect of anger augmenting risk perception.

Finally, in Chapter 5 I considered the alternative (not mutually exclusive) possibility that the agentic nature of malicious hazards can account for the biased perception of them. Two studies manipulated agency beliefs directly, by framing the hazards in such a way as to imply that those deaths arose through human agency or situational factors. Neither study, however, showed any evidence of an agency effect, and I concluded that agency beliefs are not a significant factor in the overestimation of malicious hazards.

A possible limitation of the conclusions is that, although the manipulation of agency was based on previous research, and despite participants' manipulation-consistent attributions of the scenarios, it is possible that participants failed to generalise those attributions to the more abstract hazard stimuli.

Keltner et al. (1993) are the only other researchers to have manipulated agency to study likelihood judgements, but there are other manipulations used in different research contexts. Recently, for example, Roberts, Bennett, Elliott & Hayes (2015) taught participants movement sequence patterns, which participants would later have to reproduce and recognise, informing half of their participants that the movement sequence patterns were generated by humans, and the other half that they were computer generated. Participants' reproduction success was roughly equivalent across conditions, but their recognition differed. Participants were shown the patterns they had been taught earlier as well as new ones and they were asked to state the confidence with which they believed the pattern to be 'old'. All participants were more likely to claim confidence in recognising old patterns than new ones, and, as predicted, those informed the original patterns were generated by computers were more confident in their recognition of old patterns than those told they were generated by human agents, suggesting that participants under the apprehension that the patterns they learnt were computer generated engaged in more top down, explicit processing relative to the more implicit sensorimotor processing preferred by participants who learnt purportedly agentically generated patterns (because implicitly encoded memories are less likely to be available for deliberate retrieval; Schott, Richardson-Klavehn, Heinze & Düzel, 2002; Slamecka & Graf, 1978). Conceivably, a similar manipulation could be used to study risk perception, even though it seems, on its face, less easily generalised to hazard judgments than the procedure used here.

Winterich, Han & Lerner (2010) utilised a task similar to the scenarios paradigm I used. They asked participants to memorise vignettes, adapted from Keltner et al. (1993), depicting negative events. For half of the participants, the events were described as though caused by a human agent (e.g. 'You break your leg while skiing when another skier cuts you off') and for the other as though caused by situational factors (e.g. ' While skiing, icy slopes cause you to break your leg'). All participants then viewed an anger-inducing film clip, before reading two vignettes in which the negligent behaviour of an employee resulted in others incurring harm. Participants primed by human agency reported greater anger and recommended more severe punishments against the workers in the vignettes. Unfortunately, it is not clear in this study how agency operated on punishment judgments, and in particular the role of anger. The authors proposed that the impact of the situational factors prime was to 'blunt' the anger elicited by the mood induction – that is, participants in that group were less affected by the MIP and subsequently less punitive in their judgements. An alternative explanation is that the human agency and situational factors primes elicited different amounts of anger themselves, and that the self-reported anger of human agency condition participants after the mood induction was an additive or multiplicative effect of the human agency prime and the anger induction. Indeed, a post-test reported in one of the notes showed that when angry affect was measured immediately after presentation of the priming task it was higher when the human agency version had been presented than when the situational factors version had been.

Finally, Baumeister, Masicampo & DeWall (2009) attempted to manipulate participants' beliefs in free will versus determinism. Although these concepts do not map on precisely to human agency and situational factors respectively (a human agent's deliberate actions could reasonably be interpreted as deterministically motivated), they have a clear relationship with internal and external attributions. Participants were presented with a

series of statements that endorsed free will as a valid explanation for why people act (e.g. 'Avoiding temptation requires that I exert free will'), statements that instead supported determinism (e.g. 'Ultimately we are biological computers – designed by evolution, built through genetics, and programmed by the environment) or neutral statements. Consistent with the authors' expectations that deterministic beliefs would be inconsistent with pro-social behaviour, participants primed with determinism displayed a lower propensity towards helping behaviour than controls and participants primed with free will (who did not significantly differ). There is a problem though, which is that Baumeister et al's participants appeared to internalise the free will and determinism statements from the manipulation and apply them to themselves, altering their behaviour (in the case of the determinism condition) to take account of their primed beliefs, behaving in a less accountable way when primed with determinism. In risk perception research such as mine there is a danger in this context that participants may infer that if they themselves felt less accountable for their actions under determinism then others would as well, and as a consequence they might suppose that if moral accountability is understood to be illusory others would be more likely to commit malicious acts. The belief that actions generally are explained by deterministic influences on actors and that negative events, when they occur, cannot sensibly be attributed to actors at all are not equivalent – the implication of the first belief is that malicious acts are either equally likely or more likely to occur, whereas the implication of the other is the reverse. Similarly, discrepant universal beliefs about accountability were not a hypothesised part of the mechanism I postulated through which agency beliefs might influence risk perception. In other words, by using Baumeister et al's prime there is a likelihood that universal accountability beliefs will be confounded with agency beliefs. However, it may be possible to adapt the manipulation used by Baumeister et al. such that rather than having a free will/deterministic flavour the priming sentences

are replaced with ones that speak to human agency or situational factor beliefs (e.g. 'When things happen, most of the time their cause can be traced back to human actions' or alternatively 'When things happen, most of the time it turns out that factors outside of anyone's control caused them'). As stated earlier, this would also have the benefit of following a similar format to my affect manipulation, so it is a direction worth considering for future research.

