

**Understanding how individuals respond to climate change information using a terror  
management framework**

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Understanding how individuals respond to climate change information using a terror  
management framework

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### **Statement of originality**

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

## Keywords

|                                 |   |
|---------------------------------|---|
| Attentional bias (AB)           | AB refers to the differential allocation of attention towards a particular stimulus over another stimulus. Attentional bias characteristics include: 1) facilitated attention, 2) difficulty in disengagement, and 3) attentional avoidance from threat.  |
| Climate change                  | Climate change is defined as the variability of the mean state of a climate that persists over an extended period (IPCC, 2014). Anthropogenic (human-caused) climate change is mainly due to a surge in atmospheric levels of greenhouse gases, which trap heat within the Earth's atmosphere.  |
| Climate change salience (CCS)   | When climate change is brought to the forefront of an individual's mind.  |
| Communitarian worldview         | A strong communitarian worldview (i.e., strong group position) inclines people to depend on each other to achieve a shared goal, and promotes solidarity rather than competitiveness.   |
| Cultural cognition theory (CCT) | Based on, and designed to test, the worldviews outlined in the cultural theory of risk by Douglas (1970).   |
| Cultural theory of risk         | The theory posits that the way in which individuals perceive and act upon the world around them is determined largely by their social relations and cultural adherence. The theory characterises cultural worldviews along two dimensions: group and grid. An individual's relative position on the group/grid matrix is determined by the extent to which they are absorbed by, and participate in, a group (group), and the |

|                                   |   |
|-----------------------------------|---|
|                                   | degree of regulation and restriction they maintain in their social roles (grid).  |
| Cultural worldview                | A large-scale system of beliefs and assumptions derived by cultural surroundings by which an individual makes sense of their experiences.   |
| Death-word-fragment task (DWFT)   | The most commonly used measure to capture death-thought-accessibility in the TMT literature. The DWFT involves completing several word fragments, some of which can be completed as either a death-related or a non-death-related word.                 |
| Death-thought accessibility (DTA) | DTA refers to how readily accessible death-related constructs are activated outside conscious awareness.  |
| Distal defences                   | Distal defences are activated when thoughts about death are outside conscious awareness. Distal defences buffer concerns about death by providing the individual with meaning and purpose (e.g., cultural worldview, self-esteem, close relationships). |
| Egalitarian worldview             | An egalitarian worldview (i.e., weak grid position) denies preventing participation in social roles because of certain characteristics, such as age, gender, or ethnicity.  |
| Group worldview                   | In the cultural theory of risk, the group categorisation pits economic interests (low group, individualistic worldview) against social interests (high group, communitarian worldview).   |
| Greenhouse gas (GHG)              | GHGs are gasses that trap heat within the Earth's atmosphere. GHGs with the greatest impact on climate change are: carbon dioxide (CO <sub>2</sub> ), methane (CH <sub>4</sub> ), and nitrous oxide (N <sub>2</sub> O; IPCC, 2014).                     |

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| Grid worldview                    | In the cultural theory of risk, the grid categorisation pits ranking based constraints (high grid, hierarchical worldview) against social equality interests (low grid, egalitarian worldview).   |
| Hierarchical worldview            | A hierarchical worldview (i.e., strong grid position) honours the maintenance of rank-based constraints.  |
| Implicit measures                 | Evaluations that occur without conscious awareness towards an attitude object or the self.  |
| Individualistic worldview         | An individualistic worldview (i.e., low group position) incorporates a belief in “fending for themselves”, and that collective assistance is a sign of weakness.  |
| Terror management theory (TMT)    | TMT proposes that awareness of death underlies most human decision-making.  |
| Mortality salience (MS)           | An experimental procedure designed to elicit conscious awareness of one’s mortality.  |
| Mortality salience hypothesis     | The MS hypothesis posits that if psychological structures defend against concerns about death, then reminders of death should intensify the need for these structures.  |
| Pro-environmental behaviour (PEB) | PEBs are volitional behaviours, mostly taken at individual or household level, that minimise the negative impact of one’s actions on the environment, and that contribute to environmental sustainability (e.g., reducing energy consumption, recycling, environmental activism). |
| Proximal defences                 | Proximal defences are activated when thoughts about death are consciously perceived. People attempt to directly confront psychological  |

