THE IMPACT OF THREAT APPEALS ON RISKY DRIVING BEHAVIOURS

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List of Works

Below is a list of publications, conference presentations, and awards, which have stemmed directly from this thesis.

Publications

Carey, R. N., McDermott, D. T., & Sarma, K. M (2013). The impact of threat appeals on fear arousal and driver behaviour: A meta-analysis of experimental research 1990-2011. *PloS one*, *8*(5), e62821. doi: 10.1371/journal.pone.0062821

Conference Presentations

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Awards

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Abstract

A threat appeal is a form of persuasive communication that aims to change behaviour through the presentation of threatening material. Despite their widespread use in road safety campaigns, the empirical research exploring the impact of threat appeals on driving behaviour has reported inconsistent findings. While a number of studies have found that threat appeals can be effective, provided certain factors are incorporated into their design, methodological and conceptual inconsistencies have made it difficult to draw generalised conclusions. The primary aim of the current research is to examine the effectiveness of threat-based road safety advertisements in reducing risky driving behaviours, among young male drivers in Ireland. This research examined the role of threat, cognitions, and emotions on risky driving, and involved a trilogy of experimental studies (Studies 2-4), which were informed by the existent empirical literature, and the findings of a meta-analytic review (Study 1). Study 1 (*k* = 13) used meta-analytic techniques to measure the overall impact of threat appeals on fear arousal and driving behaviours. Study 2 (*n* = 61) examined subjective (i.e. self-report) and objective (i.e. physiological) fear responses to threat-based road safety messages. Study 3 (*n* = 62) examined the impact of a fear arousing, high threat road safety advertisement on the speeding behaviour of young male drivers. Study 4 (*n* = 81) investigated the impact of state anger on the effectiveness of the message, reflecting growing interest in the impact of mood on risky decision-making. Findings from the meta-analysis suggest that threat appeals had a strong impact on fear arousal, but that, overall, their effect on behavioural outcomes was weak. Study 2 isolated a threat appeal that elicited a physiological fear response. Study 3 found that the presentation of a high threat road safety advertisement, when combined with increased levels of perceived threat and efficacy, led to a decrease in speeding behaviour. Finally, Study 4 indicated that increased levels of state anger negatively impacted on the effectiveness of a threat appeal. Overall, findings suggest that threat appeal road safety messages have the potential to reduce a number of risky driving behaviours, but that their effectiveness is likely to be impacted by cognitions, such as perceived efficacy, and by state variables, such as anger. Findings are considered in the context of effective road safety advertisement design, and future research in the area.

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List of Abbreviations

ANCOVA: Analysis of Covariance

ANOVA: Analysis of Variance

ATC: Australian Transport Council

CI: Confidence Interval

BPM: Beats per Minute

BSL: Biopac Student Lab

DAS: Driving Anger Scale

EDA: Electrodermal Activity

EMG: Electromyography

EPPM: Extended Parallel Process Model

ESS: Excitement Sensation Seeking

FD: Following Distance

fMRI: functional Magnetic Resonance Imaging

GPS: Global Positioning System

HBM: Health Belief Model

HD: High Definition

HR: Heart-Rate

IVDR: In-vehicle Data Recorder

MANOVA: Multivariate Analysis of Variance

PMT: Protection Motivation Theory

PPG: Pulse Plethysmograph

PRM: Parallel Response Model

RSA: Road Safety Authority

RTC: Road Traffic Collision

SCL: Skin Conductance Level

SCR: Skin Conductance Response

SEU: Subjective Expected Utility

SRV: Speeding and Rule Violation

TMT: Terror Management Theory

TPB: Theory of Planned Behaviour

VST: Video Speed Test

WHO: World Health Organisation

Preface

Road traffic collisions are responsible for approximately 1.2 million deaths worldwide, every year, according to the World Health Organisation. A number of developed countries, including Ireland, have experienced a decline in road fatalities in the past decade (Sheridan, Howell, McKeown, & Bedford, 2011), but the number of preventable road traffic collisions (RTCs), and their resulting fatalities, remains alarmingly high. In 2011, for example, there were more than 27,000 collisions reported by police in Ireland, costing a total €792 million. RTCs present a major social and financial challenge, and road safety has become a critical international public health issue.

Of the 162 people that were killed on Irish roads in 2012, 67% were male. This statistic is in line with international trends, which suggest that young male drivers are consistently overrepresented in global road fatality statistics (Hatfield & Fernandes, 2009; Özkan & Lajunen, 2006). Although the definition of a young driver varies from study to study, research examining age differences in risky driving typically identify 18-24 year olds as a “high-risk” group (e.g. Marcil, Bergeron, & Audet, 2001; Mathijssen, 2005).

A body of research has examined possible reasons for the disproportionate representation of young male drivers in RTCs, and a number of explanations have been proposed. Specifically, studies have suggested that neurological developmental factors (Galvan et al., 2006; Steinberg, 2008), social influence variables, such as peer pressure (Gardner & Steinberg, 2005; Simons-Morton et al., 2012), and cognitive biases, such as crash-risk optimism (Harré, Foster, & O'Neill, 2005; Sibley & Harré, 2009), contribute to the engagement in risk-taking behaviours among young males. The propensity for risky behaviours in general, and risky driving behaviours in particular, among this group (Deery, 2000; Jonah, 1990, 1997; Sarma, Carey, Kervick, & Bimpeh, 2012) may be what leads to their overrepresentation in RTC fatality statistics. Since a majority of RTCs are considered preventable (Abbas, Hefny, & Abu-Zidan, 2011), national and international road safety agencies have waged mass-media campaigns aimed at changing driver practice, and a number of campaign-approaches have been proposed. While some road safety campaigns are educational (Koenig & Wu, 1994; Thomson et al., 2005), or humour-based (Lee & Shin, 2011), a majority employ threat-based, graphic advertisements, aimed at deterring risky driving behaviours (Lewis, Watson, Tay, & White, 2007). The effectiveness of these threatening advertisements, or “threat appeals”, has generated an array of experimental studies, across a number of health-promotion contexts, including smoking (Keller & Block, 1996; Smith & Stutts, 2003), and binge-drinking (Jessop & Wade, 2008; Moscato et al., 2001).

Despite several decades of empirical research, there is a lack of consensus in the literature regarding the effectiveness of threat appeals (Lewis, et al., 2007). Specifically, while their use has prompted skepticism among some researchers (Hastings, Stead, & Webb, 2004), others have argued that threat appeals can work, provided a number of variables are incorporated into their design (Witte & Allen, 2000). The main problem with the research in this area, to date, is that conceptual and methodological inconsistencies across studies have made it difficult to draw definitive conclusions. At a conceptual level, the constructs of threat and fear, and their relation to behaviour, have not been clearly defined in the literature. Methodologically, while some studies have used national RTC statistics to determine the effectiveness of mass-media campaigns (Kreibig, Wilhelm, Roth, & Gross, 2007; Phillips, Ulleberg, & Vaa, 2011), others have examined driving behaviour in the laboratory, using driving simulators (Bella, 2008; Lee, McGehee, Brown, & Reyes, 2002; Matthews & Desmond, 1998) or self-reported risky driving intention measures (Jessop, Albery, Rutter, & Garrod, 2008). Further, although fear arousal responses play an integral role in determining the effectiveness of threat appeal messages, many experimental studies fail to provide a reliable measure of fear (Bolls, Lang, & Potter, 2001; Carey, McDermott, & Sarma, 2013).

The aim of the current programme of research is to examine the impact of threat-based road safety advertisements on fear arousal and risky driving behaviours. Four empirical studies were conducted, including a meta-analysis and three experiments (these are described in more detail in Chapter 4). Broadly, the meta-analytic review examined the impact of threat appeal messages on fear arousal, and on laboratory-based indices of risky driving. Study 2 addressed key limitations of previous experimental research, as highlighted by the meta-analysis, by examining physiological responses to threat-based road safety advertisements. In Study 3, and drawing on relevant theory, including the Extended Parallel

Process Model (EPPM; Witte, 1994), and Terror Management Theory (TMT; Greenberg, Pyszczynski, & Solomon, 1986), the impact of a fear arousing threat appeal on a behavioural driving outcome (i.e. speed choice), was investigated. Finally, Study 4 examined behavioural responses (i.e. speed choice, close following, gap acceptance and overtaking) to this appeal, under conditions of heightened state anger.

Thesis Overview

This thesis presents four empirical chapters, preceded by a general introduction to the area and thesis overview, and followed by a general discussion of the research findings and implications. Chapter 1 introduces the road safety literature, with particular emphasis on the trait and state factors associated with risky driving. Chapter 2 centres on empirical research into threat appeals, focusing, in particular, on the effectiveness of threat appeals in the context of road safety. It outlines prominent threat appeal models, and provides a critical discussion of current theoretical perspectives and debates. Chapter 3 highlights a number of important conceptual and methodological issues within previous experimental studies. Chapter 4 provides a summary of the literature review, and outlines key research questions.

Chapters 5-8 present the findings of four empirical studies. In Chapter 5, with the aim of synthesising and evaluating previous experimental research, a meta-analytic review is presented (Carey, et al., 2013). Stemming from the meta-analytic findings, Chapter 6 presents an experimental study that examines physiological fear responses (Ordonana, González-Javier, Espín-López, & Gómez-Amor, 2009; Popova, 2012) to threat-based messages. Chapter 7 describes Study 3, which examines the impact of a fear arousing, high threat road safety advertisement, on the behavioural (i.e. speeding) responses of young male drivers. Chapter 8 presents the findings of the final experimental study, which investigates the impact of a threat appeal, and state anger, on a number of risky driving indices. Finally, Chapter 9 provides a summary of each empirical chapter, and an overview of the implications, and limitations, of the current findings. The overall implications of the current findings in terms of application to message-design, and relevance to policy-makers are outlined.

1. Chapter One

Risky Driving: Motivations and Associated Factors.

This chapter provides an overview of the empirical research into risky driving, and its associated factors. First, it provides the context for this research by outlining the prevalence, cost, and global impact of road traffic collisions (RTCs; Section 1.1). It then considers the trait and state variables that relate, causally or non-causally, to various risky driving behaviours (Sections 1.2 & 1.3). Next, the comparatively high levels of risk-taking among young people, and males in particular, are discussed (Section 1.4). Finally, this chapter outlines the ways in which predictive models of risk (Section 1.5), developed through cross-sectional studies, can provide a more comprehensive understanding of driver risk-taking.

There are four main conclusions reached. First, the persistently high number of preventable RTCs, and their considerable social and financial cost, has made road safety an international public health issue. Second, individual differences in traits like anger and sensation seeking, as well as state variables such as mood, are likely to contribute to an increase in risk-taking among drivers. Third, the consistent overrepresentation of young male drivers in road fatality statistics has made this population an “at-risk” group for RTCs, and a longstanding focus of empirical inquiry. Finally, although a number of demographic, trait, and state factors are discussed in this chapter, in reality, the picture emerging is complex. It is likely to be the interaction between an array of different variables, rather than the independent influence of any one variable, that underlies risk-taking behaviours on the road.

1.1 Road Traffic Collisions

The World Health Organisation (WHO) has estimated that approximately 1.2 million people die every year in RTCs. Despite a steady reduction in the number of road deaths in Ireland, and in other developed countries, in recent years (Sheridan, et al., 2011), RTCs continue to represent a leading cause of death worldwide (Subramanian, 2005). In addition to the fatality statistics, RTCs also present a serious challenge in terms of financial cost. In Ireland, for example, a Road Safety Authority (RSA) report estimated the cost of RTCs, in 2011, to be

€792 million (RSA, 2011). In the United Kingdom (UK), RTCs are believed to cost the National Health Service £470 million per annum (Cunningham, 2008), while other studies have reported that, per year, road collisions cost the equivalent of $146.3 million in Jordan (Al-Masaeid, Al-Mashakbeh, & Qudah, 1999), and €9039 million in Spain (in 2004; Mirmohammadi et al., 2013). The WHO has stated that, overall, RTCs cost between 1-3% of a country's gross national product.

Despite their prevalence, and high financial cost, a body of literature has demonstrated that a majority of collisions are preventable (Abbas, et al., 2011; Goonewardene, Baloch, Porter, Sargeant, & Punchihewa, 2010), and can be attributed to human factors (Boyce & Geller, 2002; Evans, 1993). Specifically, research has suggested that up to 90% of RTCs involve mistakes, or risky driving (Lewin, 1982; Treat et al., 1979). High levels of driver risk-taking are leading, either directly or indirectly, to RTCs, and this represents a major cause for concern among road safety practitioners.

1.2 Risky Driving Behaviours

Risky driving behaviours are actions that increase an individual's likelihood of being involved in a RTC, and/or that increase the severity of the RTC in the event that it occurs (Simpson, 1996). Since human behaviour is believed to cause a majority of RTCs (Boyce & Geller, 2002), risky driving has been a longstanding focus of academic enquiry (Pearson, Murphy, & Doane, 2013). Research has uncovered an array of risky behaviours engaged in by drivers, including speeding (Blincoe, Jones, Sauerzapf, & Haynes, 2006; Hatfield, Fernandes, Faunce, & Job, 2008), driving under the influence of drugs or alcohol (Li, Simons-Morton, & Hingson, 2013), distracted driving (Garner, Fine, Franklin, Sattin, & Stavrinos, 2011; Jacobson & Gostin, 2010), risky manoeuvres such as close following or unsafe overtaking (Harbeck & Glendon, 2013), street racing (Vingilis et al., 2011), not wearing a seatbelt (Carpenter & Stehr, 2008) and driving while fatigued (May & Baldwin, 2009; Simon et al., 2011).

While some research has focused exclusively on one driving behaviour, such as speeding (Hatfield, et al., 2008), fatigue (Thiffault & Bergeron, 2003), or drink-driving (Gruenewald & Johnson, 2010), other studies have used self-report questionnaires that measure the frequency with which participants engage in a number of risky driving behaviours (e.g. driving fast around bends, driving while fatigued, drink-driving and distracted driving), and combined responses to create an overall risky driving score (Jessop, et al., 2008; Rhodes & Pivik, 2011). This is problematic, because it assumes that these different behaviours are comparable, and can be weighted evenly, when research suggests that this is not the case. Specifically, the prevalence rates (Constant, Salmi, Lafont, Chiron, & Lagarde, 2009) and motivating factors (Fernandes, Hatfield, & Soames Job, 2010) of various risky driving behaviours are different, and should be treated as separate, individual outcomes in experimental research (Begg & Langley, 2004; Tay, 2005a). For example, speeding has been found to relate to authority-rebellion, while drink-driving has been linked to the personality trait of sensation seeking, and cognitive biases (Fernandes, et al., 2010). Following on from this, while the current thesis uses the term "risky driving behaviours" to refer to the array of actions that constitute driver risk-taking, it is crucial to keep in mind that these are discrete, distinct indices, which may be rooted in different causes.

Road safety agencies have attempted to deter risky driving behaviours, and have drawn on empirical research findings to understand the reasons underlying their occurrence. The engagement in behaviours like speeding, drink-driving, or phone-use while driving, can lead to a number of well-known aversive outcomes (e.g. involvement in a RTC, or legal consequences), and yet individuals regularly take these kinds of driving risks. The motivation behind this is likely to be complex. Decades of research has led to the identification of an array of trait and state factors that lead individuals to overlook the potential consequences, and engage in risky driving behaviours.

1.3 Factors influencing Driver Risk-Taking and RTCs

Trait Variables

Although personality factors do not cause RTCs directly, they can increase the likelihood of being involved in a collision, through their influence on risky driving behaviours. Within the risky driving literature, an array of studies have examined the link between personality traits and driving (Constantinou, Panayiotou, Konstantinou, Loutsiou-Ladd, & Kapardis, 2011; Garrity & Demick, 2001; Iversen & Rundmo, 2002; Lajunen, 2001; Loo, 1979; Matthews &

Desmond, 1998; Smith & Kirkham, 1981; Ulleberg, 2001; Ulleberg & Rundmo, 2003; West & Hall, 1997). Research has isolated a number of personality characteristics that directly (Dahlen, Martin, Ragan, & Kuhlman, 2005), and indirectly (i.e. through risk perception; Ulleberg & Rundmo, 2003) influence driver risk-taking, including anger, sensation seeking, and impulsiveness.

Anger and aggression have been identified as predictors of risky driving and RTC involvement (Dahlen, et al., 2005; Ulleberg & Rundmo, 2003). Driving can be a frustrating and stressful task (Jovanović, Lipovac, Stanojević, & Stanojević, 2011), and when individuals are angry, their perception, information processing, and motor performance can be hindered, which can mean they are at increased risk for a collision (Deffenbacher, Huff, Lynch, Oetting, & Salvatore, 2000).

In order to explore the link between anger and risky driving, Deffenbacher and colleagues proposed the construct of "driving anger", a context-specific form of anger that relates specifically to the tendency to exhibit anger while driving (Deffenbacher, Oetting, & Lynch, 1994). They measured driving anger using a Driving Anger Scale (DAS; Deffenbacher, et al., 1994), and found that "high anger" drivers tended to report higher levels of risky driving than "low anger" drivers (Deffenbacher, Deffenbacher, Lynch, & Richards, 2003). Responses on the DAS have been found to predict near-collisions, aggressive and risky driving behaviours, losses of vehicle-control and physically and verbally aggressive driving anger expressions (Dahlen, et al., 2005). In examining the impact of driving anger on risky driving behaviours, researchers (Stephens & Groeger, 2009) have drawn a distinction between trait driving anger, a stable personality characteristic (Schwebel, Severson, Ball, & Rizzo, 2006), and state driving anger, a context-specific variable that tends to be transitory (Abdu, Shinar, & Meiran, 2012). State anger is considered in more detail later in this chapter.

Overall, evidence would suggest that driving anger is extremely prevalent. Underwood and colleagues (1999), for example, found that 85% of participants reported at least one experience of anger while driving, over a period of two weeks. Joint (1995) reported that 90% of drivers surveyed had experienced an incident of aggressive driving in the past year, while 60% reported having lost their temper behind the wheel. In short, research indicates that there are "many, many angry drivers on the road" (Deffenbacher, Lynch, Oetting, & Yingling, 2001, p. 1321), and that angry drivers tend to be higher in risky driving behaviours (Ellison-Potter, Bell, & Deffenbacher, 2001).

Sensation seeking, a trait associated with the extent to which an individual needs “varied, novel, and complex sensations and experience” (Zuckerman, 1979, p. 312), has also been linked to risk-taking. It has been found to predict a number of risky driving behaviours (Scott-Parker, Watson, King, & Hyde, 2012), including drink-driving (Zakletskaia, Mundt, Balousek, Wilson, & Fleming, 2009) and speeding (Jonah, 1997). In a review of 40 studies examining the relationship between sensation seeking and risky driving, Jonah (1997) concluded that all but four studies showed positive correlations (with values between .30 and .40) which, when included in statistical models, accounted for between 10 and 15% of the variance in risky driving. It is unclear if sensation seekers fail to perceive or acknowledge that the risk is high, or are aware of the risk, but choose to engage in the behaviour anyway. Regardless of the underlying reason, and given that research has found this trait to have no relation to driving anger (Dahlen, et al., 2005), it seems that sensation seeking is an important, independent predictor of risky driving.

The link between impulsiveness and risky driving has also emerged in the literature. Although conceptually similar to sensation seeking, impulsiveness relates to an individual’s control over thoughts and behaviour (Barratt, 1972). It can be viewed as an aspect of self-regulation, in the sense that it relates to an inability to regulate one’s actions, and to act without thinking (Lengua, 2002). The influence of impulsiveness on both risky (Dahlen, et al., 2005) and aggressive driving (Berdoulat, Vavassori, & Sastre, 2012) has been highlighted by empirical research. Individuals high in impulsiveness may lack the self-regulatory capacities needed to inhibit risk-taking, leading them to engage in risky behaviours.

Finally, several studies have found links between extraversion and risky driving. High levels of extraversion, characterised by a desire for interpersonal interaction, and linked to traits like gregariousness and sociability (Vinchur, Schippmann, Switzer, & Roth, 1998), can lead individuals to act more spontaneously, and sometimes aggressively (Renner & Anderle, 2000). Within a driving context, extraversion has been found to relate to traffic fatalities (Lajunen, 2001), traffic offences (Lev, Hershkovitz, & Yechiam, 2008), and the willingness to drink-drive (Martin & Boomsma, 1989). Individuals high in extraversion tend to seek out external stimulation, and need higher levels of stimulation than introverts (Vestewig, 1977), which may explain their engagement in risky behaviours. Importantly, several driving studies have found interactions between extraversion and other personality traits. For example, Thiffault and Bergeron (2003) found that sensation seeking explained 26% of the variance in measures of driving while fatigued, but only for participants who were high in extraversion.

These kinds of interactions between personality traits are common, and research has attempted to predict risky driving by studying combinations of traits. With the aim of drawing the personality literature together, by classifying subtypes of risky drivers, Ulleberg (2001) identified two 'high-risk' groups. The first of these was characterised by high levels of driver aggression, irresponsibility and sensation seeking. They had a high-risk driving style, risky driving attitudes, high confidence in their driving skills, and perceived their likelihood of being involved in a RTC as low. The second high-risk personality group had high levels of risky driving and RTC involvement, and consisted of individuals high in sensation seeking, aggression, anxiety, and driving anger. What this paper highlights is that there may be combinations of personality traits (i.e. personality "clusters") that increase driver risk-taking and, by extension, RTC involvement. The authors point to the potential for tailored campaigns designed to target these particular at-risk subgroups.

Personality studies tend to differ in the individual traits they focus on, and the behaviours they measure, and it is often difficult to compare the various findings. It is also likely that different risky driving behaviours are associated with different personality traits. For example, drink-driving is not likely to be linked to the same personality characteristics as speeding (Fernandes, et al., 2010). Overall, the amount of variance explained by stable, individual difference variables tends to be relatively small (e.g. Jonah, 1997), and recent research has explored the effect of more transitory, state variables on risky driving.

State Variables

There are a number of factors, aside from individual differences, that can affect the way we drive, the risks we take, and the possibility of being involved in a RTC. These include the level of traffic congestion (Shinar & Compton, 2004), the presence of music (Brodsky, 2001), the time of day, and day of the week

(Doherty, Andrey, & MacGregor, 1998), the road and weather conditions (Fridstrøm, Ifver, Ingebrigtsen, Kulmala, & Thomsen, 1995), the amount/type of passengers, and peer influence (Simons-Morton, Lerner, & Singer, 2005; Simons-Morton, et al., 2012; Simons-Morton et al., 2011).

Circumstantial and personality variables are likely to interact in their effects on driver risk-taking, and the expression of certain personality characteristics may be dependent on situational variables. For example, some people might be predisposed to take risks while driving, but will not do so unless certain variables, such as traffic, or time-pressures (Mowen, Harris, & Bone, 2004), are present. A comprehensive review of all of these factors is outside the scope of the current research programme, but one state variable, which is of particular relevance to the current research, is mood.

While driving researchers have long acknowledged the importance of trait factors, focus is now turning to “the effect of affect” on risky driving (Garrity & Demick, 2001; Groeger, 1997). Specifically, research has found that individuals drive faster when experiencing anger, than when in any other type of mood (Arnett, Offer, & Fine, 1997). Findings from studies examining the impact of state anger on risky driving have been inconsistent (Stephens & Groeger, 2009), and have largely failed to establish cause and effect relationships (Abdu, et al., 2012). In order to address this literature gap, a recent study measured behaviour in a driving simulator following an anger manipulation, and found that high levels of state anger led to increased risky driving behaviours, such as crossing yellow traffic lights (Abdu, et al., 2012).

Importantly, the trait and state factors that influence risky driving behaviours may be more likely to be present among certain demographic groups. For example, studies have demonstrated that younger drivers tend to be higher in risk-related personality traits (Wilson & Daly, 1985), and driving anger (Sullman, 2006), than older drivers. This is in line with more general research findings, and global trends, which indicate that young people are consistently overrepresented in RTC fatality statistics (Begg & Langley, 2001).

1.4 Risk-Taking by Young Drivers

A body of research has reported that young people, and males in particular, are disproportionately involved in RTCs (Doherty, et al., 1998;

Hatfield & Fernandes, 2009; Özkan & Lajunen, 2006). Males have been found to score higher on measures of risky driving behaviours (Zuckerman & Kuhlman, 2000), and to report more speeding violations (Machin & Sankey, 2008), than females. Further, while female drivers are most likely to be involved in RTCs that result from perceptual errors, male drivers tend to be involved in RTCs caused by violations such as speeding, drink-driving, and unwarranted risk-taking (West, Elander, & French, 1993). Young males (i.e. those aged 18-24; Marcil, et al., 2001) have been found to take more risks on the road, such as speeding and close-following, than any other driver population (Deery, 2000; Jonah, 1990, 1997; Sarma, et al., 2012).

In Ireland, 17-24 year old males are six times more likely to be killed in a RTC than any other driving cohort (RSA, 2011). A number of explanations for this have been put forward, including factors linked to inexperience (i.e. the "young driver problem"), and general risk-taking characteristics associated with youth (i.e. the "problem young driver").

Experience. Since young drivers tend to also be novice drivers, a body of research has attributed the persistently high rates of RTCs among young people to inexperience. Research has suggested that driving experience, typically measured by the amount of time an individual has spent driving, plays a strong role in RTC involvement (McKnight & McKnight, 2003). Driving can be a difficult task to master, and the cognitive skills required for interaction with complex traffic situations can take years of experience to develop (Deery, 2000). Driver error is likely to be high among novice drivers (McKnight & McKnight, 2003), and the learning curve they face makes their RTC risk high, regardless of age (Williams, 2006). Importantly, though, it is not just driver error that causes RTCs among novice drivers. Studies have indicated that inexperienced drivers are more likely to engage in risky driving behaviours, such as speeding and close following, than more experienced drivers (Williams, 2006).

Since people tend to begin driving during adolescence, at a stage when engagement in risky behaviours is high, this has been suggested to explain the high levels of risky driving among novice drivers (Falk, 2010; Hatfield & Fernandes, 2009; Jonah, 1990; White, Cunningham, & Titchener, 2011). The tendency for novice drivers to engage in risky driving is a cause for concern, particularly given that a lot of driving experience and driving skill are required to perform high-risk manoeuvres. Deery (2000), for example, notes that a higher level of driving skill (i.e. hazard perception reaction time) is required when an individual is engaged in a high-risk driving behaviour (i.e. speeding).**A propensity for risk-taking.** Evidence from cognitive neuroscience suggests that structural and functional brain development may be responsible, at least in part, for a propensity towards risk-taking in adolescence. Neurological findings have suggested that the prefrontal cortex, which is the part of the brain associated with self-regulation, is still maturing during adolescence (Kuhn, 2006). Further, adolescents have been found to prioritise immediate (i.e. as opposed to long-term) gains, due to the disproportionate activation of certain sub-cortical systems, such as the accumbens (Galvan, Hare, Voss, Glover, & Casey, 2007; Galvan, et al., 2006). In short, young people may be, neurologically, less primed to consider the potential consequences of risky driving behaviours.

1.5 Predictive Models of Risk

On the whole, it would seem that a complex combination of factors, including demographic, neurological, trait, and state variables, influence the engagement in risky driving behaviours. A number of cross-sectional surveys have attempted to tie these bodies of literature together, with the aim of building predictive models of risk-taking. Ulleberg and Rundmo (2003) found that the personality traits of altruism, anxiety, normlessness, sensation seeking, and aggression explained 47% of the variance in attitude towards road safety. They also found that, while more aggressive individuals tended to perceive high risks associated with RTCs, they reported negative attitudes towards road safety, and higher levels of risky driving.

Results from a recent survey in Ireland, conducted among 1638 Irish drivers, found that speeding and rule violation was linked to being young and male, being higher in extraversion, lower in normlessness, having higher perceived behavioural control, higher driving anger, more positive attitudes towards speeding, drink-driving, and peers' risky driving behaviours, lower driving-related self-esteem and less belief that future RTCs would be caused by fate (Sarma, et al., 2012). As demonstrated by these detailed predictive models, the reasons underlying risky driving behaviours are likely to be extremely complex. It is also likely that different combinations of variables predict different risky driving behaviours. For example, research has suggested that “reckless driving”, defined as the tendency to disregard traffic law, leading to reduced traffic safety (Vaughn et al., 2011)is predicted by gender, time urgency and attitude, while drink-driving is predicted by a model including sensation seeking, perceived crash-risk, attitude to drink-driving, and optimism bias (Fernandes, Job, & Hatfield, 2007).

Understanding risky driving is of central importance in the prediction and prevention of RTCs caused by human behaviour. Researchers are adopting complex, state-trait approaches to explain why some individuals may be more likely than others to become angry, or take risks, in a driving situation (Deffenbacher, et al., 2001). A young male driver is statistically most likely to be involved in a RTC, but research would suggest that the likelihood of this occuring will increase if he is high in trait anger, and other risk-related personality variables, and if he encounters a driving situation that provokes state anger. In other words, the various demographic, trait, and state factors interact to create a high-risk group for RTC involvement.

1.6 Conclusions

Risky and reckless driving behaviour is a central concern for law-enforcement and road safety agencies. As indicated in the global statistics, young males are the most at-risk group for RTCs. The disproportionate levels of RTC involvement among this population is likely to be due to a combination of neurological developmental factors, personality traits, and state variables, that lead to increased risk-taking (Boyce & Geller, 2002; Galvan, et al., 2006; Ulleberg, 2001; Ulleberg & Rundmo, 2003; Wilson & Daly, 1985). The picture is emerging is complex, and it is becoming increasingly important for driving researchers to consider a number of relevant factors, and their interaction, in predicting risky driving.

Based on the predictive models of risky driving that have emerged from the literature, national and international road safety bodies have gone to considerable effort and expense in their attempts to change driver practice. These agencies have designed and implemented persuasive communication campaigns, targeted at young male drivers, aimed at reducing risky driving behaviours.

2. Chapter Two

Threat Appeals: Theory and Application to Road Safety Campaigns.

This chapter examines the use of threat-based messages in health-promotion campaigns, particularly in the context of road safety advertising. It provides an overview of previous empirical research in this area, and highlights current perspectives, key issues, and future directions. The chapter begins with a general outline of the persuasive communication literature (Section 2.1), and follows with a more specific discussion relating to threat-based messages (Section 2.2). An overview of theoretical and experimental threat appeal research is then presented, highlighting concerns raised by researchers, inconsistent experimental findings, and current theoretical perspectives. Finally, the application of threat appeal research to the area of road safety is discussed, with emphasis on relevant issues and key questions.

There are a number of key points to emerge from this chapter. First, threat-based messages remain a key focus of road safety advertising campaigns, and therefore warrant frequent review and systematic evaluation. Second, despite ethical and practical concerns raised by researchers, contemporary theoretical models suggest that threat appeals have the potential to be effective in deterring health-risk behaviour, provided a number of conditions are met. Finally, while there is some clarity within the theoretical literature, in terms of key variables, findings have been obscured by a number of methodological limitations and inconsistencies in the experimental research, making it difficult to draw generalised conclusions or make authoritative recommendations to policy-makers.

2.1 Persuasive Communication and Risk

Miller (1980) defined persuasive communication as “any message that is intended to shape, reinforce, or change the responses of another or others” (p. 11). A core aspect of this definition is the emphasis it places on intention. There is a *conscious* process involved in persuasion that aims to change thoughts or behaviour, through the communication of a message (Bettinghaus & Cody, 1994). Persuasive messages are regularly employed by health researchers and practitioners in an attempt to motivate the adoption of a healthy behaviour, or to deter the engagement in a risky one (Gallagher & Updegraff, 2012). Although the aim of these health-promotion messages is, invariably, the recommendation to engage in safe, healthy behaviour, the approach they adopt, and their content, tends to vary widely.

First, the messages can be gain-framed, aiming to highlight the potential benefits of adopting a recommended, healthy behaviour (e.g. engaging in physical activity), or they can be loss-framed, with an emphasis on the potential negative consequences of continuing to engage in the health-risk behaviour (O'Keefe & Jensen, 2008). Alternatively, messages can be “mixed-frame”, containing both gain-framed and loss-framed elements (Latimer et al., 2008). So, an anti-smoking appeal might place emphasis on the benefits of quitting (i.e. gain-framed), it might underline the undesirable, and potentially fatal, consequences of continuing to smoke (i.e. loss-framed), or it might contain elements of both (mixed).

Sibley and Harré (2009) found that advertisements that depicted people exhibiting cautious driving behaviour, choosing safe alternatives to risky driving and thereby avoiding negative consequences (i.e. gain-framed), were more effective than messages depicting people engaging in risky driving behaviours (e.g. drink driving), and experiencing negative consequences such as a RTC (i.e. loss-framed). Importantly, though, findings from another recent study (Kaye, White, & Lewis, 2013) suggest that individual differences may affect the ways in which gain-framed and loss-framed messages are processed. Specifically, Kaye and colleagues (2013) found that reward-sensitive individuals showed higher processing of social gain-framed messages, and perceived these messages to be effective, due to an attentional bias towards incentive stimuli. However, this effect did not affect reward-sensitive individuals’ behavioural intentions. This suggests that the effectiveness of gain/loss framed messages may depend on an individual’s personality, although the differential effects on behaviour remain unclear.

Second, persuasive communications may take the form of information-based, rational messages, that present objective information and target the cognitive processes of the audience, or they may be emotion-based, and aim to change behaviour through the use of emotive pictures or graphic footage (McKay-Nesbitt, Manchanda, Smith, & Huhmann, 2011). A body of research has suggested that, particularly for younger audiences (Delaney, Lough, Whelan, & Cameron, 2004), emotion-based appeals are more effective than non-emotional messages. For example, results from a recent systematic-review of the effectiveness of health warnings on tobacco products indicated that large, picture-based messages, that evoke an emotional reaction, are significantly more effective than small, text-based messages (Hammond, 2011).

These emotional appeals can be either positive (e.g. humour-based), or negative (e.g. threat-based). Within a road safety context, the vast majority of emotion-based appeals used in advertising campaigns are negative and threat-based (Lewis, Watson, & White, 2008), and their use has sparked a plethora of empirical research. It is these negative, threat-based persuasive messages, aimed at changing risky driving behaviours, that represent the focus of the current programme of research.

2.2 Threat Appeals

In their meta-analytic review of the literature, Peters and colleagues (Peters, Ruiter, & Kok, 2012) define threat as the danger of harm, typically consisting of some level of severity (i.e. how serious it is) and susceptibility (i.e. how vulnerable an individual is to it). A threat-based message, or “threat appeal”, is a persuasive communication that attempts to change behaviour through the presentation of threatening material. Some researchers argue that all health-promotion campaigns are in some way threat-based, or fear-arousing, since they focus on a serious health-risk (Witte & Donohue, 2000).

Threat appeals have been widely adopted by health-promotion professionals, and have been employed in mass-media campaigns and advertisements (Soames Job, 1988) in a number of contexts, including risky driving (Carey & Sarma, 2011; Jessop, et al., 2008; Lennon, Rentfro, & O’Leary, 2010), smoking (Keller & Block, 1996; Smith & Stutts, 2003), binge-drinking (Jessop & Wade, 2008; Moscato, et al., 2001), and tanning (Keesling & Friedman, 1995; McMath & Prentice-Dunn, 2005). Road safety, over and above other health-related disciplines, is renowned for its prominent use of threat appeal messages (Lewis, et al., 2007). Typically, road safety advertising campaigns attempt to discourage risky driving by presenting graphic representations of consequences that may occur as a result of a RTC (e.g. serious or fatal injuries), as well as recommending a behaviour that may reduce the likelihood of this occurring (e.g. reducing speed).

Despite their prevalence, threat appeals have provoked controversy for both ethical and practical reasons, and their effectiveness in producing behaviour change has been questioned (De Hoog, Stroebe, & De Wit, 2008; Hastings & MacFadyen, 2002; Hastings, et al., 2004). This skepticism is partly due to inconsistent findings in the empirical research. Specifically, while some papers argue that threat appeals can be highly effective, provided a number of conditions are met (e.g. Witte & Allen, 2000), findings from other studies suggest that they can lead to maladaptive responses, and may even provoke an increase in the risky behaviour (e.g. Carey & Sarma, 2011; Jessop, et al., 2008).

Despite the inconclusive research findings, threat appeal messages continue to play a key role in health promotion campaigns. Road safety agencies have increasingly sought out the advice and expertise of researchers and psychologists, in an effort to make targeted, relevant, effective campaigns and advertisements (Australian Traffic Council; ATC, 2006). This has resulted in an array of empirical research that spans several decades, a summary of which is now provided.

2.3 An Overview of Threat Appeal Research: 1950-2013

Psychological research into threat appeals dates back to 1953 (Witte & Allen, 2000), making it one of the oldest topics in the mass communications literature (Rotfeld, 1988). During the early 1950s, the use of threat appeals was largely based on the then "common-sense" belief that the more fear the campaign evoked, the greater the chance the recommended behaviours would be carried out (Higbee, 1969). The premise that fear was the most effective form of persuasion, upon which most campaigns were based, was questioned by Janis and Feshbach (1953). In this study, the researchers divided a sample of students into three groups, each of which received a health-promotion message. The messages all related to dental hygiene, but differed in their level of threat (i.e. the extent to which they highlighted potential negative consequences). Findings suggested that, while high threat appeals were effective in arousing emotional reactions, conformity to the message's recommendations was most strongly produced by a subtle or "minimal" appeal (p. 92).

Following the publication of the Janis and Feshbach study, the assertion that low threat appeals were the most effective became pervasive, appearing in a number of Psychology and Social Psychology textbooks (Higbee, 1969). However, while several subsequent studies reported similar findings (e.g. Janis & Terwilliger, 1962; Krisher, Darley, & Darley, 1973), a number of other studies highlighted the effectiveness of more highly threatening messages (Berkowitz & Cottingham, 1960; Insko, Arkoff, & Insko, 1965), and others reported mixed or inconsistent findings (Leventhal, 1965). By 1969, several papers had proposed that these inconsistent threat appeal findings could be explained by conceptualising the fear-persuasion relationship as a curvilinear, inverted U-shape, where a low level of threat is seen as being insufficient to motivate behaviour change, while too high a threat level may provoke defensive avoidance reactions (Janis, 1967). This curvilinear relationship is conceptually similar to the Yerkes-Dodson law, which relates to arousal and performance (Yerkes & Dodson, 1908).

In an early attempt to review the existing threat appeal research findings, Higbee (1969) supported the use of this curvilinear model, and made a number of other key points. First, despite researchers claiming that high threat appeals trigger defensive avoidance responses, making them less effective than lower threat messages, Higbee argued that this was largely untrue and unsupported. Second, he recommended that a threat appeal should make specific recommendations regarding the desirable health behaviour, and that these recommendations should be easy to implement. Third, he drew attention to individual differences in threat appeal processing, and suggested that an individual's self-esteem may influence their responses. Finally, he contended that high fear arousal is generally more effective than low fear arousal, provided a number of conditions are met. Although this review was influential and provided a valuable synthesis of the literature, the curvilinear model, and a so-called "optimal level of fear" (i.e. the point in the curvilinear model at which threat appeals are most effective), has since been refuted by researchers, and is unsupported by data (Rotfeld, 1988).