The manipulation of mood in the current studies, while more successful in terms of generating interpretable results, also warrants discussion. Velten (1968) reported that his mood manipulation, used in the current studies, appeared to induce affect even after accounting for demand characteristics, Larsen & Sinnett's (1991) meta-analysis of this procedure also showed that although there was a larger effect size when self-report measures were used and where no deception was employed to conceal the intent of the MIP, the Velten manipulation was still effective and valid when these conditions were altered. Notwithstanding this evidence, the Velten procedure is still vulnerable to criticism. It is possible, for example, that participants were able to distinguish the nuances of anger and sadness and infer that whilst the former was the sort of emotion that ought to increase risk perception the latter was not. Relatedly, although Larsen & Sinnett (1991) showed that even without the potential for demand characteristics the Velten MIP was effective, it was nonetheless less effective, and perhaps differential effectiveness of the manipulation, rather than differential effects of emotion, could account for differences between anger and sadness in the current studies.

Both of these criticisms could, in future research, be answered either by employing behavioural or physiological measures of affective arousal or by using a cover story to dissociate the mood induction phase from the risk perception measure. Unfortunately, to my knowledge, no valid behavioural anger measurements exist. Measures of aggression are

available, such as the 'hot sauce' paradigm (Lieberman, Solomon, Greenberg & McGregor, 1999) in which participants administer a potent hot sauce to a (fictional) co-participant, or the 'point subtraction' paradigm (Cherek, 1981) in which participants press a button to deduct earnings from a (fictional) participant in another room. However, measures such as these would run the risk of interfering with the anger manipulation due to their complexity and duration.

Alternatively, more potent deception might be used to safeguard against demand characteristics. For example, Sinclair, Mark, Enzle, Borkovec & Cumbleton (1994) gave participants the impression that they would be taking part in two different studies run by two separate researchers. The first study was due to involve a task requiring participants to allocate reward payments to two different workers (this was the authors' implicit measure of elation/depression) as well as an explicit emotion self-report questionnaire, and the second study was supposed to assess the effectiveness of the Velten MIP. However, the researcher running the first study would always claim, just before it was about to start, that they needed to make an urgent phone call, asking the researcher responsible for the second study to run theirs first. Sinclair et al. found that despite (presumably) believing that the two phases of the procedure were theoretically distinct, the mood induction still worked. It is easy to see how their procedure could be adapted to risk perception research, although it is not certain that a modified version of the anger procedure would be equally capable of eliciting anger in the absence of demand characteristics.

A third limitation concerns the primary dependent measure, which is of questionable sensitivity. Although frequency judgments varied with emotional state, they did not vary by hazard type, time of measurement, or context (global versus New Zealand). For example, given our understanding of anger as a galvanising, empowering emotion, it is surprising that anger was just as likely to increase personal risk (i.e., in New Zealand) as to

increase general risk. Several aspects of the measure are suspect. For example, when contrasted with other risk perception measures its items are more brief, more densely packed, more affectively detached, and more numerous. Taken together, this could conceivably cause participants to expend less cognitive effort adjusting to the nuances of the different hazards. One possible solution would be to utilise a much shorter list of hazards (no more than seven or eight, as in DeSteno et al, 2000) described in somewhat more detail. For example instead of merely listing 'Earthquakes', items might read 'Every year a certain number of people die because of earthquakes (due to the shock of the earthquake or because of falling debris or entrapment in collapsed buildings). This ought to focus participants' attention more closely on the content of the question.

Returning to the issues at the outset of this thesis, the reader may question what implications, if any, the current results have for bringing the 'solutions' for malicious hazards back into line with their true risk. Establishing that anger augments risk perception of malicious hazards does not necessarily warrant that it has any effect on attitudes or behaviour. Evidence from Dowler (2003), Pfeiffer et al. (2005) and Roberts & Indermaur (2007) suggests that greater risk perception of crime predicts policy attitudes, but such data cannot establish a causal effect. Causal effect could be established by administering a crime attitudes scale immediately following the risk perception task – this would offer the advantage of allowing researchers to test for a mediating effect of risk perception and anger on attitudes. As far as the scale is concerned, scales from the studies cited above could be used, but ideally a scale would not only address punitive attitudes but also support for civil liberties and allocation of public money to mitigating crime (and other hazards).

Another means of improving on my findings would be by using a behavioural measure to validate them. However, it must be stressed that it is difficult to predict exactly what sort of behaviour to expect from someone whose risk perception is augmented due to

state anger. This is because the appraisals associated with anger tend to invoke personal invulnerability. As a consequence, behavioural measures that gauge protective behaviours (such as giving participants the chance to choose whether or not to leave their personal belongings in an unlocked room) might not be sensitive to changes in risk perception. Alternatively, there are measures of aggression against other participants (real or fictional) believed to have transgressed in some way. There is an important disadvantage to this type of task though, which is that it is already understood that anger causes people to adopt more punitive attitudes (Ask & Pina, 2011; Gault & Sabini, 2000; Lerner et al, 1998) and it cannot be assumed that anger exerts its effect on punitiveness through risk perception. In order to fully test this, it would be necessary to develop a means of inducing anger for a sufficiently long period to administer the behavioural measure and the risk perception measure.

I argued, in the introduction, that overreaction to malicious hazards is societally costly. My research, as described in this thesis, makes the case that they are overestimated relative to other hazards, that they are angering, and that anger leads to increased risk perception (and therefore greater overestimation). Greater overestimation, in turn, is hypothesised to predict public support for expensive risk mitigation strategies.

I mentioned at the start of Chapter 3 that an alternative explanation, not empirically addressed by this thesis, is that the typical human reaction to the threat of malicious hazards is driven by moral accountability rather than risk perception – in other words, that reducing the potential for malicious hazard events to occur and ensuring that retribution is meted out against those who cause such events is a form of altruistic punishment (see De Quervain et al, 2004; Fehr & Gächter, 2002; Marlowe et al, 2008). This has been elucidated most vividly in the past by researchers' use of the Ultimatum Game (UG). In the UG, participants are assigned an arbitrary amount of some currency or other, and they are then

invited to offer a proportion of that endowment to a second participant. Both players are aware of the rules, which state that the offeror is only allowed to keep his or her assignment if the other participant accepts whatever offer they decide to make (if the offer is rejected both players leave with nothing). This paradigm, therefore, allows researchers to gauge the minimum amount the offeror must offer in order to secure the offeree's acceptance. Although multiple factors influence this threshold, it is generally found that offers below 20% of the total amount are likely to be rejected (Camerer & Thaler, 1995; Roth, 1995) – even though on the face of it, by rejecting the offer, the offeree leaves themselves worse off. Thus it is shown that people are willing to incur costs to punish what they see as deviant, or unfair, behaviour.