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|                         | implications of the threat. This can be achieved by increasing health protective behaviours, thereby reducing threat likelihood, or adopting cognitive strategies that serve to distance oneself from the reality of death (e.g., denying, minimising the threat). |
| Risk perceptions        | Risk perceptions are beliefs about potential harm or the possibility of a loss. They are subjective judgments that people make about the characteristics and severity of a risk.   |
| Self-esteem             | Self-esteem is defined within a TMT framework as being the belief that one is meeting or exceeding the standards and values outlined by the subscribed worldview.  |
| Worldview defence (WVD) | Worldview defence is characterised by an enhanced preference for personal worldview-supporting others and enhanced negative evaluations of personal worldview-challenging others.  |

## **Preface**

### **Publication during candidature**

Naidu, P. A., Hine, T. J., & Glendon, A. I. (2020). Methodological weakness of the death-word-fragment task: Alternative implicit death anxiety measures, *Death Studies*, 1–10.  
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Naidu, P. A., Glendon, A. I., & Hine, T. J. (2020). Communicating response-efficacy to motivate climate mitigation intent. *International Journal of Communication*, under review



Included in this thesis are papers in *Chapters 4, 5, 6, and 7*, which are co-authored with other researchers. My contribution to each co-authored paper is outlined at the front of the relevant chapter. Bibliographic details, if published or accepted for publication, for these papers including all authors, are:

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Appropriate acknowledgements of those who contributed to the research but did not qualify as authors are included in each paper.

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## **Abstract**

Global climate change will bring devastating consequences and potentially irreversible damage to natural (e.g., environmental, mass species extinction) and human systems (e.g., global security, mass population relocations, economical security). Whilst a widespread public perception is that climate change is the current greatest threat to human life, individual-level mitigation attempts remain low. This thesis applies a terror management theoretical framework to understand and predict individual responses to climate change information. Research described in the thesis investigates whether exposure to climate change information elicits unconscious concerns about death, which in turn, is a psychological factor explaining differences in climate change attitudes and perceptions of climate change threat. To my knowledge only two empirical studies have used a terror management theoretical framework to frame research questions concerning responses to climate change. However, both studies failed to test the mechanism by which terror management responses are thought to be produced (i.e., death-related thoughts). The current research further examined whether exposure to climate change information would predict two main terror management responses: increased worldview defence, and self-esteem striving reactions. Depending on one's worldview affiliation, terror management responses may motivate beneficial (e.g., increase climate mitigation intent) or detrimental (e.g., increased climate denial, low perceptions of climate threat) responses to climate change.

The thesis describes four empirical research investigations that were carried out. A Pilot Study examined whether exposing individuals to information about climate change impacts (e.g., increased natural disasters, biodiversity loss, mass species extinction) would increase accessibility of death-related thoughts, when compared with a no-threat control condition (information about the ineffectiveness of multi-tasking). Also examined was whether different

levels of death-thought-accessibility and trait death anxiety were associated with climate change attitudinal responses – climate change acceptance or denial, and perception of climate change risk as low or high. The main findings were that, compared with the control condition, after climate change information exposure, higher death-word completions in a word-fragment task was related to: 1) climate change acceptance, and 2) higher perceptions of climate change risk, even amongst climate change deniers.

Appraisal of climate change risk may depend on trait death anxiety. When trait death anxiety was low, participants exposed to climate change information reported higher climate change risk perceptions, compared with control participants. Thus, participants with low-trait death anxiety may be less likely to activate cognitive distancing strategies observed after mortality-related information. Overall, participants were more likely to demonstrate a liberal shift in attitudes when exposed to climate change information. The Pilot Study demonstrated that exposure to climate change threat-related information can lead to greater perceptions of climate change risk.

Climate change information in the Pilot Study was not found to elicit greater death-related thoughts when compared with the control condition. Two methodological limitations of the Pilot Study were deemed likely to have impacted these null results. First was that the most commonly used measure of death-thought accessibility in the terror management literature, the death-word-fragment task, had low sensitivity due to word completion rates being skewed on important word dimensions (e.g., word frequency, arousal, valence) that impact word recall. Further, internal reliabilities for the DTA measure in both conditions were unacceptably low (climate change salience,  $\alpha=.21$ , control  $\alpha=.50$ ). As a result of the interference from word dimensions on word recall, it was not possible to determine whether the climate change information failed to elicit mortality salience (MS), (i.e., the conscious awareness of one's own

death), or whether null differences resulted from the low sensitivity of the death-word-fragment task. Second, was the lack of evidence for the mediational model (i.e., that when reminded about death, death-related thoughts mediate terror management responses), observed in the Pilot Study and the terror management literature. The subsequent study was aimed at investigating these limitations.