Towards the end of the twentieth century, the number of threat appeal studies continued to grow, and researchers began identifying particular conditions under which threat appeals are more likely to be effective. For example, Keller and Block (1996) contended that a certain amount of elaboration on the negative consequences of the depicted behaviour is necessary, while too much elaboration interferes with processing of the message and may be ineffective. A much-needed review and meta-analysis of the research was provided by Witte and Allen (2000). Findings from this analysis indicated that strong threat appeals produce the greatest levels of behaviour change, when accompanied by messages that create high perceptions of efficacy among the audience. Specifically, when the audience are presented with a recommended response that they believe they are capable of performing, and that they believe will effectively minimise the threat, their perceptions of efficacy will be high, and the threat appeal will be effective. This reflected conclusions drawn by a number of earlier meta-analyses, which indicated that higher levels of threat in a message are more effective than low levels, once certain variables are present (Boster & Mongeau, 1984; Sutton, 1982; Witte & Allen, 2000). A number of subsequent empirical studies (Cauberghe, De Pelsmacker, Janssens, & Dens, 2009; Lewis, Watson, & White, 2010) have supported these conclusions.

2.4 Threat Appeals: Criticism

Despite these findings, several papers published in the past decade have argued against the use of threat-based messages in persuasion. For example, Hastings, Stead and Webb (2004) criticise the use of threat appeals, pointing out methodological problems with experiments in the area, and ethical questions regarding the responses they evoke. Their use has come under further criticism following the findings of a number of recent experimental studies, which demonstrated that threat appeals can, under certain conditions, lead to maladaptive and destructive responses (e.g. Carey & Sarma, 2011; Jessop, et al., 2008; Taubman Ben-Ari & Findler, 2003). For example, research has found that, among individuals who perceive driving to be relevant to their self-esteem, presenting a death-related threat may lead to an increase in risky driving intentions (Carey & Sarma, 2011). This is discussed further later in this chapter. Further, the lack of longitudinal studies in the literature has made it problematic to make inferences about the long-term effectiveness of threat appeals, particularly since intervention effects tend to take time to manifest themselves (Earl & Albarracín, 2007). In order to draw together the research findings, and to provide a cohesive and inclusive perspective on the psychology of threat appeals, several theoretical models have been proposed.

2.5 Theoretical models

By adopting a clear, falsifiable theory, the planning, analysis and interpretation of threat appeal research becomes easier and more precise (Hutchinson, 2012). A myriad of theoretical models have been proposed and adopted by researchers, to help delineate the complex psychological processes surrounding threat appeals and health-risk behaviours. These include the Theory of Planned Behaviour (TPB; Ajzen, 1985), the Health Belief Model (HBM; Becker, 1974), the fear-as-acquired drive model (Hovland, Janis, & Kelley, 1953), the Parallel Response Model (PRM; Leventhal, 1970), Protection Motivation Theory (PMT; Rogers, 1975) the Extended Parallel Process Model (EPPM; Witte, 1992), and Terror Management Theory (TMT; Greenberg, et al., 1986).

The Theory of Planned Behaviour (Ajzen, 1985) has been used extensively by health and social psychologists in an attempt to understand and explain behaviour change. It asserts that an individual's behaviour is ultimately determined by their *intention* to carry out that behaviour. Intention, in turn, is affected by three key variables: attitude (i.e. positive or negative evaluations of the behaviour), subjective norms (i.e. how the behaviour is viewed by significant others), and perceived behavioural control (i.e. how easy it would be for the individual to carry out the behaviour). The TPB has been applied widely to health-risk behaviours, including risky driving (Conner, Smith, & McMillan, 2003; Forward, 2009; Parker, Manstead, Stradling, Reason, & Baxter, 1992), condom use (for a meta-analysis, see Albarracin, Johnson, Fishbein, & Muellerleile, 2001), and smoking (Godin, Valois, Lepage, & Desharnais, 1992; Higgins & Conner, 2003). It is an appealingly parsimonious theory (Perugini & Bagozzi, 2001), and research has generally provided support for the utility of its core variables (Armitage & Conner, 2001; Hastings, Angus, & Bryant, 2011). Its cognitive focus, however, means that it fails to account for the potential influence of affective processes on decision-making (Bish, Sutton, & Golombok, 2000), which are likely to be key in determining responses to threat appeal messages.

The Health Belief Model was one of the first behavioural models used in health research and education (Hastings, et al., 2011). It was developed with the aim of understanding people's failure to take preventative measures, such as vaccination, against health-risks and diseases. The model focuses on five constructs that, it proposes, determine the amount of behaviour change likely to be exhibited in response to a health-threat: perceived susceptibility (i.e. perceptions of one's vulnerability to the health-threat), perceived severity (i.e. perceptions of how serious the health-threat is), perceived benefits (i.e. perceptions of the effectiveness of the recommended behaviour), perceived barriers (i.e. perceptions of the potentially negative costs associated with adopting the behaviour), and prompts to action (i.e. internal or external events that activate cues to carry out the behaviour). So, for example, the HBM might assert that an individual will be likely to adopt breast cancer screening behaviours (e.g. Glanz, Rimer, & Viswanath, 2008) if they (a) believe that breast cancer is serious, (b) believe that they are at risk of developing the disease, (c) believe that the recommended screening behaviours will effectively reduce their risk of dying from the disease, (d) see no major barriers to carrying out screening behaviours, and (e) are reminded by their friends to carry out the behaviour. Evaluations and reviews of the HBM have varied in their support, and a recent meta-analysis suggested that the direct-effects version of the model (i.e. the type most commonly employed by studies in the area) should no longer be used, due to inconsistent effects across studies, and poor predictive power of its core constructs (Carpenter, 2010). Overall, while the HBM and the TPB have been valuable in aiding our understanding of health-related decision-making processes, several other theoretical models have been proposed that examine behaviour specifically in response to threat appeal messages. Witte and Allen (2000) and Dillard (1994) have grouped these threat appeal theories into three distinct categories: drive theories, parallel response models, and subjective expected utility (SEU) models.

Drive theories, such as the fear-as-acquired drive model (Hovland, et al., 1953), posit that the fear aroused by threat appeal messages "drives" individuals to change their behaviour. Depending on the level of fear, the nature of the behavioural change may be adaptive (e.g. adopting the recommended behaviour), or maladaptive (e.g. exhibiting defensive avoidance responses; Witte & Allen, 2000). Drive models had, at their premise, the notion of a curvilinear, inverted U relationship, where moderate amounts of fear arousal are more likely to lead to adaptive behavioural responses than extremely high or low levels. As noted earlier in this chapter, the curvilinear fear model was criticised for being non-falsifiable and unsupported by empirical data (Rotfeld, 1988), leading drive theories to be heavily criticised (Leventhal, 1970; Mewborn & Rogers, 1979). Overall, despite being popular among early threat appeal researchers, early drive models have since largely been discounted due to validity problems, a failure to specify moderator variables, and an overall lack of empirical support (Boster & Mongeau, 1984).

Following on from the limitations with drive theories, Leventhal (1970) developed a new, alternative model of fear appeals, the Parallel Process Model, or Parallel Response Model (PRM). The PRM posited that exposure to a threat appeal leads to two distinct processes within an individual: danger control (i.e. the individual is motivated to control, or reduce, the threat), and fear control (i.e. the individual is motivated to control, or reduce, the fear experienced in relation to the threat). Danger control (i.e. cognitive) processes are likely to lead to the adoption of the recommended behaviour, as a way of reducing the risk of experiencing an aversive outcome. The engagement in fear control (i.e. emotional) processes, on the other hand, may lead to maladaptive behavioural outcomes, since the focus is on reducing the level of fear experienced. These processes are discussed in more detail during the EPPM section, later in this chapter. Overall, despite its theoretical promise, the Parallel Response Model was criticised for being vague and untestable (Rogers, 1975), and focus turned instead to cognitive models, such as Rogers' PMT.

Protection Motivation Theory (Rogers, 1975), and extended versions of PMT (e.g. Block & Keller, 1998), propose that the motivation to protect oneself against a threat or risk is based on the activation of, and interaction between, two cognitive appraisals (Cameron, 2009). The first, a threat appraisal, involves an individual's perceptions of severity (i.e. of the threat) and susceptibility (i.e. to the threat) of the threat-based message content. The second, coping, appraisal involves an individual's perceptions of the recommended behaviour, and consists of a combination of perceived response efficacy (i.e. perceived effectiveness of the recommended behaviour), and perceived self efficacy (i.e. the individual's belief in their ability to perform that behaviour; Hastings, et al., 2011). The decision to engage in a particular behaviour is based, according to PMT, on the interaction between these four variables (i.e. severity, susceptibility, response efficacy and self efficacy). PMT has been applied to health-risk behaviours in a number of studies (for a meta-analysis, see Floyd, Prentice-Dunn, & Rogers, 2000), and revised PMT models have largely held up empirically (Mulilis & Lippa, 1990). However, PMT has come under criticism for its failure to account for the ineffectiveness of threat appeals (Witte & Allen, 2000), its lack of clarity surrounding the role of fear arousal (Dillard, 1994), and its assumption that individuals process information rationally, without accounting for the potential influence of habit or the environment (Cameron, 2009). In order to overcome these limitations, and drawing on key aspects of preceding models, Witte (1992) proposed the EPPM.

The Extended Parallel Process Model (EPPM)

By drawing on PMT, extending Leventhal's (1970) PRM, and with the aim of re-integrating emotion into threat appeal theories, Witte (1992) proposed, developed, and tested a contemporary model of threat appeals: the EPPM. In the EPPM, Witte addressed limitations of previous models, like PMT, by offering an explanation as to why certain studies find threat appeals to be effective in reducing risky behaviour, some find no impact, and others report "boomerang" results, where threat appeals lead to an increase in maladaptive behaviour.

According to the EPPM, a threat appeal leads individuals to one of two possible appraisals, which lead to one of three possible outcomes (Witte & Allen, 2000). First, the content of the threat appeal message is appraised in terms of its level of threat. Perceived threat, Witte proposes, is determined by perceived severity of the threat (e.g. "skin cancer is a serious disease"), and perceived susceptibility to the threat (e.g. "my risk of getting skin cancer is high"). If the threat is not considered to be high, individuals will not be likely to process the message any further. If, however, the content of the threat appeal is considered high on severity and susceptibility, an individual may begin a second appraisal, relating to the efficacy of the recommended response. Perceived efficacy, according to the EPPM, is made up of response efficacy (i.e. beliefs about the effectiveness of the recommended behaviour, e.g. "wearing sunscreen is an effective way to avoid getting skin cancer") and self-efficacy (i.e. beliefs about one's ability to carry out the recommended behaviour, e.g. "'I could easily apply sunscreen and thereby reduce my chances of getting skin cancer").

Based on perceptions of efficacy, an individual may engage in one of two possible responses: danger control, or fear control (as in Leventhal's PRM). If perceptions of threat and efficacy are high, danger control processes are initiated, involving the consideration of possible ways to reduce or remove the threat, such as adopting the recommended responses. If efficacy perceptions are low, however, and threat is high, fear control processes may be triggered. In this instance, the individual will attempt to reduce or remove the fear by engaging in denial (e.g. "this disease won't happen to me"), or avoidance (e.g. "If I don't think about it, it might go away"), responses (Witte, 1992, 1994; Witte & Allen, 2000).

In other words, when a threat-based message is sufficiently high in severity and susceptibility, and perceived efficacy is high, individuals will be motivated to control the threat by adopting the recommended response (i.e. danger control). Contrastingly, when the threat is too high, and the perceived efficacy too low, rather than trying to reduce the risk of the threat (i.e. by engaging in a healthy behaviour), the individual will instead focus on relieving the fear (Eppright, Hunt, Tanner Jr, & Franke, 2003), which can result in maladaptive behavioural responses (i.e. fear control). In short, high threat, high efficacy messages have the greatest potential for creating behaviour change (Witte & Allen, 2000).

Importantly, the construct of efficacy is a characteristic of both the threat appeal itself (i.e. the provision of a recommended coping strategy), and the audience's response to that appeal (i.e. the individual's perception of how effective that strategy is). Lewis and colleagues (2010), suggest that the "true level" (p. 461) of response efficacy is determined by the *perceived* effectiveness of a recommended response, hence it is ultimately an individual characteristic.

In tests of the EPPM, efficacy has largely been treated as a process variable, and is generally measured as part of a post-manipulation questionnaire (Lewis, LaRose, Rifon, & Wirth, 2007). Among the threat appeal studies that have directly manipulated efficacy levels, most have done so by creating low and high efficacy conditions, involving the presence or absence of additional written information. For example, studies examining responses to threat appeal messages relating to skin cancer have told participants in a high efficacy condition that skin cancer is easily preventable by using sunscreen. In this case, participants in the low efficacy condition received no such information (Good & Abraham, 2011; Rimal & Real, 2003). Similarly, high efficacy conditions in anti-smoking studies have provided smokers with strategies for quitting smoking, like using nicotine patches (Wong & Cappella, 2009).

Within a driving context, manipulating efficacy in this way is more complicated. Specifically, as noted by Tay (2005a), while it is relatively straightforward to provide an effective, achievable strategy for avoiding drink-driving (i.e. taking a taxi, nominating a designated driver) and fatigued driving (i.e. pulling the vehicle over and drinking a caffeinated beverage), few such coping strategies exist in relation to speeding. This means that efficacy manipulations, in experiments that examine speeding, can be difficult to design. Lewis and colleagues (Lewis, Watson, & White, 2009), for example, point out that, since response efficacy is widely considered one of the most important characteristics in message persuasiveness, it is crucial that it is addressed in some form, irrespective of the behaviour being targeted. Lewis and colleagues (2010) recommended that researchers should try to adopt new, creative approaches to increasing levels of efficacy in experimental studies.

The Extended Parallel Process Model has been adopted in a number of areas related to health promotion. A test of its constructs, in the context of Acquired Immunodeficiency Syndrome (AIDS) prevention (Witte, 1994), provided general support for the model, while a test of the theory in relation to a Meningitis campaign (Gore & Bracken, 2005) supported its main predictions, but found that a marginal amount of threat is sufficient in creating behaviour change among the target audience.

Within a road safety context, the EPPM would suggest that, if a threat appeal message produces high levels of perceived severity and susceptibility (i.e. the consequences of the depicted RTC are serious, and relevant to the audience), high response efficacy (e.g. "driving slowly is an effective way to avoid road traffic collisions"), and self efficacy (e.g. "I could drive slowly and, in that way, reduce my chances of being involved in a road traffic collision"), then an individual is likely to be motivated to adopt the recommended behaviour (i.e. drive more slowly; Carey, McDermott & Sarma, 2011). Several studies have examined risky driving behaviours through the lens of the EPPM (Cauberghe, et al., 2009; Lewis, et al., 2010; Witte & Donohue, 2000), and found perceptions of efficacy, and threat-by-efficacy interactions, to ultimately determine the effectiveness of the message. Cauberghe and colleagues (2009), for example, found perceived threat and perceived efficacy to have independent effects on message involvement (measured using a self-report message involvement questionnaire), with the impact of efficacy cognitions being stronger than that of threat. Similarly, Lewis and colleagues (Lewis, et al., 2010) found a positive correlation between response efficacy and message acceptance, and a negative correlation between response efficacy and message rejection.

Overall, despite proposals to refine the model by adding additional variables, and accounting for cultural differences, the EPPM is largely unchanged since its development (Maloney, Lapinski, & Witte, 2011), and remains among the most contemporary, and widely adopted, theories in the field (Lewis, et al., 2010; Maloney, et al., 2011; Popova, 2012; So, 2013). Principles of the EPPM, particularly relating to the role of efficacy, have received substantial empirical support, with a number of recent reviews, updates, and commentaries having highlighted its merit as a theoretical model (Gore & Bracken, 2005; Maloney, et al., 2011; Popova, 2012; So, 2013). Based on these recommendations, Studies 3 and 4 in the current research draw on, and have been informed by, the EPPM.

One important limitation of all preceding theoretical threat appeal models, including the EPPM, relates to the emphasis they place on the level of threat in the message, which, according to Hunt and Shehryar (2011) has come at the expense of, and led to a lack of focus on, the “qualitative nature” (p. 373) of the threat. Research into TMT suggests that the amount of mortality salient (i.e. death-related) content in the message plays an important role in determining the audience’s responses. Specifically, some road safety threat appeal messages depict a RTC involving the death of the driver or passengers, while others show non death-related consequences, such as injury or undesirable social outcomes. Since the EPPM fails to account for this, Hunt and Shehryar propose that TMT principles should be integrated into threat appeal research.

Terror Management Theory (TMT)

TMT was proposed by a group of researchers from the University of Kansas (Greenberg et al., 1986), based on the writings of cultural anthropologist, Ernest Becker. In Becker’s book, *The Denial of Death,* he described a fundamental paradox that he believed to be at the core of human existence. As humans, we have a unique awareness of our own mortality; we are aware that our death is inevitable, and that it could occur anytime, in any number of ways. Becker proposed that this knowledge is juxtaposed with our survival instinct, that this creates a paradox, and that the ultimate goal of human life is to deal with this paradox. In other words, we continuously strive to manage our existential anxiety (Becker, 1973).

Greenberg and colleagues followed on from Becker's work, proposing that we manage this anxiety, or "deny death", in a number of ways. According to TMT, once death is made salient to us (i.e. once our mortality is brought into our conscious awareness), we employ a number of defensive mechanisms, including investing in a cultural worldview, and bolstering our self-esteem. The latter of these, the role of self-esteem, has been inherently linked to the threat appeal literature in a number of studies (see Burke, Martens, & Faucher, 2010).

TMT suggests that, following a mortality salient threat, we endeavour to bolster our self-esteem. For example, after being exposed to a death-related message, we are more likely to engage in a behaviour that is perceived to be beneficial for our self-esteem, as a distal, defensive response to mortality salience. Importantly, for a number of young males, self-esteem can be linked with fast driving (Carey & Sarma, 2011). Following on from this, because a majority of threat-based road safety advertisements end in death (i.e. death of the driver, the passenger(s) or a pedestrian), and therefore make mortality salient, such advertisements may lead to an increase in risky driving, among those who find risky driving to be relevant for their self-esteem.

Evidence for this has been found in a number of recent experiments (Carey & Sarma, 2011; Jessop, et al., 2008; Shehryar, 2011; Taubman Ben-Ari & Findler, 2003). Specifically, several studies have found increased intentions to drive dangerously (Carey & Sarma, 2011; Jessop, et al., 2008; Taubman Ben-Ari, Florian, & Mikulincer, 1999), following exposure to mortality salient information, among males with high driving-related self-esteem. Shehryar and Hunt (2005) found participants who were exposed to a death-related threat appeal rejected the message, whereas this rejection was not present among those exposed to an appeal depicting physical injury or an arrest. The authors inferred that when a threat has high mortality salience (i.e. when the consequence of the unsafe behaviour is death), then individuals who perceive the targeted behaviour to be beneficial for their self-esteem are likely to elicit unique, maladaptive responses.

Such findings are not limited to the risky driving literature. In fact, in the face of mortality salience, intentions to engage in binge drinking (Jessop & Wade, 2008), tanning (Routledge, Arndt, & Goldenberg, 2004) and smoking (Hansen, Winzeler, & Topolinski, 2010) have all been found to increase, among those who perceive these behaviours to boost self-esteem. Among individuals who do not perceive driving to be a source of self-esteem, a threat appeal message may reduce risky driving. This response can also be explained through the lens of TMT. A recent paper by Hutchinson (2012) points out that a finding of decreased risky driving following a threat appeal is not incompatible with TMT, since driving safely can be seen as conforming to social norms, which is another defence mechanism for dealing with existential anxiety.

Drawing literature in this area together, Goldenberg and Arndt (2008) integrated TMT and health psychology by proposing a Terror Management Health Model (TMHM). They provide a possible explanation for the engagement in health-risk behaviours by individuals who are aware of the health-risk involved. For example, they suggest that a health promotion campaign (including warning labels on cigarette packets) which attempts to reduce smoking, by equating smoking with death, is likely to have the opposite effect to that intended. This is particularly likely to happen if an individual’s self-esteem or worldview is tied up in smoking – if, for example, they identify with a worldview that smoking is “cool”. Thus, TMHM proposes that subconscious, death-related thoughts may impede the effectiveness of a threat appeal message, if that message relates to mortality. In providing an extensive theoretical framework for health-relevant decisions in the face of mortality salience, the paper by Goldenberg and Arndt has important implications for policy-makers.

A meta-analysis of the TMT literature (Burke, et al., 2010) found the TMT mortality salience hypothesis to be robust. Specifically, moderate to large effect sizes were found across a range of manipulation types (i.e. death-related essay questions, subconscious death-related priming, death-related survey-based questionnaire, and death-related stories or videos), and across a variety of outcomes (i.e. attitude-based, behavioural, and cognitive). Based on this meta-analysis, on the TMHM, and on the recent paper by Hunt and Shehryar (2011), it can be concluded that TMT may provide a valuable addition to existing threat appeal frameworks, by accounting for differences in the qualitative nature of the threat, and providing detailed explanations for the exhibition of defensive risky driving increases (Carey & Sarma, 2011; Jessop, et al., 2008; Taubman Ben-Ari, et al., 1999). Aspects of the current research design, therefore, were guided by TMT principles.

2.6 Current Perspectives

There is a great deal of overlap between theoretical models, since the theories in this area tend to draw on, and borrow from, earlier models (Witte & Allen, 2000). Overall, though, current perspectives support the validity of EPPM, and its related constructs. The dominance of the EPPM as a theoretical framework stems from the emphasis it places on the construct of fear, which was largely ignored by several preceding models (Lewis, et al., 2007; So, 2013). It also has an appealingly intuitive, easy-to-understand structure (Popova, 2012), and an integrative nature, through which it has drawn together important aspects of previous frameworks, and attempted to reconcile contradictory literature findings (Lewis, et al., 2007).

Overall, current perspectives highlight the importance of the role played by perceived threat (i.e. perceived severity and susceptibility), and perceived efficacy (i.e. perceived self efficacy and response efficacy) in moderating the impact of threat appeal messages on risky driving. The emphasis on efficacy perceptions is not specific to the EPPM, but has been highlighted across a number of threat appeal models (Ruiter, Verplanken, De Cremer, & Kok, 2004). PMT, for example, posits that if one can induce these types of cognitive responses, one can change behaviour. Meta-analytic research is largely in line with this, with findings suggesting that persuasive communications that focus on enhancing perceived efficacy are most likely to create positive behaviour change (Peters, et al., 2012; Witte & Allen, 2000).

2.7 Conclusions

Despite decades of controversy (Peters, et al., 2012), including ethical and practical concerns regarding their use (Hastings, et al., 2004), threat appeal messages continue to feature prominently in health-promotion campaigns in a number of contexts, including road safety. The conclusion from a majority of researchers at present, insofar as one can be drawn, is that threat appeals can effectively deter risky driving, provided perceptions of threat and efficacy are high (Cauberghe, et al., 2009; Lewis, et al., 2010; Peters, et al., 2012; Witte & Allen, 2000). It seems that there is agreement across the literature, conceptually at least, that these cognitive components play a key role in changing behaviour (Lewis, et al., 2010; Peters, et al., 2012). While a majority of threat appeal frameworks distinguish between different levels of threat in a message, TMT emphasises that there are variations in the nature of the content (i.e. the level of mortality salience) in the message (Hunt & Shehryar, 2011).

Importantly, despite some conceptual and theoretical clarity emerging in the threat appeal literature, the ways in which behaviour change has been measured in road safety studies have varied widely, making it problematic to draw generalised conclusions (Lewis, et al., 2007), or to identify the most effective strategies (Plant, Reza, & Irwin, 2011). The need for methodological cohesion across the experimental literature is apparent.

3. Chapter Three

Conceptual and Methodological issues in Road Safety and Threat Appeal Research.

This chapter examines conceptual and methodological limitations in the existing road safety and threat appeal literature. First, it outlines the way fear arousal has been conceptualised in previous threat appeal studies (Section 3.1). Specifically, it discusses the need for a distinction between the constructs of threat and fear, the potential for emotions other than fear (e.g. disgust) to be elicited in response to threat-based messages, and the complexity of the relationship between emotion and behaviour. Second, this chapter considers the methodological issues within this body of research (Section 3.2), particularly focusing on the ways in which driving behaviour and fear arousal have been measured in previous driving-related, threat appeal experiments.

There are three key points to emerge from this chapter. First, there is a general lack of coherence and consistency across experimental studies, in terms of the conceptualisation of key constructs, and the methodology employed. An up-to-date synthesis of the research findings is warranted. Second, this chapter highlights the lack of empirical research studies that have examined the impact of threat appeal messages on risky driving behaviours, within a controlled experimental setting. Finally, threat appeal experiments, to date, have varied substantially in their emphasis on, and treatment of, fear arousal. Many such studies have failed to include a measure of fear and, among those that have, few have employed objective means, such as physiological measures, to do so. Increased conceptual clarity is required which may, in turn, encourage greater methodological rigour.

3.1 Conceptual Problems

Fear Arousal in Threat Appeal Research

Fear is a basic emotion, elicited as a defensive response to a specific, immediate threat (Quinn & Fanselow, 2006; Woody & Teachman, 2000). Within the context of threat appeal studies, researchers suggest that fear arousal is prompted by a threatening stimulus, creating a negative emotional state (Ruiter, Abraham, & Kok, 2001), which motivates action (or non-action) that reduces the threat. In other words, threat appeals aim to "scare people" (Witte, 1992, p.3) into aligning their behaviour with the recommended response in the message. This is the central premise upon which most threat appeal experiments are based.

Despite fear arousal playing an implicit role in the design of threat appeals, over the history of threat appeal research, the empirical literature has varied in the emphasis it has placed on the role of fear in examining and predicting their effectiveness. Early theoretical frameworks, for example (as discussed in Chapter 2), described a fear-behaviour relationship that was curvilinear, where a threat appeal's effectiveness depended on a so-called "optimal level" of fear being achieved (Janis, 1967). Subsequently, drive models (Ray & Wilkie, 1970), the PRM (Leventhal, 1970) and PMT (Rogers, 1975) were developed to help capture the complexity of the relationship more accurately. These later models incorporated a number of potential moderating factors, but placed little emphasis on fear arousal, largely treating its role as indirect (Lewis, et al., 2007). Although more recent frameworks, such as the EPPM (Witte, 1992) attribute a more central role to fear than its predecessors, the nature of the threat-fear-behaviour relationship remains unclear (Ordonana, et al., 2009).

Fear and Threat

A core problem with the conceptualisation of fear in the threat appeal literature is that many studies in this area have failed to clearly distinguish between the threat-based stimulus that aims to generate an emotional response, and the psychological fear response itself. Bolls and colleagues have referred to the need for this distinction several times (Bolls, et al., 2001; Lang, Bolls, Potter, & Kawahara, 1999), pointing out that conceptualising emotion (i.e. fear) as being a feature of the message, as well as a feature of the viewer's response, presents a major challenge for researchers. They recommend that this be addressed by clearly differentiating between emotional tone (i.e. a feature of the stimulus) and emotional experience (i.e. a feature of the response). Within the threat literature, the adoption of the term "threat appeal" (i.e. to replace "fear appeal"), is an attempt to separate emotional content from emotional response (Donovan & Henley, 1997; Lewis, et al., 2007). A second reason this distinction is important relates to the failure of threat appeal studies to control for emotions, other than fear, evoked by the message. Threat messages can elicit emotions such as disgust, guilt, shame and anger, and researchers have recognised that the interplay between these different emotions can determine the effectiveness of the message (Dillard & Nabi, 2006).

Disgust

Specifically, several studies have addressed the need to differentiate between the related emotions of fear and disgust, when examining responses to threat-based stimuli (Leshner, Vultee, Paul, & Moore, 2010; Yartz & Hawk, 2002). Fear and disgust are both, according to Yartz and Hawk, "negatively-valenced, highly-arousing, withdrawal-related" emotions (2002, p. 56). Disgust is evoked by stimuli that are revolting or impure (Woody & Teachman, 2000), such as body products (excretion), sex, body envelope violations, and death (Haidt, McCauley, & Rozin, 1994). Threat appeals that use graphic images of individuals being seriously injured or killed following a RTC may therefore be eliciting disgust, as well as, or instead of, fear. As pointed out by Leshner and colleagues (Leshner, et al., 2010), scenes in a threat message that elicit disgust may lead individuals to process the message in a different way to a message that does not contain such scenes (Morales, Wu, & Fitzsimons, 2012). To date, though, few experimental studies have measured or controlled for these types of emotions (Carey, et al., 2013).

The Emotion-Behaviour Relationship

The link between cognition and emotion, and that between emotion and action, has generated controversy among researchers (Mohiyeddini, Pauli, & Bauer, 2009). The complexity of the fear arousal response has been emphasised several times (e.g. Higbee, 1969; LaTour & Rotfeld, 1997; Mewborn & Rogers, 1979), yet it remains poorly understood, and tends to be over-simplified, in the threat appeal literature. Baumeister and colleagues (Baumeister & Lobbestael, 2011; Baumeister, Vohs, Nathan DeWall, & Zhang, 2007) have argued that, while psychology has long held that emotions directly cause behaviour (i.e. a direct causation model), in reality, the evidence-base for this position is "neither extensive nor convincing" (Baumeister, et al., 2007, p.171). The link between fear and behaviour, they suggest, is far more complex. They propose that a key function of emotion is to provide feedback as to the appropriateness of different actions. For example, take an individual who experiences fear after engaging in a dangerous driving manoeuvre. This negative emotional state, and the desire to avoid a similar state in the future, forces the individual to reflect on the initial decision to accelerate past the vehicle, and to identify lessons (if-then rules) to avoid a repeat of the action (i.e. dangerous-bend approaching = do not pass). These rules, according to Baumeister, are stored with an affective residue associating guilt with that action, thereby guiding future behaviour. Overall, their point is that the main proximal impact of emotions, such as fear, is on cognitions, and not on behaviour.

Other researchers have reached the same conclusion. Schwarz and Clore (Schwarz & Clore, 1996) asserted that the direct effects of emotion are more cognitive than behavioural, and that the onset of fear does not, in itself, predict "whether people will sell their stocks, listen to the weather report, or start running" (p.402). Drawing on the work of Baumeister (2007), researchers have argued that evoking a fear response in the audience of a threat appeal is intended, not to make them "freeze, fight or flight, but to stimulate and inspire learning" (van 't Riet & Ruiter, 2013, p. 110). In this way, if we perceive a persuasive message to be threatening, cognitions are triggered which in turn, influence behaviour. It may be cognitions, then, including those involving lesson-learning and if-then rules, that can impact on later decisions. If conceptualising a simple, causal relationship between emotion and behaviour is misleading, then models that do this may fail to take into account the complex processes involved. While it is difficult to directly apply this kind of feedback model to our understanding of threat-appeals, it raises the possibility that the impact of fear, elicited through such appeals, on behaviour, is mediated or moderated by the extent to which the fear results in cognitions.

3.2 Methodological Problems

Measuring the Impact of Threat Appeals on Driving Behaviours.

Empirical studies within the driving literature have employed different methodologies, operationalising and measuring driving-related dependent variables in a number of ways (Peters, et al., 2012). Several studies of risky driving have used large-scale, survey-based methods to examine factors associated with RTC involvement (e.g. Iversen & Rundmo, 2002; Sarma, et al., 2012), while others have used national collision data to estimate the impact of previously implemented road safety advertising campaigns. For example, one recent paper estimated that, allowing for heterogeneity, road safety campaigns coincided with a 9% reduction in RTCs (Phillips, et al., 2011), while another study found intentions to drink and drive among students were reduced following a road safety advertising campaign in New Zealand (Kreibig, et al., 2007). A meta-analysis of these types of studies found that, in general, mass-media campaigns can significantly reduce drink-driving (Tay, 2005b). Importantly, though, these findings relate to road safety campaigns in general, and cannot reliably be applied to a threat appeal-specific context.

Other studies have used an experimental, laboratory-based approach (Matthews & Desmond, 1998; Thiffault & Bergeron, 2003). Laboratory settings have a number of advantages, such as greater levels of experimental control (Gainsbury & Blaszczynski, 2011), but are also associated with problems relating to ecological validity (Plant, et al., 2011). Further, laboratory-based experiments present the question of how driving behaviour should be measured. Methods of assessing driving behaviour have varied greatly across experimental studies, with different approaches being associated with various advantages and disadvantages (Reimer, D'Ambrosio, Coughlin, Kafrissen, & Biederman, 2006). In experimental research, driving tends to be measured through self-report intention to act measures (e.g. Jessop, et al., 2008), driving simulators (e.g. Taubman Ben-Ari, 2000) or simulated driving scenarios presented through digital video images [i.e. Video Speed Test (VST; Horswill & McKenna, 1999a, 1999c; Horswill & Plooy, 2008; McKenna, Horswill, & Alexander, 2006; Thornton & Rossiter, 2003)]. An overview of each of these types of measures is now provided.

Self-report Driving Measures

In the road safety literature, a majority of threat appeal studies (Donovan, Jalleh, & Henley, 1999; Harré, et al., 2005; Nielsen & Shapiro, 2009; Panić, Cauberghe, & De Pelsmacker, 2011) have adopted the use of self-report outcome variables, such as anti-speeding attitude and message involvement (Cauberghe, et al., 2009; Janssens & De Pelsmacker, 2007), or message acceptance, defined as a change in belief or attitude in line with the threat appeal message (Good & Abraham, 2007; Witte, 1992). Message acceptance is typically measured by an attitude-change scale, or a self-reported behavioural intentions questionnaire (Lewis, et al., 2007).

Self-report measures of driving are popular across studies of traffic and transport psychology (af Wåhlberg, Dorn, & Kline, 2010), since valid self-report measures maintain confidentiality and are relatively easy to use and cost-effective. Further, some researchers have argued that self-report measures of risky driving correspond well to driving behaviour in a real-life context (West, et al., 1993). The limitations of these types of measures, in general, however, have been well documented (see Soames Job, 1988), and researchers within the driving literature have expressed a number of concerns related to their use (Lewis, et al., 2009). For example, Lajunen and Ozkan (2011) drew attention to the marked lack of driving-related studies that have thoroughly dealt with validity issues, and emphasised the importance of addressing the cross-cultural applicability of self-report measures of driving.

One particular problem associated with self-report measures of risky driving is the nature of the behaviours they assess. Specifically, as discussed in Chapter 1, a number of studies have used questionnaires that measure a combination of risky driving behaviours (e.g. speeding, driving under the influence of drugs or alcohol, texting while driving), and then calculated an average risky driving score for each participant (e.g. the Risky Driving Scenario Scale; Taubman Ben-Ari, et al., 1999). While such scales are useful in gaining a broad overview of driver risk-taking, and are reported to have adequate internal reliability (Taubman Ben-Ari, et al., 1999), they combine behaviours which may be motivated by different factors (see Fernandes, et al., 2010). They may have less utility than questionnaires which focus on one specific risky driving behaviour (e.g. speeding), in terms of their validity in predicting negative driving outcomes (e.g. RTCs).

A meta-analysis of forty-seven experiments by Webb and Sheeran (2006) found that a medium to large change in self reported intentions led only to a small to medium behaviour change. Overall, then, while self-report measures are useful, and easy-to-administer, concerns have been raised about their validity in predicting driving behaviour (Lewis, et al., 2007). Increasingly, driving studies are using behaviour-based dependent variables, such as data from driving simulators, video-based speed tests and in-vehicle data recorders.

Driving Simulators

A large number of studies have employed the use of driving simulators (e.g. Lee, et al., 2002; Taubman Ben-Ari, 2000), though there are few such studies within the threat appeal literature. Driving simulators enable the researcher to generate a safe situation in which participants' driving behaviour can be measured. Since driving simulators tend to be developed on an individual, independent basis, and tend to differ on a number of characteristics, such as the quality of the display (Godley, Triggs, & Fildes, 2002), it is important that information relating to the validity of the simulated driving experience is provided. In testing the validity of these simulators, a distinction has been made (Törnros, 1998) between absolute validity (the correspondence between driving behaviour exhibited on a task in the simulator and driving behaviour exhibited on a similar task in a real car) and relative validity (the correspondence between effects of different variations in the driving situation). Several studies have established the relative validity (i.e. differences between different experimental conditions are similar in direction and magnitude on the simulator and in a real car), but failed to establish absolute validity (i.e. the values obtained for simulator data and data from a real car, on a particular task, are the same; Bella, 2008; Godley, et al., 2002). Even aside from concerns of validity, simulators are expensive to purchase, and are not without additional limitations (see Liu, Miyazaki, & Watson, 1999). Video-based speed tests can offer a cost-effective alternative.

Video Speed Tests

Computer-based Video Speed Tests (VST; Horswill & McKenna, 1999a) involve presenting scenes depicting different driving situations, and measuring participants' responses. They have been used in a number of experimental studies in the United Kingdom (Horswill & McKenna, 1999a, 1999c; Horswill & Plooy, 2008; McKenna, et al., 2006), and have also been adapted for use elsewhere (Thornton & Rossiter, 2003). VSTs have been studied in relation to hazard perception training (McKenna, et al., 2006), and in efforts to understand the differential rates of RTC involvement among motorcyclists (Horswill & Helman, 2003). There has, to date, been no Irish-specific version of the VST adopted for use, which would provide a context-specific, low-cost alternative to driving simulators.

In-Vehicle Data Recording Devices (IVDRs)

The psychological realism and ecological validity of the dependent variables described above have been criticised (e.g. Soames Job, 1988; West, et al., 1993), as has the potential for social desirability biases to confound results (af Wåhlberg, 2010). The gold standard in driving research is a naturalistic driving approach, but this is almost impossible to conduct due to the resource and ethical implications. Several studies have used IVDRs in cars, which measure behaviour in a real-life setting, and therefore provide an ecologically valid measure (Farmer, Kirley, & McCartt, 2010; Toledo & Lotan, 2006; Toledo, Musicant, & Lotan, 2008). Recently, the feasibility of using phone applications as a measure of driving behaviour has been investigated by researchers (Kervick, O'Hora, & Sarma, submitted).

Self-report driving measures, driving simulators, VSTs and IVDRs are the four primary means through which driving has been measured in experimental studies. While self-report measures are easy to implement and analyse, their validity, particularly among those that combine different behaviours, has been questioned. Driving simulators offer a safe and more naturalistic approach, but are expensive to buy, and VSTs can provide a useful, cost-effective alternative. Finally, while IVDRs are high in ecological validity, their use makes the ethical and practical control of the experiment difficult. One key concern among threat appeal researchers is that discordant findings in the experimental literature may be due, at least in part, to the deployment of driving measures that differ in their sensitivity to the effects of the experimental threat-based manipulations. Another possible reason for the inconsistent research findings is that the conceptualisation and measurement of fear arousal, in threat appeal experiments, has widely varied.

Measuring the Impact of Threat Appeals on Fear Arousal

Recently, meta-analytic research (Carey, et al., 2013) highlighted that methods of measuring fear in experimental studies have often been inconsistent or unreliable, when not absent entirely. This reflects points raised by other researchers who suggest that there are large differences in the way fear has been measured in the literature, from self-reported anxiety measures, to reported worry or concern (Higbee, 1969).