It must be recognized that in a democracy, should people knowingly and willingly assign a higher dollar value to lives lost to malicious activity than lives lost in other ways, societies have every right to react more stridently against malicious hazards than other hazards. However, this is not a question that is usually posed in the public forum of political discourse, and as such there is no way of knowing whether people make the connection between high expenditure on malicious hazard prevention and lower relative expenditure on other, potentially more dangerous hazards. Furthermore, given the distinctly moral justification behind incurring costs in order to exact altruistic punishment against rule-breakers, there must surely also be a moral case against incurring those costs, as to do so presumably means expending less in order to prevent potentially more deaths from another cause. Indeed, the argument could be made that failing to act in a way that is likely to minimise human suffering overall will inevitably result in avoidable, and thus unfair, deaths.

Finally, it is shown in this research that anger, the typical affective reaction to malicious hazards, does augment risk perception. That appears to suggest that whatever decisions voting publics make about risk mitigation, those decisions are probably not fully

and accurately informed. Research cited earlier in this thesis (Dowler, 2003; Pfeiffer et al, 2005; Roberts & Indermaur ,2007) showed that beliefs about crime do in fact influence support for policies designed to mitigate against it. From this perspective, if it is accepted that by reducing risk perception, attitudes that perpetuate overreaction to the threat of malicious hazards can also be reduced, the next step is to ask how my findings can be applied in practice to bring about that change.

One way is in the communication of risk information. Risk information is communicated by politicians, governmental departments and agencies, news outlets and companies with an interest in security. To communicate information related to malicious hazards responsibly, disseminating parties need to convey it in a way that is less likely to elicit anger. Although my thesis does not address how that might be done, previous literature offers some insight. One can, for example, compare countries such as the UK and the US, where penal policy is heavily influenced by public opinion (Lappi-Seppälä, 2007; Robers & De Keijser, 2014; Roberts, Stalans, Indermaur & Hough, 2002), with countries where the judicial system is relatively insulated from political influence like the Nordic countries (Green, 2012; Lappi-Seppälä, 2007; Pratt, 2008). Where policy and sentencing decisions are more influenced by popular sentiment, regimes tend to be harsher but no more effective at reducing crime levels (Green, 2014). At the same time, there appears to be an association between heavy popular influence and communication of risk information in a certain way. Although a similar amount of news coverage is devoted to crime in the UK and Finland, for example, the way the news is related differs dramatically (Curran, Salovaara-Moring, Coen & Iyengar, 2010). In the UK, crime reporting focuses on culprits, crime victims and sensationalised violence whereas in Finland it takes on a more criminological tone, addressing the causes and societal implications of crime. The former method of communicating crime news entails much more angering stimuli. Indeed it is substantively

comparable to the video anger manipulation introduced by Gross & Levenson (1995) in which a bully brutalises an innocent victim, and the crime story used by Johnson & Tversky (1983). Note, as well, the proclivity of British newspapers to report the punitive reactions of crime victims (e.g. Clench & West, 2008; Warren & Bates, 2012). Such reports may have the effect of normalising anger as a response to the threat of criminal behaviour. They stand in stark contrast to the almost phlegmatic reactions of survivors, and victims' relatives, of Anders Breivik's atrocity in Norway (Lewis, 2012; Lewis & Lyall, 2012). Where people are encouraged to view crime through an angering prism, that anger appears to catalyse political activity and incentivise politicians to prosecute ill-advised policy.

As elected representatives, however, it is not necessarily the sole purpose of politicians to echo the populist sentiments of their electors – rather they may use their positions of influence to advocate for policies that serve the broader, overarching goals of society (i.e. spending public money wisely and enacting policies that are shown to reduce harm). In countries with more punitive cultures though, they often foment and promote anger as a reaction to crime. A prime example would be former Home Secretary Michael Howard's claims that 'the silent majority has become the angry majority' and that 'prison works' (Brown, 1993) or Bill Clinton's statement ,'no wonder Americans are fed up with a system that lets too many career criminals get out of jail free' (Richter, 1995). In Norway, by contrast, law and order is not contested as a general election issue and politicians seldom make statements related to criminal justice policy (Green, 2007). De Castella & McGarty (2011) analysed the content of George Bush and Tony Blair's speeches on the subject of terrorism from 2001-2003 and found that 12% of the former's, and 26% of the latter's, consisted of angering remarks (defined as characterised by attributions of blame). Again, this can be contrasted with Jens Stoltenberg's declaration in the wake of Breivik's act of

terrorism that: 'our response is more democracy, more openness, and more humanity… we will answer hatred with love' (Orange, 2012).