The first main study (Study 1) was designed to investigate two methodological limitations observed in the Pilot: 1) Is the death-word-fragment task a sensitive measure of death anxiety? and 2) Is there evidence of the terror management mediation model (that death-related thoughts are the mechanism by which MS leads to worldview defence)? Study 1 used a common way of eliciting MS, which asks participants to reflect and write about their own death. In Study 1a the death-word-fragment task did not differentiate between MS and control conditions. Further, the study found supporting evidence, as did the Pilot Study, that word completion rates on the word-fragment task were associated with word dimensions (e.g., valence, arousal) that predicted word completion rates over and above the mortality manipulation. Study 1b further examined three alternate implicit measures of capturing death anxiety: lexical decision task (measuring construct accessibility), dot probe task (measuring attentional bias), and an ambiguous pictures interpretation task (measuring interpretation bias). The picture task included Rorschach inkblots, followed by images that could be interpreted either in a death-related or non-death-related manner. These latter images had a picture of a skull superimposed on a neutral image. All measures successfully differentiated between MS and control conditions.

None of the four measures mediated the terror management response – that is, via worldview defence. Only the Rorschach inkblots, which excluded the more explicit death-related images in the ambiguous picture task, revealed a moderation effect. Thus, the full



ambiguous picture, lexical decision, and dot probe tasks did not show moderation effects for worldview defence. For the Rorschach inkblots only, participants exposed to a MS, compared to a control condition, who demonstrated greater worldview defence, were those demonstrating higher cognitive avoidance as observed by the low number of death-related interpretations on the inkblots. This may reflect participants' attempts to suppress death-related thoughts after being reminded about death. The study did not determine whether this overall lack of mediating or moderating effects occurred because, in testing implicit death anxiety, subsequent responding may be impacted, negating differences between conditions. Interference effects have been observed in TMT research when using measures of implicit death anxiety – for example, a word puzzle using death-related words and the death-word-fragment task. Consistent with this idea, TM outcomes (e.g., climate change author preferences) were shown to differ depending on the measure administered, possibly due to the measure itself eliciting differential intensities (and awareness) of death-related thoughts.

Study 2 design was informed by methodological concerns addressed in the Pilot Study and Study 1: 1) compared to the death-word-fragment task, the dot probe task is a more sensitive measure of unconscious concerns about death, and, 2) measuring the proposed intervening process (i.e., death-related thoughts), may impact subsequent responding. For this reason, it was first examined whether climate change information elicited attentional bias towards death-related stimuli (manipulation check), followed by whether climate change information elicited terror management responses, such as increased material strivings and greediness tendencies in a resource dilemma task, both of which have been found under MS conditions. Increased material strivings (e.g., desire for expensive houses, cars) is posited as a way of managing terror because material possessions can signify a successful existence. This is likely to be an important terror management outcome to study as the continual production and consumption of consumer purchases is antithetical to curbing greenhouse gas emitting behaviour.

Study 2 differentiated between two climate change information frames as not all climate change communications may elicit mortality concerns, or at least, not to the same extent. One emphasised the losses of unmitigated climate change (loss-frame), and the other emphasised the gains of mitigated climate change (gain-frame). It was posited that the loss-frame would be more likely to elicit concerns about death and subsequent terror management responses. Loss-framed climate change information was posited to be more likely than a gain-frame to elicit MS because of the emphasis on threatening and mortality-related consequences of climate change. Also included was a third no climate change threat (control) information condition. Results revealed that climate change loss-framed information resulted in greater death avoidance (manipulation check) and increased desire for future wealth, when compared with both information frames. Gain-frame climate change communication revealed no differences in death-thought accessibility or desire for future wealth when compared with the control information. Although there was evidence of material desires post threatening climate change information, there was no framing differences on greediness tendencies on a resource dilemma task. It may be that whilst climate change threat bolsters the desire to acquire status seeking symbols, it may not induce desires of wanting more (greed) when “more” does not fulfil motives of wealth and status display.