Many threat appeal experiments assume that their “high threat” manipulation evokes fear in the audience, but fail to support this assumption with a manipulation check (Plant, et al., 2011). Findings that emerge from these types of studies cannot be reliably interpreted or generalised, making it problematic to draw inferences about the fear-behaviour relationship. A related problem is that, of the threat appeal studies that have included a measure of fear, a majority have done so using self-report measures (e.g. Cauberghe, et al., 2009; Nielsen & Shapiro, 2009). For example, Carey and colleagues (Carey, et al., 2013) noted that, of the studies in their meta-analysis that included fear arousal as an outcome variable (k = 4), all used a form of self-report measure.

Self-report Measures of Fear Arousal

There is some variation in the literature in the measurement of self-reported fear, particularly in relation to the number of scale-items used. Laros and Steenkamp (2004) recommend using multi-item, unidimensional measures, while other studies have adopted one-item measures (e.g. Lerman et al., 1997). Regardless of the measure used, debate has persisted regarding whether or not self-report measures alone can accurately capture fear arousal. Rogers (1983), for example, proposed that self-reported fear measures (using mood adjectives) are adequate, and may even be preferable to physiological measures, since they tend to fluctuate less. Contrastingly, Matsumoto and colleagues (Matsumoto, Hwang, Harrington, Olsen, & King, 2011) point out that emotions fluctuate because they are transitory, and thus can change substantially in a number of seconds. This means that, by using only self-report measures, researchers may not be capable of capturing the complexity of the emotional experience, due to the fact that self-reported fear tends to be measured at a particular point in time (typically following stimuli presentation).

Most importantly, researchers have pointed out that fear, like other emotions, is a multi-factorial construct, incorporating physiological, behavioural and cognitive elements, and should therefore be measured in a number of ways (Mewborn & Rogers, 1979). For this reason, while self report measures access the cognitive dimension of fear, they cannot accurately capture the complexity of the fear response. Using additional measures can provide valuable data (Bolls, et al., 2001), which is particularly important given that self report and physiological indices of fear arousal tend to differ (Lee & Shin, 2011).

Physiological Measures of Fear Arousal

In order to address theoretical and methodological problems related to the conceptualisation and measurement of fear, a more objective and comprehensive approach has been proposed. Lang and colleagues (Lang, Davis, & Öhman, 2000) point out that physiological responses associated with fear (e.g. changes in facial musculature, electrodermal activity and heart rate) are valuable measures of emotional expression. Such physiological measures provide information that is objective and temporally precise, meaning that it is possible to record a fear response in real-time (Warr, 2000). Further, since physiological responses are typically involuntary, the limitations associated with self-report, such as social desirability (Bolls, et al., 2001), do not apply.

Two such physiological measures, heart rate (HR) and electrodermal activity (EDA), provide important measures of arousal. HR has been widely used in psychological research to measure physiological fear responses. Fear has been most widely associated with a HR increase, while the emotion of disgust has been linked to HR deceleration (Ekman, Levenson, & Friesen, 1983). EDA, or skin conductance, relates to the amount of perspiration exhibited by participants. Previous studies have found increased skin conductance in response to threatening stimuli (Ordonana, et al., 2009). These responses can be evidenced as an increase in phasic skin conductance responses (SCRs), or as increases in tonic skin conductance level (SCL). SCRs are momentary increases in arousal levels, typically measured by counting the number of data peaks, whereas the tonic SCL refers to the absolute level of conductance at a given moment (Dawson, Schell, & Filion, 2000).

In a recent study that examined physiological responses to threat appeal messages, using HR and EDA measures, findings indicated an autonomic response pattern for high threat messages that was significantly different to that for low threat messages (Ordonana, et al., 2009). Importantly though, while HR and EDA provide important information about an individual’s level of physiological arousal, they cannot provide information about the valence of the physiological response.

Facial Electromyography (EMG), another physiological measure, provides a method of measuring valence, using the electrical activity of the facial muscles. It has been found to be a useful indicator of both the valence and the intensity of emotional expressions (Cacioppo, Petty, Losch, & Kim, 1986). In this sense, it has advantages over other physiological measures (e.g. EDA), which give information about arousal only. Facial EMG can detect responses to mildly evocative emotional stimuli that go undetected by EDA measures (Cacioppo, et al., 1986). Further, because Facial EMG provides a continuous measure of facial muscle activity, its temporal resolution is better than other types of physiological measures (Arndt, Allen, & Greenberg, 2001). Hazlett and Hazlett (1999) found Facial EMG to more effectively and sensitively discriminate between different types of television advertisements than self-report measures. Facial EMG was also more strongly associated with recall measures, and peaks in Facial EMG were found to be temporally related to specific emotional points in the advertisements. Overall, it has proven to be a useful tool in the objective measurement of implicit emotional responses.

One general criticism of physiological measures relates to the question of whether emotions can be physiologically distinguished from one another. This can become particularly problematic when trying to differentiate between emotions of a similar valence (e.g. emotions that are negative). For example, a meta-analysis by Cacioppo and colleagues (Cacioppo, Berntson, Larsen, Poehlmann, & Ito, 2000) posited that “even a limited set of discrete emotions such as happy, sad, fear, anger, and disgust cannot be fully differentiated by visceral activity alone” (p. 184). Despite this, several researchers have demonstrated that it is possible to distinguish one emotion from another. For example, Stemmler, Aue and Wacker (2007) and Sinha (1996) found distinct, emotion-specific response patterns for fear and anger, while other studies have found differential response patterns for fear and disgust (e.g. Ekman, et al., 1983), and anger and sadness (Hess, Kappas, McHugo, Lanzetta, & Kleck, 1992). Finally, findings from a study by Kreibig and colleagues (2007) indicated a linear increase of activity in the Corrugator Supercilii muscle (i.e. forehead) from the neutral emotion condition over sadness to fear, as well as a corresponding decrease of activity in the Zygomaticus muscle (cheek). From the distinct patterns emerging from the combination of cardiovascular, electrodermal and respiratory systems recordings, the authors concluded that physiological responses during these negative emotions were produced by differential types of activation of the autonomic nervous system.

Overall, despite the many advantages of using physiological measures in addition to self-report measures (Yzer, Southwell, & Stephenson, 2012), and despite the potential for physiological measures to provide an objective addition to subjective responses (Ohme, Reykowska, Wiener, & Choromanska, 2009), threat appeal studies that measure the physiological properties of fear are uncommon (Ordonana, et al., 2009).

3.3 Conclusions

Understanding the effectiveness of threat appeal messages in a risky driving context would allow researchers to authoritatively advise road safety practitioners as to what works when designing threat appeals, as well as whether or not such appeals should feature prominently in road safety communications. Historically, experimental findings in this area have been mixed (Elliott, 2011; Lewis, et al., 2007), which may be attributed to the “eclectic” (LaTour & Rotfeld, 1997, p. 47) nature of the threat appeal literature. Studies have varied in the methods used to measure driving behaviour, and in their treatment of fear arousal. In order to reconcile cognitive and affective approaches, and in order to advance knowledge in the area, the current research involved four studies, designed to measure the impact of threat appeals on fear arousal and risky driving behaviours.

4. Chapter Four
Rationale and Research Questions

4.1 Summary of Literature

There are a number of key points to emerge from the literature, as reviewed in Chapters 1-3. First, global statistics, as well as experimental research, have indicated that young males take more risks on the road than any other driving cohort, and are most likely to be involved in a RTC (Jonah, 1990, 1997; Sarma, et al., 2012). The reasons behind this are complex, and are likely to be due to a host of neurological, cognitive, trait, and state variables. Recent research, for example, has focused on the impact of state anger on driving-related outcomes (Abdu, et al., 2012). However, the effect of anger on driving, when combined with threat appeal-induced fear, remains unclear.

Second, while several decades of empirical research have examined threat-based advertisements, consensus regarding their effectiveness remains elusive. The use of threat appeals in health-promotion campaigns, when used under certain conditions, has been advocated by some researchers (Witte & Allen, 2000), and questioned by others (Hastings & MacFadyen, 2002; Hastings, et al., 2004). Theoretical frameworks, such as the Extended Parallel Process Model, have attempted to reconcile disparate findings. However, this model is not specific to road safety, and the effectiveness of threat-based advertisements in reducing risky driving behaviours is still unclear. For example, while several studies have found that threat appeals, when combined with high perceptions of efficacy, can be effective (Cauberghe, et al., 2009; Lewis, et al., 2010), others have found evidence of increased risky driving intentions in response to death-related threat appeals (Carey & Sarma, 2011; Jessop, et al., 2008).

Finally, despite conclusions emerging from the theoretical threat appeal literature regarding the importance of perceived efficacy, conceptual and methodological inconsistencies in the experimental literature have made it difficult to draw generalised conclusions. The need for a comprehensive synthesis of the existing driving-related, threat appeal literature is apparent.

4.2 The Current Research

The primary aim of the current research is to determine the conditions under which threat appeals are most likely to work, and for whom. The research focuses on young male drivers, aged 18-24, based on research suggesting this group are overrepresented in RTC statistics, and more likely to engage in risky driving behaviours (e.g. Marcil, et al., 2001; Mathijssen, 2005).

The current research was conducted in two phases. First, a meta-analysis of the experimental research examining the impact of threat appeals on fear arousal and driving behaviour was conducted. Broadly, this study aimed to synthesise the existing body of research, and to systematically identify conceptual and methodological limitations within this evidence-base. The research questions that guided this analysis were:

1. What is the overall effect of threat appeals on fear arousal and risky driving behaviours?
2. What can this review tell us about the limitations of the existent body of experimental research, and how can the current research address these limitations?

The meta-analytic review findings highlighted some important methodological gaps in the literature, which contributed to the design of Studies 2-4. Specifically, the review noted a pervasive assumption in the literature that threat appeals induce fear in the audience, despite experimental threat appeal studies largely failing to explicitly or reliably test this. In order to address this issue, and with the aim of ensuring that the manipulations used in the subsequent experiments were fear arousing, Study 2 tested the extent to which fear was elicited by a number of road safety advertisements, using both self-report and physiological measures. The guiding research question for this study was:

1. What is the impact of different types of threat appeal messages on physiological and self-report indices of fear?

Following Study 2, having isolated a road safety advertisement that elicited an increase in fear arousal, Study 3 examined if exposure to this message would lead to a reduction in risky driving. Further, it investigated whether or not probing cognitions, relating to threat and efficacy, would increase the effectiveness of the advertisement, as predicted by the EPPM. This study was guided by the following research questions:

1. What is the impact of a fear arousing, threat-based road safety advertisement on speeding behaviour?
2. Will this threat appeal, when combined with forced cognitions (i.e. relating to threat and efficacy) lead to a reduction in speeding behaviour?

Based on the results of this study, and following on from recommendations by researchers to treat different risky driving behaviours as separate, distinct indices (e.g. Tay, 2005a), the impact of the threat appeal on speeding, close following, gap acceptance and overtaking behaviours was then examined in the final experimental study. Stemming from recent literature on the effect of mood, and specifically anger, on risky driving (Abdu, et al., 2012), Study 4 also examined the impact of state anger on the effectiveness of a threat-based road safety advertisement. Specifically, the following research questions were explored:

1. What is the effect of a fear arousing, threat-based road safety advertisement on speeding, close following, gap acceptance and overtaking?
2. What is the impact of state anger on the effectiveness of the threat appeal?

Specific hypotheses relating to each of the studies are presented in the relevant empirical chapter.

5: Chapter Five

Study 1: The Impact of Threat Appeals on Fear Arousal and Driver Behaviour: A Meta-Analysis of Experimental Research 1990-2011

Note: An earlier version of this chapter was published in *PLoS One*:

Carey, R. N., McDermott, D. T., & Sarma, K. M (2013). The impact of threat appeals on fear arousal and driver behaviour: A meta-analysis of experimental research 1990-2011. *PloS one, 8*(5), e62821. doi: 10.1371/journal.pone.0062821

This chapter presents a meta-analysis of the impact of threat appeal messages on fear arousal and risky driving behaviours. Meta-analytic techniques are employed to examine responses to threat appeals, in order to shed light on previous, inconsistent empirical findings. The central objective of this study is to provide an up-to-date review and synthesis of previous experimental research that has directly tested the impact of threat appeals on laboratory-based indices of fear and driving.

5.1 Limitations of Previous Research

Threat appeals are incorporated into health promotion campaigns under the assumption that they elicit anticipatory fear of experiencing a negative outcome in the audience, and that the audience subsequently responds by adopting healthy behaviours and/or avoiding risky ones (Ray & Wilkie, 1970). That is, threat elicits fear, and fear results directly in behavioural avoidance or modification. However, as outlined in Chapter 3, despite detailed theoretical models and numerous experimental studies and reviews, the role of fear in the experimental threat appeal literature remains distinctly unclear (Ordonana, et al., 2009).

A number of high-quality meta-analyses have been published that examine factors related to driving behaviour (Arthur, Barret, & Alexander, 1991; Masten & Peck, 2004; Mathias & Lucas, 2009), such as the effectiveness of mass-media campaigns, in general, in reducing RTCs (Phillips, et al., 2011). Additionally, several meta-analyses (e.g. De Hoog, Stroebe, & De Wit, 2007; Good & Abraham, 2007; Witte & Allen, 2000) have analysed the threat appeal literature, in general, combining multiple risky behaviours in their analyses (e.g. non-condom use and smoking; Peters, et al., 2012). While this body of literature can help inform our knowledge, it cannot directly and specifically inform predictions in relation to the utility of threat-based road safety campaigns.

5.2 Rationale for the Current Study

Since a certain level of fear arousal is seen as a prerequisite for threat appeals to work, one aim of the current study is to examine if and how previous studies have measured fear, and whether or not the manipulations in these studies had a significant impact on fear. A second aim of the analysis is to examine the causal impact of threat appeals on driving behaviour. Drawing on a meta-analysis by Gerber and Wheeler (Gerber & Wheeler, 2009), findings from experimental paradigms only were included, which, in cases like these can be “more meaningful and interpretable” (p.472). In order to compare the different types of outcome variables used across studies in this area, the current analysis examines the impact of threat appeals on three distinct indices of driving: self-reported driving intentions, simulated driving and scores from a VST.

The current chapter therefore presents the results of the first meta-analysis of the experimental research on threat appeals and driving. Specifically, in this study, meta-analytic techniques are used to explore the impact of threat-based messages on fear arousal and lab-based indices of driving behaviour, and to examine factors that may be moderating the emotion-behaviour relationship in this context.

5.3 Method

Inclusion Criteria and Selection Procedures

The broader threat appeal literature from the 1960s to the 1990s has been widely reviewed, with numerous papers providing conceptual and methodological analyses of this body of research (LaTour & Rotfeld, 1997; Rotfeld, 1988; Soames Job, 1988; Strong, Anderson, & Dubas, 1993; Sutton, 1982; Witte & Allen, 2000). With the aim of advancing meta-analytic research in this area, the current analysis covers the period from 1990 to 2011. A second reason for restricting the review to this time period is that mass media campaigns have evolved over time, and this meta-analysis sought to include studies that used exposure materials which were likely to resonate with current threat appeal message design.

In order to establish an estimate of the causal impact of threat appeals on behaviour, and in line with several recent meta-analyses (Murry Jr, Stam, & Lastovicka, 1993; Webb & Sheeran, 2006), experimental control was an important factor in the inclusion criteria. All included studies therefore adopted an experimental design. Previous reviews and meta-analyses of the general threat appeal literature were searched for relevant articles. A comprehensive search of electronic databases was conducted, including EBSCO, PubMed, PsycArticles, PsycInfo, Sage, MEDLINE and ScienceDirect. Keywords included "threat appeals", "fear appeals", "scare tactics", "advertisements", "road safety" and "risky driving" [e.g. Driv* AND (fear appeals OR threat appeals OR road safety campaigns)]. A manual search of key journals (e.g. *Accident Analysis and Prevention*, *Transportation Research Part F* and the *Journal of Personality and Social Psychology*) was conducted, and reference lists of relevant articles were reviewed. In order to address the so-called file-drawer problem (Rosenthal, 1979), where unpublished studies are considered to represent the 95% of studies that show non-significant results, the grey (unpublished) literature was searched through the ProQuest database. Conference abstracts were accessed and leading authors in the field were contacted to request relevant, unpublished material.

Data Extraction

Titles and abstracts of papers were scanned with reference to relevant inclusion criteria, leading to the identification of 54 articles. As outlined in Figure 1, the full text of these papers were accessed and read, with specific emphasis on methodology, and 38 were deemed true experiments (clear, controlled manipulation by the researcher, inclusion of a control group). Fifteen of these were subsequently eliminated as they did not provide the statistics (nor could the statistics be accessed from the authors) necessary to compute an effect size. Of the remaining 23 studies, 13 examined the difference in fear- or driving-based dependent variables between participants exposed to threat appeals, and those in a control group. Results presented here are based on the analysis of these 13 studies (see Table 1).

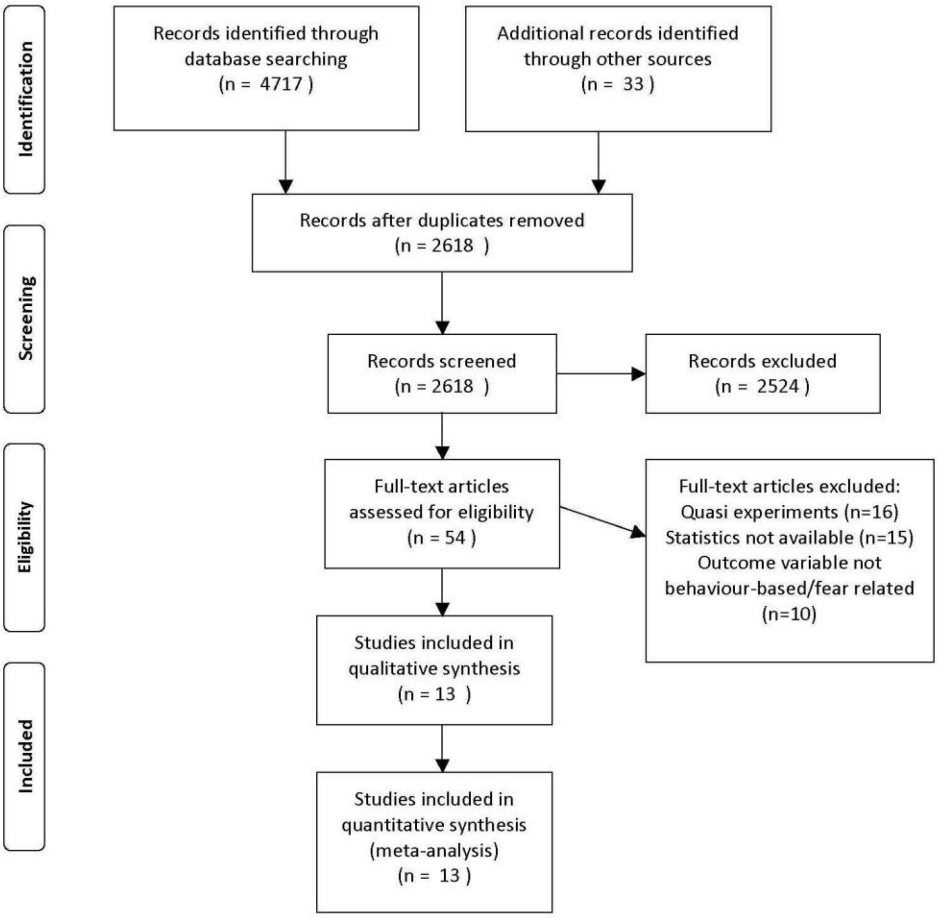


Figure 1: Flow Diagram outlining Selection Procedures (Moher, Liberati, Tetzlaff, & Altman, 2009).

Coding and Analysis

Relevant characteristics of all studies were independently coded by two raters. Agreement on coding was 95%, and differences were resolved through discussion. Studies were coded according to outcome variables, type of risky driving (where applicable), modality of exposure (i.e. how the manipulation was presented to participants; video-based or still image/fact-based), as well as gender, age (ages 17-24, 25-30 and 30 plus), whether or not the study was published, year of the study, country of origin, theoretical framework, inclusion of a fear arousal measure, whether or not a follow-up test was carried out, and whether or not previous risky driving behaviours/crash history had been measured.

Statistical values (i.e., *p*, *t*, means and standard deviations) were extracted from the identified studies and converted to correlation effect sizes (i.e., *r*). Calculation of the weighted average effect size, as well as all other computations, was performed using the software *Comprehensive Meta-Analysis* (CMA; Copyright ©2006 Biostat, Inc.). For all analyses, the threat appeal group was compared with the control group. Where there were multiple levels or trials of an outcome variable in a study, one average effect size per outcome variable, per study, was calculated. Effects were not averaged in a study when they related to different outcomes.

According to Fern and Monroe (1996), effect sizes can "only be unequivocally interpreted when the research uses a random-effects model" (p.95). Due to wide range of studies, and the importance of generalizing the findings beyond the included studies, random effects models were chosen as the computational model across all analyses. In contrast to the fixed effects model, the random effects model does not assume that all of the studies in the meta-analysis are functionally equivalent, allowing the true effect sizes to differ (Borenstein, Hedges, Higgins, & Rothstein, 2010). The 13 studies included in the meta-analysis contributed 71 effect sizes and a total sample size of 3044 (1894 males, 972 females, 178 unreported). A majority of the studies ($k = 9$) used both male and female participants, while 4 used an all-male sample.

Assessing Heterogeneity and Publication Bias

Heterogeneity analyses were conducted using Cochran's (1954) *Q*-statistic, as well as Higgins and Thompson's (2002) I^2 index. A significant *Q*-statistic suggests that the hypothesis of homogeneity should be rejected, while the I^2 index represents a value of heterogeneity in percentage form. According to Higgins and Thompson, 25% suggests low heterogeneity, 50% suggests medium heterogeneity and 75% or higher represents high heterogeneity. Tests of heterogeneity were significant, as expected, with the I^2 value indicating high heterogeneity in the studies ($p < .001$, $I^2 > 75\%$). This result further justifies the adoption of the random effects model in the current analyses. Funnel plot analyses (Light & Pillemer, 1984) and Duval and Tweedie's trim and fill procedure (Duval & Tweedie, 2000), carried out by the *CMA* software, revealed no evidence of publication bias ($r = .04$, [95% CI: .01-.09], number of studies trimmed = 0).

Table 1
Characteristics of Included Studies

First-named author (year)	Included *N*	P / UP	Age	Location	MO/ mixed	Driving behaviour	Outcome
Carey (2011)	80	P	17-24	IRE	MO	Various	SRI
Chen (2011)	200	UP	18-30	USA	Mixed	Talking on cell	FA, SRI
Goldenbeld (2008)	81	P	M = 51	NL	Mixed	Speed	SRI
Jessop (2008)	199	P	18-30	UK	Mixed	Various	SRI
Lennon (2010)	673	P	M=21.6	USA	Mixed	Various	SRI
Nielsen (2009)	168	P	17-24	USA	Mixed	Drink Driving	FA
Rosenbloom (2003)	120	P	20-33	Israel	Mixed	Various	SRI
Shehryar (2011)	178	UP	M=22.8	USA	Mixed	Drink Driving	FA
Taubman Ben-Ari (1999)	603	P	18-21	Israel	MO	Various/Speed	SRI/DSS
Taubman Ben-Ari (2000)	109	P	18-21	Israel	MO	Various/Speed	SRI/DSS
Taubman Ben-Ari (2003)	206	P	18-21	Israel	Mixed	Various	SRI
Thornton (2005)	354	UP	17-28	AUS	Mixed	Speed	VST
Yaoshan (2011)	73	UP	NS	China	MO	Various	FA, SRI

Note. P = published; UP = unpublished; M = mean age; NS = not stated; IRE = Ireland; USA = United States of America; NL = Netherlands; UK = United Kingdom; AUS = Australia; MO = males only; SRI = self-reported intentions; FA = fear arousal; DSS = driving simulator speed; VST = video speed test.

5.4 Results

Analysis of Threat Appeals on Fear Arousal and Driver Behaviour

Theoretically, threat appeals aim to modify behaviour by increasing fear of negative outcomes. Thus, first, it was investigated if threat exposures were resulting in an elevated fear response. Four of the included studies measured fear as an outcome variable, all of which used a form of self-report scale. When these four studies were analysed, large effects emerged, with experimental groups reporting increased fear arousal in comparison to control groups (r = .64, n = 619, p < .01). None of the included studies, however, controlled for emotions other than fear which may have been evoked by the message, the importance of which is highlighted by previous research (Leshner, Bolls, & Thomas, 2009; Leshner, et al., 2010).

Subsequently, the overall effect of threat appeals on driving behaviour was examined, not differentiating between self-report, simulated, or VST outcome variables. No significant effect of threat appeals on the driving outcomes emerged (r = .03, n = 2425, p = .17 [95% CI: -.01 to .07]). When each outcome variable was analysed separately, there were no significant differences between threat appeal and control groups on self-reported intention to take driving risks (r = .02, n = 2125, p = .38 [95% CI: -.03 to .07]) or speed in a driving simulator/during a VST (r = .08, n = 573, p = .26 [95% CI: -.06 to .21]).

Studies using a video-based manipulation produced particularly strong effects on fear (r = .64, n = 273, p < .05), but no effect on driving behaviour/intentions (r = -.01, n = 1610, p = .62). The studies included used male-only or mixed samples. Focusing on males, (k = 5, n = 925) the threat-appeals had no impact on this sub-sample (r =.05, p =.06). Since there were no studies in the current analysis which used a female-only sample, it was not possible to compare across genders.

Moderator Analyses

No moderator of the impact between threat and driving outcomes emerged consistently across a majority of studies included in this meta-analysis. Consequently, it was not possible to conduct a moderator analysis. Of the 13 studies, 11 included moderators or mediator variables in their analysis, reflecting four distinct theoretical positions [TMT, (Greenberg, et al., 1986), PMT, (Rogers, 1975), the fear-as-acquired drive model, (Hovland, et al., 1953) and the EPPM, (Witte, 1992)]. The variables were self-esteem, perceived severity, perceived susceptibility, perceived response efficacy, perceived self-efficacy, ego involvement, perceived behavioural control, social norms, the third-person effect, fear pattern, group discussions and the personality trait of sensation seeking. Significant moderators within studies included self-esteem (Carey & Sarma, 2011; Jessop, et al., 2008; Taubman Ben-Ari, 2000; Taubman Ben-Ari & Findler, 2003), perceived severity, susceptibility, response efficacy, and self-efficacy (Shehryar, 2011), and these variables are considered further later in this chapter.

5.5 Discussion

Despite the numerous relevant reviews and meta-analyses, there has been no attempt to systematically identify and synthesise experimental, cause-effect studies in the threat-based road-safety literature, the findings of which would offer a source of more conclusive evidence. The findings of this meta-analysis suggest that, while threat appeals can have a strong impact on the level of fear aroused in individuals, they do not reliably impact on behaviour.

This finding points to the complexity of the relationship between emotion and behaviour, a relationship that is poorly understood in the threat appeal literature. A review of the literature indicates that there seems to be a general lack of cohesion across studies regarding the role played by fear in the psychology of threat appeals. It is possible that experimental research has not, as of yet, adopted the types of complex conceptualisations (Baumeister & Lobbestael, 2011; Baumeister, et al., 2007) of the fear-behaviour relationship that are necessary to yield valid, replicable findings. The underlying psychological mechanisms at play here are likely to be complex, and do not always involve direct causation. Rather, there are likely to be moderators and mediators of the fear-behaviour relationship, and a key task for researchers and advertisers is to identify and better understand these factors. Findings of the current analysis point to the likelihood that the effectiveness of threat appeals is being moderated and mediated by other factors.

At a methodological level, there is a lack of consistency in how fear is defined, measured and interpreted. For example, only four of the 13 studies, in the current analysis, measured fear as an outcome, (i.e. providing data on fear arousal responses). As pointed out by Lewis, Watson and White (2009), a measure of fear arousal can provide important information about the emotions evoked by the appeal, as well as serving as a manipulation check. The assumption that threat appeals evoke fear appears to be pervasive in the literature, despite a majority of studies failing to reliably test this. The current findings suggest that the impact of threat appeals on fear is strong, but it is important that this effect is measured and analysed, rather than assumed, in individual experimental studies.

In the current analyses, of the studies that measured fear as an outcome variable, all used a form of self-report scale [e.g. Likert Scales, the Positive and Negative Affect Scale (Watson, Clark, & Tellegen, 1988)]. Problems associated with self-report fear arousal measures have been highlighted by researchers for decades (see Chapter 3). Although self-report questionnaires are easy to administer, and provide useful data, they measure fear at one point in time, typically post-stimulus, and are thus unable to capture the complexity of the fear experience (Matsumoto, et al., 2011). One way of addressing the limitations posed by self-report measures is to measure fear objectively, using physiological measures such as HR monitoring and skin conductance responses (Ordonana, et al., 2009), or a fear-relief continuous measurement dial, which records individuals' reactions to an advertisement by instructing them to move a dial in accordance with the level of fear experienced (Algie & Rossiter, 2010). By using physiological measures to examine threat appeal messages, their impact on behaviour can be systematically and comprehensively piloted, prior to experimentation.

Of further note within the included studies is that emotions, other than fear, evoked by the message, were largely not controlled for. Threat messages can elicit emotions such as guilt, shame and anger, and researchers have recognized that the interplay between the different emotions can determine the effectiveness of the message (Consedine & Moskowitz, 2007; De Pelsmacker, Cauberghe, & Dens, 2011; Dillard & Nabi, 2006). Specifically, several studies have addressed the need for a distinction between the related emotions of fear and disgust, when examining responses to threat-based stimuli (Leshner, et al., 2010; Yartz & Hawk, 2002). Again, this can be controlled for by a comprehensive piloting procedure, prior to the experimental study.

Experiments using male-only samples showed particularly weak effects of threat appeals on driving behaviour, although it should be noted that cross-gender comparisons could not be made. As emphasised by Lewis et al. (2007), such findings represent a major challenge to road safety practitioners and researchers, particularly since male drivers tend to engage in more risky and less cautious driving than females (Sarma, et al., 2012). The current analysis provides further evidence that the main target audience of many road safety campaigns may be the audience least influenced by them. It is important for research to explore the profile of individuals who are resilient to threat appeal messages, and to determine the message-related variables that are likely to bring about a change in behaviour among this population.

An important limitation of the current analysis is that, due to the eclectic nature of the included studies, moderator analyses were not possible. Previous meta-analyses in the area of threat appeals or risky driving have included moderator variables such as trait anxiety (Witte & Allen, 2000), the context of the accident (Clarke & Robertson, 2005) and the type of driver improvement intervention (Masten & Peck, 2004). A more recent meta-analysis reported an interaction between threat and efficacy (Peters, et al., 2012). Specifically, the authors noted that, as posited by the EPPM, threat appeals may have an effect only when there is high efficacy in the message, and efficacy may have an effect only when the message is high in threat. In other words, in line with experimental research (Cauberghe, et al., 2009; Lewis, et al., 2010), perceptions of threat and efficacy are likely to moderate the effectiveness of threat appeal messages. An analysis of the threat/efficacy interaction was not possible within the current analysis, and this represents an important avenue for future meta-analyses in road safety.

From reviewing the included studies, as well as the broader literature base, it seems likely that cognitions are moderating the impact of threat appeals on behaviour outcomes. Incorporating EPPM variables (i.e. perceived efficacy and perceived severity/susceptibility) into threat appeal research may help advance current knowledge and improve predictive power. Threat and efficacy were measured in one of the included studies (Shehryar, 2011) and findings suggested that, while they are useful in explaining responses to non death-related threats, TMT variables, such as ego-involvement and self-esteem, are of more use in explaining responses to death-related messages. These findings suggest that including TMT variables may help add to the explanatory power of threat appeal studies (Hunt & Shehryar, 2011). In line with this, five of the studies included in the current analysis found self-esteem to significantly moderate the impact of threat appeals on behaviour, such that individuals who derived self-esteem from driving reported higher risky driving intentions following a mortality salient (death-related) prime (Carey & Sarma, 2011; Jessop, et al., 2008; Taubman Ben-Ari, 2000; Taubman Ben-Ari & Findler, 2003; Taubman Ben-Ari, et al., 1999). Again, this suggests that drawing on TMT theory, in addition to extant threat appeal theories, may help improve our understanding of psychological responses to threat appeals.

5.6 Conclusion

While strong evidence exists to suggest that threat-based messages can be effective under the right conditions, the current study found no evidence to suggest that they consistently impact on driving behaviour. Findings suggest a disconnect between emotion (i.e. fear) and behaviour (i.e. driving), and point to a lack of sophistication surrounding our understanding of the link between emotion and action (Baumeister & Lobbestael, 2011; Baumeister, et al., 2007). Most importantly, the current findings highlight a failure of previous experiments to provide measures of fear arousal, and a reliance on self-report measures among those that do. Self-report measures of fear are subjective, and rely on individuals being able to accurately recall and report their levels of fear.

What is now needed, in order for the contributions of experimental science to this area to be applied to policy and campaign design, is for research to a) adopt complex theoretical positions and b) adopt designs that can test these theories in full. This means that emotional responses, both fear and other emotions, need to be measured or statistically controlled for, preferably through a comprehensive piloting procedure.

6: Chapter Six

Study 2: The Impact of Threat Appeals on Physiological and Self-Reported Fear Arousal Responses

This chapter presents the findings of the first of three experiments on threat appeals. The central aim of this study is to examine the impact of a road safety threat appeal on physiological and self-reported fear arousal. Following on from the meta-analytic findings, Study 2 aims to address conceptual and methodological problems relating to the measurement of fear in previous experimental studies. This study provides a comprehensive manipulation check for Studies 3 and 4, by identifying a road safety advertisement that is highly threatening, and fear-arousing.

6.1 Limitations of Previous Research

As discussed in Chapter 3, historically, measures of fear arousal in experimental studies have been inconsistent [i.e. measures include self-report questionnaires (Nielsen & Shapiro, 2009), continuous measurement dial procedures (Algie & Rossiter, 2010), and physiological measures of arousal (Ordonana, et al., 2009)], or unreliable, when not absent entirely (Carey, et al., 2013; Higbee, 1969). For example, many threat appeal experiments contain the misleading assumption that threat appeals evoke fear in the audience, but fail to support this assumption with a manipulation check or pilot study (Plant, et al., 2011).

Further, of the threat appeal studies that have measured fear, most have done so using self-report questionnaires (e.g. Cauberghe, et al., 2009; Nielsen & Shapiro, 2009), which are likely to lack sensitivity and reliability (see Chapter 3). A small number of studies have used physiological indices to measure fear responses to threatening stimuli, but these have focused on topics such as vaccination behaviour (Ordonana, et al., 2009), venereal diseases (Mewborn & Rogers, 1979), and animals/humans in distress (Schartau, et al., 2009); therefore the application of their findings to threatening road safety advertisements is unclear. Further, while previous research has examined fear arousal through HR and electrodermal response measures (e.g. Ordonana et al., 2009), researchers have recommended the inclusion of a measure of valence, such as Facial EMG, since emotional responses consist of both arousal and valence dimensions (Bolls, et al., 2001; Cacioppo, et al., 1986).

6.2 Rationale for the Current Study

The meta-analytic findings pointed to the need for experimental threat appeal studies to provide reliable fear arousal measures. It was concluded that, although self report measures provide a simple, and often valuable, measure of fear, it is possible to more comprehensively capture an individual's emotional response by using both subjective (i.e. self-report) and objective (i.e. physiological) fear responses. The advantages of employing physiological measurements to help understand and delineate emotional experiences have been emphasised by Mewborn and Rogers (1979) and Cacioppo and Gardner (1999), who suggest that physiological investigations lead to improved psychological theories, by providing more detailed data. Physiological measures represent an objective, reliable indicator of fear arousal (Ordonana, et al., 2009).

Researchers have emphasised the benefits of including physiological measures of both arousal (e.g. HR and EDA), and valence (e.g. Facial EMG), in studies of emotion, since we have different response systems to serve different adaptive functions (Lazarus, Averill, & Opton, 1970; Mewborn & Rogers, 1979). As such, the use of several distinct measures allows for additional detail and more representative information. Facial EMG represents a sensitive, and temporally specific, indicator of the valence of an emotional response, while HR and EDA data provide information on arousal.

Following on from techniques employed by recent studies (e.g. Ordonana et al., 2009), and guided by the recommendations of previous research (e.g. Cacioppo & Gardner, 1999; Carey, et al., 2013; Popova, 2012), the current study examines the impact of threat-based road safety advertisements on HR, EDA, Facial EMG, and self-reported fear arousal responses. It adopts a four-group experimental design that aims to compare physiological responses between groups (i.e. exposed to different levels of threat) and across time (i.e. at various points during the video exposure period). Specifically, with the aim of advancing the literature, both conceptually and methodologically, the following hypotheses are explored:

1. Participants who view a high threat road safety advertisement will evidence increased HR, increased EDA and increased Corrugator muscle (i.e. frowning) activity, compared both to baseline, and to participants exposed to medium threat, low threat, and control messages.
2. Participants who view a threat-based road safety advertisement will exhibit increased self-reported fear, relative to those in a control group.
3. Based on previous research findings (Lee & Shin, 2011), the self-reported fear measure will show a low correlation with autonomic (i.e. physiological) fear arousal response patterns.

6.3 Method

Participants

Sixty-three participants took part in this study. Of these, 61 participants were included in the analyses; data from 2 participants were excluded due to technical problems during data acquisition (i.e. problem with hardware, signal, recording, etc.). All participants were male, aged 18-24 (M = 20.36, SD = 2.00), and almost all (96.70%) were university students, recruited largely from the Engineering and Psychology Departments. The other 3.30% classified themselves as ‘at work’, and were recruited through poster advertisements for the study. Course credit was allocated for participants who were enrolled in undergraduate psychology modules, while other participants received a €5 voucher for lunch in the university canteen.

Materials

Videos. The threat-based video stimuli used in Study 1 were selected on the basis of a small pilot study. The pilot involved participants (n = 7) being shown ten road safety advertisements, all of which were threat-based, and none of which had been aired on Irish television. Following each advertisement, participants were asked how frightening they found the advertisement, from 1 (= *Not at all frightening*) to 7 (= *Very frightening*), and how disgusting they found the advertisement, from 1 (= *Not at all disgusting*) to 7 (= *Very disgusting*). They were also asked whether or not they had viewed the advertisement before.

Advertisements that were familiar to participants were ruled out. On the basis of participants' responses, the 10 advertisements were categorised as high, medium or low in threat. One advertisement from each of these three categories, which were rated low in disgust, were then selected for use in Study 1, along with two neutral advertisements (described below). The three road safety advertisements chosen for use in this study were all related to speeding behaviour, but differed in content and approach. This is considered in more detail in the discussion section of this chapter.