Government departments such as ministries of justice and government agencies like the police also communicate risk information. This is usually communicated in the form of advice to take various precautions. Such precautions may or may not be warranted by the circumstances but more worrying is when departments and agencies resort to angering rhetoric. Examples of this are the Police Executive Research Forum's claims that 'for a growing number of cities across the United States, violent crime is accelerating at an alarming pace' and that 'FBI statistics reflect the largest single year percent increase in violent crime in 14 years' (Rosen, 2006; p. 1), both made in spite of the fact that for 12 of the past 14 years violent crime had fallen and that over the entire course of the past 14 years it had dropped by 27%. In addition to presenting statistics in a misleading way, police representatives sometimes misrepresent crime statistics entirely. Gardner (2009) recounts a quote from Julian Fantino (p. 248), the former Toronto chief of police: 'well, [crime] may be going down in numbers, but violent crime, it's been up, it's been going up for years'. This was not true – in fact violent crime had been steadily declining in Toronto. Such distortions are not limited to law enforcement personnel either – policy-making departments may also convey risk information in unnecessarily angering terms. The UK's Home Office (2011) published a report outlining its new crime-fighting strategy which it justified by asserting that 'despite having one of the most expensive criminal justice systems in the world, Britain remains a high-crime country' and that 'only half of the public trust our criminal justice system to protect them from criminals' (p. 3). This was at a time when Britain's crime rate was similar to other western European countries' (Eurostat, 2014).

Perhaps the most egregious example of a needlessly fear- and anger-inducing governmental practice is the issuance of colour-coded terrorism alerts that the DHS

operated from 2002-2011. For the most part, rather than being issued with respect to specific events and regions that were most likely to attract the attention of terrorists, the system was orchestrated such that threat levels covered the entire country on an indefinite basis (that is, until the threat level was changed to something else). As well as being colour-coded, a descriptor was associated with each threat level from 'low' through to 'severe'. In practice though, the threat level was never reduced below 'elevated' (the third highest alert) which was essentially used as the default threat level, it periodically being raised to 'high' when officials had reason to believe the terror threat might be higher than usual. In reality, for the entire period during which the Homeland Security Advisory System was in effect 46 deaths occurred in the US that were attributable to terrorism. As well as stoking concerns about terrorism unnecessarily, the advisory system offered Americans no practical advice as to how they should modify their behaviour in response to the terrorist threat. It was simply too vague and general to be of any use – its only real effect was giving the issue of terrorism heightened prominence, which it did not necessarily deserve. An analogous system is still in operation in the UK (the 'UK Threat Levels') and, as with the DHS's system, the threat level has never been set lower than the third highest level. They are thus subject to the same criticisms regarding their utility as the discontinued DHS system.

So how might risk information about malicious hazards be better communicated? The most succinct answer might be to communicate less of it. In fact, after the DHS's colour-coded advisory system had been phased out, it was replaced with a much less sensationalist and more functional system called the National Terrorism Advisory System (NTAS). Under this system (which is still in place), alerts are issued on an ad hoc basis, in response to specific threats. Information is communicated about what geographical area and what infrastructure is likely to be affected by the threat and what actions citizens might consider taking to mitigate the threat (Department of Homeland Security, 2015). Another example of

competent risk communication related to terrorism comes from François Hollande in the aftermath of the terrorist attack on the publishers of the *Charlie Hebdo* magazine, who asserted his commitment to the values of the French republic and opined that Muslims were the main victims of Islamic terrorism, discouraging the opening up of divisions between the Islamic community and other French people (Lichfield, 2015). He also announced plans to devote more school time to teaching freedom of religion, freedom of speech and civic duty, assured the French that the government was doing everything it could to protect them from threats whilst at the same time appealing for vigilance.

Rogers, Amlôt, Rubin, Wessely & Krieger (2007) set out guidelines for what risk information about terrorism ought to consist of. They recommend that information should be disseminated by trusted sources, be updated on a regular basis, be accurate, provide 'useful, relevant advice and information before, during and after a terrorist incident' (p. 283) and acknowledge the inherent uncertainty that accompanies living in a liberal democracy, encouraging citizens to accept that uncertainty. Between the NTAS and François Hollande's response to the Charlie Hebdo shootings, examples of all these attributes can be identified.

The principle that less risk communication is better information applies even more to the case of violent crime than to terrorism. Oliver & Marion (2008) analysed US party political crime platforms of both major parties (and third party candidates when they were sufficiently important) between 1868 and 2004 and found that of the 76 crime platforms analysed, 60 addressed crime in predominantly symbolic terms as opposed to proposing policies intended to address specific issues. The outcome of the use of symbolism in couching crime discourse is that the perception of crime becomes divorced from reality because the number of references to crime in political rhetoric need bear no relation to its frequency. Furthermore with no frame of reference, electorates are unable to assess

whether new crime policies would be effective at reducing crime. Instead frequent, general, and abstract warnings serve to provoke anger at a social problem – anger that, the current research suggests, ultimately promotes a distorted perception of the risk and the required response to it.

Alternatively, politicians wishing to address crime ought to cite empirically valid issues, and propose solutions to tackle them. For example, shortly after his appointment as Justice Secretary in 2010, Ken Clarke announced his intention to end the use of short custodial sentences, on the basis that such sentences only put convicts in a position where they are likely to re-offend when released (Woodcock & Bogustawski, 2010). Another example of an effective crime policy, this one with a more authoritarian flavour, is the Safer Cities Programme (implemented in Bradford, Coventry, Hartlepool, Hull, Lewisham and Wolverhampton) which was introduced partly to reverse the car crime trend which had reached epidemic levels during the 1980s (Webb & Laycock, 1992). Part of the programme provided funding for the installation of security cameras in car parks, and a pre- and post-camera installation comparison, which also compared car parks in which cameras were installed with car parks where they were not installed, showed that the policy had proved effective in reducing car crime (Tilley, 1993). There is, therefore, scope for the public to assign subjective values to the civil liberty of privacy and protection from car crime, and decide on that basis whether the trade-off is worthwhile. This contrasts with anger-characterised approaches to policy, which cite ill-defined (and sometimes illusory) problems, propose solutions that do not necessarily relate to the problems and offer no concrete criteria for their success to be evaluated on, resulting in a self-perpetuating cycle where the public is never satisfied that public institutions are able to protect them from crime and consequently demand increasingly harsh policies.