Exploratory analyses in Study 2 revealed two unexpected findings. It was observed that participants exposed to the loss-frame (compared with other frames) and who responded with the highest greed and fear responses in the resource dilemma task, were also those who showed the highest climate change concern and mitigation intent, respectively. Although preliminary, these findings point towards the exposure to loss-framed climate change information motivating individuals to reduce feelings of psychological threat in ways that are both threat-focused (e.g., higher climate change concern), and symbolic (e.g., pursuit of status showing symbols, greed). Interestingly, there were no differences between information frame exposure and climate

change attitudes and mitigation intent. Overall, Study 2 findings suggested that societal risk announcements, such as those referring to climate change, may elicit mortality concerns and impact various life domains (e.g., managing impressions of success) as a result of managing psychological threat.

One reason that climate change information is posited to elicit terror management responses is because evidence of climate change and its impacts serve to remind individuals that death, decay, and destruction are inevitable, and that we have little control over our own death. By emphasising its worst consequences, loss-framed climate change information may invite feelings of *climate change helplessness* – the belief that climate change impacts are beyond personal control as the threat is so enormous. It was reasoned that manipulating climate change response efficacy in ways that individuals are led to believe that their individual actions (e.g., turning up the thermostat in summer) will have an impact on climate change, may increase feelings of control over the outcomes of the perceived threat and thereby reduce feelings of helplessness and concerns about death. Communicating high climate change response efficacy (vs. low climate change response efficacy) may therefore prevent the activation of terror management reduction responses – such as worldview defence and material strivings.

In conjunction with TMT, the extended parallel processing model (EPPM) was adopted to understand Study 3 findings. The EPPM provides an explanation to why, after exposure to fear appeals, threat-reduction vs. threat-avoidance responses are observed. It is posited that fear appeals, combined with a high response-efficacy message, elicits threat control responses (e.g., mitigation) whereas fear appeals, combined with a low response-efficacy message, elicit fear control responses (e.g., minimising risks, avoidance, denial). Study 3 examined high and low threat by manipulating the outcome frame (loss as high threat vs. gain as low threat) followed by a response efficacy (high vs. low) message. The same loss- and gain-frame information from

Study 2 was used for this study. Outcomes measured post-information (Time 1; T1) were mitigation intent worldview defence and material strivings. Also examined was whether differences in reported behavioural engagement remained at either 3 to 5 days (Time 2; T2), or 5 to 7 days post information (Time 3; T3).

It was posited that high-response efficacy would buffer concerns about death for individuals exposed to the loss-framed climate change information, thereby negating possible terror management responses. Results at T1 showed that high-response efficacy frames (vs. low-response efficacy frames) had moderate to large increases in mitigation intent. However, outcome frames (loss vs. gain) made no difference to mitigation intent. At T2 and T3, there were no differences between information frame and reported behavioural engagement, suggesting that either intentions did not translate into behaviour, or that increased mitigation intent does not endure. Terror management responses, worldview defence, and material strivings, were not observed in this study. It was posited that all climate change communication frames may have elicited similar levels of existential threat. Without a control condition it was not possible to detect between condition differences in terror management strategies.

This thesis offers novel original and innovative contributions to the climate change risk communication and terror management literature. This work empirically investigated responses towards exposure to climate change information using a terror management theoretical and methodological framework. Study findings provided evidence that a terror management framework is useful in understanding and predicting societal responses to climate change. Responses to climate change has been under-researched within the terror management literature. This study was the first to examine whether climate change information elicited concerns about death. Second, the research described in this thesis aimed to report a number of responses to climate change information as a result of death anxiety, such as climate change

attitudes, perceptions of climate change risk, climate change mitigation intentions, and consumer behaviour. Measuring responses to climate change information in domains other than attitudes towards climate change is also largely absent from the climate change literature.

As the risks of climate change increase and the need for widespread behavioural engagement accelerates, it is necessary to understand how best to communicate climate change information taking account of individual differences. Together, the studies demonstrate potential positive trajectories (e.g., greater perception of climate change threat), as well as possible backfire consequences (e.g., increased wealth enhancement) that exposure to climate change threat-related information can have in motivating sustainable attitudes. Results from the studies described in the thesis may be useful for environmental advocates, risk communication researchers, media, and policymakers seeking to communicate the need for effective and urgent climate action. For instance, although more negatively focused climate change information may elicit threat-dismissal/minimisation/denial as a death-attenuating response, communicating high individual climate change response-efficacy can elicit increased behavioural intentions to take climate mitigating actions. Furthermore, it may be important that climate change appeals that elicit psychological threat are directly followed by opportunities that attenuate the perceived threat in ways that help rather than hinder environmental sustainability efforts.