High threat advertisement. The high threat advertisement was created as part of the UK's Drive SMART initiative by Surrey County Council. It depicts a young man driving a car, with other young people in the back and passenger seats, who are urging him to go faster. As the man accelerates, ropes around his arms and legs become tighter and begin to cut him, at which point there is a sudden, brief, crash-impact moment. The car collides with another vehicle, and the people in the car are thrown forward. The video then cuts to a scene where the young man has brain-damage and is sitting in a wheelchair, while his friend sits beside him crying (see Figure 2).

Figure 2. Still Images from the High Threat Advertisement.

Medium threat advertisement. The advertisement identified by pilot participants as "medium" threat was created as part of the UK's "Think!" road safety initiative. The video is in extreme slow motion, and the only audio is a voiceover that reads "At just five miles per hour over the thirty miles per hour speed limit, how much longer does it take to stop?" Following this sentence, a car is seen braking and skidding, and eventually hitting a child, as the narrator counts the number of feet the cars travels after it brakes (see Figure 3). There is a strong cognitive element to this advertisement, as the questions posed by the narrator prompt cognitions relating to speeding behaviour.

Figure 3. Still Images from the Medium Threat Advertisement.

Low threat advertisement. The low threat advertisement was also taken from the UK's "Think!" initiative. The video is narrated by a teenage boy who is walking around a town. As the advertisement progresses, it becomes clear that the boy is no longer alive. As he visits his family and friends, who are grieving, he realises that they are unable to hear him. At the end of the video, he runs on to the road and gets hit by a car, but the car goes straight through him, and he turns to the camera saying "That's the second time that's happened this week. Hurt a lot more the first time" (see Figure 4). Cognitions are also prompted explicitly in this advertisement, as the content of the narration by the boy prompts the audience to think about the aftermath of a RTC.

Figure 4. Still Images from the Low Threat Advertisement.

Neutral advertisements. Neutral advertisements were included in the video-presentation in order to recreate a naturalistic advertisement-break. The neutral videos advertised home-ware products, specifically paint, dishwasher tablets and a vacuum cleaner, and were selected on the basis that they were comparable in length to the threat-based videos, and were similar to the types of advertisements that appear on television regularly.

Physiological measures. HR, EDA and Facial EMG were recorded using a Biopac MP35 amplifier (Biopac version 3.7.2 for Windows XP), and displayed visually by the Biopac Student Lab (BSL) Pro software. All physiological responses were recorded continuously throughout the presentation of the stimuli.

HR. HR was measured using an SS4LA pulse plethysmograph (PPG) transducer (Biopac Systems Inc.), which was attached to the thumb of the participants' non-dominant hand using a Velcro strap. The PPG is a non-invasive measure that uses a combined light source and sensor to measure the density of blood in an individual's fingertip. Specifically, a light was shone into the participants' fingertip and the amount of reflected light was measured, which was then converted into an electrical signal. The transducer was connected to a PPG amplifier through a shielded cable, and a continuous analogue measure of cardiac function was yielded. This was graphed as a heartbeat trace and converted to HR (beats per minute; BPM) through a calculation channel on the BSL Pro software.

EDA. To measure EDA, two EL507 disposable electrodes (Biopac Systems Inc.), with a contact area of 1cm diameter, were attached to the index and middle fingers of the participants' non-dominant hand. These electrodes were pre-gelled with isotonic wet gel, and were chosen for convenience and hygiene reasons. Choice of electrode attachment and sampling was based on published research guidelines for EDA (Dawson, Schell, & Filion, 2000). The electrodes connected to two of three fully-shielded cables of an SS2L electrode lead set, which in turn connected to an MP35 data acquisition unit, via a Smart Sensor. EDA data, measured in micro-mho or microSiemens, was digitised and analysed offline using the BSL Pro software.

Facial EMG. Finally, Facial EMG was measured, as recommended by Fridlund and Cacioppo (1986), by the placement of two electrodes on the left zygomaticus major (cheek), which elevates the lips and is therefore associated with smiling, and two electrodes on the left corrugator supercilii (brow), which knits together the eyebrows and is therefore associated with frowning, muscle regions, on the left side of the face. A ground electrode was placed high on the forehead. One electrode was also placed on the back of the neck, in order to distract from the face as being the source of interest. The skin of the participants was cleaned before placing the electrodes. Ag-AgCl (EL505) disposable, 2.5cm square, cloth electrodes were used, which contain adhesive solid gel. Again, the electrodes connected to cables of a SS2L electrode lead set, which in turn connected to an MP35 data acquisition unit via a Smart Sensor. An EMG amplifier (Biopac EMG 100A) with a band-pass filter (50-5000 Hz) was used, and muscular activity was measured in micro-volts (μV).

Self-report measures. As recommended by Laros and Steenkamp (2004), self-reported fear was measured in the current study by asking participants to indicate the extent to which they experienced six fear emotions: afraid, panicky, scared, worried, nervous and tense. Emotions were rated on a 5-point scale ranging from 1 (= *I feel this emotion not at all*) to 5 (= *I feel this emotion very strongly*) and a mean self-reported fear value was calculated. In addition, participants were asked to indicate, overall, on a 10-point scale, "How frightening did you find the last advertisement?" (see e.g. Lerman, et al., 1997) Internal consistency for these seven items together was high (Cronbach's Alpha >.9).

Procedure

Participants were each given a time at which to present themselves for an individual laboratory session. They were informed that the study measured physiological responses to a number of video advertisements. On arrival, they were greeted and asked to sit at a desk in front of a computer screen. At this point, they were asked to read a detailed information sheet and, provided they wanted to continue, to sign a consent form. They were then given a short demographic questionnaire. This period (of approximately 10 minutes) allowed participants to familiarise themselves with the environment. Following this, participants were reminded of the experimental procedure verbally by the researcher, and were given the opportunity to ask questions. They were also informed that the physiological measures recorded involuntary responses, and that they should react naturally.

Prior to the application of the electrodes, the designated sites on the skin surface were cleaned using water-based wipes. The Facial EMG electrodes were positioned on the face, the EDA electrodes were placed on the index and middle fingers, and the PPG measure was placed around the thumb. Once the measures were in place, participants were asked to relax for five minutes (pre-stimulus). Physiological data recording began one minute prior to the presentation of the first (neutral) advertisement.

Three advertisements were presented to participants on a computer monitor, and sound was reproduced using two external speakers. Participants were randomly allocated to one of four conditions: high threat, medium threat, low threat or control. Participants were allocated to groups using a computer programme, such that there was an equal number of participants in each condition. Participants in all four groups initially viewed a neutral advertisement. The aim of this was to have a reference point with which to compare subsequent data, while also recreating a "commercial break", with which participants would be familiar. Previous research has employed the use of a "vanilla baseline" task (Jennings, Kamarck, Stewart, Eddy, & Johnson, 1992), which aims to control for individual differences at baseline, by exposing participants to a neutral video/task prior to manipulation. Studies have demonstrated that participants' exhibit decreases in physiological responses during baseline when they are exposed to this type of vanilla baseline task, compared to when they are quietly resting (e.g. Piferi, Kline, Younger, & Lawler, 2000). In the current study, as a pre-manipulation comparison measure, participants' responses during the first neutral advertisement were used as baseline data. For the remainder of this chapter, this time-point is called "resting" or "baseline".

The second advertisement (Ad. 2) contained a high threat, medium threat, low threat or neutral message, depending on group. The third advertisement (Ad. 3) was neutral for all groups. Following the second and third advertisements, all participants were asked to complete the self-report measure of fear arousal. When the advertisements were over, recording was stopped, electrodes were removed, and participants were debriefed verbally. The experimental procedure, in full, took approximately forty minutes.

Physiological Data Reduction

HR data was reduced using a 'smoothing' function in the Biopac software. This is a quicker process than digital filtering, and has the same effect as a low-pass filter (i.e. a filter that attenuates high frequency components). It involves computing the moving average of a series of data points, each of which are then replaced with the mean value of the moving average "window" (Cramp, McCullough, Lowe, & Walsh, 2002). For the current study, based on Biopac recommendations, the "width" of the moving average window (i.e. the number of sample data points used to calculate the mean) was set to 25. Based on a paper by Palatini (1999), which proposed a cut-off point between "normal" and "high" resting HR of 85 BPM, participants' data was excluded from analyses when their resting HR was higher than 85 BPM. This led to the exclusion of 10 participants from HR analyses.

The EDA data was smoothed using the software function described above. Tonic skin conductance was determined by calculating averages of the mean SCL using the smoothed EDA data, and phasic skin conductance was calculated by subtracting the initial (baseline) EDA value from the entire waveform. SCRs (i.e. momentary increases in arousal) were identified by counting the number of peaks equal to or exceeding .02 (Dawson, et al., 2000). This was carried out using the "count peaks" function of the BSL Pro software. The amplitudes of the largest SCRs were noted.

The raw facial EMG data were rectified and integrated. The data were sampled at a rate of 2,000 Hz, and digital filtering was performed to remove low and high frequencies (50-500Hz). The data was then smoothed using the smoothing function described above, where, based again on Biopac recommendations, the number of sample data points used to calculate the mean was set to 500.

Based on a protocol adopted in similar studies (e.g. Mewborn & Rogers, 1979; Opton, Rankin, & Lazakus, 1965), physiological data recordings were divided into ten second intervals. Within these intervals, average HR, EDA and Facial EMG responses, as well as peak activity and maximum amplitudes, were determined. The last ten seconds of Ad. 2 and Ad. 3 were selected for analysis and compared to baseline. Then, focusing on Ad. 2, the 10 second interval during which the collision happened was selected as the "point of maximum impact" (Mewborn & Rogers, 1979, p. 247). This was coded as an additional outcome, in order to provide more detailed and sensitive information relating to participants' fear responses. The temporal equivalent in the neutral advertisement was chosen as the comparison interval. For the remainder of the chapter, this time-point is referred to as 'Ad. 2 Collision'. Responses were compared across participants and across time.

6.4 Results

Data Analytic Strategy

Following an examination of the distributions of the data, the main hypothesis, that participants in the high threat group will show an increase in HR, EDA and Corrugator muscle activity, was tested. First, change scores were calculated for all participants. Change scores are commonly used in psychophysiological research (Blascovich, Seery, Mugridge, Norris, & Weisbuch, 2004), particularly in the context of examining responses to a task, relative to baseline (Llabre, Spitzer, Saab, Ironson, & Schneiderman, 1991). In order to calculate these scores, an average of participants' baseline data was subtracted from an average of their data during the second and third advertisements. Positive change scores indicate an increase in a particular physiological measure, while negative change scores indicate a decrease. Where the assumption of sphericity was violated, degrees of freedom were corrected using Greenhouse-Geisser corrections.

Preliminary analyses were conducted to examine any potential differences between groups at baseline. Following this, between-group differences were tested for significance, using ANOVAs, and *post-hoc* tests were conducted to examine these differences in more detail. Where partial η^2 effect sizes are presented, .01, .06 and .14, represent small, medium and large sizes, respectively, while, for Cohen's *d*, small, medium and large sizes are represented by .2, .5 and .8, respectively (Cohen, 1988).

Normality

The normality of the data was assessed in a number of ways, prior to the application of statistical procedures. Graphical representations of the data were first inspected visually. Skew and kurtosis values were then examined. When skew values were greater than twice the standard error (Tabachnick, Fidell, & Osterlind, 2001), and where the Kolmogorov-Smirnov normality test indicated significant skewness, transformations were applied.

Graphical representations of the change scores for the HR data depicted normal distribution overall. Skew values indicated normal distribution, with the exception of one group (the medium threat group), who evidenced potential non-normality (skew value = 2.02, p = .02) during Ad. 2 Collision. However, since all other groups, at all other timepoints, were within acceptable ranges, and given that a visual inspection of the data indicated normal distribution, no transformations were applied, and parametric statistics were employed.

The EDA change scores were then inspected graphically, and also showed normal distribution overall, with the exception of the medium threat group during Ad. 2 Collision ($p < .001$), and the high threat group at the end of Ad. 2 ($p = .02$). Since skew values for these groups were within acceptable levels, and since the data were otherwise normally distributed, no transformations were applied, and parametric statistics were used.

The Corrugator muscle change score data showed non-normal distribution (e.g. Skew value 2.81, $p < .001$), and the Zygomaticus data were also non-normally distributed (e.g. Skew value -3.5, $p < .001$). In accordance with previous studies (Bunce, Bernat, Wong, & Shevrin, 1999; Soussignan, Schaal, Rigaud, Royet, & Jiang, 2011), data were subjected to a log-transformation to approximate normal distributions. Following log-transformations, the EMG data were within acceptable levels for skewness (Tabachnick, et al., 2001). Results presented below are based on these logarithmically transformed data.

Hypothesis Testing

In order to establish whether there were pre-existing differences across groups, a one-way analysis of variance (ANOVA) was conducted to test for significant differences across groups during the baseline phase. This analysis revealed no significant differences across groups for HR ($p = .60$), EDA ($p = .11$), Corrugator ($p = .62$) or Zygomaticus muscle activity ($p = .90$), suggesting that randomisation to groups was effective.

HR. Descriptive statistics for the HR change scores indicate that, from baseline to Ad. 2 Collision (i.e. the point of maximum impact of the second advertisement), HR increased most notably for the high threat group, who exhibited an increase of approximately 14 BPM ($M = 13.91$, $SD = 15.33$). An increase in HR was also evident among the medium threat ($M = 6.52$, $SD = 10.78$), low threat ($M = 3.29$, $SD = 11.40$) and control ($M = 3.71$, $SD = 6.33$) groups. By the end of Ad. 2, HR had decreased for the high threat ($M = 5.85$, $SD = 12.32$), and control ($M = 2.08$, $SD = 5.98$) groups, and had fallen to below baseline levels for participants in the medium ($M = -1.53$, $SD = 7.79$) and low threat (*M* = -.40, *SD* = 10.67) groups. Finally, at the end of Ad. 3, there was an increase in HR among all groups (see Table 2 for raw HR data).

Table 2
Descriptive Statistics for HR Data across Groups at Four Timepoints

	High Threat		Medium Threat		Low threat		Control	
Timepoint	Mean	(*SD*)	Mean	(*SD*)	Mean	(*SD*)	Mean	(*SD*)
Resting	68.17	(10.08)	68.52	(9.58)	72.31	(9.49)	71.67	(9.45)
Ad 2. Collision	82.08	(20.42)	75.04	(15.98)	75.60	(13.80)	75.38	(11.27)
Ad. 2 End	74.02	(18.08)	66.99	(12.53)	71.92	(12.27)	73.76	(12.22)
Ad. 3	75.49	(14.27)	69.12	(10.44)	78.92	(10.16)	73.78	(9.82)

In order to determine whether differences across groups were statistically significant, a 4 × 3 analysis of covariance (ANCOVA), where baseline HR data was entered as a covariate, to control for initial values (see Wilder, 1962), was first conducted on the HR change scores. The overall difference between groups in HR change did not reach significance ($p = .06$), and there was also no overall significant change over time ($p = .72$).

While the analysis of the change score data facilitated a clear comparison between groups, it did not allow for an examination of differences within groups from resting to Ad. 2 (since the baseline data was incorporated into the calculation of the change scores). In order to address this, a mixed ANOVA was conducted on the original (i.e. unadjusted) HR data across all four timepoints. Mauchly's test was significant ($p < .001$), and Greenhouse-Geisser corrections were used. Across the four groups combined, there was a main effect for time, $F(2.23, 104.58) = 9.01$, $p < .001$, partial $\eta^2 = .16$.

In order to examine these differences more closely, a series of *post-hoc* paired samples *t*-tests were then conducted, applying a Bonferroni correction to adjust for Family-wise error rate (such that the adjusted criterion level was $p = .01$). Significant differences were found within groups from resting to Ad 2. Collision, $t(50) = -4.15$, p $< .001$, $d = .56$, and from Ad 2. Collision to the end of

Ad. 2, $t(50) = 4.10$, $p < .001$, $d = .37$. There were also significant differences from baseline to Ad. 3 $t(50) = -4.59$, $p < .001$, $d = .41$. .

Individual *post-hoc* *t*-tests were then conducted for each individual group. Within the high threat group, adjusting for multiple comparisons using Bonferroni corrections, there was a significant change in HR (see Figure 5) between resting and Ad 2. Collision, $t(13) = -3.40$, $p = .01$, $d = .86$, from Ad 2. Collision to the end of Ad. 2, $t(13) = 3.19$, $p = .01$, $d = .42$, and from baseline to Ad 3. $t(13) = -4.01$, $p = .001$, $d = .60$, but not from resting to the end of Ad 2. ($p = .10$). Among the medium threat group, HR changed significantly from Ad. 2 Collision to the end of Ad. 2, $t(12) = 3.10$, $p = .01$, $d = .56$, but not from resting to Ad. 2 Collision ($p = .05$), or from resting to the end of Ad. 2 ($p = .49$). Individual analysis of the low threat group indicated that the only significant change in HR was from baseline to Ad. 3 $t(13) = -3.64$, $p = .003$, $d = .67$, while an individual analysis of the control group's data did not reveal any significant changes over time, once Bonferroni corrections had been applied.

EDA. EDA data were analysed by examining participants' overall SCL, their number of SCRs and the amplitude of the largest SCR. These measures were analysed separately, since the correlation between the three is suggested to be low (Dawson, et al., 2000).

SCL. Descriptive statistics for SCL change scores indicate that, from resting to Ad. 2 Collision, there was an increase in SCL among the high threat ($M = .65$, $SD = .95$), medium threat ($M = .49$, $SD = 1.17$), low threat ($M = .62$, $SD = 1.01$) and control ($M = .74$, $SD = 1.14$) groups. By the end of Ad. 2, SCL had decreased for the high threat ($M = .34$, $SD = .89$) and medium threat ($M = .21$, $SD = .62$) groups (although it remained higher than baseline levels), while it had increased for the low threat ($M = .67$, $SD = 1.30$) and control ($M = .76$, $SD = 1.18$) groups. During Ad. 3, there was an increase, relative to resting levels, among all four groups (see Table 3 for raw SCL data).

Participants' SCL change scores were compared using a 4 (condition) × 3 (time) mixed analysis of covariance (ANCOVA), where baseline SCL data was entered as a covariate. The overall difference between groups' SCL change scores was not significant ($p = .86$). There were significant differences, however, within groups for the change in SCL, $F(1.42, 79.21) = 11.48$, $p < .001$, partial $\eta^2 = .17$.

Table 3

Descriptive Statistics for SCL Data across Groups at Four Timepoints

	High Threat		Medium Threat		Low threat		Control	
Timepoint	Mean	(*SD*)	Mean	(*SD*)	Mean	(*SD*)	Mean	(*SD*)
Resting	8.00	(5.26)	8.37	(6.44)	12.39	(6.48)	11.05	(4.19)
Ad 2. Collision	8.66	(5.02)	8.86	(7.23)	13.01	(6.95)	11.79	(4.95)
Ad. 2 End	8.35	(4.97)	8.58	(6.67)	13.06	(7.06)	11.80	(4.86)
Ad. 3	8.79	(4.92)	8.99	(6.40)	13.60	(6.86)	11.98	(4.67)

In order to examine the changes over time in more detail, as with the HR data, a mixed ANOVA was conducted on the original EDA data. Across the four groups, there was a main effect for time, $F(2.27, 129.13) = 18.95$, $p < .001$, partial $\eta^2 = .25$.

A series of *post-hoc* paired samples *t*-tests were conducted, applying a Bonferroni correction to adjust for Family-wise error rate (where the adjusted criterion level was $p = .02$). Significant differences were found within groups from resting to Ad 2. Collision, $t(60) = -4.69$, p < .001, $d = .10$, and from resting to the end of Ad 2., $t(60) = -3.75$, $p < .001$, $d = .08$). There was also a significant change in participants'SCL from baseline to Ad. 3, $t(60) = -6.20$, p < .001, $d = .15$, and from the end of Ad. 2 to Ad. 3, $t(60) = -4.03$, p < .001, $d = .07$ but not from Ad 2. Collision to the end of Ad. 2 ($p = .06$).

In order to examine differences across time within each of the individual groups, a series of *post-hoc* *t*-tests were conducted for each group separately. For the high threat group, the only significant change in SCL (see Figure 6), following Bonferroni corrections, was from, Ad 2. Collision to the end of Ad. 2, $t(15) = 3.42$, $p < .01$, $d = .06$. There was a significant change from baseline to Ad. 3 within the medium threat, $t(14) = -3.51$, $p < .01$, $d = .10$, low threat, $t(14) = -3.14$, $p < .01$, $d = .18$, and control groups $t(14) = -3.71$, $p < .01$, $d = .21$.

Number of SCRs. Next, the number of SCRs equal to or exceeding .02 were counted (Boucsein et al., 2012), and change scores were calculated by subtracting the number of SCRs at baseline, from the number of SCRs at three subsequent timepoints. A 4 (group) × 3 (time) mixed measures ANOVA was then conducted to examine differences in the number of peaks across groups and over time. There were overall significant differences across groups in the change in SCRs, $F(3, 57) = 3.13$, $p = .03$, partial $\eta^2 = .14$, but the change in SCR change scores across time was not significant ($p = .34$).

Post-hoc Tukey tests were conducted to examine between-group differences in SCR change scores in more detail. Results indicated that the change in SCRs from resting to the end of Ad. 2 (see Figure 7), in the high threat group ($M = 5.87$, $SD = 6.01$), was significantly different to that in the medium threat group ($M = -4.07$, $SD = 8.06$, $p = .001$), and the low threat group ($M = -2.87$, $SD = 4.87$, $p < .01$), but not the control group ($M = .53$, $SD = 8.03$, $p = .15$). No other differences across groups were significant.

Amplitude of SCRs. Finally, in order to compare the amplitude of the largest SCRs across condition and time, change scores were calculated, and a 4 (group) × 3 (time) mixed ANOVA was conducted. Overall, differences between groups did not reach statistical significance ($p = .08$). After adjustments to degrees of freedom were made using Greenhouse-Geisser corrections, differences across time for SCR amplitude change scores were also not significant ($p = .05$).

Facial EMG. Descriptive statistics (see Tables 4 & 5) indicated that, from resting to Ad. 2 Collision, Corrugator muscle activity increased among the high threat ($M = .14$, $SD = .18$), medium threat ($M = .13$, $SD = .21$), low threat ($M = .09$, $SD = .15$), and control ($M = .06$, $SD = .08$) groups. An initial increase in Corrugator activity across all groups has been reported in previous experimental research (Dimberg, Thunberg, & Elmehed, 2000).

Zygomaticus muscle activity increased among the high threat group ($M = .01$, $SD = .14$), and among the control group ($M = .05$, $SD = .31$), and decreased among the medium ($M = -.11$, $SD = .21$), and low ($M = -.15$, $SD = .29$) threat groups. From Ad. 2 Collision to the end of Ad. 2, Corrugator activity increased further among the high threat group ($M = .17$, $SD = .15$), and decreased among the medium threat ($M = .11$, $SD = .16$), low threat ($M = .09$, $SD = .16$), and control ($M = .05$, $SD = .10$) groups, although it remained higher than baseline levels.

Table 4

Descriptive Statistics for Corrugator Data across Groups at Four Timepoints

	High Threat		Medium Threat		Low threat		Control	
Timepoint	Mean	(*SD*)	Mean	(*SD*)	Mean	(*SD*)	Mean	(*SD*)
Resting	-5.11	(.26)	-5.12	(.29)	-5.08	(.30)	-5.00	(.26)
Ad 2. Collision	-4.97	(.27)	-4.99	(.31)	-4.99	(.33)	-4.94	(.26)
Ad. 2 End	-4.94	(.25)	-5.02	(.29)	-4.99	(.33)	-4.95	(.24)
Ad. 3	-4.96	(.28)	-5.04	(.32)	-4.88	(.33)	-4.90	(.24)

Note. Descriptive statistics presented here are based on log transformed data.

Table 5

Descriptive Statistics for Zygomaticus Data across Groups at Four Timepoints

	High Threat		Medium Threat		Low threat		Control	
Timepoint	Mean	(*SD*)	Mean	(*SD*)	Mean	(*SD*)	Mean	(*SD*)
Resting	-5.21	(.26)	-5.17	(.23)	-5.20	(.31)	-5.25	(.31)
Ad 2. Collision	-5.20	(.27)	-5.28	(.22)	-5.35	(.21)	-5.20	(.32)
Ad. 2 End	-5.17	(.26)	-5.27	(.20)	-5.34	(.17)	-5.22	(.27)
Ad. 3	-5.18	(.22)	-5.22	(.23)	-5.20	(.24)	-5.22	(.22)

Note. Descriptive statistics presented here are based on log transformed data.

Zygomaticus activity decreased among the control group (*M* = .03, *SD* = .26), and increased among the high (*M* = .04, *SD* = .33), medium (*M* = -.10, *SD* = .26), and low (*M* = -.14, *SD* = .28) threat groups. Finally, during Ad. 3, there was a decrease in Corrugator activity among the high (*M* = .15, *SD* = .14), and medium (*M* = .08, *SD* = .15) threat groups, and an increase among the low threat (*M* = .20, *SD* = .22), and control (*M* = .10, *SD* = .14) groups. Zygomaticus activity increased among the high threat group (*M* = .02, *SD* = .29), and decreased among the medium threat (*M* = -.05, *SD* = .17), low threat (*M* = .00, *SD* = .33), and control (*M* = .02, *SD* = .27) groups.

Change scores for the logarithmically transformed Corrugator muscle activity data were compared across groups using a 4 (condition) × 3 (time) analysis of covariance (ANCOVA), where baseline data was entered as a covariate. The analysis suggested no overall significant difference across groups in Corrugator change scores (p = .49), and no significant effect for time (p = .91).

Next, the maximum amplitudes for peaks in the EMG data were calculated (Hazlett & Hazlett, 1999), and change scores were obtained by subtracting the largest amplitude at baseline from that at the three subsequent timepoints. A 4 (group) × 3 (time) mixed ANOVA was conducted on the Corrugator muscle data. Overall differences between groups did not reach statistical significance (p = .29), but there were significant differences across time, F(1.64, 92.00) = 4.18, p = .03, partial η^2 =.07. In order to explore differences across time in more detail, a mixed ANOVA was conducted on the unadjusted Corrugator data. This revealed a main effect for time, F(2.13, 121.56) = 18.56, p < .001, partial η^2 =.25. A series of *post-hoc* paired samples *t*-tests were then conducted, applying a Bonferroni correction. Significant differences were found within groups from resting to Ad 2. Collision, t(60) = -5.20, p < .001, d = .39, from resting to the end of Ad 2., t(60) = -5.86, p < .001, d = .40, and from resting to Ad. 3, t(60) = -6.12, p < .001, d = .46, but not from Ad 2. Collision to the end of Ad. 2 (p = .91).

Individual *post-hoc t*-tests were conducted for each individual group. For the high threat group, and adjusting for multiple comparisons using Bonferroni corrections, there was a significant change in Corrugator activity between resting and Ad 2. Collision, t(15) = -3.19, p = .01, d = .53, from resting to the end of Ad. 2, t(15) = -4.54, p < .001, d = .67, and from resting to Ad. 3, t(15) = -4.03, p = .001, d = .56, but not from Ad 2. Collision to the end of Ad 2. (p = .14). There was a significant change over time among the low threat group from baseline to Ad. 3, t(14) = -3.59, p = .003, d = .64, from Ad. 2 Collision to Ad. 3, t(14) = -3.15, p < .01, d = .33, and from the end of Ad. 2 to Ad 3, t(14) = -3.29, p < .01, d = .33. Individual analyses of the medium threat and control groups did not reveal any significant changes over time, following the application of Bonferroni corrections.

Change scores for the logarithmically transformed Zygomaticus muscle activity data were compared across groups using a 4 (condition) × 3 (time) analysis of covariance (ANCOVA), where baseline data was entered as a covariate. The analysis suggested no overall significant difference across groups in Zygomaticus change scores (p = .17), and no significant effect for time (p = .08). A 4 (group) × 4 (time) mixed ANOVA was then conducted on the original Zygomaticus data and revealed, after Greenhouse-Geisser corrections, no significant effects for time (p = .20). Finally, when the Zygomaticus muscle peak change scores were analysed, the effect of time was not significant (p = .51), and there were also no significant differences between groups (p = .06).

Negative emotionality

Recent research has examined physiological data by creating a single easure of "negative emotionality", consisting of arousal (i.e. HR and EDA) and valence (i.e. Facial EMG) dimensions (Kleider, Parrott, & King, 2010). Based on this study, and as an additional analysis, change scores from the three physiological measures were transformed into *z* scores and summed, producing a single negative emotionality measure. A one-way ANOVA was then conducted to examine between-group differences. Descriptive statistics (see Table 6) indicated a clear trend at Ad 2. Collision, with the high threat group being higher in negative affect (M = .74, SD = 1.46) than the medium threat (M = -.24, SD = 1.98), low threat (M = -.46, SD = 1.57) and control (M = -.09, SD = 1.51) groups. At the end of Ad. 2, this trend was still present, with the highest levels of negative affect evident among the high threat group (M = .46, SD = 1.65). Overall, these between-group differences were not significant at Ad 2. Collision (p = .19), or at the end of Ad. 2 (p = .53). However, exploratory comparisons between groups indicated that the difference between the high threat group and the low threat group, at Ad. 2 Collision, was significant, t (29) = 2.21, p = .04, d = .79.

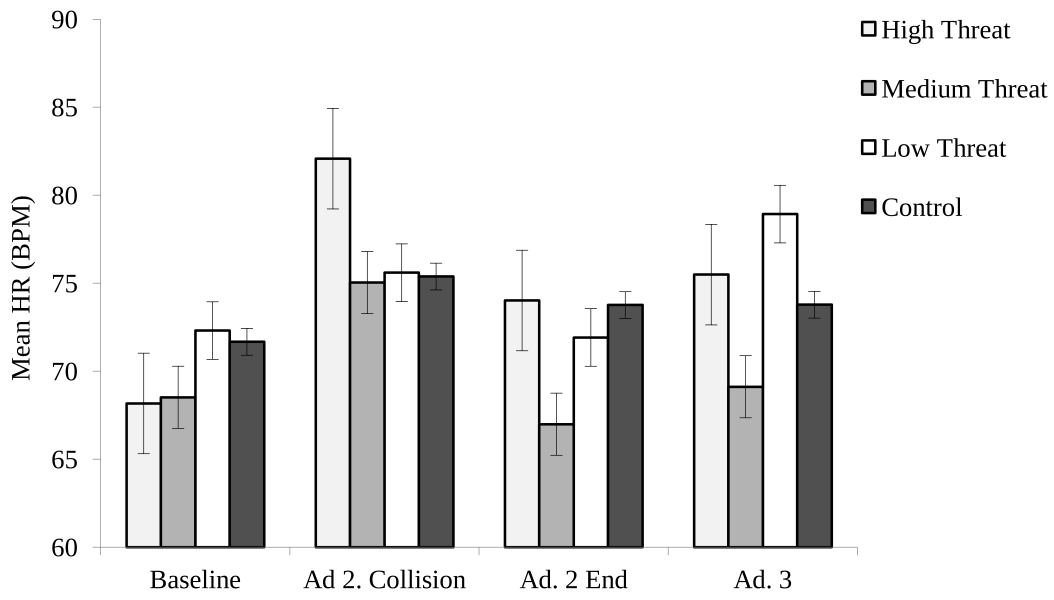


Figure 5: Mean HR over four time-points across four groups; High threat (*n* = 14), medium threat (*n* = 13), low threat (*n* = 14), control (*n* = 10). Error bars denote standard error. Significant changes over time among the high threat group from baseline to Ad 2. Collision (p = .01), from Ad 2. Collision to the end of Ad. 2 (*p* = .01), and from baseline to Ad 3. *(* p = .001). Significant changes over time among the medium threat group between Ad. 2 Collision and the end of Ad. 2 (*p* = .01), and significant changes among the low threat group from baseline to Ad. 3 *(*p = .003).

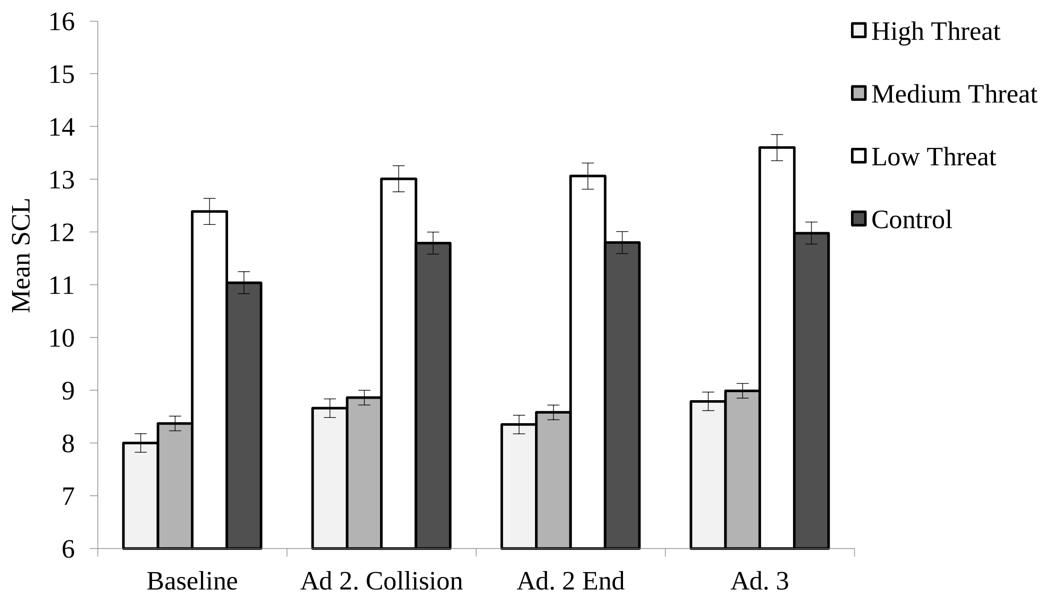


Figure 6: Mean SCL over four time-points across four groups; High threat (*n* = 16), medium threat (*n* = 15), low threat (*n* = 15), control (*n* = 15). Error bars denote standard error. Significant changes over time among the high threat group from Ad 2. Collision to the end of Ad. 2 (*p* < .01), and significant changes between baseline and Ad. 3 among the medium threat (*p* < .01), low threat (*p* < .01), and control groups (*p* < .01).

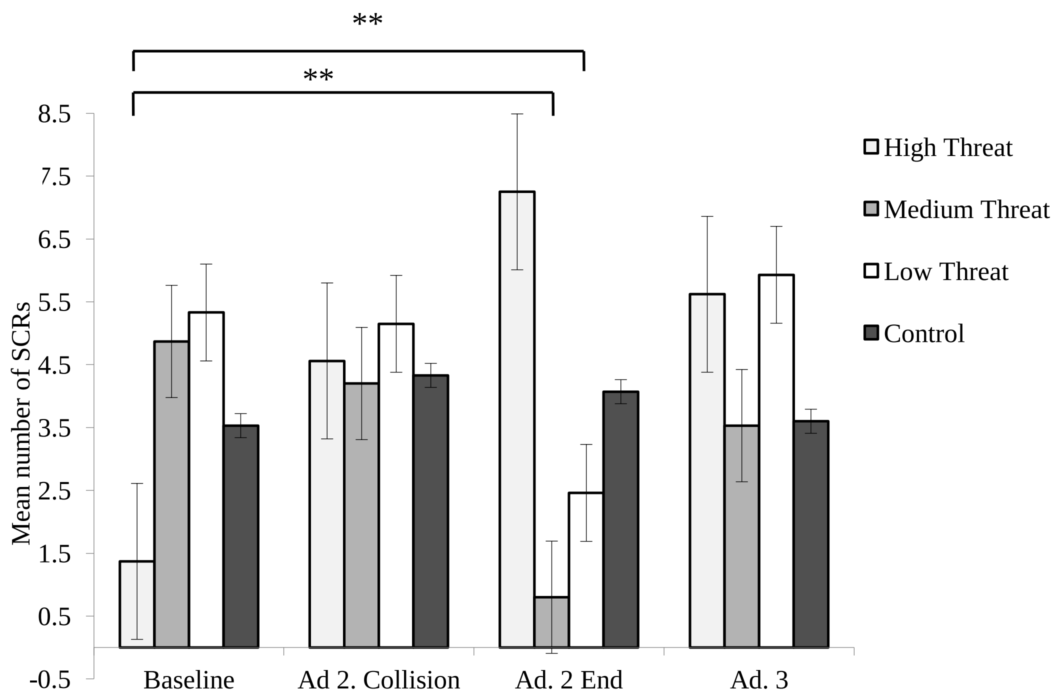


Figure 7: Mean number of SCRs elicited over four time-points across four groups; High threat (*n* = 16), medium threat (*n* = 15), low threat (*n* = 15), control (*n* = 15). Asterisks denote significance between groups. Error bars denote standard error. * $p < .05$, ** $p < .01$.

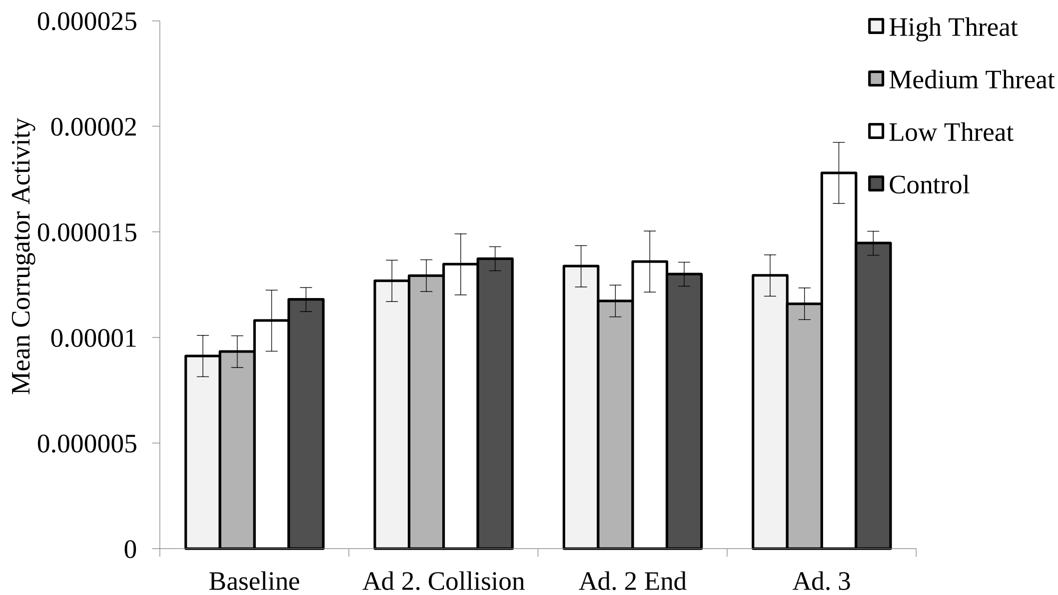


Figure 8: Mean levels of Corrugator muscle activity over four time-points across four groups; High threat (*n* = 16), medium threat (*n* = 15), low threat (*n* = 15), control (*n* = 15). Error bars denote standard error. Significant changes over time among the high threat group from resting to Ad 2. Collision ($p = .01$), resting to the end of Ad. 2 ($p < .001$), and resting to Ad. 3 ($p = .001$). Significant change among the low threat group from baseline to Ad. 3 ($p = .003$), from Ad. 2 Collision to Ad. 3 ($p < .01$), and from the end of Ad. 2 to Ad 3 ($p < .01$).