In addition to their day-to-day law enforcement roles, police can, and do, introduce initiatives and communicate those initiatives as well as other crime prevention advice. Again, initiatives and advice ought to clearly address certain threats and have apparent or measurable outcomes. A particularly high-profile initiative is 'MetTrace' (originally introduced in London), under which police forces train their officers to check suspected stolen goods for Smartwater (a traceable liquid), encourage property owners to apply it to their valuables, instruct them as to how to use it and then extensively publicise, in public areas, the widespread use of Smartwater and its effectiveness as a means of deterring would-be thieves (Metropolitan Police, 2015). Police also publish practical advice relating to specific types of crime – to protect against identity fraud, for example, people are advised to install internet security software (Thames Valley Police, 2015). Just as importantly, campaigns and reasonable safety advice play a part in building and sustaining public trust in the police which, as we have seen, is critical to ensuring that the public supports proportionate criminal justice measures. By contrast, irresponsible advice would be advising women to stay home at night, as happened after the murder of Joanna Yeates (Morris, 2011). Clearly it is impractical for many members of the public to stay at home every night, and the connotation of the police's advice was that murder was a serious risk across the entire area – a message which is unnecessarily angering.

## Concluding remarks

Malicious hazards form a distinct group, are particularly angering, and this effect may be sufficient to account for overestimation of their likelihood, and the personal and institutional response required to combat them. By contrast, another feature of malicious hazards, the belief that consciously acting human agents are responsible for them, does not appear to play a role. One implication is that particular attention to the angering aspects of

risk communication is warranted. There may be no intrinsic harm in promoting public awareness of malicious hazards, so long as one does not do it in an inflammatory way. This gives rise to my suggestions that risk communicators resist assertions that malicious hazards are a serious problem, that public institutions cannot be trusted to deal with the threat they pose or that offenders are either not caught or are treated too leniently, and also refrain from depicting vivid details about exceptionally heinous crimes. A more balanced, and ultimately more effective strategy would be to cite specific trends in crime (perhaps supported with representative examples) and to propose steps individuals can take to attenuate the threat to themselves and measured responses to reverse the trend on a societal level.

Unfortunately, all risk communicators have certain vested interests in risk communication: police are motivated to appear effective in keeping the crime rate down, while media outlets and politicians may be motivated to emphasise crime to assert their pro-social, anti-crime credentials, or to attract viewers or voters. In terms of media, there is little to do beyond appealing to journalistic ethics, but politicians might be persuaded to change the tone of their crime platforms based on the deleterious effect angering assertions about crime's prevalence have on the perception of institutions they aspire to lead. Politicians (in democracies at least) derive their authority from their electorates' confidence in organs of state power, and by undermining that confidence they will ultimately reduce their own clout and ability to shape and influence society should they be elected. This is, in effect, a tragedy of the commons – the argument I advance is that the short term gains from sensationalising malicious hazards are outweighed both by the long term cost to society and the cost to the legitimacy of state power and the political establishment.

I also propose further research, both in respect of the unsettled hypothesis about agency beliefs and by way of elaborating on and applying the findings with respect to affect.

To answer the agency beliefs question I suggest the identification, or development, and use of a more effective priming paradigm, and I have identified three primes that might be of interest (Baumeister et al, 2009; Roberts et al, 2015; Winterich et al, 2010). To expand upon this thesis's main finding, the next step is to develop a valid and comprehensive scale for the measurement of attitudes related to malicious hazards and then to determine whether angry affect predicts greater inclination towards unnecessary preventative action or support for inimical policies, mediated by risk perception.

Overall, I believe that this thesis takes the study of the relationship between individual differences variables and attitudes about malicious hazards, and extends it beyond descriptive observations. With our understanding that anger is not purely trait-driven, that it influences risk perception and that risk communication can be framed in such a way as to promote angry responses or minimise them, there is now the possibility that risk communicators can lead public opinion away from expensive and punitive short-termism and towards trust in institutions and support for evidence-based policy.

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Please name 20 distinct hazards that can potentially cause death:

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<3rd dialog box>

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Appendix B

# Demographics

1. Age: _____

2. Female [ ] male [ ]

3. Ethnicity
    a. New Zealand European [ ]
    b. Chinese [ ]
    c. Maori [ ]
    d. Other [ ] , please specify _____

4. Nationality:_____

5. Religion:_____

6. How many years have you been in New Zealand _____

7. Is English your first language?
    a. Yes [ ]
    b. No [ ]

8. How would you rate your English language proficiency
    a. Excellent [ ]
    b. Good [ ]
    c. OK [ ]
    d. Poor [ ]

9. Are you left of right handed, or ambidextrous?
    a. Left handed [ ]
    b. Right handed [ ]
    c. Ambidextrous [ ]

# Appendix C

T___

Participant Number: _____

Please indicate the extent to which you are experiencing the following emotions **at this moment**, where 1 is 'very slightly or not at all' and 7 is 'extremely'.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Anger | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Sadness | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Disgust | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Happiness | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Fear | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Surprise | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

# Appendixes - Appendix D

This questionnaire concerns your perception of risk.

Out of every 1,000,000 deaths in **New Zealand**, how many are attributable to the following causes?