Table 6

Descriptive statistics for Negative Emotionality and Self-reported Fear

	High Threat	Medium Threat	Low threat	Control
Measure	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)
N.E. Ad. 2 Coll	.74 (1.46)	-.24 (1.98)	-.46 (1.57)	.09 (1.51)
N.E. Ad. 2 End	.46 (1.65)	-.52 (1.40)	-.13 (2.19)	.16 (2.24)
Self-report	5.31 (2.12)	6.47 (1.55)	4.00 (1.96)	1.00 (.00)

Note. N. E. = negative emotionality; Ad. 2 Coll = Ad. 2 Collision

Self-report measures

Self-reported fear was measured using both a one-item measure "How frightening did you find the last advertisement?" (as in Lerman, et al., 1997), as well as a 6-item measure of the extent to which participants experienced six fear emotions (as in Laros & Steenkamp, 2004). However, approximately only two-thirds of participants (n = 39) completed the full 6-item measure. Since the one-item measure was highly correlated with each of the six items, and since separate analyses yielded similar results, ANOVA results presented here are based on the one-item, ten-point measure.

As outlined in Table 6, descriptive statistics indicated that levels of self-reported fear were highest among the medium threat group (M = 6.47, SD = 1.55), followed by the high threat (M = 5.31, SD = 2.12), low threat (M = 4.00, SD = 1.96) and control (M = 1.00, SD = .00) groups. A one-way ANOVA revealed significant differences across groups, $F(3,60) = 30.74$, $p < .001$, partial $\eta^2 = .62$. Post hoc Dunnett's *t*-tests revealed that the control group differed significantly from all other groups ($p < .001$).

Pearson's correlation analyses showed that the one-item measure did not significantly correlate with any of the physiological measures during Ad. 2. Mean self-reported fear, as measured by the mean of the 6 items fear measure, correlated significantly with EDA at Ad 2. Collision ($r = -.33$, $p = .04$), and at the end of Ad. 2 ($r = -.36$, $p = .03$), but did not correlate with any other measure.

6.5 Discussion

The primary goal of this study was to measure physiological responses to a number of threatening road safety advertisements and, in doing so, to identify an advertisement that is fear-arousing for young males. Results point to the high threat advertisement as evoking higher levels of arousal, and increased negative affect, compared to the medium threat, low threat, and control advertisements.

Specifically, while all groups exhibited a HR increase during the middle advertisement, the high threat group were the only participants whose HR, at Ad, 2 Collision and at the end of Ad. 2, differed significantly from baseline. Further, although between-groups differences for the unadjusted (i.e. non change score) data, at Ad. 2 Collision, were not examined, the HR of the high threat group was notably higher than that of all other groups at this timepoint, as displayed in Figure 5.

Findings from previous experimental research examining a fear-related HR response have lacked consistency. Specifically, while a number of previous studies have found an acceleration in HR, in response to a threat-based stimulus (Ekman, et al., 1983; Kreibig, et al., 2007), others have reported that threatening messages produce a HR decrease, a response that is suggested to indicate heightened attention (e.g. Bolls, et al., 2001; Ordonana, et al., 2009). Such studies have reconciled their findings with a defence cascade model (Bradley & Lang, 2000) which proposes that, when the defence system is moderately activated (i.e. when a potentially harmful stimulus is encountered), a decrease in HR is exhibited that relates to heightened attention. Then, if the stimulus becomes more threatening, or immediate, HR increases, reflecting a fight/flight response.

Some researchers (Ordonana, et al., 2009) have suggested that a threat message, in an experimental context, is unlikely to produce the levels of fear necessary to induce a HR increase, but is more likely to create an oriented attention response. Findings from Ordonana et al (2009) and Bolls et al (2001) have supported this. Importantly though, since these studies employed threatening stimuli that were either not visual (e.g. radio-based; Bolls et al., 2001) and/or unrelated to road safety (e.g. focused on vaccine uptake; Ordonana et al., 2001), it is problematic to apply their conclusions to other types of threat appeal messages. Findings from the current study suggest that a threat appeal *can* arouse a HR increase, indicative of a fear response, provided the message is relevant and highly threatening.

Analyses of the EDA data suggested that SCL increased for all four groups during Ad. 2. The fact that SCL increased for the control group, as well as the threat groups, may be due to the fact that SCL generally tends to increase rapidly when a novel stimulus appears (Dawson, et al., 2000). Individual within-group comparisons were less ambiguous, and revealed that the high threat group were the only group to significantly increase SCL during Ad. 2 Collision, relative to baseline levels. Further, the increase in SCRs among the high threat group, during Ad. 2 Collision, differed significantly from the medium and low threat groups. Increased skin conductance in response to threatening stimuli has been found in previous research studies (Mewborn & Rogers, 1979; Ordonana, et al., 2009; Potter, LaTour, Braun-LaTour, & Reichert, 2006), and is indicative of heightened levels of arousal.

In order to advance on previous experiments (e.g. Ordonana et al., 2009), the current study used a third physiological measure (i.e. Facial EMG), in order to determine the valence of the emotional response. Findings from the Facial EMG analyses suggested increased levels of negative affect (i.e. increased Corrugator muscle activity) among all four groups during the second advertisement, relative to resting levels. Increased Corrugator muscle activity, in response to new stimuli, has been found in several previous studies (Bolls, et al., 2001; Potter, et al., 2006). During Ad. 2 Collision, the high threat group was the only group to evidence an increase in Corrugator muscle activity that differed significantly from baseline. Finally, negative emotionality (a combined measure including all three physiological indices; Kleider et al., 2010) data indicated that participants in the high threat group were significantly higher in negative affect than those in the low threat group, during Ad. 2 Collision.

Findings from the self-report measures indicated significant differences overall across the four groups, such that the medium threat advertisement was rated the most fear-arousing. This finding differs slightly from the physiological findings, which indicated the greatest levels of arousal and negative affect were among the high threat group. Differences between the physiological and self-report data are in line with previous research, which has indicated that verbal and physiological measures are largely independent, and "converge only momentarily" (Mewborn & Rogers, 1979, p. 250), following an emotion-inducing event.

While previous research has found significant negative correlations between HR and self-reported fear (Ordonana, et al., 2009), no such correlations were found in the current study. Overall, in this study, the correlation between self-report measures and physiological data was low, a finding that is in line with recent research (Lee & Shin, 2011; Matsumoto, et al., 2011), and that suggests participants' subjective reports of their fear levels may not always reflect their physiological responses. Using only self-report measures may not allow for the complexity of the fear arousal experience to be captured (Matsumoto et al., 2011), since fear is a multifaceted (i.e. consisting of physiological, cognitive and behavioural) construct (Mewborn & Rogers, 1979). The current findings highlight the importance of using physiological measures when testing novel threat manipulations, since self-report measures may lack sensitivity and reliability (see Chapter 3).

Overall, since there were no significant differences between the high and medium threat groups in self-reported fear, and since the physiological data isolated the high threat group as evoking the highest levels of fear, the current findings lead to the selection of the high threat advertisement for use in subsequent studies. While the medium and low threat advertisements explicitly probed cognitions relating to RTCs (both came from the Think! campaign), the high threat advertisement did not involve forced cognitions, and its selection therefore allows for the addition of a cognition manipulation (see Chapter 7).

In order to control for possible pre-exposure effects, the manipulations used in the current study had not been aired on Irish television. Further, responding to recent recommendations for disgust-related affective responses to be distinguished from those relating to fear (Consedine & Moskowitz, 2007; Leshner, et al., 2009; Leshner, et al., 2010), the manipulations were piloted prior to experimentation.

Since the current programme of research focuses specifically on young males, it is unclear whether the findings can be applied more generally. There is some evidence to suggest that males may have a different facial response pattern than females. Thunberg and Dimberg (2000), for example, found that, while males and females displayed similarly large SCRs, and ratings of unpleasantness, for fear-relevant stimuli, females evidenced increased Corrugator muscle activity that was not evident among males. More generally, researchers have suggested that individual physiological responses are likely to vary depending on the level of the threat, and on the organism's learning history and context (Ordonana et al., 2009). It may be imprudent, therefore, to draw conclusions that generalise to other populations, or to other types of health-risk behaviours.

Another potential limitation of the current study concerns the measure of self-reported fear used. Since only two-thirds of participants completed the full, six-item questionnaire, statistical analyses were based on the one-item fear measure. Since researchers have previously recommended using a number of items to measure fear (Laros & Steencamp, 2004), this should be explored further in future experimental studies.

Another interesting avenue for future research involves the adoption of additional types of physiological measures. In 2011, a method was developed that allowed for the simultaneous acquisition of Facial EMG and functional Magnetic Resonance Imaging (fMRI; Heller, Greischar, Honor, Anderle, & Davidson, 2011). These types of advanced measures can provide valuable data, and are likely to become the gold-standard in future physiological studies.

6.6 Contribution

Measuring physiological responses to threatening stimuli is not a new approach, and has been used in a number of early studies (e.g. Mewborn & Rogers, 1979). However, the need for physiological experiments within the context of threat-based road safety advertisements was apparent. By using physiological measures, this study overcomes limitations of previous studies that have relied on self-report measures only, contributing to the threat appeal evidence-base in general, as well as to the driving-specific literature. It advances on recent studies (e.g. Ordonana et al., 2001) by using additional physiological variables (i.e. Facial EMG), and by using stronger, more highly threatening stimuli, as recommended by Henthorne and colleagues (Henthorne, LaTour, & Nataraajan, 1993). Most importantly, this study has isolated a high threat advertisement, which can now be referred to as "fear arousing", and used in subsequent studies, including those that follow this chapter.

6.7 Conclusion

Since the road safety advertisements used in this study had not been used in any previous controlled psychological experiments, it was important to test, as objectively and systematically as possible, their effects on fear. Similar to Ordonana and colleagues (2001), our findings suggest a complex physiological response to threat appeal messages. Specifically, the fear response is likely to depend on the intensity of the threat-based stimulus. The findings of this study may, at least in part, explain some of the discrepancies in the threat appeal literature to date. Given that the fear arousal construct has previously been poorly explained and understood, and inconsistently measured, it is unsurprising that research studies have often failed to produce consistent findings. By increasing the complexity of our conceptualisation of fear arousal, and by increasing methodological rigour, more definitive conclusions may be reached. Overall, the key outcome of this study is the identification of a high threat advertisement that produces physiological fear responses. Questions remain, however, regarding the impact these types of manipulations have on behavioural outcomes.

7: Chapter Seven

Study 3: The Impact of a Threat Appeal on Speeding Behaviour.

This chapter presents the findings of a second experiment examining responses to threat appeal messages. Findings from Study 2, described in Chapter 6, allowed for the identification and isolation of a threat appeal that objectively elicited a fear response among young males, thereby overcoming limitations of previous research. This appeal, and its effects on behaviour, can now be systematically evaluated. Accordingly, Study 3 investigates the impact of this fear arousing road safety advertisement on driving behaviour, and examines the conditions under which a change in behaviour is most likely to occur. Specifically, drawing on the EPPM (Witte, 1992) the current study examines the roles played by perceived threat and perceived efficacy in reducing speed choice among young male drivers, as measured by an Irish version of the VST (Horswill & McKenna, 1999a).

7.1 Limitations of Previous Research

While a number of experimental studies have provided support for the use of threat appeals, conceptual and methodological inconsistencies and limitations have made it difficult to generalise their findings (Plant, et al., 2011), or to apply them to a road safety context (Lewis, et al., 2007). Although Study 2 addressed a core limitation associated with previous studies (i.e. relating to the measurement of fear), there are a number of other issues within the literature that warrant investigation.

Specifically, at a conceptual level, a systematic examination of the role of cognition in threat-based road safety advertisements is lacking. While a small number of experimental studies have examined efficacy in a road safety context (e.g. Cauberghe, et al., 2009; Lewis, et al., 2010), the dependent variables used in these studies have been self-report measures, which are associated with a number of reliability problems (see Lajunen & Ozkan, 2011; Soames Job, 1988). Despite the known limitations associated with self-report measures of driving, the number of controlled experiments that examine the impact of threat-based messages on behavioural outcomes remains relatively low (Elliott, 2011). For example, in a review of the evaluations of anti-speeding messages, Plant, Reza and Irwin (2011) found only one study meeting their inclusion criteria that included a direct measure of speed. Contrastingly, 63% of their included studies examined self-reported perceptions of the message.

The small number of studies that have examined behavioural responses to threat appeal messages have largely done so using driving simulators (e.g. Griffeth & Rogers, 1976; Taubman Ben-Ari, 2000). As noted in Chapter 1, while simulators have advantages over self-report driving measures, they are expensive to purchase, and are not without additional limitations (see Liu, et al., 1999).

7.2 Rationale for the Current Study

Overall, half a century of threat appeal research has led to the identification of three key variables (see Chapter 2); fear (an emotion), perceived threat (a cognition), and perceived efficacy (a cognition; Levin, Dato-on, & Manolis, 2007). Following on from the selection of a high threat advertisement in Study 2, the current research now investigates the relationships between threat, fear, and behaviour, by examining the impact of a fear arousing threat appeal on driving.

Specifically, in order to address conceptual gaps in the existing road safety literature, the advertisement selected in Study 2 is now modified, and forced cognitions related to threat and efficacy are integrated into its presentation, in order to examine the factors that enhance or erode the effectiveness of the threat appeal. Study 3 proposes that threat appeal advertisements will only create behaviour change when, consistent with the EPPM (Witte, 1992), perceived threat and efficacy cognitions are high. Thus, as recommended by a recent review (Maloney, et al., 2011), the current study provides a test of the EPPM, and does so within a driving context (Elliott, 2011).

This study aims to overcome methodological issues in previous research by examining whether a threat appeal advertisement that is fear arousing (as identified by Study 2) will lead to a concurrent, adaptive change in a behavioural measure of driving (i.e. a reduction in speed). It focuses on speeding behaviour, since evidence suggests that drivers' speed choice affects the number and severity of RTCs (Quimby, Maycock, Palmer, & Butteress, 1999). This study adopts a four-group experimental design that aims to compare speeding responses across time, and between groups. Specifically, the following hypotheses are explored:

1. Participants exposed to a threat appeal, who are presented with cognitive prompts relating to perceived threat and perceived efficacy, will show a decrease in speeding behaviour, relative to baseline, and compared to the other three groups.
2. Consistent with the EPPM, participants exposed to a threat appeal, who are not presented with the cognitive prompts, will not change their behaviour, or will change it in a maladaptive way (i.e. evidencing an increase in speeding).

7.3 Method

Participants

Sixty-two participants took part in this study. All participants were male, aged 18-24 (*M* = 20.92, *SD* = 3.21), and in possession of a full driver's licence (90%, *n* = 56), or a provisional driver's licence with a minimum of one year's driving experience (10%, *n* = 6). Of the sample, 79% (*n* = 49) were university students, recruited largely from the Engineering and Psychology Departments, 19% (*n* = 12) categorised themselves as employed, and 2% (*n* = 1) were unemployed. Psychology participants were allocated Course Credits, and other participants were entered into a draw for a Tablet.

Materials

Video: threat advertisement. The threat appeal message used in this study was the high-threat road safety advertisement from Study 2, as described in Chapter 6. Two of four groups saw this video, and it was followed, for both groups, by a screen displaying the words "Don't Speed". While the advertisement itself was identical for these two groups, one of the groups was presented with a number of questions, displayed as text on screen, during the message, while the other group watched the advertisement with no text. Specifically, at the moment in the video when the driver's friends are encouraging him to speed up, a number of questions appeared in text-format at the bottom of the screen. The text read: "Imagine you are the person driving the car, how might you react?" Then, at the end of the video, when man is shown in a wheelchair, the text read "How likely is it that this could happen to you?", and "How might this car crash have been avoided?" The purpose of including these prompts during the message was to encourage participants to actively think about what they were watching, and to induce forced cognitions about the material.

Then, following the advertisement, this group was presented with seven prompts that appeared in text-format on separate screens, for ten seconds each. The prompts were: “Do you think it is likely that you could be involved in a road traffic collision?”, “What kind of consequences could arise from being involved in a road traffic collision?”, “How bad could these consequences be?”, “What kind of strategies could you employ to avoid being involved in a road traffic collision?”, “In terms of avoiding a road traffic collision, how effective would these strategies be?”, “Do you think you could drive slowly in order to avoid being involved in a road traffic collision?” and “How easy do you think it would be for you to adopt a strategy like this?”

Again, these questions were presented to participants with the aim of prompting forced cognitions relating to efficacy, severity and susceptibility, which research has suggested to be critical to message acceptance and behaviour change (Lewis, et al., 2010; Maloney, et al., 2011). The wording of the questions was adapted from that used in previous experimental research (Cauberghe, et al., 2009), and the principle behind this type of mental elaboration task was taken from Falk (2010). For the other group who watched the threat appeal advertisement, the “Don’t Speed” screen was followed by a screen that read “Please wait. Video is loading”.

Video: neutral videos. Two neutral, driving-related advertisements were included in the video presentation to take focus away from the road safety advertisement as the video of interest, and to increase ecological validity (i.e. in a real life environment, we do not watch road safety advertisements in isolation). The first video, for all groups, was an instruction video relating to the function and mechanics of a car air-conditioning system. The third video, for all groups, was a neutral video explaining how to effectively clean a car’s plastic mouldings.

The middle advertisement varied, depending on group, whereby two groups watched the threat appeal message, described above, and two groups watched a neutral video, that explained how to remove marks from the exterior of a vehicle. During this neutral video, for one of the no-threat groups, text appeared at the bottom of the screen, line by line, and read “How useful do you think this video is?”, “Do you think this video is easy to follow?”, “Is this video informative?", and "Is this video helpful?" These neutral prompts were included in order to examine whether probing general, neutral cognitions, relating to a neutral video, would affect behavioural responses (i.e. as a comparison for the threat cognitions group). The other no-threat group (i.e. the control group) watched the neutral video without the text. All videos were presented to participants on a computer monitor, and sound was reproduced using external speakers.

Distractor tasks. Participants were presented with an excerpt from a newspaper article about Ireland's most popular cars in 2010, about which they were then asked five, simple, multiple-choice questions (e.g. "Are we more likely to see Renault or Porsche on our roads?"; see Appendix C) This was followed by a word-search task, where participants were asked to find seven car-related words. Both tasks were simple, and served only to further disguise the true purpose of the experiment.

Cognitive responses. The four cognitive responses of interest (i.e. perceived efficacy, severity and susceptibility) were measured using one-item, seven-point scales, the wording of which was based on a previous study (Cauberghe, et al., 2009). Perceived severity was measured using the item "Thinking about a road traffic collision, I believe the consequences are:" Participants were asked to indicate their response on a Likert scale, from 1 (= *Not at all severe*) to 7 (= *Very severe*). Perceived susceptibility was measured using the item "I believe my chances of getting involved in a road traffic collision are:" Participants were asked to indicate their response on a Likert scale, from 1 (= *Not at all likely*) to 7 (= *Very likely*).

Perceived self efficacy, in relation to the recommended behaviour (i.e. reducing speed), was measured using the item "Thinking about ways I could change my behaviour that would reduce my chances of being involved in a road traffic collision (e.g. driving more slowly), I believe changing my behaviour in this way would be:" Participants were asked to indicate their response on a Likert scale, from 1 (= *Very easy*) to 7 (= *Very difficult*). Perceived response efficacy, in relation to the recommended behaviour, was measured using the item "Thinking about the effectiveness of a change in behaviour (e.g. driving more slowly) in reducing my chances of being involved in a road traffic collision, I believe this kind of a change in behaviour would be:" Participants were asked to indicate their response on a Likert scale, from 1 (= *Not at all effective*) to 7 (= *Very effective*). One of the items (self efficacy) was reverse-scored, and each of the 4 items was analysed separately.

Self-reported fear. Despite concerns relating to the sensitivity of self-report measures of fear (see Chapter 3), such a measure was included in the current study in order to provide additional detail on participants' responses to the manipulation. Based on previous research (e.g. Laros & Steenkamp, 2004), and in order to advance on Study 2, which analysed a one-item fear measure, participants in the current study were asked to indicate the extent to which they experienced six fear emotions: afraid, panicky, scared, worried, nervous and tense. Responses were made on a Likert Scale from 1 (= *I feel this emotion not at all*) to 5 (= *I feel this emotion very strongly*). The mean of the six items was calculated for each participant, all of whom, in this study, completed the full measure. Cronbach's alpha indicated that there was good internal consistency between the six items (α = 0.96).

Death thought accessibility. In the current study, since the outcome of the RTC shown in the threat appeal was serious injury, as opposed to death, the manipulation was not expected to make mortality salient. In order to exclude this as a potential process variable, a death-thought accessibility measure (see Hayes, Schimel, Arndt, & Faucher, 2010 for a recent review) was used. Specifically, participants were asked to complete a word-fragment completion task (Greenberg, Pyszczynski, Solomon, Simon, & Breus, 1994), which has been used in previous TMT experiments (Arndt, Greenberg, & Cook, 2002; Carey & Sarma, 2011; Harmon-Jones et al., 1997).

The task included twenty-two words, eight of which could be completed to make either a death-related word, or a word unrelated to death (e.g. COFF_ _ could be completed to make either coffin or coffee; KI _ _ ED could be completed to make killed or kissed; CO_ _ SE could be completed to make corpse or course). A score from 0-8 was calculated for each participant, with higher scores indicating higher levels of death-thought accessibility.

Driving scales. Participants were asked to answer questions relating to their car, driver's licence, and driving history (i.e. history of road traffic collisions, driving offences, incidence of racing another driver on a public road).

In addition to this, and based on findings of a recent study (Sarma, et al., 2012), they were asked to complete a number of additional self-report driving scales.

Driving Anger Scale. The short-form of the Driving Anger Scale (DAS; Deffenbacher, et al., 1994) was used to measure participants' tendency to become angry while driving. The scale includes fourteen items that describe various scenarios in which an individual may be likely to become angry (e.g. "Someone backs right out in front of you, without looking"). Participants were asked to respond to these statements by indicating, on a Likert Scale, the amount of anger that would be provoked, ranging from 1 (= *none at all*) to 5 (= *a lot*). Items were summed to a scale total, and internal consistency was acceptable ($\alpha = 0.75$).

Speeding and Rule Violation. Participants were asked to complete the Speeding and Rule Violation (SRV) subscale of the Driver Behaviour Scale (DBS; Iversen, 2004). This subscale contains six items (e.g. "Overtake the car in front, even when it keeps the appropriate speed"), that measure the frequency with which participants engage in SRV, from 1 (= *Never*) to 5 (= *Very Often*). Items were summed to a scale total, with higher scores indicating higher levels of SRV. Internal consistency for this scale was acceptable ($\alpha = 0.83$).

Personality variables. Since the study ostensibly examined "personality influences on driving style", and since previous research has found personality variables to impact on both driving behaviour (Dahlen, et al., 2005; Ulleberg & Rundmo, 2003), and responses to threat appeals (Mowen, et al., 2004), participants were asked to complete a number of personality scales, including extraversion, impulsiveness, and excitement sensation seeking. These three variables chosen for the current study following the findings of a recent national survey (Sarma, et al., 2012).

Extraversion. Extraversion was measured using the ten-item Extraversion scale from the International Personality Item Pool (IPIP; Goldberg, 1999). Participants responded to statements about themselves, such as "Am the life of the party", based on how they "generally are now" (as opposed to how they would like to be in the future). A five-point Likert-scale (i.e. Very Inaccurate, Moderately Inaccurate, Neither Accurate nor Inaccurate, Moderately Accurate, Very Accurate) was used, and items were summed to give scale totals, with negative items, e.g. “Have little to say”, being reverse-coded. The scale showed good internal consistency (α = 0.87).

Impulsiveness. Impulsiveness was measured using a nineteen-item sub-scale of the Eysenck Personality Questionnaire (Eysenck & Eysenck, 1978). Participants were asked to respond to questions such as “Do you often buy things on impulse?” in a Yes/No format. Items were summed to scale totals, with negative items (e.g. “Do you prefer to ‘sleep on it’ before making decisions?”) being reverse coded. Cronbach’s alpha indicated that the scale had good internal consistency (α = 0.82).

Excitement Sensation Seeking. Excitement Sensation Seeking (ESS) was measured using the ESS subscale of the IPIP. Participants responded to ten statements about themselves (e.g. “Seek danger”), based on how they generally are. A 5-point Likert-scale (i.e. Very Inaccurate, Moderately Inaccurate, Neither Accurate nor Inaccurate, Moderately Accurate, Very Accurate) was used, and items were summed to give scale totals (with negative items, e.g. “Would never go hang gliding or bungee jumping”), being reverse-coded). The scale showed acceptable internal consistency (α = 0.81).

Outcome Variable: Driving Behaviour Measure.

Driving behaviour was measured using an Irish version of the VST (VST; Horswill & McKenna, 1999a, 1999c; Horswill & Plooy, 2008; McKenna, et al., 2006; Thornton & Rossiter, 2003), a driving measure that was designed specifically for the purposes of this study, and that involves the presentation of simulated driving scenarios through digital video images.

A Sony High Definition (HD) handheld video-camera was mounted on the driver’s seat of a Ford Mondeo, using a Headrest Mount for cars (Hague & Co. Ltd.). Driving scenes were filmed from the driver’s perspective, such that the dashboard and road ahead were clearly visible (see Figure 9). The footage was shot on motorways, dual carriageways, primary roads and secondary roads, around Galway city and county. During filming, the vehicle speed was kept constant, such that the car was driven at the speed limit (i.e. 100 kph on the Dual Carriageway and 120 kph on the motorway), as measured by the in-vehicle speedometer, and as confirmed by a Global Positioning System (GPS)-based monitor. Scenes were selected for editing where lighting and visibility were good, and where there was minimal vibration evident.

The primary and secondary road footage proved unusable for two reasons. First, poor quality roads meant that a shake in the camera was present, particularly when compared to the smoother Motorway footage. Secondly, it was important that the scenes showed a clear road ahead, in order to maintain a standardised measure across the different scenes, and it proved extremely difficult to find lengthy sections of primary/secondary road footage where there were no cars coming in the opposite direction. For these reasons, of the 6 final scenes chosen for use in the study, 3 were shot on the motorway, and 3 on the dual carriageway.

Editing process. The 6 video clips were edited using *Vegas Movie Studio* software. The first part of the editing process involved cropping the footage such that there were no legible speed limit signs, no other cars on the road and no severe bends. Next, the scenes were edited such that the speed of the vehicle, from which the footage was shot, appeared to increase incrementally. These speed increases were created during the editing process, as opposed to during filming, as it allowed for more consistent, regulated and specific speed increases to be designed.

Figure 9. Screenshots of Motorway Scene (left) and Dual Carriageway Scene (right), taken from the Irish VST.

The footage was then segmented, and each segment was compressed to represent an increase in speed of 10kph. The intensity of speed increase was decided upon on the basis that, while gradual, it was also substantial enough to allow for normal distribution among participants. The method of segmentation and compression of the footage was carried out using the *Vegas Movie Studio* software, which allowed for it to be standardised across driving scenes.

Specifically, the full clips were broken into thirteen segments, each of which was compressed by a number of seconds or milliseconds. The exact amount of compression needed was calculated, per segment, based on the length of the segment and the length of the specific speed increase needed. For example, the first segment of a Motorway clip lasted approximately four seconds and depicted a speed of 120kph. Since the car in the original footage was already travelling at this speed, no compression was required. For the next segment, a speed increase of 10kph (i.e. from 120kph – 130kph) was created by compressing 4.33 seconds of footage down to 4 seconds. This was calculated by dividing the previous segment's speed by the desired speed of the current segment (i.e. 120/130 = .923), and then dividing the uncompressed segment-length by the result (i.e. 4/.923). In other words, the 4.33 seconds needed to be compressed by .33 seconds to represent an increase in speed of 10kph.

This approach was applied to each segment, for each driving scene. The final, edited clips were approximately one minute long. The clips were projected from a Hitachi CP-X301 data projector, and the resulting image was 1470 × 830 millimetres. Participants were seated 950 millimetres away from the projected image.

Response pedal. Previous studies using VST measures have adopted self-reported responses as the dependent variable. For example, Horswill and McKenna (1999a) asked participants to indicate, using a written-response format, the extent to which they would be driving faster or slower than the vehicle in the video.

For the current study, in order to advance on previous research, and to provide a more naturalistic response measure, a mechanical response-pedal was used. A pedal was attached to an Ergodex DX1 board, which was connected to the P.C. via a USB port, making it an interactive part of the driving task. Participants were asked to press down on the 'accelerator' pedal to begin the driving scene, and were instructed to lift their foot fully off the pedal once the car had reached the speed at which they would normally drive. When participants lifted their foot off the pedal, that particular driving scene ended, and their response-time was recorded in milliseconds. Six such scenes were completed at baseline, and then again post-exposure. Participants' mean response time across the scenes was recorded for pre-and post-manipulation, and change scores were calculated. The dependent variable for this study, therefore, was the change in response time (i.e. in milliseconds) from pre- to post-manipulation, such that higher scores indicate greater response latencies (i.e. higher speeds).

Procedure

Participants were allocated a time at which to present themselves for an individual session at a laboratory on the university campus. On arrival, they were greeted and asked to sit at a desk, where they were presented with a detailed information sheet (see Appendix A). Provided that they were content to continue with the study after reading this, they were asked to sign a consent form (see Appendix B). Participants were then verbally reminded by the researcher that the study examined personality influences on driving-related cognitions and tasks.

At this point, participants were given a questionnaire that included demographic questions, and the Extraversion and Impulsiveness scales. Once this was completed, they were asked to be seated in front of the projector screen and pedal, and the driving tasks were explained to them in detail. They were told that the aim of the task was to validate a new measure of driving that was in development within the Department, and that it was separate to the main study they would be participating in. They first completed a trial version of the task, which contained three scenes (two Motorway, one Dual-Carriageway). They then viewed and responded to six driving scenes (three Motorway, three Dual-Carriageway), pre-manipulation, as a baseline measure of speed choice. Following the driving task, they completed the two distractor tasks (i.e. recall word-search tasks). They were then informed that they would be presented with several driving-related videos. All participants were informed that they did not need to write anything down or answer any questions, but that they should pay attention to the videos. The three videos were then presented to participants on a computer screen.

Participants were randomly assigned to one of four groups. Participants were allocated to groups using a computer programme, such that there was an equal number of participants in each condition. The "threat cognitions" group viewed the threat appeal followed by the cognition-relevant screens. The "threat only" group viewed the threat appeal followed by "Please wait, screen is loading" (i.e. relevant cognitions were not probed). The "neutral cognitions" group viewed a neutral video containing questions that probed general cognitions. Finally, participants in a control group viewed the neutral video without these questions.

After the videos were over, participants were asked to complete the driving task once more, ostensibly so that as much data as possible, from each participant, would be obtained. Once the driving task had been completed for the second time, participants were presented with one final questionnaire, measuring cognitive responses, self-reported fear, death-thought-accessibility, ESS, driving history, as well as driving anger and SRV. Once these final questionnaires had been completed, participants were debriefed verbally and thanked for their participation. On average, the experimental procedure took approximately fifty minutes in total.

7.4 Results

Data Analytic Strategy

Prior to statistical analyses, the data were examined for missing values, and the normality of the distributions were checked. Where non-normality was found, relevant transformations were applied. Three one-way ANOVAs were conducted, as manipulation checks, in order to examine whether the threat manipulation led to an increase in (a) threat and efficacy cognitions, (b) the level of fear elicited and (c) death thought accessibility. Next, in order to provide additional detail regarding the relationships between variables, correlations between participants' chosen driving speeds, and other driving and personality variables, were examined. This gives an indication as to whether related constructs are correlated with each other, providing a clearer picture of the data and informing future research. It is important to note that the scale of the dependent variable (i.e. the change scores) crosses zero (i.e. scores are both negative and positive). This does not impact on the statistic itself, but it makes interpretation of the direction of the relationships between variables (e.g. from the bivariate correlation matrix) more difficult. In order to address this, graphical representations of these relationships are examined (i.e. in the form of simple slopes in a regression analysis; see Table 11).

Change scores were calculated for each participant by subtracting their baseline response time from that at post manipulation. Previous studies have recommended the use of difference scores when the outcome variable of interest is participants' change in behaviour (Hurling, Fairley, & Dias, 2006), and particularly when there are no significant differences across groups at baseline (Maris, 1998). Positive change scores indicate a greater response latency (i.e. higher speed), while negative change scores indicate an earlier response press (i.e. a decrease in speed choice).

The main hypothesis, that participants in the threat cognitions group will show a decrease in speeding behaviour, following the manipulation, relative to the other three groups, was tested. Preliminary analyses were first conducted on the baseline speed scores to determine whether pre-existing differences between groups were evident. Then, after calculating difference scores for each participant, between-group differences were tested for significance. Finally, potential interaction between specific cognitions and condition were explored using hierarchical multiple regression analyses. Where the assumption of sphericity was violated, Greenhouse-Geisser corrections were used. For partial η^2 effect sizes,.01, .06 and .14, represent small, medium and large sizes, respectively, while, for Cohen's *d*, small, medium and large sizes are represented by .2, .5 and .8 (Cohen, 1988).

Normality

As in Study 2, the normality of the data was assessed through a visual inspection of the graphical representations, an examination of the skew and kurtosis values, and the Kolmogorov-Smirnov test result. The data for all four cognitions appeared to be negatively skewed, with skew values exceeding acceptable levels (and $p < .05$ for all cognitions), so the values were reflected (i.e. each score was subtracted from the highest score + 1), and subjected to a log transform. This reduced Skewness to within acceptable levels (i.e. not greater than twice the standard error). ANOVA results presented below are based on these log transformed data.

For self-reported fear arousal, the data were normally distributed for the threat cognitions and the threat only groups (i.e. the groups who viewed the threat appeal), but there was non-normality for the two groups who viewed the neutral advertisement ($p < .001$), since the two non-threat groups largely responded to the fear arousal questions with *none at all*. This is to be expected, since these two groups were answering questions related to fear about an advertisement related to removing marks on the exterior of a vehicle. No transformations were therefore applied. Data from the word fragment completion task were normally distributed.

The driving behaviour data were normally distributed for the threat appeal cognitions, threat appeal only, and neutral cognitions groups. There was potential non-normality for the control group ($p = .04$), but since skewness (= -.30) and kurtosis (= -1.35) levels for this group were well within acceptable levels (Kline, 2011), no transformations were applied.

Manipulation Checks

Cognitive responses. Descriptively (see Table 7), participants who viewed the threat appeal message (i.e. the threat only and the threat cognitions groups) were higher in perceived severity and susceptibility than those who viewed a neutral message. For efficacy, however, the threat only group were lower than both the neutral cognitions group and the control group. A one-way ANOVA on the transformed data revealed significant differences across groups for severity, F (3, 61) = 3.09, $p = .04$, partial $\eta^2 = .14$, susceptibility, F (3, 61) = 5.01, $p < .001$, partial $\eta^2 = .21$, self efficacy, F (3, 61) = 7.95, $p < .001$, partial $\eta^2 = .29$ and response efficacy, $F(3, 61) = 3.50$, $p = .02$, partial $\eta^2 = .15$.

Post-hoc Tukey tests suggested that, for perceived severity, the threat cognitions group differed significantly from the neutral cognitions group ($p = .04$), and there were no other between-group differences. For susceptibility, the control group differed significantly from the threat cognitions group ($p = .01$), and from the threat only group ($p = .04$). For self efficacy, the threat cognitions group differed significantly from the threat only ($p < .001$), neutral cognitions ($p = .01$), and control ($p < .001$) groups. Finally, the threat cognitions group differed significantly from the control group in terms of response efficacy ($p = .01$).

Table 7

Descriptive Statistics for Cognitive Responses (Study 3)

	Threat Cog		Threat Only		Neutral Cog		Control	
Cognition	Mean	(*SD*)	Mean	(*SD*)	Mean	(*SD*)	Mean	(*SD*)
Severity	6.50	(.63)	6.12	(1.09)	5.60	(.91)	5.60	(1.30)
Susceptibility	4.50	(.82)	4.25	(1.00)	3.67	(.98)	3.27	(.88)
SE	5.63	(.89)	3.94	(1.06)	4.47	(1.19)	4.07	(1.53)
RE	5.81	(.98)	4.88	(1.31)	5.07	(1.67)	4.20	(1.57)

Note. Descriptive statistics presented here are based on the raw (i.e. untransformed) data. SE = self efficacy; RE = response efficacy.

Fear arousal. The results of a one-way ANOVA, conducted on self-reported levels of fear (see Table 8), indicated that there were significant differences across groups F (3, 61) = 28.37, p < .001, partial η^2 = .60. *Post-hoc Tukey* test procedures indicated that the threat cognitions group (M = 2.86, SD = .97) significantly differed from the neutral cognitions (M = 1.01, SD = .04; p < .001) and control (M = 1.06, SD = .22; p < .001) groups. Similarly, participants in the threat only group (M = 2.75, SD = 1.10) were significantly different to those in the neutral cognitions (p < .001) and control (p < .001) groups. No significant differences were observed between the threat cognitions and threat only group, or between the neutral cognitions and the control group. In other words, consistent with Study 1, participants who watched the threat appeal advertisement reported significantly higher levels of fear, compared to those who watched the neutral advertisement.

Death thought accessibility. As discussed earlier in this chapter, a word fragment completion task was used to assess levels of death thought accessibility, in order to determine whether the threat appeal message was making mortality salient among participants. A one-way ANOVA revealed no significant differences across groups in levels of death thought accessibility (see Table 8), p = .80, indicating that, as anticipated, those who viewed the threat appeal manipulation did not experience significantly higher levels of mortality salience than those who viewed the neutral videos.

Table 8

Descriptive Statistics for Self-reported Fear Arousal and DTA Data

	Threat Cog		Threat Only		Neutral Cog		Control	
Measure	Mean	(*SD*)	Mean	(*SD*)	Mean	(*SD*)	Mean	(*SD*)
SR fear	2.86	(.97)	2.75	(1.10)	1.01	(.04)	1.06	(.22)
DTA	2.93	(1.22)	3.25	(1.34)	2.93	(1.58)	3.27	(.80)

Note. SR = self-report; DTA = death thought accessibility.

Correlations

Pearson's correlations (see Table 9) were examined in order to better understand the relationship between variables in the study, as well as to inform the use of covariates of the dependent variable. A lot of driving history variables, as expected, correlated with each other. For example, the length of time participants had been driving was positively associated with the amount of penalty points (i.e. the Irish system for recording driving offences) they had received (r = .26, p = .04), and their history of SRV (r = .25, p < .05), and was also, interestingly, negatively correlated with response efficacy (r = -.36, p < .001).

Participants who reported a higher number of penalty points were also more likely to have raced another driver on a public road (r = -.26, p = .04), were higher on driving anger (r = .27, p = .03), and chose a higher speed as a 'normal driving speed' at baseline (r = .28, p = .03). Participants who reported having previously raced another driver on a public road were higher in driving anger (r = -.32, p = .01), higher in ESS (r = -.26, p < .05), and higher in SRV (r = -.38, p < .001). Participants' driving change scores were positively correlated with their self-reported fear (r = .29, p = .02), as well as their levels of perceived self efficacy (r = .34, p = .01) and susceptibility (r = .27, p = .04).

Driving anger was negatively correlated with perceived severity (r = -.31, p = .02), and response efficacy (r = -.28, p = .03), and positively correlated with SRV (r = .46, p < .001) and baseline driving speed (r = .26, p = .04). Finally, participants who were higher in SRV were higher in baseline (r = .32, p = .01), as well as post-manipulation (r = .32, p = .01) driving speed, and higher in ESS (r = .31, p = .02).

Table 9

Pearson's Correlations for Demographic, Driving-related, Psychometric, Cognitive and Behavioural Data (Study 3)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Age	-																		
2. LoTD	.15	-																	
3. Car	-.08	-.30*	-																
4. No. PP	.10	.26*	-.19	-															
5. Raced	-.00	.11	.07	-.26*	-														
6. EV	.22	.02	-.37**	-.02	-.01	-													
7. Imp.	-.10	-.09	.16	-.08	.23	-.13	-												
8. Sev.	.13	.00	.18	-.05	.16	-.15	.11	-											
9. Susc.	-.01	.23	-.12	.13	.04	-.11	-.24	.20	-										
10. SE	.12	.13	.10	.18	.13	-.05	.06	.19	.11	-									
11. RE	-.09	-.36**	.13	-.10	.15	.05	.05	.27*	.16	.26	-								
12. SRF	.07	-.00	.10	-.04	.16	.04	-.19	.35**	.47**	.17	.39**	-							
13. DTA	-.17	-.12	.19	-.17	.17	-.16	.03	.11	.25	-.13	.20	.20	-						
14. DA	-.00	.07	-.21	.27*	-.32*	-.01	-.03	-.31*	-.10	-.10	-.28*	-.28*	-.19	-					
15. ESS	.01	-.06	-.02	.05	-.26*	.21	-.26*	-.13	-.15	.03	-.04	-.08	-.09	.07	-				
16. SRV	-.01	.25*	-.21	.21	-.38**	.05	-.15	-.10	.06	-.01	-.22	-.13	-.35**	.46**	.31*	-			
17. BL Speed	.07	-.03	-.03	.28*	-.15	.00	.05	-.19	.12	.27*	-.03	-.04	-.11	.26*	.25	.32*	-		
18. PM Speed	-.03	-.04	-.05	.19	-.12	-.02	.03	-.26*	.01	.14	-.06	-.18	-.11	.28*	.16	.32*	.91**	-	
19. Ch. Speed.	-.23	-.02	-.03	-.25*	.12	-.06	-.06	-.12	-.27*	-.34**	-.06	-.29*	.02	.04	-.24	-.05	-.40**	.02	-

Note: LoTD = Length of time driving; Car = Car ownership (Yes/No); No. PP = Number of penalty points; Raced = Have you raced another driver on a public road (Yes/No); EV = Extraversion; Imp. = Impulsiveness; Sev. = Perceived severity; Susc. = Perceived susceptibility; SE = Perceived self efficacy; RE = Perceived Response Efficacy; SRF = Self-reported fear; DTA = Death-thought accessibility; DAS = Driving anger; ESS = Excitement sensation seeking; SRV = Speeding and rule violation; BL Speed = Baseline speed choice; PM Speed = Post-manipulation speed choice; Ch. Speed = Change scores for speed choice. * $p < .05$, ** $p < .01$.

Hypothesis Testing

First, in order to determine whether pre-existing differences existed across groups in speed choice, a one-way ANOVA was conducted. The results indicated that there were no significant differences across groups at baseline (p = .44). Difference scores were then calculated for each participant by subtracting their baseline response time from their response time at post-manipulation. If the main hypothesis of the current study is supported, a reduction in speed, from pre to post manipulation, will be evident among the threat cognitions group.

Descriptive statistics (see Table 10) suggest that the most notable change in speed choice was among the threat cognition group, whose response press at post-manipulation was approximately three seconds earlier (*M* = -3286.92, *SD* = 3388.33) than at baseline. Comparatively, and contrary to expectation, the threat only group also reduced their speed from pre to post (*M* = -1277.38, *SD* = 2986.11), although this change approximated closer to one second. A different trend was evident among the neutral cognitions group, whose change score (*M* = 1415.755, *SD* = 3556.47) indicated a slight increase in speed choice from baseline to post-manipulation. Speed choice among the control group changed the least (*M* = 415.59, *SD* = 2635.68).

Table 10

Descriptive Statistics (in Milliseconds) for Speed Choice

	Pre		Post	
Timepoint	Mean	(*SD*)	Mean	(*SD*)
Threat Cog	27428.75	(8194.71)	24141.83	(6333.25)
Threat Only	25236.33	(8936.88)	23958.95	(8695.39)
Neutral Cog	28847.34	(7043.26)	30263.10	(5749.29)
Control	24265.15	(9463.26)	24680.73	(8586.40)

In order to examine whether statistically significant differences existed across groups' change scores, a one-way ANOVA was conducted. Results indicated that the difference across groups was significant F (3, 61) = .6.60, p <

.001, partial $\eta^2 = .26$. *Post-hoc* Tukey test procedures suggested that the threat cognitions group changed their driving speed significantly more than the control group ($p < .001$) and the neutral cognitions group ($p = .01$). Contrary to expectation, there was no significant difference between the threat cognitions and the threat only groups ($p = .29$), and there were no other significant differences across groups.

Findings of the analysis (see Figure 10) suggest that the threat cognitions group was the group most impacted by the manipulation (which, in their case, contained the cognition prompts), leading to a decrease in speed from pre- to post-testing. This is compatible with the *a-priori* hypothesis, informed by the EPPM, that the presence of threat and efficacy cognitions can lead to a moderation in speeding behaviour.

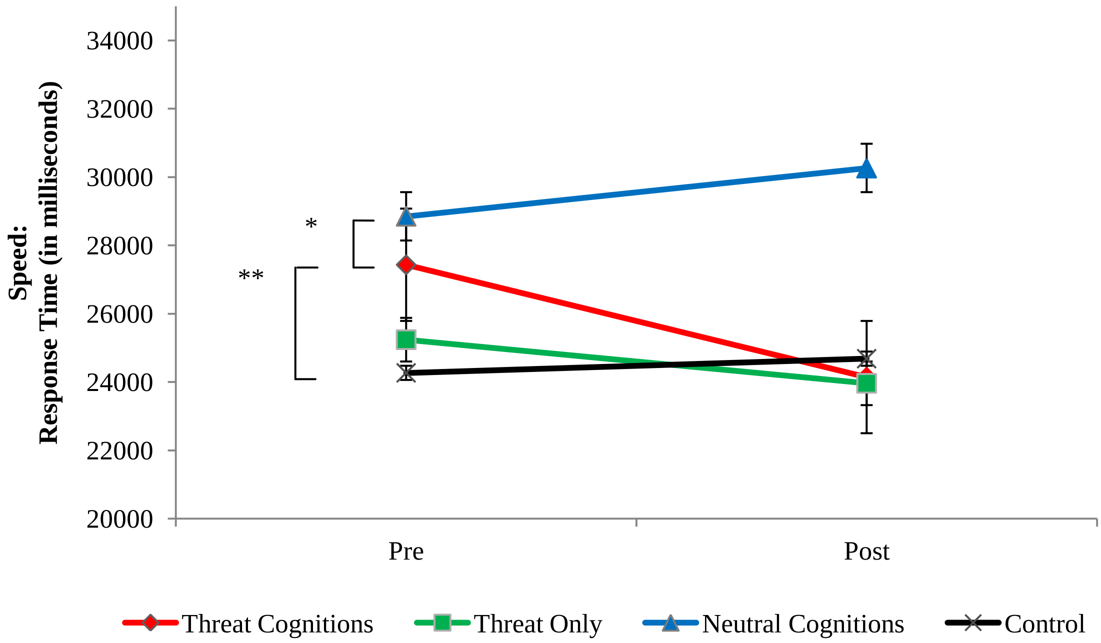


Figure 10. Change in Speed from Baseline to Post-manipulation, across Four Groups. Asterisks denote significance between groups for change in driving behaviour.
* $p < .05$, ** $p < .01$.

The current experiment used a manipulation check to measured perceived severity, susceptibility, self efficacy and response efficacy. Although the manipulation check could not provide a detailed measure of the four cognitions, it was tentatively used in an analytic strategy that aimed to examine the potential moderating role of cognitions on the main effect. Specifically, a hierarchical multiple regression analysis was used to test for interactions between variables. Condition was dummy-coded, where the control group was assigned a value of zero for all three dummy variables. The four cognition measures were mean-centred, to reduce the potential for multicollinearity to arise. Finally, interaction terms (i.e. condition*cognition) were calculated.

Due to concerns about statistical power, efforts were made to keep the number of variables entered into the equation to a minimum. The bivariate correlations between the moderators (i.e. cognitions), the moderator × cognition interaction terms, and the dependent variable (i.e. change in speed), were then examined. Two of the mean-centred cognition variables, namely susceptibility ($r = -.27$, $p = .02$) and self efficacy ($r = -.34$, $p < .001$), were significantly negatively correlated with change in speed. Further, the correlation between the product term of susceptibility × threat cognitions condition, and the change in speed outcome variable, was significant ($r = -.36$, $p < .001$). Similarly, the correlation between the product term of self efficacy × threat cognitions condition, and the change in speed outcome variable, was also significant ($r = -.34$, $p < .001$). There were no significant correlations between either of the other two cognitions, or the other conditions, and driving change scores.

These two cognitions were probed further in separate models. Model 1 examined the moderating effect of susceptibility. In this model, conditions (dummy-coded) were entered in Block 1, mean-centred susceptibility was entered in Block 2, and the interaction terms for conditions × susceptibility were entered in Block 3. There was a significant effect for condition, adjusted $R^2 = .22$, F (3, 58) = 6.60, $p < .001$. When susceptibility was added at Block 2, the model remained significant adjusted $R^2 = .21$, F (4, 57) = 4.98, $p < .001$, although the contribution of susceptibility did not significantly enhance the model ($p = .56$).

Table 11

Summary of Hierarchical Regression Analysis for Susceptibility Model (N = 62)

	Model 1			Model 2			Model 3		
Variable	*B*	*SE B*	β	*B*	*SE B*	β	*B*	*SE B*	β
Condition									
Control Vs TA Cog	-3702.51	1136.81	-.46**	-3375.72	1272.64	-.42*	-3364.60	1418.99	-.42*
Control Vs TA Only	-1692.96	1136.81	-.21	-1432.42	1227.11	-.18	-2307.48	1327.23	-.29
Control Vs Neutral Cog	1000.17	1155.00	.12	1106.16	1175.67	.13	261.59	1338.42	.03
Susceptibility				-264.96	453.23	-.08	713.30	954.96	.20
Control Vs TA Cog × Susceptibility							-2156.97	1381.67	-.29
Control Vs TA Only × Susceptibility							-276.27	1225.65	-.04
Control Vs Neutral Cog × Susceptibility							-1686.15	1288.31	-.23

Note. Condition was represented as three dummy variables with the control group serving as the reference group;
*$p < .05$; **$p < .01$.

Table 12
Summary of Hierarchical Regression Analysis for Self Efficacy Model (N = 62)

	Model 1			Model 2			Model 3		
Variable	*B*	*SE B*	β	*B*	*SE B*	β	*B*	*SE B*	β
Condition									
Control Vs TA Cog	-3702.51	1136.81	-.46**	-2769.61	1239.98	-.34*	-3223.52	1549.33	-.40*
Control Vs TA Only	-1692.96	1136.81	-.21	-1770.29	1118.44	-.22	-2066.29	1258.55	-.26
Control Vs Neutral Cog	1000.17	1155.00	.12	1239.63	1143.78	.15	1155.58	1190.42	.14
Self Efficacy				-598.65	344.75	-.22	-439.56	554.13	-.17
Control Vs TA Cog × Self Efficacy							-188.52	1080.60	.034
Control Vs TA Only × Self Efficacy							-532.24	950.85	-.09
Control Vs Neutral Cog × Self Efficacy							-311.29	905.27	-.05

Note. Condition was represented as three dummy variables with the control group serving as the reference group;
*p < .05; **p < .01.

Finally, while Block 3, as a whole, was significant, adjusted $R^2 = .22$, F (7, 54) = 3.44, $p < .001$, the interactions between susceptibility and threat cognitions ($p = .12$), threat only ($p = .83$) and neutral cognitions ($p = .20$) were not significant.

Model 2 was a replication of Model 1, but the susceptibility variable, as well as relevant interactions, was replaced with self efficacy. In this model, when self efficacy was added at Block 2, the model remained significant adjusted $R^2 = .24$, F (4, 57) = 5.88, $p < .001$, but the change did not reach statistical significance ($p = .09$). Finally, Block 3, as a whole, was significant, adjusted $R^2 = .21$, F (7, 54) = 3.28, $p = .01$, the interactions between self efficacy and threat cognitions ($p = .86$), threat only ($p = .58$) and neutral cognitions ($p = .73$) were not significant.

7.5 Discussion

The primary goal of this study was to measure the behaviour of young male drivers in response to a highly threatening road safety advertisement. The findings indicate that threat appeals reduced speeding behaviour among participants whose perceptions of threat and efficacy were high. Specifically, participants who were prompted to think about threat (i.e. severity and susceptibility) and efficacy (i.e. self efficacy and response efficacy), in relation to a RTC, subsequently reported higher levels of these cognitions than all other groups, and reduced their speed significantly more than those in the neutral cognitions, and control groups. These findings are in line with the EPPM, and are also consistent with recent experimental findings from the driving literature (e.g. Cauberghe, et al., 2009; Lewis, et al., 2010).

Descriptive statistics from the cognitive responses questionnaire indicate that the threat cognitions group, and the threat only group, reported higher levels of perceived severity and susceptibility, relative to the other two groups. Good and Abraham (2007) argued that questions relating to the seriousness of the consequences of a health threat are, in threat appeal studies, essentially a measure of message acceptance. In the current study, then, although the threat cognitions group was the only group to have threat-related cognitions explicitly prompted, participants in both threat groups were more inclined to accept the consequences of the threat appeal as serious, than those who viewed a neutral video.

The current findings also suggest, however, that perceiving the consequences of a RTC to be severe, and perceiving oneself to be vulnerable to these consequences, does not necessarily lead to a change in behaviour. This is evidenced by the finding that participants in the threat only group, despite having relatively high levels of perceived threat, did not change their driving behaviour after viewing the threat appeal message. Since both threat groups reported high perceived threat, but only the threat cognitions group modified their behaviour accordingly, this implies that another factor is impacting on the threat-behaviour relationship. Specifically, perceptions of efficacy were high among the threat cognitions group, and low among the threat only group, suggesting that efficacy may be the key factor responsible for bringing about the change in behavioural responses.

Interestingly, while the threat only group did not significantly reduce their speeding behaviour following the message, they also did not exhibit any reactive, counter-productive responses. Current theoretical positions would suggest that threatening messages, when presented in the absence of an efficacy manipulation, may lead to defensive responses (see Witte & Allen, 2000), including increased risky driving (Carey & Sarma, 2011; Jessop, et al., 2008). Contrary to what these studies might suggest, no such responses were evidenced in the current study.

The absence of defensive responses, among the threat only group, may be explained by the findings of the word fragment completion task. Previous research has found increased risky driving behaviours in response to death-related threat appeals, and has suggested that increased levels of mortality salience lead certain groups of people to react defensively (Carey & Sarma, 2011; Jessop, et al., 2008; Taubman Ben-Ari, 2000; Taubman Ben-Ari & Findler, 2003). Findings from the word fragment completion task, a measure of death thought accessibility, suggest that the threat message did not make mortality salient, and no defensive reactions were therefore exhibited. This was expected, since the threat appeal used in the current study relates to serious injury, and not to death,

The correlational data analyses raise a number of important points. First, in terms of the personality variables examined, individuals who were high in ESS tended to be higher in impulsiveness and SRV, and were more likely to report having previously raced another driver on a public road. This supports previous research indicating that certain personality types are more likely to take risks while driving (Iversen & Rundmo, 2002; Ulleberg & Rundmo, 2003), and more likely to violate traffic rules (Loo, 1979). Second, participants' change scores on the VST measure were negatively correlated with the number of penalty points they had received (r = -.25, p = .04), indicating that the more penalty points they had, the less their driving behaviour changed in response to the manipulation.

Although the regression analyses conducted in the current study did not find a significant interaction between cognitions and condition, the correlational data indicated a relationship between participants' change in driving speed and both their susceptibility and self efficacy cognitions. Further research is needed, however, to clarify the nature of the role played by these variables in moderating speeding behaviour.

The correlational analyses also point to driving anger as being a potential variable of interest for studies in this area. Participants who were higher in general driving anger were also higher in SRV, chose higher driving speeds at baseline and had lower perceptions of severity and efficacy. Since the outcome variable used in this study involved a task that was not likely to elicit an anger response, the impact of driving anger on behavioural responses is, as yet, unclear. An important area for future driving research is an exploration of the impact of anger on the effectiveness of a threat appeal message. As indicated in Chapter 1, very little research has been done in this area to date, despite driver anger and aggression having an important role to play in maintaining road safety (Abdu, et al., 2012). Given the current findings, an examination of the impact of anger, as both a trait and state variable, is warranted.

The findings of the present study also have relevance for the types of efficacy manipulations, related to speeding, used in experimental studies. Specifically, although the threat appeal message, for both groups, ended in a screen reading 'Don't Speed', perceptions of efficacy were high only among the group who received the additional prompts. This implies that, as suggested by previous researchers (Tay, 2005a), providing a single recommended strategy aimed at reducing speeding behaviour is complex and, likely, ineffective.

An alternative type of efficacy manipulation was proposed in this experiment, stemming from a recent study by Falk (2010), which was based on the question-behaviour effect (Sprott et al., 2006). Falk (2010) found that traffic safety could be increased by means of a mental elaboration task. Specifically, simply asking participants about their driving behaviour led to a significant decrease in self-reported risky driving. The author concluded that, when participants are prompted to think about a particular issue, this can make their belief structures and attitudes more accessible, which may, in turn, influence behaviour. The current study explored whether this kind of forced cognition, mental elaboration task could be used to effectively manipulate threat and efficacy cognitions. Rather than providing recommended strategies as part of the message itself, this study manipulated these cognitions by prompting participants to consider the severity of the consequences of a RTC, their vulnerability to those consequences, and possible strategies for avoiding such consequences. The cognitive prompts approach adopted here provided a subjective efficacy manipulation that can be easily applied to other contexts. Moreover, since the group who received the manipulation were highest in all cognitions, the forced cognitions manipulation appears to have effectively increased levels of perceived threat and efficacy. The use of single-item measures to access cognitive responses, however, presents a possible limitation (Fairlie et al., 2010).

Because this study took place in a laboratory, and not in a natural driving environment, ecological validity is reduced (see Plant, et al., 2011). For example, studies conducted in a laboratory, where participants are asked to pay close attention to presented stimuli, do not resemble normal conditions under which individuals are usually exposed to road safety advertisements. It is likely that the amount of attention participants pay to the advertisements in these experimental studies is far greater than that paid in real life (Lewis, et al., 2009). Further, because the current study looked only at speeding behaviour, conclusions cannot be drawn regarding other forms of driver risk-taking. Importantly though, the paucity of studies that have examined the impact of threat appeals on speeding behaviour, in a controlled experimental setting (Elliott, 2011), means that the experimental approach adopted here is also an important strength of the study. By using a naturalistic, pedal-based response, which was integrated into a real driving scene, the current study advanced on previous VST measures that used measured self-reported responses to video-based driving scenes (e.g. Horswill & McKenna, 1999a). Because the scenes used were filmed locally on Irish roads, they were also relevant to Irish drivers. Finally, despite the purpose of this type of driving research often being clear to participants (Lewis et al., 2007), in the current study, every effort was made to ensure that the true purpose of the experiment was hidden. When participants were asked, as part of the post-manipulation questionnaire, to give details of what they believed the purpose of the experiment to be, less than 5% gave an accurate description. The current study aimed to make the exposure procedure as realistic as possible, by embedding the road safety advertisement within other videos (Lewis, et al., 2009).

7.6 Contribution

The use of threat appeals is more common in road safety campaigns than almost any other area of health promotion (Rotfeld, 1999). Despite researchers repeatedly highlighting the importance of evaluating the impact of road safety advertising campaigns on behaviour, in a controlled experimental setting, (Elliott, 2011; Hoekstra & Wegman, 2011), relatively few experimental studies have been conducted (Glendon & Walker, 2013). The current study therefore contributes to this research area. It advances on previous studies by including a behaviour-based outcome variable, and by using a manipulation that has been systematically identified as eliciting a fear response.

7.7 Conclusion

From a theoretical standpoint, a certain amount of clarity is emerging in relation to the key variables that determine the effectiveness of a threat appeal (e.g. Lewis, et al., 2009; Maloney, et al., 2011). Based on the present findings, which are in line with the consensus from the general threat literature, it seems likely that threat appeal messages can effectively reduce risky driving behaviours, provided that perceptions of efficacy are high. There remain questions, however, regarding whether risky driving behaviours, other than speeding, can be deterred by the threat appeal message. Further, an examination of the impact of anger, as a characteristic of both the individual and the situation, on driving outcomes, may be warranted.

8: Chapter Eight

Study 4: Threat Appeals, Anger, and Risky Driving Behaviours.

This chapter presents the final experimental study in the current programme of research. In Study 3, findings indicated that exposure to a fear-arousing, threat-based road safety message, containing a manipulation that probed threat and efficacy cognitions, led to a reduction in speeding behaviour among young male drivers. Study 4 aims to advance on this, by examining whether these findings can be generalised to driving behaviours other than speeding, and, secondly, to what extent they might be influenced by conditions of heightened state anger.

8.1 Limitations of Previous Research

As discussed in Chapter 1, previous studies have often failed to adequately distinguish between different types of risky driving behaviours in the outcome measures they adopted. Specifically, several studies have employed questionnaires that combine a number of types of driving behaviours, and calculated an overall risky driving score, based on participants' responses (e.g. Jessop, et al., 2008; Taubman Ben-Ari, et al., 1999). This approach is limited, and researchers have highlighted the importance of treating different risky driving behaviours as separate outcomes, since they are likely to be motivated and affected by different factors (Begg & Langley, 2004; Schmidt, Morrongiello, & Colwell, 2013; Tay, 2005a).

Correlational analyses in Study 3 indicated that participants who reported high general levels of driving anger tended to be higher in SRV, and chose higher driving speeds at baseline. While previous literature has looked at the impact of situational anger on driving (Abdu, et al., 2012; Underwood, Chapman, Wright, & Crundall, 1999), and other studies have examined the impact of mood (i.e. either naturally occurring, or induced) on the processing of threat-based messages (Andersen & Guerrero, 1997; Moons & Mackie, 2007), very little research has examined how increased levels of state anger, following exposure to a fear-evoking threat appeal, affect risky driving. In other words, although studies have examined the impact of anger, and others have looked at that of fear, very little research has explored the cumulative effect of these two emotions on driving behaviours. This is a particularly interesting question given that research has identified fear and anger to be the most important driving-specific emotion states (Jeon & Walker, 2011), and has found that anger provoked by one situation can lead to increased risk-seeking choices in a separate situation, while fear has the opposite effect (Lerner & Keltner, 2001).

8.2 Rationale for the Current Study

Drawing on previous literature (reviewed in Chapter 1) that suggests different types of risky driving behaviours are motivated and influenced by different factors (Begg & Langley, 2004; Tay, 2005a), the current research examines whether a threat appeal that has been found to lead to a decrease in a particular type of risky driving behaviour (i.e. speeding), will lead to a decrease in other risky driving behaviours (i.e. following distance, gap acceptance and overtaking; see Horswill & Helman, 2003; Horswill & McKenna, 1999a, 1999c; McKenna, et al., 2006). Secondly, following on from the findings of the previous study, and stemming from research relating to the impact of both trait (Nesbit, Conger, & Conger, 2007) and state (Abdu, et al., 2012; Underwood, et al., 1999) anger on driving, the present study explores the effect of state anger, and its potential to interact with threat-induced fear, in moderating risky driving.

Specifically, the following hypotheses were explored:

1. Participants exposed to a threat appeal, containing a threat/efficacy manipulation (i.e. a threat cognitions group, as in Study 3), will show increased perceptions of threat and efficacy, and will exhibit a reduction in four risky driving behaviours.
2. Participants exposed to an anger-provoking manipulation, who are not exposed to a threat appeal message, will, in accordance with previous research, demonstrate increased levels of risky driving.
3. The experience of anger, among participants who are given both the threat appeal manipulation and the anger-provoking task, will dilute the impact of the threat appeal message, leading to no change in behaviour.

8.3 Method

Participants

Eighty-one participants took part in this study. All participants were male, aged 18-24 (M = 19.80, SD = 1.84), and in possession of a full driver's licence (77.8%, n =63), or a provisional driver's licence, with a minimum of one year's driving experience (22.2%, n = 18). Of the sample, 87.7% (n = 71) were university students, 8.6% (n = 7) categorised themselves as employed, and 3.7% (n = 3) were unemployed. Course credits were granted to Psychology students who participated (n = 15), while other participants were entered into a draw for a Tablet (n = 30), or given ten euro monetary compensation (n = 36). The type of incentive used was modified during data collection due to difficulties with participant recruitment, but all participants, across all forms of reward-type, were randomly allocated to groups.

Materials

Video: Threat advertisement. The threat appeal message used in Study 4 was the same high-threat road safety advertisement as that used in Studies 2 and 3 (described in Chapter 6). Two of four groups watched the threat appeal message, which included, for both groups, questions relating to threat and efficacy (i.e. the cognitions manipulation, as described in Chapter 7). The aim of this manipulation was to prompt efficacy, severity and susceptibility cognitions.

Video: Neutral videos. For all four groups, two neutral videos relating to driving were included in the video presentation, in order to create a more ecologically valid viewing protocol, and also to take focus away from the road safety video. A third, neutral advertisement was seen by the two no-threat groups (i.e. the anger-only group and the control group). The three neutral videos in this study were the same videos as those used in Study 3 (see Chapter 7), and related to the mechanics of an air conditioning system in a car, how to remove marks from the exterior of a vehicle, and how to effectively wash a car's plastic mouldings.

Word-search task. Following the video presentation, participants were presented with a word-search task, where they were asked to find seven car-related words. The word-search task provided an additional time-lapse between the fear-arousing road safety advertisement, and the anger-arousing description task. Since research on 'emotional blunting' suggests that a particular emotion can blunt the experience of a subsequent emotion (Pe & Kuppens, 2012; Winterich, Han, & Lerner, 2010), the word-search task also served as a delay/distraction.

Cognitive responses. The four cognitive responses of interest (i.e. perceived response efficacy, self efficacy, severity and susceptibility) were measured using one-item, seven-point scales, as described in Chapter 7. Again, the wording of these scales was based on measures used in previous research (Cauberghe, et al., 2009).

Self-reported fear. Self-reported fear was measured again in Study 4, as an additional manipulation check. Participants were asked to indicate the extent to which they experienced six fear emotions, as described in Chapters 6 and 7. The mean of the six items was calculated for each participant, and internal consistency for these items was high (α = .97).

Driving scales. As in Study 3, participants were asked a number of questions relating to their car, driver's licence, and driving history (i.e. history of RTCs, driving offences, incidence of racing another driver on a public road). They were also asked to complete the following driving-related measures:

Driving Anger Scale. The short-form of the Driving Anger Scale (DAS; Deffenbacher, et al., 1994), described in Chapter 7, was used to measure participants' tendency to become angry while driving. Items were summed to a scale total, with higher scores indicating higher levels of driving anger, and internal consistency was acceptable (α = .84).

Speeding and Rule Violation. Participants were asked to complete the Speeding and Rule Violation (SRV) subscale of the Driver Behaviour Scale (DBS; Iversen, 2004), described in Chapter 7. Items were summed to a scale total, with higher scores indicating higher levels of SRV. Internal consistency for this scale was acceptable (α = .77).

Personality Variables

Extraversion. Since the study ostensibly examined personality influences on driving style, participants were asked to complete a scale measuring extraversion. Extraversion was measured using the ten-item scale from the International Personality Item Pool (IPIP; Goldberg, 1999), as described in

Chapter 7. Items were summed to scale totals, with negative item being reverse-coded. The scale showed acceptable internal consistency (α = .83).

Trait Anger. Since a key aim of the current study was to examine the influence of dispositional and situational anger on driving behaviour, participants were asked to complete a trait anger scale. Trait anger was measured using the trait anger subscale of the State-Trait Anger Expression Inventory 2 (Spielberger, 1999). Participants responded to ten statements about themselves (e.g. “I am quick tempered”), based on how they “generally feel or react”. A four-point Likert scale was used (Almost Never, Sometimes, Often, Almost Always), and items were summed to give a scale total. Internal consistency for these items was acceptable (α = .78).

State Anger. The anger manipulation used in the current study was an event-recall task. Participants in the two anger groups were asked to answer two open-ended questions. The first question required participants to “describe 3-5 things that make you most angry”, and the second question asked that participants “describe, in detail, the one situation that makes you, or has made you, the most angry you have been in your life”. Participants were instructed to write their descriptions such that a person reading it “might become angry from hearing about the situation”. Participants in the two no-anger groups were asked to describe the experience of watching television (i.e. a neutral description task). This is a mood induction that is subjective to the individual, and has been used in a number of previous studies (Lerner & Keltner, 2001; Moons & Mackie, 2007). A similar task was recently used in an examination of the impact of situational anger on driving behaviour (Abdu, et al., 2012).

Since giving a label to situational emotions has been found to reduce their impact (e.g. on judgment; Kehner, Locke, & Aurain, 1993), a manipulation check was not used in the main study. Rather, the anger task was first piloted with 19 young males aged 18-24 (as in Lerner & Keltner, 2001). Participants in the pilot were randomly allocated to the anger task (anger condition; n = 10), or to the neutral task (control condition; n = 9). Following the task, participants were asked to rate the extent to which they felt 16 emotions: anxious, angry, amused, disgusted, downhearted, engaged, fearful, frustrated, happy, interested, irritated, nervous, mad, repulsed, sad, joyful (Lerner, Goldberg, & Tetlock, 1998; Lerner &

Keltner, 2001), on a 7-point Likert scale from 1 (*not at all*) to 7 (*very strongly*). The "angry" and "mad" items were then averaged to give a composite measure of anger. An independent samples *t*-test was conducted to examine differences across groups, and revealed that those who received the anger induction reported higher levels of anger (M = 4.15, SD = 1.33), than those in the neutral condition (M = 2.39, SD = 1.65; t (17) = -2.57, p = .02, d = 1.17).

Outcome variables: Driving behaviour measures.

The current study involved the measurement of four driving behaviours: speed choice, following distance, gap acceptance and overtaking. The scenes related to these driving behaviours were filmed using a Sony HD handheld video-camera, mounted on the driver's seat of a Ford Mondeo, with the headrest mount used in Study 3. Driving scenes were filmed from the driver's perspective, such that the road ahead was clearly visible (see figures below). The footage was shot on motorways, dual carriageways and primary roads around Galway city and county. Scenes were selected for editing where lighting and visibility were good, and where there was minimal vibration evident. After the footage was shot, the scenes were edited and integrated into tasks, based on previous research (Horswill & Helman, 2003; Horswill & McKenna, 1999a; McKenna, et al., 2006), and described below. These were completed by participants at both pre- and post-manipulation.

Speeding. Speeding behaviour was measured using the Irish VST, adapted from previous research (Horswill & McKenna, 1999a, 1999c; Horswill & Plooy, 2008; McKenna, et al., 2006; Thornton & Rossiter, 2003), and as described in Chapter 7. In Study 4, participants completed a practice trial (shot on a motorway), followed by four "test" scenes (two motorway scenes and two dual-carriageway scenes). These test scenes were completed at baseline, and then again post-exposure. Similar to Study 3, participants' mean response time across the four scenes was calculated for both pre- and post-manipulation, and change scores were calculated. Higher scores indicate greater response latencies (i.e. higher speeds).

Following Distance. For the following distance task, participants viewed scenes in which the car from which the footage was shot gradually approached the back of another car on a motorway (see Figure 11). They were asked to press down on the response pedal to begin the driving scene, and were instructed that they would need to make two responses. First, they were asked to lift their foot fully off the pedal once the car had reached their “normal following distance” (average FD), the distance at which they would normally follow another car. Second, when participants reached a following distance at which they felt “dangerously or uncomfortably” close (dangerous FD), they were asked to press the Space bar on the keyboard (labelled “Brake”). This general protocol is based on an earlier version of this measure (Horswill & McKenna, 1999c), and has produced findings in line with an alternative measure of close following (see Horswill & Helman, 2003, for details). In the current study, each participant first completed a practice trial, followed by two test scenes. Their two responses (i.e. pedal release and brake) were measured in milliseconds (i.e. from the beginning of the scene). The timing of the two average FD (i.e. pedal) responses for the two trials was averaged, and an average of the two dangerous FD (i.e. brake) responses was also calculated. Higher scores, for both the pedal response and the brake response, indicate greater response latencies (i.e. closer following distance). Participants completed this measure at baseline, and then again post-exposure, and change scores were calculated.

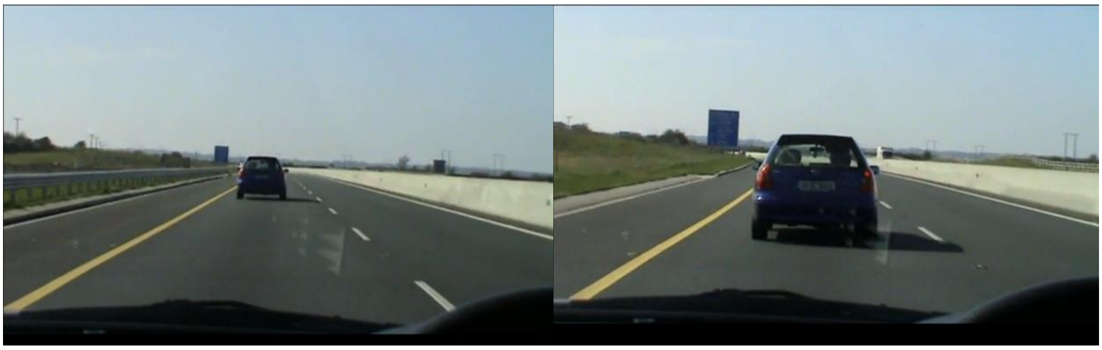


Figure 11. Still Images from the Following Distance Task.

Gap Acceptance. For the gap acceptance task, participants viewed scenes in which the car from which the footage was shot was at a T-junction, attempting to turn left, from a side road, on to a busy main road (see Figure 12). The scene is shot from the perspective of the driver, with the camera positioned on the right-hand window (i.e. focusing on the oncoming traffic). Participants were instructed to monitor oncoming traffic, and were told that every time there was a gap between cars that they would be willing to pull the car out into, they should press the response pedal once. This protocol is based on an earlier version of this measure (Horswill & McKenna, 1999c), and a similar measure was found to correspond to an alternative, photograph-based measure of gap acceptance (see Horswill & Helman, 2003, for details). In the current study, participants completed one practice trial, followed by two test scenes, comprised of 22 gaps. A gap acceptance score was calculated for participants by summing the number of gaps they chose to pull out into (i.e. the number of pedal responses), with higher scores indicating higher levels of gap acceptance. They completed the measure at baseline, and then again post-exposure, and change scores were calculated.

Figure 12. Still Images from the Gap Acceptance Task.

Overtaking. The overtaking task involved participants viewing scenes in which the camera-car was following a vehicle, on a primary road. The footage (see Figure 13) paused at various moments during the video, and participants were instructed that they should press the response pedal if they would overtake the car in front at the point indicated. When the footage paused, text appeared at the bottom of the screen that read “If you would overtake at this moment, press the response pedal once, now. If you would not overtake at this moment, do not respond”. The points indicated varied in the extent to which it would be risky to overtake. A similar type of overtaking task has been adopted in previous research (Horswill & Helman, 2003). Participants completed a practice trial, followed by three test scenes, comprised of 6 possible overtakes. The number of pedal presses made by participants, over these three scenes, was recorded, and a total overtaking score was calculated per participant. Higher numbers of responses indicated greater levels of overtaking. This measure was completed at baseline, and again post-exposure, and change scores were calculated.

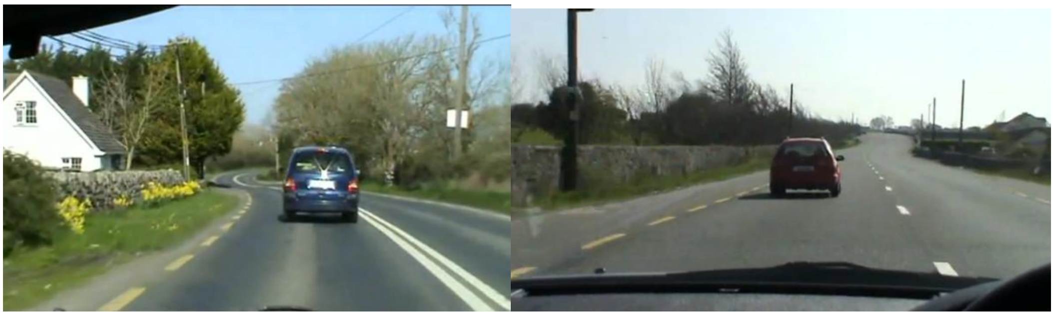


Figure 13. Still Images from the Overtaking Task.

Procedure

Participants were allocated an individual time at which to arrive at the psychology laboratory on campus. On arrival, they were greeted and asked to sit at a desk, where they were given a detailed information sheet. Once they had read this, and after any questions they had were answered, they were asked to sign a consent form. A short questionnaire was then presented to participants that included demographic questions, and the Extraversion scale.

Once this was completed, they were asked to sit in front of the projector screen and response pedal, where they would complete four driving tasks. Participants were informed that the aim of this was to validate a new measure of driving that was in development within the Psychology Department, and that it was a separate project to the main study they would be participating in. The four tasks were outlined verbally, and participants were informed that detailed instructions would appear on screen before each task. They were also told that they would complete a practice trial of the tasks, in order to familiarise themselves with the measures, prior to beginning each task. Participants then completed the speed task, close-following task, gap acceptance task, and overtaking task, in order to provide baseline driving data.