Your answers need **NOT** add up to 1,000,000.

| | |
|---|---|
| Avalanche | _____ out of 1,000,000 |
| Boating | _____ out of 1,000,000 |
| Cleaning products | _____ out of 1,000,000 |
| Cold snaps | _____ out of 1,000,000 |
| Crossing the road | _____ out of 1,000,000 |
| Cycling | _____ out of 1,000,000 |
| Domestic animals | _____ out of 1,000,000 |
| Drinking alcohol | _____ out of 1,000,000 |
| Driving a car | _____ out of 1,000,000 |
| Swimming | _____ out of 1,000,000 |
| Earthquakes | _____ out of 1,000,000 |
| Eating unhealthy food | _____ out of 1,000,000 |
| Electricity | _____ out of 1,000,000 |
| Extreme sport | _____ out of 1,000,000 |
| Extreme weather | _____ out of 1,000,000 |
| Fighting | _____ out of 1,000,000 |
| Fire | _____ out of 1,000,000 |
| Flying | _____ out of 1,000,000 |
| Heat waves | _____ out of 1,000,000 |
| Heights | _____ out of 1,000,000 |
| Bacteria & Viruses | _____ out of 1,000,000 |
| Insects | _____ out of 1,000,000 |
| Violent criminals | _____ out of 1,000,000 |
| Slippery surfaces | _____ out of 1,000,000 |
| Smoking | _____ out of 1,000,000 |
| Team sport | _____ out of 1,000,000 |
| Taking drugs | _____ out of 1,000,000 |
| Terrorists | _____ out of 1,000,000 |
| Travelling by train | _____ out of 1,000,000 |
| Tsunami | _____ out of 1,000,000 |
| Volcanic eruption | _____ out of 1,000,000 |
| War | _____ out of 1,000,000 |
| Wild animals | _____ out of 1,000,000 |

# Appendix E

MALOWE-CROWNE Social Desirability Scale

Please read each of the items below and indicate what you generally do or feel using the scale provided. Remember there are no right and wrong responses to any of these statements. *(coding scheme is indicated for the benefit of the reading).*

| | Yes | No |
|---|---|---|
| 1-It is sometimes hard for me to go on with my work if I am not encouraged. | 0 | 1 |
| 2-I sometimes feel resentful when I don't get my way. | 0 | 1 |
| 3-There have been times when I felt like rebelling against people in authority even though I knew they were right. | 0 | 1 |
| 4- On a few occasions, I have given up doing something because I thought too little of my ability. | 0 | 1 |
| 5- No matter whom I'm talking to, I'm always a good listener. | 1 | 0 |
| 6- There have been occasions when I took advantage of someone. | 0 | 1 |
| 7- I'm always willing to admit it when I make a mistake. | 1 | 0 |
| 8- I sometimes try to get even rather than forgive and forget. | 0 | 1 |
| 9- I am always courteous, even to people who are disagreeable. | 1 | 0 |
| 10- I have never been irked when people expressed ideas very different from my own. | 1 | 0 |
| 11- There have been times when I was quite jealous of the good fortune of others. | 0 | 1 |
| 12- I am sometimes irritated by people who ask favours of me. | 0 | 1 |
| 13- I have never deliberately said something that hurt someone's feelings. | 1 | 0 |

# Appendix F

Human agency condition:
*Situational factors condition:*

Participant Number:_____

In this section you will read a series of scenarios in which an incident occurred – whenever something happens, there are usually several different alternative ways of explaining why it happened – you will be asked to determine how responsible three different factors are in percentage terms. Please make sure your percentages add up to 100%.

On 23rd July 2011, in Nyala, Sudan, a fire broke out in a paper shop. The occupants of the shop were away, and as such were unable to alert the emergency services. The fire quickly spread to other buildings on the commercial street the shop was located on, forcing those inside to attempt to evacuate. The blaze was brought to the attention of the fire brigade by one or more of these evacuees, but due to a work timetabling oversight on the part of the fire brigade no-one was available to respond immediately. Four teams of firemen had to be recalled specially, and they took an hour to arrive. 10 people were killed by the fire, and it was widely felt that if the fire brigade had arrived earlier these deaths could have been prevented.

*On 23rd July 2011, in Nyala, Sudan, a fire broke out in a paper shop. The occupants of the shop were away, and as such were unable to alert the emergency services. The fire quickly spread to other buildings on the commercial street the shop was located on, forcing those inside to attempt to evacuate. The blaze was brought to the attention of the fire brigade by one or more of these evacuees, who then made their way to the scene as quickly as possible, equipped with four fire engines. They immediately set about extinguishing the fire, but despite their best efforts 10 people were still killed by it.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 24th December 2011, in Dawei, Burma, a tsunami struck. Seismologists had reason to believe there was a significant chance of such a natural disaster striking, and warned town officials. These town officials could have broadcast public information announcements on television and radio as well as leaning on local newspapers to draw attention to the potential catastrophe. However, they made no effort to inform the populace, and 50 people who were on the beach were killed by the tsunami.

*On 24th December 2011, in Dawei, Burma, a tsunami struck. Seismologists had reason to believe there was a significant chance of such a natural disaster striking, and warned town officials. These town officials immediately went about broadcasting public information announcements on television and radio, as well as leaning on local newspapers to draw attention to the potential catastrophe using prominent places in their publications. 50 people were on the beach anyway however (presumably these danger alerts hadn't reached them), and were killed by the tsunami.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 15th August 1987, BA flight 157, which was on its way from London to Singapore, suffered a 'bird strike', an event in which the flight path of the aeroplane intersects the flight path of birds in the area, and the birds are caught in the jet engines. Such incidents are usually avoided by air traffic control warning pilots not to take off. However, on this occasion the air traffic control employee responsible was found to have had a high blood alcohol content, and clearly hadn't been concentrating. Because of the bird strike the engines failed, bringing the plane crashing to the ground. All 350 passengers on board, all members of the crew and the captain and co-pilot died.

*On 15th August 1987, BA flight 157, which was on its way from London to Singapore, suffered a 'bird strike', an unfortunate event in which the flight path of the aeroplane intersects the flight path of birds in the area, and the birds are caught in the jet engines. Air traffic control wasn't able to alert the pilot as to the ensuing danger because it was unforeseeable. As a consequence of the bird strike the engines failed, bringing the plane crashing to the ground. All 350 passengers on board died.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 25th January 2000, two South African mountaineers attempted an assault on K2, the second highest mountain in the world. The mountain poses many perils of its own, but the fate that befell the mountaineers was the extreme cold. Temperatures plumbed -40 degrees as they neared the top. This was to be expected, but the clothing they had been provided by their supplier did not offer as good insulation as the supplier had claimed. Both died.