After these driving tasks had been completed, they were asked to sit back at the first desk (i.e. away from the projector screen and pedal), and informed that they would be presented with several driving-related videos on a computer screen. All participants were told that they did not need to write anything down, or answer any questions, but that they should pay attention to the videos. Participants were randomly assigned to one of four conditions: a “threat cognitions” group, a “threat cognitions anger” group, an “anger-only” group, or a control group. Participants were allocated to groups using a computer programme, such that there was an equal number of participants in each condition. At the beginning of the video presentation, all four groups watched a neutral video relating to air conditioning. The threat cognitions and threat cognitions anger groups then viewed the threat appeal advertisement. For the threat cognitions group, the advertisement was followed by the cognition-relevant screens. The two no-threat groups (i.e. the anger-only and control groups) viewed a neutral video containing instructions about removing marks from a car’s exterior. All four groups then viewed the video explaining how to clean a vehicle’s plastic mouldings. After the videos were over, all participants were asked to complete the word-search task. Following this, the two anger groups were given the anger-recall task, while the two no-anger groups were given the neutral description task.

Participants were then asked to sit once more in front of the projector, and to complete the four driving tasks again, ostensibly so that as much data as possible, from each participant, would be obtained. This time, participants viewed the same driving scenes, without the practice trials. Once the driving tasks had been completed for the second time, participants were presented with one final questionnaire, measuring cognitive responses, self-reported fear, driving anger, trait anger, driving history, and SRV. Once these final questionnaires had been completed, participants were debriefed verbally and thanked for their participation. The procedure of this experiment took, on average, approximately sixty minutes.

8.4 Results

Data Analytic Strategy

After inspecting the data for missing values, and following an examination of the distributions of the data, a number of manipulation checks were conducted. Next, in order to better understand the relationships between variables, correlations between participants’ driving behaviours, and other relevant variables, were examined.

The main hypotheses, that participants in the threat cognitions group will show a decrease in risky driving, while participants in the anger-only group will exhibit increases in risky driving, were then tested. First, change statistics (i.e. difference scores) were calculated for all four driving behaviours, for each participant, and between-group differences were tested for significance. Field (2005) notes that, while Multivariate Analyses of Variance (MANOVAs) can be preferable to several ANOVAs, it is unwise to include several DVs in a MANOVA design unless there is a strong empirical reason for doing so. Given that a core theme in the current research relates to treating different risky driving behaviours as distinct, separate outcomes (since they are likely to be motivated by different factors; Tay, 2005), between-group differences were analysed using multiple ANOVAs. *Post-hoc* Tukey tests were then conducted to examine between-group differences in more detail.

Missing Data

Data missing from the SPSS file were checked against the raw data-files and original questionnaires. Within the driving data, data from all participants was present for three of the four outcomes. For gap acceptance, there were two participants whose responses on the task at post-manipulation were absent, and change scores could not be computed. These participants were therefore excluded from gap acceptance analyses.

Normality

The normality of the data was assessed through a visual inspection of the distribution, and an examination of the skewness and kurtosis levels, and the Kolmogorov-Smirnov test results. Where skew values were greater than twice the standard error (Tabachnick, et al., 2001), the data was examined for outliers and, where necessary, transformations were applied.

For the cognitive responses variables, the perceived severity data appeared negatively skewed, with skew values more than twice the standard error (= -1.08), and a significant K-S result ($p < .001$). The severity data were therefore reflected (i.e. each score was subtracted from the highest score + 1), and subjected to a log transform. This reduced Skewness to within acceptable levels (= .33). The ANOVA results for severity, presented below, are based on these log transformed data. Skew values for the three other cognitive response variables (i.e.

susceptibility, self efficacy and response efficacy) were within the acceptable range.

The self-reported fear arousal data, as in Study 3, were normally distributed for the two groups who viewed the threat appeal, but were potentially non-normal for the two groups who viewed the neutral advertisement. Since the two non-threat groups largely responded to the fear arousal questions with the response 'none at all' (M = 1.05, SD = .21), this was expected, and, as in Study 3, no transformations were applied.

Within the driving data, skew values for speed change scores (=.08) indicated that the data were normally distributed. For normal FD change scores, because skew values indicated negative skew (= -.87), and since the K-S normality test was significant (p < .001), data were reflected and subjected to a log transform. This reduced Skewness to within acceptable levels (= .01). ANOVA analyses of Average FD are based on these log transformed data.

The data for dangerous FD change scores also appeared non-normally distributed, with skew values suggestive of positive skew (= 1.10) and a significant result from the K-S test (p = .01). On examination of the graphical representation of the distribution, it was noted that there was one extreme (± 3 IQR from the median) score. This was likely to be due to a problem with the response pedal recording the response. Specifically, since triggering the button on the Ergodex board required a firm pedal press, it is possible that this participant's initial response may not have been recorded. Removing this outlier reduced Skewness to within acceptable levels (= .27), and no transformations were therefore applied. The ANOVA results for the Dangerous FD data, presented below, are based on the dataset following the removal of this outlier. Skew values for the final two driving outcomes indicated that both the gap acceptance (= .52), and overtaking (= -.44) data were normally distributed.

Manipulation Checks

Cognitive responses. Descriptively (see Table 13), levels of perceived severity were highest for participants in the threat cognitions anger group (M = 6.29, SD = 1.23), followed by those in the threat cognitions group (M = 6.05, SD = 1.32), the anger-only group (M = 5.90, SD = 1.25) and the control group (M = 5.35, SD = 1.14). Perceived susceptibility was highest among the threat cognitions group (*M* = 3.90, *SD* = .1.29), followed by the threat cognitions anger (*M* = 3.76, *SD* = 1.22), anger-only (*M* = 3.30, *SD* = 1.13), and control (*M* = 3.00, *SD* = .79) groups. The threat cognitions group were highest in levels of perceived self efficacy (i.e. in relation to the recommended response; *M* = 4.85, *SD* = 1.42), followed by those in the threat cognitions anger (*M* = 4.81, *SD* =1.44), anger-only (*M* = 4.45, *SD* = 1.50), and control (*M* = 4.15, *SD* = 1.46) groups. Finally, participants in the threat cognitions group reported highest levels of perceived response efficacy (*M* = 5.35, *SD* =1.39), followed by those in the threat cognitions anger (*M* = 4.90, *SD* = 1.00), control (*M* = 4.65, *SD* = 1.35), and anger-only (*M* = 4.55, *SD* = 1.50) groups.

Table 13

Descriptive Statistics for Cognitive Responses (Study 4)

	Threat Cog Anger		Threat Cog		Anger Only		Control	
Cognition	Mean	(*SD*)	Mean	(*SD*)	Mean	(*SD*)	Mean	(*SD*)
Severity	6.29	(1.23)	6.05	(1.32)	5.90	(1.25)	5.35	(1.14)
Susceptibility	3.76	(1.22)	3.90	(1.29)	3.30	(1.13)	3.00	(.79)
SE	4.81	(1.44)	4.85	(1.42)	4.45	(1.50)	4.15	(1.46)
RE	4.90	(1.00)	5.35	(1.39)	4.55	(1.50)	4.65	(1.35)

Note. The descriptive statistics for severity presented here are based on the raw (i.e. untransformed) data.

A series of one-way ANOVAs revealed a main effect for condition on perceptions of severity (using the transformed severity data), F (3, 80) = 3.01, p = .04, partial η^2 = .11, and susceptibility, F (3, 80) = 2.74, $p < .05$, partial η^2 = .01. There were no significant differences between groups for self efficacy (p = .38), or response efficacy (p = .23).

Post-hoc Tukey tests were conducted to examine any differences between groups in more detail. For perceived severity, results indicated that the threat cognitions anger group differed significantly from the control group (p = .03). For perceived susceptibility, none of the *post*-hoc comparisons yielded significant effects, although the difference between the control group and the threat cognitions group approached significance (p = .06).

Self-reported fear. A one-way ANOVA was conducted on levels of self-reported fear arousal. Results indicated that there were significant differences across groups F (3, 80) = 53.67, p < .001, partial η^2 = .68. Since Levene's test was significant (p < .001), *post-hoc* Dunnett's C tests were conducted. Results indicated that the threat cognitions anger group reported significantly higher levels of fear arousal (M = 3.02, SD = 1 .06) than participants in the anger-only group (M = 1.02, SD = .05, p < .05) and the control group (M = 1.08, SD = .30, p < .05). Similarly, participants in the threat cognitions only group were significantly higher in self reported fear (M = 3.34, SD = 1.03) than those in the anger-only (M = 1.02, SD = .05, p < .05) and control groups (M = 1.08, SD = 1.08, p < .05). No significant differences were observed between the threat cognitions and threat cognitions anger groups, or between the anger-only and the control groups. Consistent with Studies 2 and 3, therefore, participants who watched the threat appeal advertisement reported significantly higher levels of fear than those who watched the neutral advertisement.

Equivalence across reward-types

As noted earlier, participants were recruited using three different incentives: Course credits; prize draw entry and; monetary compensation. Any potential differences between the three reward-type groups were probed by means of a one-way ANOVA, where reward-type was the grouping variable, and baseline driving responses were the outcomes. Results indicated no significant differences across groups for speed, average FD, dangerous FD, or gap acceptance. The difference between reward-type groups for baseline overtaking, however, was significant F (2, 80) = 4.58, p = .01, partial η^2 = .11. *Post-hoc* Tukey test procedures indicated that the monetary compensation group (M = 2.33, SD = .93) were significantly higher in baseline overtaking than the prize-draw group (M = 1.70, SD = .70; p = .01).

Possible reasons for this were probed, and analyses indicated that the age of the monetary compensation group (M = 19.19, SD = 1.53) was lower than that of the prize draw group (M = 21.13, SD = 1.80), and the correlation between the age and reward-type was significant (r = -.46, p < .001). In order to examine this relationship further, an ANCOVA, focusing on the prize-draw and monetary compensation groups, with age entered as the covariate, was conducted. Results revealed that, even when age was controlled for, the effect of reward type was still significant F (1, 63) = 6.79, p = .01, partial η^2 = .01. Importantly, all participants were randomly allocated to groups, and participants receiving different reward-types were equally divided across the four conditions, so any effect of reward-type is diluted. However, results should be interpreted in light of this.

Correlations

In order to explore relationships between variables in the current study, Pearson's correlations (see Table 14) were examined. In the current study, participants' age positively correlated with perceptions of susceptibility (r = .27, p = .01), and negatively correlated with driving anger (r = -.30, p = .01). The length of time for which participants had been driving was positively correlated with their perceptions of susceptibility to a RTC (r = .23, p = .04), and negatively correlated with baseline levels of average FD (r = -.29, p = .01), and dangerous FD (r = -.32, p < .001). Participants who reported having been involved in a RTC in the past three years had higher levels of perceived susceptibility to a RTC (r = .24, p = .03), were more likely to have raced another driver on a public road (r = -.36, p < .001), and showed higher levels of overtaking at baseline (r = .29, p = .02). Participants who reported having raced another driver had lower levels of self efficacy in relation to carrying out the recommended behaviour (i.e. reducing speed; r = .31, p = .01), and had, surprisingly, lower levels of self-reported SRV (r = .50, p < .001), but higher levels of baseline gap acceptance (r = -.26, p = .02) and overtaking (r = -.49, p < .001). SRV also negatively correlated with driving anger (r = -.42, p < .001), and with baseline levels of gap acceptance (r = -.24, p = .03) and overtaking (r = -.24, p = .04). Levels of driving anger were positively correlated with baseline overtaking responses (r = .24, p = .03).

In order to guide future research in this area, the relationship between trait anger and baseline driving, as well as other driving-relevant variables, was examined. Participants high in trait anger tended to be younger (r = -.29, p = .01), lower in SRV (r = -.28, p = .01), and higher in driving anger (r = .60, p < .001).

Hypothesis Testing

In order to first determine whether or not there were significant differences across groups at baseline, a one-way ANOVA was conducted. Results indicated that there were no significant differences across groups in baseline levels of speed, average FD, dangerous FD, gap acceptance or overtaking (see Table 15).

Change statistics were calculated for each participant, for each of the four tasks. For the speed, average FD and dangerous FD tasks, participants' baseline response time (in milliseconds) was subtracted from their response time at post-manipulation. Positive change scores indicate greater response latencies (i.e. higher speed, and closer following distance), while negative change scores indicate shorter response latencies (i.e. lower speed, and greater following distance).

For the gap acceptance and overtaking tasks, the number of responses made by participants at baseline was subtracted from their number of responses at post-manipulation. For these tasks, positive change scores indicated an increased number of responses (i.e. increased gap acceptance, and increased overtaking), while negative change scored suggested a lower number of responses (i.e. lower levels of gap acceptance and overtaking).

If the main hypotheses of the current study are supported, participants in the threat cognitions group will exhibit reductions in risky driving behaviours, from baseline to post-manipulation, while levels of risk-taking among the anger-only group are expected to increase. Descriptive statistics (see Table 15) suggest that, as in Study 3, participants in the threat cognitions group chose lower speeds at post-manipulation than at baseline, releasing the pedal approximately eight seconds earlier (M = -8127.20, SD = 9208.72) following the threat appeal message. Reductions in speed were also evident among the threat cognitions anger group (M = -2485.02, SD = 11588.32), who released the pedal 2.5 seconds earlier, and the control group (M = -4546.61, SD = 7989.66), who released 4.5 seconds earlier. The anger-only group were the only group to show an increase in chosen speed (M = 839.05, SD = 10526.56), releasing the pedal 0.8 seconds later at post-manipulation.

Table 14

Pearson's Correlations for Demographic, Driving-related, Psychometric, Cognitive and Behavioural Data (Study 4)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Age	-																				
2. LoTD	.32**	-																			
3.RTCs	-.05	-.00	-																		
4. Raced	-.06	.18	-.36**	-																	
5. Sev.	-.10	.08	.03	.22	-																
6. Susc.	.27*	.23*	.24*	-.00	.33**	-															
7. SE	-.07	-.09	.04	.31**	.10	.07	-														
8. RE	-.06	.13	.04	-.10	.10	.17	.21	-													
9. DA	-.30**	-.12	.14	-.21	.19	-.06	-.14	.04	-												
10. TA	-.29**	-.01	.03	-.22	.14	.06	-.10	-.01	.60**	-											
11. SRV	-.02	-.21	-.17	.50**	.15	-.03	.39**	.04	-.42*	-.28*	-										
12. B Sp	-.03	.03	.11	-.16	-.04	.02	-.01	.02	.14	.07	-.19	-									
13. Ch.Sp	.15	.02	.06	.12	.04	.01	-.02	-.07	-.07	-.03	.05	-.40**	-								
14. BAFD	-.07	-.29*	.08	.01	-.10	-.11	.11	-.12	.21	.03	-.07	.07	.05	-							
15. Ch.AFD	.06	.23*	-.07	-.12	-.06	.03	-.23*	-.08	-.12	-.27*	-.11	.02	-.05	-.33**	-						
16. BDFD	-.15	-.32**	.07	-.01	-.10	-.17	.05	-.14	.18	.07	-.01	.05	.03	.70**	-.19	-					
17. Ch.DFD	-.02	.24*	-.10	-.10	.20	.13	-.26*	.13	-.04	-.12	-.21	.14	-.19	-.41**	.58**	-.43**	-				
18. BGA	.01	.05	.13	-.26*	-.04	-.04	-.22	-.18	.16	.16	-.24*	-.08	.15	.17	.04	.23	-.06	-			
19. Ch.GA	.23*	-.15	-.10	-.02	-.10	-.07	-.06	-.40**	-.06	-.14	-.00	-.07	.25*	.08	.03	-.05	-.06	-.18	-		
20. BOT	-.12	.07	.29**	-.49**	-.15	-.02	-.14	-.05	.24*	.22	-.24*	.15	-.14	.07	.01	.01	-.03	.26*	-.19	-	
21. Ch.OT	.09	-.15	-.15	.13	.02	.01	-.05	-.12	-.12	.02	-.00	-.06	.11	-.19	.04	-.13	.15	-.19	.32**	-.56**	-

Note: LoTD = Length of time driving; RTCs = Number of road traffic collisions in the past three years; Raced = Have you raced another driver on a public road (Yes/No); Sev. = Perceived severity; Susc. = Perceived susceptibility; SE = Perceived self efficacy; RE = Perceived Response Efficacy; DA = Driving anger; TA = Trait anger; SRV = Speeding and rule violation; B Sp = Baseline speed choice; Ch. Sp = Change scores for speed choice; BAFD = Baseline average FD; Ch. AFD = Change scores for average FD; BDFD = Baseline Dangerous FD; Ch. DFD = Change scores for Dangerous FD; BGA = Baseline Gap Acceptance; Ch. GA = Change scores for Gap Acceptance; BOT = Baseline Overtaking; Ch. OT = Change scores for overtaking. * $p < .05$, ** $p < .01$.

Table 15

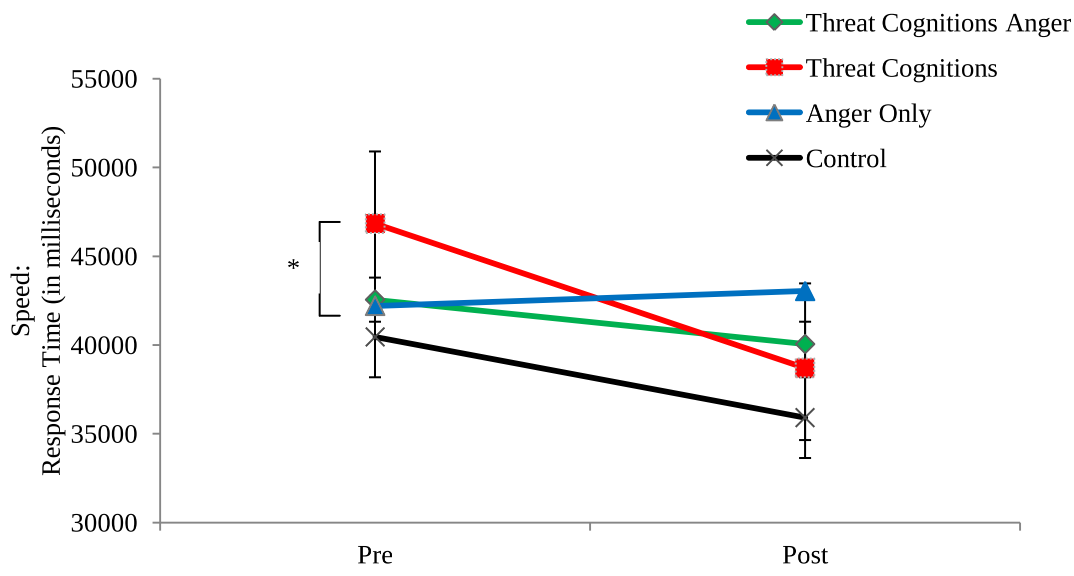
Descriptive Statistics for Driving Data (Study 4)

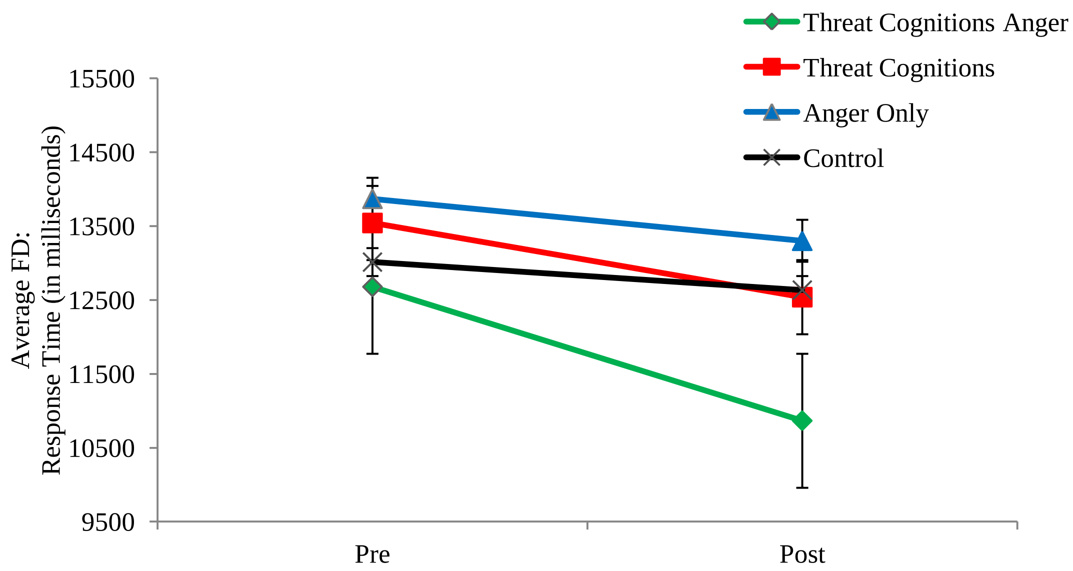
	Threat Cognitions Anger		Threat Cognitions		Anger-only		Control	
	M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Speed (Pre)	42549.57	(13692.83)	46833.54	(9844.35)	42208.13	(8909.22)	40451.82	(11943.70)
Speed (Post)	40064.56	(14400.48)	38706.34	(9361.14)	43047.19	(11160.38)	35905.21	(11497.23)
Speed (Change)	-2485.02	(11588.32)	-8127.20	(9208.72)	839.05	(10526.56)	-4546.61	(7989.66)
Average FD (Pre)	12678.55	(3347.34)	13541.76	(4540.68)	13869.52	(3997.60)	13012.65	(4025.70)
Average FD (Post)	10864.83	(4329.12)	12537.92	(3968.86)	13301.15	(3910.92)	12634.27	(4368.02)
Average FD (Change)	-1813.73	(3844.65)	-1003.83	(3768.66)	-568.38	(2420.86)	-378.38	(2327.53)
Dangerous FD (Pre)	18926.04	(3625.05)	19294.37	(2625.55)	19652.25	(3662.92)	19895.58	(4116.32)
Dangerous FD (Post)	18133.03	(3074.06)	17964.00	(2763.55)	19127.21	(2728.67)	19273.11	(4473.25)
Dangerous FD (Change)	-793.02	(2194.67)	-1330.37	(1768.65)	-525.04	(1356.78)	-622.47	(2053.02)
Gap Acceptance (Pre)	8.15	(2.48)	8.20	(3.78)	7.75	(3.35)	9.25	(2.84)
Gap Acceptance (Post)	8.60	(3.07)	7.75	(3.23)	9.21	(4.05)	9.70	(3.18)
Gap Acceptance (Change)	.45	(2.50)	-.45	(1.76)	1.32	(1.92)	.45	(1.32)
Overtaking (Pre)	1.90	(.83)	2.20	(.89)	2.00	(.97)	2.00	(.92)
Overtaking (Post)	1.90	(.77)	1.80	(.89)	2.35	(.88)	2.00	(.73)
Overtaking (Change)	.00	(.63)	-.40	(1.14)	.35	(.67)	.00	(.86)

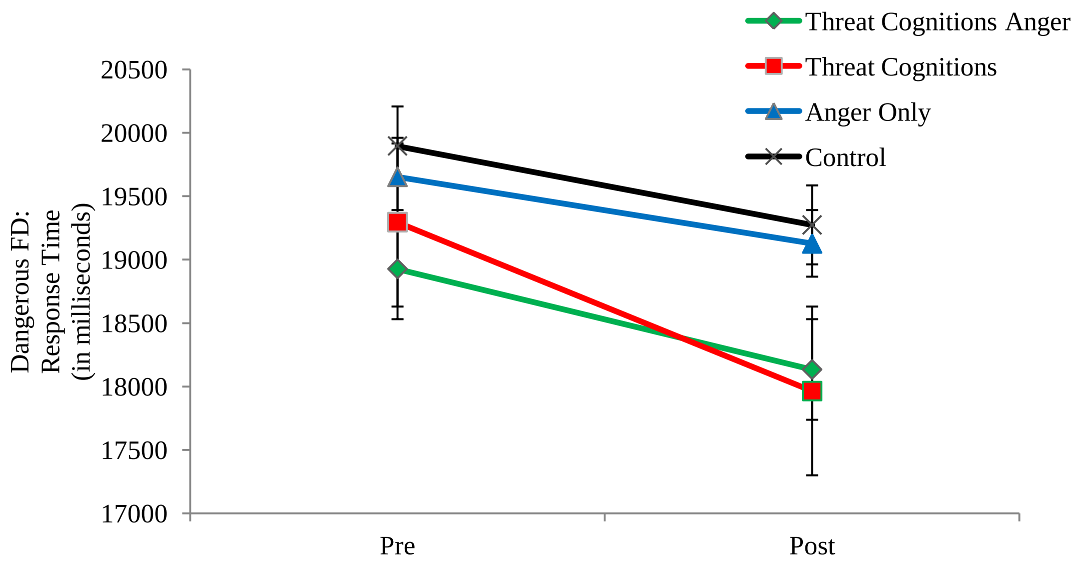
For average FD, the threat cognitions anger group showed the greatest change from pre- to post-manipulation, releasing the pedal approximately two seconds earlier than at baseline (M = -1813.73, SD = 3844.65). The threat cognitions group showed a reduction in average FD from pre- to post-manipulation of approximately one second (M = -1003.83, SD = 3768.66), while little change was seen among the anger-only group (M = -568.38, SD = 2420.86), and the control group (M = -378.38, SD =2372.53). For dangerous FD (with the outlier removed), all four groups released the pedal earlier than at baseline, with the threat cognitions group exhibiting the greatest change (M = -1330.37, SD = 1768.65).

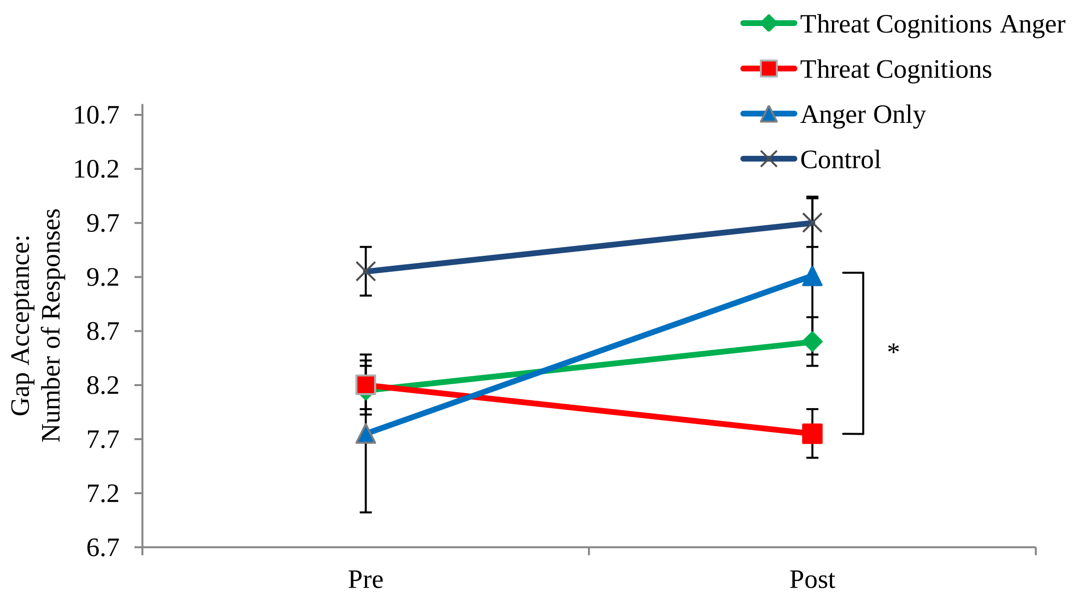
For gap acceptance, the threat cognitions group were the only group to exhibit a decrease in pedal presses (i.e. to choose fewer amounts of gaps to pull their car out into) at post-manipulation, relative to baseline (M = -.45, SD = 1.76), while the anger-only group showed the greatest increase (M = 1.32, SD = 1.92) in gap acceptance. Finally, the threat cognitions group were the only group to exhibit a decrease in levels of overtaking (M = -.40, SD = 1.14). The threat cognitions anger (M = 0.00, SD = .63) and control (M = 0.00, SD = .86) groups showed no change, while the anger-only group showed a slight increase in overtaking at post-manipulation (M = .35, SD = .67).

In order to determine whether or not these differences were statistically significant, a one-way ANOVA was conducted on the change statistics for each driving outcome. For the speed scores (see Figures 14 and 15), ANOVA results indicated that there were significant differences across groups F (3, 80) = 2.86, p = .04, partial η^2 = .10. *Post-hoc* Tukey tests were conducted to further probe these differences. Results suggested that the threat cognitions group (M = -8127.20, SD = 9208.72) differed significantly from the anger-only group (M = 839.05, SD = 10526.56; p = .03), but not from the control group or the threat cognitions anger group. There were no other significant differences across groups. In other words, the reduction in speed evidenced by the threat cognitions group, and the increase in speed evidenced by the anger-only group, were significantly different to each other, but not significantly different from the control group. ANOVA results suggested that there were no overall significant differences across groups for either average FD (p = .50), or dangerous FD (p = .55).


Threat Cognitions Anger
Threat Cognitions
Anger Only
Control
Speed:
Response Time (in milliseconds)
55000
50000
45000
40000
35000
30000
*
Pre
Post


Threat Cognitions Anger
Threat Cognitions
Anger Only
Control
Average FD:
Response Time (in milliseconds)
15500
14500
13500
12500
11500
10500
9500
Pre
Post


Threat Cognitions Anger
Threat Cognitions
Anger Only
Control
Dangerous FD:
Response Time
(in milliseconds)
20500
20000
19500
19000
18500
18000
17500
17000
Pre
Post



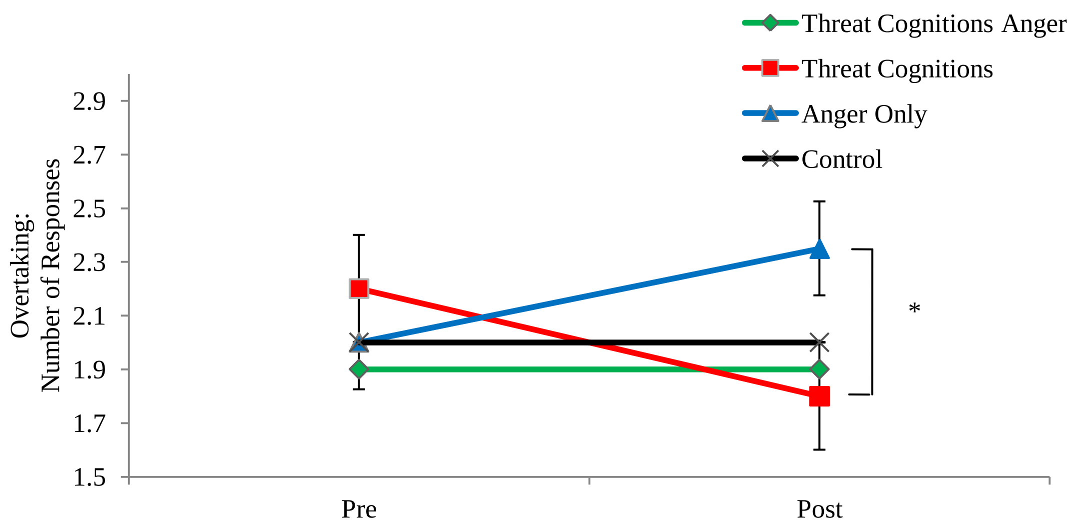


Figure 14: Changes from Pre- to Post-manipulation in Speed Choice, Average FD, Dangerous FD, Gap Acceptance and Overtaking.

Error bars denote standard error of the mean. Asterisks denote significance between groups for change in driving behaviour.

* $p < .05$, ** $p < .01$.

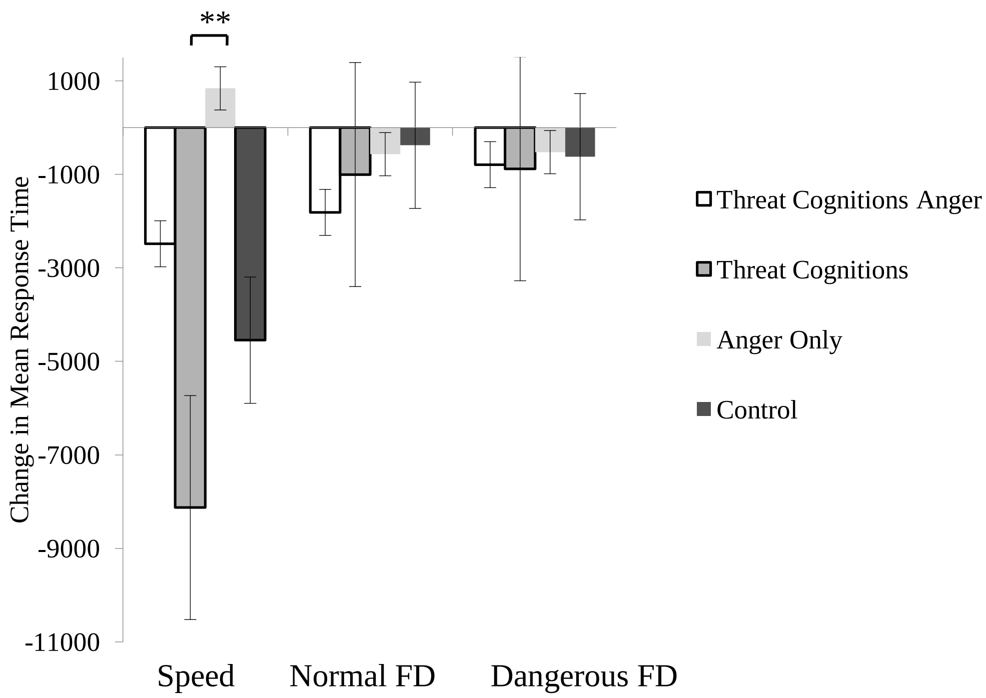


Figure 15: Changes in mean response time for speed and FD among four groups; Threat cognitions anger (*n* = 21), threat cognitions (*n* = 20), anger-only (*n* = 20), and control (*n* = 20). Asterisks denote significance between groups. Error bars denote standard error. * *p* < .05, ** *p* < .01.

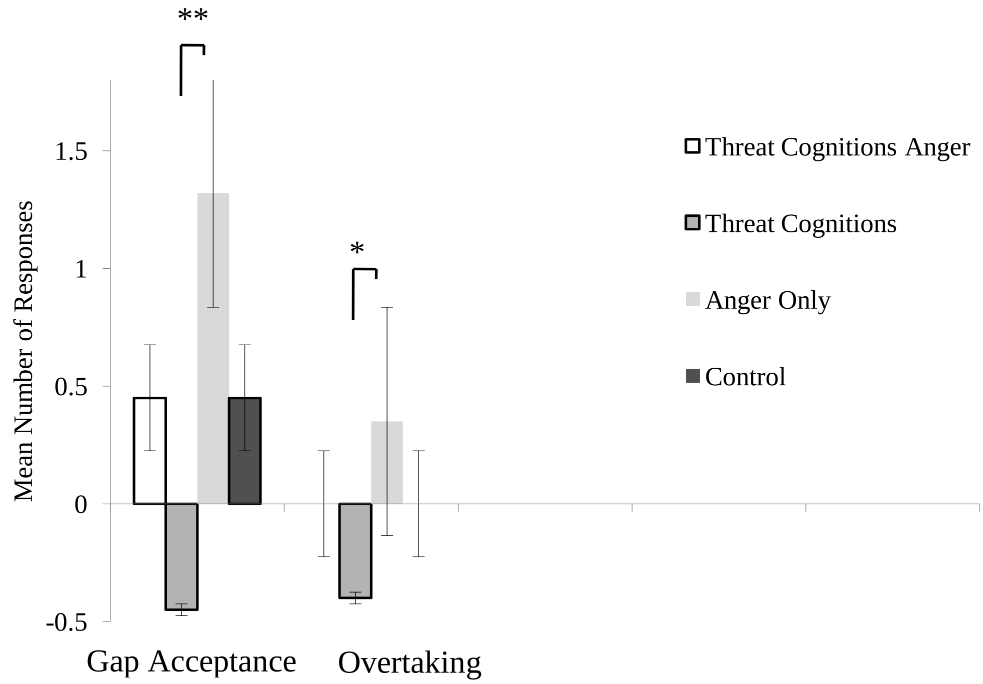


Figure 16: Changes in mean number of gap acceptance and overtaking responses among four groups; Threat cognitions anger (*n* = 21), threat cognitions (*n* = 20), anger-only (*n* = 20), and control (*n* = 20). Note that there was no change for the threat cognitions anger and control groups for overtaking, hence these groups do not appear. Asterisks denote significance between groups. Error bars denote standard error. * *p* < .05, ** *p* < .01.

For gap acceptance (see Figures 14 and 16), ANOVA results also revealed significant differences across groups, F (3, 78) = 2.75, $p < .05$, partial $\eta^2 = .01$. *Post-hoc* Tukey tests indicated that, again, the threat cognitions group (*M* = -.45, *SD* = 1.76) differed significantly from the anger-only group (*M* = 1.32, *SD* = 1.92; *p* = .03). No other significant differences across groups were evident.

For the overtaking (see Figures 14 and 16) change scores, the overall difference across groups did not reach statistical significance (*p* = .06), however, since the ANOVA result approached significance, exploratory Tukey test procedures were conducted *post-hoc*. Findings suggested that the difference between the threat cognitions (*M* = -.45, *SD* = 1.28) and the anger-only (*M* = .35, *SD* = .67) groups was significant (*p* = .03).

Overall, then, the threat cognitions group differed significantly from the anger-only group in speed choice, gap acceptance and overtaking. The anger-only group did not significantly differ from the control group, but increased significantly from baseline in two (i.e. gap acceptance and overtaking) of four measures of risky driving. The threat cognitions group evidenced a significant decrease, relative to the anger group, in three of the four risky driving measures. These findings are largely in line with the *a-priori* hypotheses, and with the results of Study 3.

8.5 Discussion

The primary goal of this study was to measure the impact of fear and anger on four types of driving behaviour. Results of the current study indicate that, in line with previous experimental research (Cauberghe, et al., 2009; Lewis, et al., 2010) and current theory (e.g. the EPPM; Witte, 1992), a fear-arousing, threat-based manipulation that probes cognitions relating to threat and efficacy, can lead to a reduction in risky driving. The current findings would also suggest, however, that this effect may not be evident when individuals are under conditions of heightened emotional arousal (i.e. when they are angry).

Specifically, the first aim of this study was to examine whether the effectiveness of a threat appeal in reducing risky driving, as demonstrated in Study 3, would apply to other types of driving behaviours. In this study, participants in the threat cognitions group significantly reduced their speeding behaviour, relative to other groups, following the manipulation. This echoes the findings of Study 3, and further highlights the potential for threat appeal messages to be effective in changing speeding behaviour. In terms of following distance, however, neither measure (i.e. average FD or dangerous FD) yielded significant findings, with relatively small changes in behaviour from baseline to post-manipulation.

For the gap acceptance measure, there were significant overall differences between groups. Specifically, the threat cognitions group was the only group to reduce the number of pedal presses made, post-manipulation, relative to baseline, and significantly differed from the anger-only group. It is important to note, however, that the magnitude of the difference (i.e. from pre- to post-manipulation) was small, with the threat cognitions group decreasing in gap acceptance by only 0.5 of a pedal press. Finally, for the overtaking measure, while the overall difference between groups was not significant, the threat cognitions group did significantly reduce their overtaking when compared directly with the anger-only group. Again, however, it should be noted that that the magnitude of this reduction was also small, and two of the groups showed no change in this measure.

Overall, results from the driving behaviour data of the threat cognitions group are in line with previous research (Peters, et al., 2012; Witte & Allen, 2000), and indicate that threat appeals can effectively reduce a number of risky driving behaviours. It is noteworthy that the greatest change from pre- to post-manipulation was seen in speeding data. This may stem from the fact that the particular road safety advertisement used in the current study focused on speeding behaviour. Previous research has suggested that theory-based, carefully designed advertisements can be effective in changing speeding behaviour (Glendon & Walker, 2013), and the current findings are in line with this.

At the end of Chapter 7, it was concluded that, based on significant differences in perceptions of efficacy across groups, efficacy plays a key role in determining the effectiveness of a threat appeal (Cauberghe, et al., 2009; Lewis, et al., 2010; Witte, 1994). In the current study, however, results of the manipulation check were less conclusive. Specifically, while *threat* perceptions were significantly higher among the threat appeal groups, and while descriptive statistics indicated that the threat groups were higher in perceptions of efficacy, there were no significant differences across groups in levels of perceived self / response efficacy.

Since the threat cognitions group were no higher in efficacy than the other groups, yet significantly reduced their risky driving behaviours, there are three possible conclusions to be drawn. First, it is possible that the manipulation check used in the current study was not sensitive to the measurement of efficacy. However, since the same manipulation check was used in Study 3, and since previous road safety studies have used similar, one-item measures (Cauberghe, et al., 2009; Lewis, et al., 2010; Tay & Watson, 2002), this is unlikely to be the case. Second, efficacy may not be the key variable that is leading to these adaptive responses in driving behaviour. There may be another variable, not measured in the current experiment, at play. For example, research has proposed that variables like need for cognition, people's tendency to engage in thinking processes (Ruiter, et al., 2004), play a key role in determining responses to threat appeal messages. Finally, it is possible that the use of a road safety message that targeted speeding, when a number of other driving behaviours were being measured, negatively impacted on efficacy perceptions.

A second aim of the current experiment was to examine the impact of situational anger on driving. Anger is among the most commonly cited reasons for risky driving (Deffenbacher, et al., 2003; Schwebel, et al., 2006), and previous research has made a strong case for both how and why trait and state anger affect risky driving behaviours (Abdu, et al., 2012; Dahlen & White, 2006; Deffenbacher, et al., 2003; Underwood, et al., 1999). The potential for state anger to affect the ways in which a threat appeal message can change behaviour, however, had not been extensively probed.

In terms of its direct impact on driving, the anger findings from the current study are largely in line with previous research (Abdu, et al., 2012), and indicate that participants who are high in state anger are likely to increase in different types of risky driving. Participants in the anger-only condition increased risky driving in three of the four tasks, and were significantly different to those who viewed the threat message only (i.e. the threat cognitions group).

Importantly, participants who were exposed to the threat message *and* the anger manipulation (i.e. the threat cognitions anger group) did not reduce their risky driving behaviours, relative to the other groups. Previous research has suggested that high levels of anger can lead to increased risk taking, while fear can have the opposite effect (Lerner & Keltner, 2001). The current result is therefore important, because it suggests that, while threat appeals have the potential to be effective in reducing risky driving (as outlined in the EPPM), their effects may be diluted by the experience of anger, or other emotions. This is in line with, and advances on, previous research that has emphasised the role played by emotion and mood on risky driving (Hu, Xie, & Li, 2013; Mesken, Hagenzieker, Rothengatter, & de Waard, 2007).

A key strength of the current study is that it developed, and adopted the use of, three new, Irish-relevant driving tasks. These were based on measures used in UK-based studies (Horswill & Helman, 2003; Horswill & McKenna, 1999a, 1999c; McKenna, et al., 2006), and measured following distance, gap acceptance and overtaking. As noted in Chapter 1, these types of computer-based driving tasks, depicting real driving situations, represent a realistic, cost-effective alternative to driving simulators.

The measures used in the current study, however, do present a number of limitations. For example, in the following distance measure, all four scenes were filmed on a motorway (i.e. as in Horswill & Helman, 2003; Horswill & McKenna, 1999b). It may be beneficial to examine following distance behaviour on a number of different road types (i.e. dual carriageway, primary road, secondary road), as this may allow for a more representative spread of responses. The gap acceptance measure contained two scenes, measuring a total of 22 gaps, of varying lengths between vehicles. A more representative measure may be developed by including an increased number of gaps (e.g. 60 monitored gaps, as in Horswill & Helman, 2003). For the overtaking measure, due to a limited amount of usable footage, a total of 6 possible opportunities for overtaking were presented to participants, meaning that the variation between participants, in terms of their number of responses, was minimal. This is illustrated in the average change scores of zero for two of the conditions. This measure could be improved by increasing the number of overtaking opportunities presented to participants, to allow for a greater distribution of responses.

Since the magnitude of the differences pre- to post-manipulation tended to be small for all three tasks, further development of these measures, within an Irish context, is warranted. As in Study 3, since participants completed the driving measures in a laboratory (i.e. not in a natural driving environment), ecological validity is reduced (see Plant, et al., 2011). As is becoming the gold-standard in driving research, there is the potential for these types of tasks to be integrated into instrumented smart cars (e.g. as in Boyce & Geller, 2002), which would allow for a more naturalistic driving measure.

Finally, it is possible that the anger findings would have emerged more clearly had different, more aggression-relevant types of outcome measures been used. Specifically, it would be beneficial for future research to examine the effects of anger, in the context of threat appeal manipulations, on behaviours like running a red light, which have been referred to as forms of aggressive driving (Nesbit, et al., 2007).

8.6 Contribution

Given that researchers have recommended the use of discrete outcome variables when measuring risky driving (Begg & Langley, 2004; Schmidt, et al., 2013; Tay, 2005a), and since the findings of Study 3 could be applied only to speeding behaviour, the current study advances on previous research, by including three new measures of risky driving. Secondly, while the literature has long highlighted the influence of anger on driving behaviour (Abdu, et al., 2012; Berdoulat, et al., 2012; Dahlen, et al., 2005; Deffenbacher, et al., 2003; Deffenbacher, et al., 1994; Nesbit, et al., 2007; Schwebel, et al., 2006; Underwood, et al., 1999), there is little clarity surrounding the role played by state anger in moderating behavioural responses to a threat appeal message. The current research addresses this and, in doing so, goes beyond a simple test of the EPPM, providing scope for future research in the area. Specifically, it highlights the importance of controlling for the role of mood, like state anger, which may be affecting driving behaviour in real-life settings, but not in the laboratory.

8.7 Conclusion

While several researchers have questioned the application of threat appeals to any health-promotion context (De Hoog, et al., 2008; Hastings & MacFadyen, 2002; Hastings, et al., 2004), the current study provides partial support for their use in a risky driving context. Provided that they are comprehensively piloted, threat appeals have the potential to effectively reduce a number of risky driving behaviours. However, the current findings also highlight the importance of situational emotion states, which are likely to impact on the effectiveness of the threat appeal. The interaction of different emotions, and specifically anger, should be taken into consideration in future theoretical and experimental research in this area.

9. Chapter Nine

General Discussion

9.0 Overview of Thesis

This chapter presents an overview and discussion of the main aims and findings of the current research programme. A summary of each empirical study will be presented, followed by an outline of their implications for research into risky driving and threat appeals. Limitations of the current studies are noted, and suggestions for possible future research directions are proposed. The chapter ends with general conclusions relating to the effectiveness of threat appeal messages in a road safety context, and the contribution of the current research findings to the risky driving literature.

The primary aim of the current research was to examine the effectiveness of threat-based messages (Peters, et al., 2012) in reducing risky driving behaviours, among young male drivers in Ireland. The rationale behind this was that, in recent years, the utility of threat appeal campaigns has been questioned (De Hoog, et al., 2008; Hastings, et al., 2004), based on inconsistent findings in the experimental literature. The current research examined possible reasons for the inconsistencies, and investigated if there are conditions under which threat appeals can be effective. This involved a four-stage research programme, including a meta-analysis, and three experimental studies.

9.1 Study 1

In order to begin the current research on firm theoretical grounds, the first study involved collating and synthesising the findings of previous experimental studies, in the form of a meta-analytic review. Results of this study (Carey, et al., 2013) indicated that, while threat appeals had a strong impact on the level of fear experienced by the audience ($r = .64$), they did not consistently impact on driving behaviour ($r = .03$). These findings point to the complexity of the emotion-behaviour relationship (Baumeister & Lobbestael, 2011; Baumeister, et al., 2007), and highlight a number of key issues in the existing threat appeal literature.

Specifically, the review identified conceptual and methodological inconsistencies regarding the measurement of fear arousal in threat appeal experiments, a point that has been raised by previous researchers (e.g. Higbee, 1969; Plant, et al., 2011). For example, of the thirteen studies included in the meta-analysis, only four measured fear arousal as an outcome, and all four used a form of self-report measure to do so. This reliance on self-report fear measures is problematic, given that such measures are associated with sensitivity and reliability issues (Matsumoto et al., 2011; Mewborn & Rogers, 1979). Overall, the findings of Study 1 highlighted the need for researchers to adopt and test more complex theoretical designs, and the importance of including more objective (i.e. using physiological measures; Ordonana, et al., 2009) measures of fear in experimental studies.

9.2 Study 2

Following on from the findings of Study 1, and based on recommendations from researchers (Cacioppo & Gardner, 1999; Mewborn & Rogers, 1979; Ordonana, et al., 2009), Study 2 examined fear arousal responses to threat appeal messages, using both subjective (i.e. self-report) and objective (i.e. physiological) measures. Findings indicated an increase in HR, EDA and Corrugator muscle activity, among participants exposed to a high threat road safety advertisement. The overall level of negative emotionality (i.e. a combination of all three physiological measures; Kleider et al., 2010) among the high threat group differed significantly from that among the low threat group. Finally, a self-report fear measure indicated that the medium threat group, followed by the high threat group, reported the highest level of fear.

Findings isolated a high threat appeal message as eliciting fear responses among the target group (i.e. young males), and thereby provided a comprehensive piloting procedure for the manipulation used in two subsequent experiments. More broadly, although it was not possible to draw inferences relating to behavioural outcomes, this experiment advanced on a recent study (Ordonana, et al., 2009), by including an additional physiological measure (i.e. of valence; Facial EMG), and by adopting the use of more highly threatening (Henthorne, et al., 1993), visual content, that was specific to road safety.

9.3 Study 3

Findings from Study 2 led to the identification of a threat-based, fear arousing road safety advertisement, but did not allow for inferences to be drawn regarding the effects of this message on behaviour. Study 3, therefore, aimed to examine behavioural (i.e. speeding) responses to this high threat road safety advertisement. Methodologically, Study 3 advanced on previous research that has largely used self-report driving outcomes (Cauberghe, et al., 2009; Lewis, et al., 2010), by developing an Irish version of the VST (Horswill & McKenna, 1999a), a behavioural measure of driver's speed choice. From a theoretical perspective, drawing on the EPPM (Witte, 1992), Study 3 explored the effects of perceived threat (i.e. severity and susceptibility) and perceived efficacy (i.e. response efficacy and self efficacy), in determining the effectiveness of a threat appeal. Findings suggested that participants exposed to a threatening road safety advertisement, who were also presented with cognitive prompts relating to threat and efficacy, evidenced a reduction in speed that significantly differed from a control group. No such reduction in speed was evident among the threat only group. These findings had a number of implications.

First, since both groups who viewed the threat appeal had high levels of perceived threat, but only the group with high perceptions of efficacy exhibited a change in speeding behaviour, it was concluded that efficacy perceptions were likely to be affecting behavioural responses. Second, the fact that the threat appeal content related to serious injury, and not to death, was suggested as a possible explanation for the lack of defensive, reactive responses (e.g. an increase in risky driving behaviours, Carey & Sarma, 2011; Jessop et al., 2008) among the threat only group. Finally, correlational analyses pointed to the potential influence of anger-related variables on speeding behaviour, since driving anger was found to be positively correlated with SRV and baseline speed choice.

9.4 Study 4

The final experimental study in the current research programme followed on from Study 3, and had two key aims. First, it examined whether a reduction in risk-taking would be evident in driving behaviours other than speeding (i.e. following distance, gap acceptance and overtaking behaviours; Horswill & Helman, 2003; Horswill & McKenna, 1999a, 1999c; McKenna, et al., 2006).

Second, based on correlational findings from Study 3, and on research suggesting that individuals drive faster and take more risks when experiencing high levels of anger (Abdu, et al., 2012; Arnett, et al., 1997), Study 4 aimed to explore the impact of state anger on the effectiveness of a threat appeal message.

Findings suggested that, in line with Study 3, participants in the threat cognitions group exhibited a decrease in speeding, gap acceptance and overtaking behaviours, relative to the other groups. However, the group who were presented with an anger-provoking task, in addition to the threat appeal message, demonstrated no change in driving behaviour from pre- to post-manipulation, relative to the other groups. Overall, then, Study 4 findings highlighted that, while threat appeals have the potential to be reduce driver risk-taking, their effectiveness may be eroded by an individual's mood state (Garrity & Demick, 2001; Groeger, 1997; Hu, et al., 2013), such as increased levels of anger (Abdu, et al., 2012).

9.5 Overall Implications of Findings

Risky Driving

Driving behaviour is difficult to operationalise, and psychological studies have varied substantially in the driving measures they employ (Reimer, et al., 2006). The current research adopted the use of computer-based driving tasks (Horswill & Helman, 2003; Horswill & McKenna, 1999a, 1999c; McKenna, et al., 2006), which, since the included scenes were filmed on local roads, were relevant to Irish drivers. Computer-based driving tasks like this are relatively easy to develop and implement, and present important advantages over self-report driving measures. Where it is not possible for experiments in this area to use driving simulators or IVDRs, this kind of measure allows for a context-specific, behavioural outcome to be measured. Although improvement could be made on the quality and quantity of scenes used in the current research (discussed later in this chapter), their use here has highlighted the potential for cost-effective driving measures to be used in future road safety research.

Demographic variables (i.e. age, gender and the level of driving exposure) have previously been found to predict 19% of the variance in risky driving (Scott-Parker, Watson, & King, 2009). As discussed in Chapter 1, there is an overrepresentation of young male drivers in RTC statistics, which has been attributed to their neurological development (Galvan, et al., 2007; Galvan, et al., 2006), and personality traits (Beirness, 1993; Iversen & Rundmo, 2002; Smith & Kirkham, 1981; Ulleberg, 2001; West & Hall, 1997), as well as state variables like mood (Abdu, et al., 2012; Doherty, et al., 1998; Shinar & Compton, 2004; Stephens & Groeger, 2009). The meta-analysis findings again highlighted the young male driver problem. This driving group are in their physical prime, and are likely to be more highly educated than generations past (Constantinou, et al., 2011), yet they continue to represent the at-risk group for RTC fatalities.

While an abundance of studies have examined the personality traits associated with driver risk-taking (Loo, 1979; Machin & Sankey, 2008; Smith & Kirkham, 1981; West & Hall, 1997), far less research has focused on state factors that may affect risky driving behaviours (Arnett, et al., 1997; Deffenbacher, et al., 2001; Garrity & Demick, 2001), particularly within the context of threat appeals. The current findings suggest that state anger is likely to impact on driving behaviour, in both the presence and absence of a threat appeal message. The importance of examining state-related variables in investigations of threat appeals and driving is of relevance to road safety practitioners and policy-makers. For example, while it is practically impossible to attempt to change risk-related neuropsychological developments or personality traits, it is conceivable that road safety strategies could focus on reducing possible causes of state anger (Abdu, et al., 2012).

Finally, when examining the impact of various forms of persuasive communications on risky driving, it is becoming increasingly important for researchers to draw context-specific, behaviour-specific conclusions and recommendations. Within risky driving, it may be overly-simplistic to use the umbrella term “risky driving behaviour” for all types of driver risk-taking. The manipulation used in the current study effectively reduced risky driving in some behaviours (i.e. speeding) and not others (i.e. gap acceptance). It is likely that different health-risk behaviours are motivated by different factors and, as pointed out by Witte and Donohue (2000), the consequences of engaging in safe driving behaviours are likely to be different to those of other healthy activities. A distinction between different driving behaviours should be drawn and, where possible, research studies should aim to investigate the differential impacts of campaigns on these various indices.

Threat Appeals

Current theoretical perspectives on threat appeals emphasise the roles of perceived threat and perceived efficacy (Peters, et al., 2012), constructs that are at the core of the EPPM (Witte, 1992). The current findings, overall, indicate that, in line with previous research (Cauberghe, et al., 2009; Lewis, et al., 2010; Tay & Watson, 2002), perceptions of threat and efficacy play an important role in shaping behavioural responses to a threat-based road safety advertisement. Findings from Study 1 indicated that there are likely to be mediators and moderators of the relationship between emotion and behaviour, and Study 3 findings suggested that efficacy may be one such factor. Study 4 findings, however, were less conclusive. Specifically, although descriptive statistics were largely in line with Study 3, efficacy perceptions did not differ significantly across groups in Study 4. As discussed in Chapter 8, this makes it problematic to conclude definitively that efficacy perceptions are the key to changing behavioural responses.

In the current research, threat and efficacy were manipulated by presenting participants with a forced cognitions task. Questions appeared on screen that probed participants' perceptions regarding the severity of, and their susceptibility to, a RTC. The questions also encouraged participants to consider behaviours they could engage in that might reduce their risk of being involved in a RTC (e.g. driving more slowly), and how effective these strategies were likely to be. The rationale behind this stemmed from concerns raised by previous researchers (Tay, 2005a), who have highlighted the complexity of providing a coping strategy for behaviours like speeding (when compared to, for example, drink-driving). By encouraging participants to think of potential coping strategies, rather than explicitly pointing one out, as in previous research (e.g. Tay & Watson, 2002), this research aimed to make efficacy perceptions subjective to the individual. While the particular manipulation used in the current research may not be practical to implement (discussed later in this chapter), new kinds of manipulations like this are important, particularly when targeting behaviours such as speeding (Lewis, et al., 2009, 2010).

While the EPPM has attempted to provide explanations for the reported boomerang effects, where individuals have exhibited increases in risky behaviours, following exposure to a threat appeal message (Carey & Sarma, 2011;

Jessop, et al., 2008; Jessop & Wade, 2008), the model has been criticised for failing to take into account the effect of the qualitative content of the message (Hunt & Shehryar, 2011). Recent research has attempted to bridge this gap, by developing a model of health-risk behaviour, as explained by TMT (Goldenberg & Arndt, 2008). The current research followed on from this, and integrated TMT principles into the experimental design, by using a message that related to serious injury, and not to death. In Study 3, despite the threat appeal only group having low levels of perceived efficacy, death-thought accessibility was low, and no increase in risky driving behaviours was evident. Current findings suggest that drawing on both the EPPM and TMT may help improve our understanding of psychological responses to threat appeals, and our design of effective threat appeal advertisements (Hunt & Shehryar, 2011; Shehryar & Hunt, 2005).

Several studies have suggested that individuals may differ in their reactions to a threat appeal message. For example, when the threat is death-related, attachment style has been found to regulate the exhibition of defensive responses (Mikulincer & Florian, 2000). Further, recent research has found specific threat appeal responses for individuals high in anxiety (Krisjanous, Ashill, Eccarius, & Carruthers, 2013). The importance of the role played by individual differences in threat appeal processing has divided researchers (Lewis, et al., 2007). While Witte and Allen (2000) have asserted that "individual differences do not appear to have much influence on the processing of fear appeals" (p. 602), other researchers have indicated that tailoring persuasive messages to individuals may ameliorate persuasive processes (Hirsh, Kang, & Bodenhausen, 2012; McMath & Prentice-Dunn, 2005). Examining the specific personality profile of individuals' reactions to threat appeals is an interesting avenue for future research to explore, particularly given that certain personality characteristics are linked with a propensity towards risk-taking in general (Cooper, Wood, Orcutt, & Albino, 2003), and driver risk-taking in particular (Dahlen & White, 2006; Lev, et al., 2008).

Emotion

The role of emotion, in general, and fear in particular, in threat appeal studies, has been a central theme of the current research. Study 1 findings indicated that increased fear does not necessarily lead to a change in behaviour, while the intricate patterns of physiological fear, evidenced among the high threat group in Study 2, pointed to the complex, multifaceted nature, of the fear response. Taken together, these findings highlight the complex nature of the relationship between threat, fear and behaviour, a relationship that has been oversimplified in the empirical literature (Baumeister & Lobbestael, 2011; Baumeister, et al., 2007). Findings also emphasise the importance of integrating, and accounting for, affective processes in theoretical and experimental threat appeal research. In particular, the current research would suggest that theoretical models with a predominantly cognitive focus (e.g. PMT; Rogers, 1975) may not be capable of explaining or predicting the full scope of responses to threat appeal messages. Although the EPPM reintroduced emotion as a key construct, there is still a lack of understanding of, and emphasis on, the role of fear arousal, in the threat appeal literature.

Researchers have long attempted to bridge the gap between cognition and emotion in persuasive communications (Nabi, 1999), but a vast majority of studies have focused on constructs like fear or anxiety, and failed to recognise that other affective processes may be impacting on health-related outcomes (Consedine & Moskowitz, 2007). It is important for researchers to control for the elicitation of emotions like anger or disgust (Haidt, et al., 1994; Leshner, et al., 2009; Morales, et al., 2012; Yartz & Hawk, 2002), in response to threat appeal messages.

Finally, through the use of physiological measures of fear, the current research addresses an important limitation of previous threat appeal studies. It is likely that the future in this area will see the use of more complex physiological measures, such as fMRI (Heller, et al., 2011), being adopted to measure responses to threatening stimuli.

An Integrative Model of Threat Appeals in Road Safety

Taken together, the current research has implications for theoretical frameworks in this area. Specifically, findings point to the importance for future research in this area to apply a number of theoretical perspectives, including the EPPM and TMT, and to draw from theoretical work on emotion, including that by Baumeister and colleagues (Baumeister & Lobbestael, 2011; Baumeister, et al., 2007). Previously, certain theoretical models have been cognitively-focus (e.g.

PMT), and have failed to account for the influence of emotion, while other research has lacked focus on the potential for cognitive processes to mediate the emotion-behaviour relationship. Although a general integration of models relating to threat appeals has been proposed previously (Hunt & Shehryar, 2011), drawing specific inferences relating to road safety has remained challenging. Drawing on the findings of this thesis, therefore, a tentative proposal for a model of threat appeals, specific to driving research, is outlined.

First, as posited by the EPPM, the model would have, at its core, the variables of perceived threat and efficacy. The inclusion of these variables is supported by experimental driving research (e.g. Lewis, et al., 2010), and by the findings of the current research. Specifically, the meta-analytic findings pointed to the likelihood that these kinds of variables were moderating the fear-behaviour relationship, and Study 3 identified efficacy as a key variable in determining the effectiveness of a threat-based road safety message. Threat appeal studies generally aim to increase perceived efficacy by providing an alternative strategy, or recommended behaviour, that will reduce the likelihood of an aversive outcome. Within a driving context, however, the complexity of providing behaviour-specific strategies should not be underestimated. For example, while proposing recommended alternative strategies for behaviours like drink-driving might be relatively straightforward, those for behaviours such as speeding may be more complex (Tay, 2005a). A road safety threat appeal model would focus on the inclusion of behaviour-specific recommended strategies, that are considered effective and achievable (i.e. are high in response and self efficacy) by the target audience. In practice, this may involve the development and testing of novel manipulations, such as the forced cognitions task used in the current research.

Second, drawing on perspectives that highlight the complexity of the emotion-behaviour relationship, and as supported by the findings of the current research, this model would reflect the need for a more complex theoretical perspective detailing the link between fear and behaviour. Practically, this would involve researchers explicitly and reliably measuring the host of potential affective responses to threat appeal advertisements (Consedine & Moskowitz, 2007), and examining how these processes translate into behaviour (Baumeister, et al., 2007).

Researchers have recently highlighted the likelihood that threat and efficacy are not the only variables at play in the threat-behaviour relationship, and that other conditions, and audience characteristics, are likely to play an important role (Nabi, Roskos-Ewoldsen, & Dillman Carpentier, 2008). Good and Abraham (2007) posited that, even when an audience's perceptions of susceptibility to a severe health threat are high, multiple other factors determine whether or not a change in behaviour will occur. Finally, then, an integrative model of threat-based road safety messages would outline the potential for individual differences to shape responses to threat appeals, currently not accounted for by the EPPM. Although this could not be probed extensively in the current research, recent research has successfully demonstrated that tailoring persuasive messages to an individual's personality can enhance message effectiveness (Hirsh, et al., 2012). Within a threat appeal context, research has long emphasised the importance of individual differences variables, such as self-esteem, in determining responses to threat appeal messages (Higbee, 1969), but contemporary theoretical models have largely failed to account for these. Recently, Hunt and Shehryar (2011) argued for the adoption of TMT principles within EPPM-guided experimental designs, and argued that TMT variables can complement the explanatory power of existing frameworks. Research by this author, and others (Carey & Sarma, 2011; Jessop, et al., 2008) has found that young males' self-esteem can become linked to their driving, leading them to react defensively to death-related threat appeal advertisements. Understanding individual differences in threat appeal processing is particularly important in the context of driving, since certain personality traits are known to increase risky driving behaviours (Sarma, et al., 2012). An integrative road safety model, therefore, should involve the inclusion of individual difference variables in research designs, with the potential for advertisements and campaigns to be specifically targeted at particular personality profiles.

Although these proposals need refinement and testing, the development of a threat appeal model that is specific to road safety would challenge the use of "risky driving behaviour", as a catch-all term, by allowing for behaviour-specific recommendations to be made. Ultimately, this kind of model would aim to develop effective, context-specific strategies that could easily and readily be implemented in road safety advertising campaigns.

9.6 Methodological Limitations

The present research contributes to a body of knowledge in the threat appeal and driving literature. Although specific limitations relating to each study were noted within the individual chapters, some general limitations are now discussed. First, due to sample restrictions, the findings are hindered by a notable lack of generalisability. Due to the consistent and global trends indicating that young male drivers are more likely to be involved in a RTC than any other group (Doherty, et al., 1998; Hatfield & Fernandes, 2009; Williams, 2006), the current research focused exclusively on this high-risk population. It is important to note, therefore, that the findings cannot reliably be applied to older populations who, research suggests, tend to exhibit poor driving performance, a finding that has been attributed to the decline of cognitive abilities during the ageing process (Adrian, Postal, Moessinger, Rascle, & Charles, 2011). Further, the findings cannot be applied to female drivers, since studies have shown that threat appeal messages are likely to be interpreted by, and affect, males and females differently, with counterproductive effects being shown in males, but not females (Goldenbeld, et al., 2008). Examining age- and gender-related differences in responses to threat appeals using a similar experimental design would be of benefit for future research in this area. In addition, since a majority of the current sample were undergraduate students, it would be interesting to conduct these studies using a more cross-sectional (e.g. Rimal, 2001) design.

A final point relating to generalisability concerns the need for longitudinal research in this area. It is unclear to what extent the current findings would hold (i.e. how effective the threat appeal would be) following a number of days, weeks or months. Longitudinal studies (e.g. Rimal, 2001; Taubman-Ben-Ari, Mikulincer, & Iram, 2004) can allow for an examination of responses to threat appeals over longer periods of time. This is particularly important within a driving context, since we do not tend to get in our cars and drive immediately after watching road safety advertisements.

A second general limitation of the current research relates to the application of the current findings to other risky driving behaviours. Specifically, although Study 4 measured four types of driving (i.e. speeding, following distance, gap acceptance and overtaking), there are a number of other behaviours, associated with risky driving and RTC involvement, that were not measured in this research. These include drink-driving, which is not likely to be motivated by the same factors as speeding (Tay, 2005a), driving under the influence of cannabis or other drugs, which research has found to increase crash risk (Ramaekers, Berghaus, van Laar, & Drummer, 2004), and to be a prevalent activity among young people (Asbridge, Poulin, & Donato, 2005), distracted driving like phone use and eating while driving (Lennon, et al., 2010), and driving while fatigued (Simon, et al., 2011). While it is usually not feasible to measure all of these behaviours within one experimental research programme, researchers should adopt caution when attempting to generalise findings from one driving behaviour to another.

Third, there are a number of limitations that could be noted with the driving measure used. As noted in Chapter 8, the small number of usable scenes for some of the driving tasks meant that participants' responses could not be averaged out over a large amount of trials. This may have contributed to the non-significant findings in the following distance and overtaking tasks. Further, in order for the task to be straightforward to both programme and use, the response button on the Ergodex board recorded on-off type responses. The use of a more graduated, continuous pedal response would provide a more naturalistic measure. Similarly, the current study used keyboard press response to represent the brake, since programming difficulties made it unfeasible to include a separate brake response pedal. For future research employing VST-type outcomes, the inclusion of a more naturalistic brake pedal may improve the realism of the tasks.

There are a number of additional limitations associated with the nature of the outcome variables used, particularly when compared to high-fidelity driving simulators (i.e. such as that used in Lee, et al., 2002). Specifically, while driving simulators tend to include three screens, representing the windscreen and two side windows, participants in the current driving tasks viewed one screen only, as in previous such tasks (Horswill & Helman, 2003; Horswill & McKenna, 1999a). This may have affected participants' speed choices, since research has suggested that lateral peripheral vision affects speed perception (Rutley, 1975; Shinar, 1978). More broadly, the driving tasks used in current research may be limited in terms of their application to a real-life driving setting. Specifically, research has suggested that laboratory-based driving indices (be they computer-based VSTs, or driving simulators) cannot provide a perfect representation of driving behaviour in a real-life context, and therefore lack ecological validity (Soames Job, 1988; Taubman Ben-Ari, 2000). Despite these limitations, the current driving measure provides a more realistic measure of driving than self-report questionnaires, is a cost-effective alternative to a driving simulator, and allowed for a high level of experimental control.

A fourth potential limitation concerns the forced cognition manipulation task used. While this allowed for subjective responses to be generated, its practicality, in terms of use in an advertising campaign, could be questioned. In particular, since seven questions were presented, screen-by-screen, after the video, the exposure in total lasted over three minutes. For future studies employing this kind of measure, a shorter version of the manipulation would be more applicable to advertisement-design. An important avenue for future research is to determine which, if any, of these prompts is most effective, allowing prioritisation of their inclusion into advertising campaigns. Alternatively, inserting the prompts into the manipulation itself, at the bottom of the screen (i.e. as opposed to following the threat appeal message), may shorten the length of the overall message.

Fifth, while the driving outcome variable itself was a computerised, behavioural driving task, the current research relied on self-report measures to assess a majority of the other driving constructs (e.g. the SRV scale and the DAS). Despite all these measures having been employed in previous peer-reviewed research, and although they demonstrated good reliability, there is always the potential, with self-report measures, for social desirability to affect responses (af Wåhlberg, 2010; af Wåhlberg, et al., 2010).

Finally, the vast array of distinct variables that have been examined in relation to driver behaviour, and proposed to have a role in the effectiveness of threat appeals, meant that a comprehensive test of all these factors was not possible. In particular, the influence of cognitive biases such as crash-risk optimism (Harré, et al., 2005) and self-enhancement (Sibley & Harré, 2009; Walton & McKeown, 2001), other cognitive factors including risk perception (Deery, 2000; DeJoy, 1992; Rhodes & Pivik, 2011; Ulleberg & Rundmo, 2003) and perceived behavioural control (Castanier, Deroche, & Woodman, 2013), and social factors like peer influence (Simons-Morton, et al., 2005; Simons-Morton, et al., 2012; Simons-Morton, et al., 2011), were not measured in the current studies.

Future research may benefit from including such additional variables, thereby integrating the various research streams. It is also important to note that, while the current research focused exclusively on a video-based message, other studies have examined responses to radio-based advertisements (Bolls, et al., 2001) and messages using facts and/or static images (Miller & Mulligan, 2002; Mowen, et al., 2004).

9.7 Overall Conclusions

Despite concerns from researchers, threat appeal messages continue to feature prominently in road safety advertising campaigns, and the current research aimed to examine whether there are conditions under which they can be effective. Findings illustrate that threat appeals have the potential to reduce a number of risky driving behaviours among young males. However, as highlighted in the Study 1 findings, a fear arousing appeal does not necessarily lead to a concurrent, adaptive behavioural change (Carey, et al., 2013), and there is a tangible need for the advertisements used in road safety campaigns to be evidence-based, and rigorously tested. As noted by LaTour and Rotfeld (1997), no threat will affect different people in the same way; their effects are likely to vary under different conditions and with different audiences.

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Appendices

Appendix A:

Participant Information Sheet

OÉ Gaillimh
NUI Galway

SCHOOL OF PSYCHOLOGY

PARTICIPANT INFORMATION SHEET

RESEARCHER: Rachel Carey, B.A. (Psych. Int.)

Title of Project:

The influence of personality on information processing and driving-related cognition tasks.

Invitation to participate

You are invited to take part in a research study. Before you decide, it is important that you understand why the research is being done and what it will involve. This *Participant Information Sheet* tells you about the purpose, risks and benefits of this research study. If you agree to take part, we will ask you to sign a *Consent Form*. If there is anything that you are not clear about, we will be happy to explain it to you. Please take as much time as you need to read this information. You should only consent to participate in this research study when you feel you understand what is being asked of you, and you have had enough time to think about your decision.

The research

This research aims to examine the relationship between personality variables on cognition tasks which are related to driving. You will be asked to answer questions related to demographic and personality information, to think about specific emotions you have experienced in particular situations, to watch some videos about driving and to complete some driving tasks. The study will take place in one single session, lasting approximately 50 minutes.

Who can take part?

For this study, we are looking for males only, between the ages of **18 and 24**, in possession of a full **driver's license** or provisional driver's license with a minimum of one year's driving experience, with fluent English.

Do I have to take part?

It is entirely up to you whether or not to take part. If you decide to take part, you will be asked to sign a *Consent Form*. If you decide to take part, you are still free to withdraw at any time and without giving a reason. A decision to withdraw at any time, or a decision not to take part, will not affect your rights in any way.

What will happen to me if I take part?

If you decide that you *do* want to participate, and you are happy that you fully understand what is being asked of you, you will be asked to sign a consent form.

You will first be asked to complete a questionnaire related to your demographics and personality. The researcher will then ask you to watch some short videos about driving. Please note that there may be graphic images used in some of the videos that may cause you some discomfort. Following this, you will be asked to recall a number of experiences you had that caused you to experience a particular emotion. Finally, you will be given one last questionnaire relating to your driving history/style. Over the course of your participation, you will be also be asked to complete some computer-based driving tasks, which will be explained to you in more detail by the researcher. After you have completed the final questionnaire, you will be finished with your participation in this study. The researcher will analyse the results and you are welcome to contact her to find out the study results at a later date.

Your data will be recorded on paper and electronically. However, all information that is collected from you during the course of the research, will be kept strictly **confidential** (i.e., the researchers will keep secret any information collected about you) and will not be shared with anyone else. The information collected in this research study also will be stored in a way that protects your identity. We will store all data securely for 5 years after which they will be destroyed. To reiterate: no personally identifying information is being gathered and the results from the study will not identify you in any way.

What are the possible benefits/ disadvantages in taking part?

Taking part in this study may offer you an insight into psychological research. There may be images used in some of the videos that may cause you some discomfort. There are no other foreseeable risks to participation in this study. However, you are free to discontinue participation at any time.

What happens if I change my mind during the study?

A decision to withdraw at any time, or a decision not to take part, will not affect your rights in any way.

Who do I contact for more information or if I have further concerns?

Should you require any further information about this study, please do not hesitate to contact the researcher Rachel Carey at r.carey1@nuigalway.ie

If you have any concerns about this study and wish to contact someone in confidence, you may contact:

- The chairperson of the Research Ethics Committee, Research Office, Science & Engineering Technology Building, National University of Ireland Galway, University Road, Galway.
  Phone: +353 (0)91 495312 Email: vpresearch@nuigalway.ie
- NUI Galway Student Counselling Services
  Phone: +353 (0)91 492484 Email: counselling@nuigalway.ie
- The Samaritans Ireland: 1850 60 90 90

Thank you for reading this!

Appendix B:

Consent Form

OÉ Gaillimh
NUI Galway

School of Psychology

CONSENT FORM

Title of Project:

The influence of personality on information processing and driving-related cognition tasks.

Name of Researcher: Rachel Carey_ **Please initial box**

1. I confirm that I have read the information sheet for the above study and have had the opportunity to ask questions. ☐

2. I am satisfied that I understand the information provided and have had enough time to consider the information. ☐

3. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my legal rights being affected. ☐

4. I agree to take part in the above study. ☐

______________________	______________	______________________
Name of Participant	Date	Signature
Rachel Carey	______________	______________________
Researcher	Date	Signature

Appendix C:
Material used in Distractor Task (Study 3)

Newspaper Article Excerpt with Instructions:
For this task, please read the following information on sales figures for 2011 regarding Ireland's favourite cars. You will then be asked some simple questions related to what you have read.

Some 89,900 new cars were registered last year, of which 90 % fell into the two lowest tax bands.

In line with the favoured lower emissions, diesel is now the favourite fuel of new car buyers here, presenting 71.2 per cent of new cars sold.

With predictions of sales for 2012 falling as low as 70,000 that doesn't bode well for the industry and will likely mean more dealerships will be forced to close.

The figures also show that after several years of Ford and Toyota having control of the top of the sales table, Volkswagen is firmly in the fray for taking top spot in the coming years. Even rivals such as Hyundai and Renault now suggest that Volkswagen will be the best-selling brand by 2013.

It's not just the top three battle that is worth watching. Renault has lost some of its pace in the market, particularly since the end of scrappage, but it's still a significant player in the market with 9.5 per cent. It will be vying to retain a top five position next year.

So what do the sales figures show? Well we like grey diesel hatchbacks and value is more important than either style or performance. And with just three Porsches and one Maserati registered in 2011, sports cars are once more a rare sight on our roads.

(Source: Irish Times - Michael McAleer)

Multiple Choice Questions on Article:

Please circle or tick the correct answers. According to this article…

1. Which is now the favourite fuel of new car buyers here?

    Petrol Diesel

2. Were sales figures predictions for 2012:

    High, which may mean opening of new car dealerships

    Low, which may mean existing dealerships will have to close

3. Which is likely to be the best-selling brand by 2013?

    Toyota

    Volkswagen

    Hyundai

4. Which type of car are we more likely to see on our roads?

    Renault

    Porsche

5. Finally, what is your favourite car make?

    ____

Appendix D

Instructions and Questions for State Anger Manipulation Task

Imagination, Emotion and Information Processing Questionnaire

PLEASE ANSWER THE FOLLOWING QUESTIONS AS **TRUTHFULLY** AS POSSIBLE, PROVIDING AS MUCH **DETAIL** AS YOU CAN:

1. Please briefly describe 3-5 things that things that make you most angry.

2. Please describe, in detail, the one situation that makes you, or has made you, the most angry you have been in your life. For this section, please write your description such that a person reading it would become mad from just hearing about the situation.