*On 25th January 2000, two South African mountaineers attempted an assault on K2, the second highest mountain in the world. The mountain poses many perils of its own, but the fate that befell the mountaineers was the extreme cold. Temperatures plumbed -40 degrees as they neared the top, and although they were properly and warmly dressed, the unexpected cold snap caused them to suffer very severe hypothermia. Both died.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 12th April 1993 in the Austrian alpine village Alpbach, an avalanche struck, killing 25 residents. Avalanches in much of the Austrian alps are common, but resultant deaths are rare because geologists are usually able to predict the occurrence of them and the at risk areas are evacuated or cordoned off. In this case the geologists responsible failed to anticipate the avalanches, despite considerable evidence that one was going to happen. They incurred a considerable amount of criticism from their peers worldwide.

*On 12th April 1993 in the Austrian alpine village Alpbach, an avalanche struck, killing 25 residents. Avalanches in much of the Austrian alps are common, but resultant deaths are rare because geologists are usually able to predict the occurrence of them and the at risk areas are evacuated or cordoned off. In this case the geologists responsible weren't able to anticipate the avalanche, but it was widely recognised that their job this time was virtually impossible owing to the peculiar and unique nature of this avalanche.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 17th August 1981, slightly outside Morecombe Bay, England, two boaters drowned after the engine on their speed boat failed. The failure of the engine was attributed to a fundamental design flaw on the part of the manufacturer.

*On 17th August 1981, slightly outside Morecombe Bay, England, two boaters drowned after the engine on their speed boat failed. The malfunction of the engine was attributed to its being too old.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 21st January 2002 in Prague, Czech Republic, a boy aged 9 was hit by a vehicle while crossing the road and killed. It was later found that the driver had not slept for 48 hours and was extremely tired. It was generally felt that he shouldn't have been driving at all.

*On 21st January 2002 in Prague, Czech Republic, a boy aged 9 was hit by a vehicle while crossing the road and killed. The boy was crossing on a curve, not having yet learnt how to cross the road properly, and it was agreed by all parties involved that the driver wouldn't have been able to stop in time.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 17th December 1987 in Vancouver, Canada, an office employee cycling to work suffered crashing to the ground, and the impact broke several ribs and caused serious internal bleeding, resulting in his death. The bike had been re-tyred only two months ago, so evidently the tyres had not been manufactured properly.

*On 17th December 1987 in Vancouver, Canada, an office employee cycling to work suffered a serious accident when one of the tyres lost its grip on the road due to ice on the road that had accumulated the night before. The cyclist was sent crashing to the ground, and the impact fractured several ribs and caused serious internal bleeding, resulting in his death.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 6th March 2006, in the highly mosquito populated area of Kinshasa, Democratic Republic of Congo, woman contracted malaria after sleeping protected by a mosquito net sold to her earlier that day which had several holes in that mosquitos presumably got through. As a result of complications from the disease, she died a few weeks later.

*On 6th March 2006, in the highly mosquito populated area of Kinshasa, Democratic Republic of Congo, a woman contracted malaria after being bitten by a mosquito while on her way to work. As a result of complications from the disease, she died a few weeks later.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 28th October 1999, in Malaga, Spain, a man died after slipping on a very wet pavement and hitting his head hard on a lamp-post. It was early in the morning, and the previous night the nightclub next to the pavement had thrown out large quantities of melting ice.

*On 28th October 1999, in Malaga, Spain, a man died after slipping on a very wet pavement and hitting his head hard on a lamp-post. It had been raining very heavily the night before, and it was early in the morning so no-one had had the chance to clear the pavements.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 12th September 2002, in Llanelli, Wales, a rugby player died after being tackled very hard, but legitimately. He suffered multiple head injuries and internal bleeding. Although the tackle was entirely legal, the pitch of the rugby club he was playing against was partly surrounded by concrete walls situated closer to the edge of the pitch than the governing regulations permitted. It was against these walls with which the player's head made impact.

*On 12th September 2002, in Llanelli, Wales, a rugby player died after being tackled very hard, but legitimately. He suffered multiple head injuries and internal bleeding when his head landed hard on the turf.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 30th November 2004, on a railway line running from Avignon to Paris, both in France, a train crashed. It was derailed as a result of a points failure, which was blamed on the contractor responsible for maintaining the line. Unfortunately the derailment killed 56 passengers.

*On 30th November 2004, on a railway line running from Avignon to Paris, both in France, a train crashed after the driver suffered a sudden stroke – there had previously been no reason to suspect his health was in jeopardy. Unfortunately though, the train derailed killing 56 passengers.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 17th April 1978, in Sicily, Italy, the frequently active volcano Mount Etna erupted, killing 400 residents of a village situated close to it. Volcanologists failed to predict the eruption, which was unusual as predicting volcanic eruptions is generally very easy.

*On 17th April 1978, in Sicily, Italy, the frequently active volcano Mount Etna erupted, killing 400 residents of a village situated close to it. Volcanologists failed to predict the eruption because the technology which today enables experts to easily predict volcanic eruptions had not yet been developed.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 25th May 1985, in the Krugar Park, South Africa, a man on a safari died after being ravaged by a lion. He was part of a touring party, which had been informed it was free to walk around the national park safe in the knowledge that should an animal pose a danger to one of the party it would be shot by the duty ranger. The duty ranger, however, was not paying attention at the time because he was talking to his friends.

*On 25th May 1985, in the Krugar Park, South Africa, a man on a safari died after being ravaged by a lion. He was wandering around the park without supervision – he was armed, but was unable to react quickly enough to shoot the animal.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 12th August 1997, in San Diego, United States, a baby was asphyxiated after the family's dog, during the night, climbed into the baby's cot and fell asleep on the baby's face, suffocating the infant. A newspaper commentator shortly afterwards reminded readers that as a routine measure to protect babies sleeping in a room alone, their door should always be shut.

*On 12th August 1997, in San Diego, United States, a baby was asphyxiated after the family's dog, during the night, climbed into the baby's cot and fell asleep on the baby's face, suffocating the infant. The usual precaution of shutting the door of the room the baby was sleeping in was taken, but the dog somehow managed to open the door.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 12th June 1998, on a beach in Miami, United States, a swimmer drowned after finding the tide too strong to swim against. The swimmer attempted to attract the attention of the lifeguards, but apparently they weren't paying attention.

*On 12th June 1998, on a beach in Miami, United States, a swimmer drowned after finding the tide too strong to swim against. The swimmer attracted the attention of the lifeguards, but they weren't able to rescue the swimmer in time.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 7th July 1995 in Detroit, United States, there was a motor car collision in which a driver ran a red light and hit another driver who died in the accident. It later emerged that the driver who ran a red light had already received points for similar traffic offences many times previously, had had his licence revoked and was driving without a licence.

*On 7th July 1995 in Detroit, United States, there was a motor car collision in which a driver ran a red light and hit another driver who died in the accident. It later emerged that the driver who ran a red light had just received a phone call from his wife who was going into labour and needed to be transported to the hospital.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 31st August 1996, in Antofagasta, Chile, an earthquake struck. It wouldn't have done any significant damage except that a recently constructed office block, which was the largest in the city, collapsed. It was the only building that entirely capitulated, with others suffering minor and easily repairable structural damage. It was widely felt that the contractors who had built the office block had used poor quality, unsuitable materials, and that despite it being known that the area was prone to earthquakes no earthquake-proof foundations had been installed. It was considered that these factors had been largely responsible for the building's collapse. 150 people inside the office block died.

*On 31st August 1996, in Antofagasta, Chile, an earthquake struck. A recently constructed office block, which was the largest in the city, collapsed. It was the only building that collapsed because it stood fairly isolated – where the highest concentration of buildings stood, the earthquake wasn't felt so strongly. 150 people inside the office block died.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 29th February 2008, in Auckland, New Zealand, a 46-year-old homemaker was reported to have been electrocuted by a hairdryer that had fallen into her bath while she was in it. Despite the company that sold the hairdryer having claimed that it was equipped with ground-fault circuit interrupters, which cut off the current when the appliance comes into contact with water, it was later found that this wasn't the case. The woman died as a result of the electrocution.

*On 29th February 2008, in Auckland, New Zealand, a 46-year-old homemaker was reported to have been electrocuted by a hairdryer that had fallen into her bath while she was in it. The hairdryer was a cheap one, and as such was not equipped with ground-fault circuit interrupters, which cut off the current when the appliance comes into contact with water. The woman died as a result of the electrocution. Electricians recommend only purchasing products with such safeguards against electrocution.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 25th November 1988, on a beach in New South Wales, Australia, a windsurfer suffered a fatal accident. A rip in the tide propelled him off his surfboard, and carried him half a kilometre out to sea where he drowned. An error on the part of the coastguard had seen the part of the coast where he was surfing classified as safe.

*On 25th November 1988, on a beach in New South Wales, Australia, a windsurfer suffered a fatal accident. A rip in the tide propelled him off his surfboard, and carried him half a kilometre out to sea where he drowned. Because he was so far out, the coastguard was unable to see him when he raised his hand to attract attention.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 3rd March 1974, in London, England, after months of torrential downpour parts of the city closest to the River Thames were flooded. Many became stranded in their houses, and 53 unfortunate immobile people died. An order had been sent down to close the Thames flood barrier, which would have prevented the deaths, but apparently the operator forgot to execute the order.

*On 3rd March 1973, in London, England, after months of torrential downpour parts of the city closest to the River Thames were flooded. Many became stranded in their houses, and 53 unfortunate immobile people died. The year after the flood barrier was built to prevent this from ever happening again.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 17th July 1997, in Palermo, Italy, a heatwave occurred over a period of several days. Temperatures soared to a blistering 45°C. The city is generally well prepared for such events since it is situated in the far south of the country, but this time faulty power cables in one part of the city which ought to have been repaired some months back meant that several thousands of residents were left without air-conditioning. 178 of them died.

*On 17th July 1997, in Palermo, Italy, a heatwave occurred over a period of several days. Temperatures soared to a blistering 45°C. The city is generally well prepared for such events since it is situated in the far south of the country, and all residences are fitted with air-conditioning units. There were some residents, however, who weren't able to make it inside quickly enough and 178 died of heat stroke.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 19th November 2003, in Merano, Italy, a fatality occurred after a man fell through the 'Il Binocolo' 50 metre viewing platform. A plank of wood in the floor was loose, a fact largely blamed on the council not paying for a regular maintenance check-up.

*On 19th November 2003, in Merano, Italy, a fatality occurred after a man fell off the 'Il Binoculo' 50 metre viewing platform. He apparently leaned too far over the barrier and lost his balance.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |

On 1st June 2002, in Delhi, India, a man who had earlier eaten at the Taj Mahal restaurant contracted severe food poisoning after eating food contaminated with the c*lostridium perfringens* bacteria. The kitchen of the restaurant was found to have adhered to deplorably low hygiene standards, and press commentators conjectured that this was the likely cause of his death.

*On 1st June 2002, in Delhi, India, a man contracted severe food poisoning after eating food contaminated with the clostridium perfringens bacteria. He had cooked the food himself, but apparently not sufficiently well. Press commentators conjectured that had he cooked the food for longer, he would have killed the bacteria responsible.*

How responsible are the following for the deaths?

| The deceased | Other person(s)/organization(s) | Bad luck/the circumstances |
|---|---|---|
| % | % | % |