Future research could take into account a terror management perspective when seeking to further understand climate change attitudes and measure the function of death anxiety. More research is needed to fully understand the role that death anxiety plays. Additionally, terror management research could investigate boundary conditions to better predict when exposure to climate change information will elicit terror management responses. It will be valuable to identify which framing and individual factors increase the likelihood of climate change communication eliciting positive terror management responses – attitudes and intentions that

align with increased mitigation – and decrease possible reactance or avoidance responses to climate change. It could mean that certain groups of individuals are more receptive than others to particular information frames (e.g., outcome, distance, threat).

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## Chapter 1: Introduction

The world is in the midst of a climate crisis (Ripple, Wolf, Newsome, Barnard, & Moomaw, 2020). Without urgent and collective action, anthropogenic (human-induced) climate change will result in catastrophic and potentially irreversible damage to human and natural systems (Field et al., 2014; Masson-Delmotte, 2018; Pörtner et al., 2019). Environmental consequences include: increasing sea level rises, intensified natural disasters and extreme weather events, increased spread of infectious diseases, lower quality of food production, accelerated mass species extinctions, and parts of the world becoming uninhabitable (Field et al., 2014). Impacts of natural disasters and extreme weather patterns aggravated by climate change are already being experienced across the world (Melillo, Richmond, & Yohe, 2014; Romero-Lankao et al., 2014; Yu, Xu, Abramson, Li, & Guo, 2020). The extensive 2019-20 bushfires across Australia, estimated to have burned up to 19 million hectares, is one example of a natural disaster exacerbated by climate change (Yu et al., 2020). These bushfires contributed to the loss of human life, the loss of almost 3 billion native vertebrates, and the destruction of thousands of buildings and homes (Filkov, Ngo, Matthews, Telfer, & Penman 2020; University of Sydney, 2020). These bushfires emitted an estimated 306 million tonnes of CO<sub>2</sub>, representing over half of Australia's annual carbon emissions (Lee, 2019). Scientists warn that climate models have underestimated impacts due to initial predictions failing to anticipate the extent of feedback loops, which further amplify environmental degradation (Ripple et al., 2020).

The scientific community maintains that humans' unsustainable high-carbon lifestyles are responsible for the mean rise in global temperatures (Cook et al., 2016). To prevent a climate catastrophe, forecasts show that Earth's mean temperature must remain below a 1.5°C increase over the pre-industrial era (Masson-Delmotte, 2018; Ripple et al., 2020). To meet

global emission targets, a coordinated international climate response and robust government policies will be necessary alongside drastic individual-level lifestyles changes (Dietz, Gardner, Gilligan, Stern, & Vandenberg, 2009). To illustrate, household energy consumption alone contributes approximately 72% of GHG emissions globally (the remainder is attributed to government consumption & non-governmental financial sources; Hertwich & Peters, 2009; Wilson, Tyedmers, & Spinney, 2013). As electricity and heat production, agriculture, and transportation are the largest sources of global GHG emissions (Barker et al., 2007), actionable steps at individual and household levels can significantly reduce greenhouse gas (GHG) emitting behaviours (e.g., limit use of domestic cooling/heating systems, reduce meat/dairy consumption, increase use of public transport/carbon free alternatives; Edenhofer, 2014). In addition to directly reducing carbon emissions, individuals can engage in pro-environmental ways by making low-carbon consumer decisions (e.g., purchasing energy-efficient appliances or local, seasonal food), voting for green policies, and participating in environmental groups.

The global lockdown due to the Coronavirus Disease 2019 (COVID-19) pandemic contributed to significant and immediate reductions in the production and consumption of GHG emissions. Daily global fossil CO<sub>2</sub> emissions fell by an estimated 17% by early April 2020, compared with 2019 levels (Le Quéré et al, 2020). However, by June 2020, as lockdown restrictions eased, emissions rapidly rose in line with pre-COVID-19 levels. Although lockdown restrictions are linked with lower carbon emissions, this should not reflect a complacency in carbon decisions. This is important to keep in mind whilst many countries deal with further lockdown restrictions and spread further COVID-19 variants. Thus, considerable reductions to mitigate climate risk requires a sustained collective long-term solution.

Despite growing public perceptions that climate change is the current greatest threat to human life (Poushter & Huang, 2019), a large discrepancy between climate concern and climate action persists (Clayton et al., 2015). Individuals continue to make decisions that increase their carbon footprint (e.g., purchasing large houses and cars, road and air travel; Hares, Dickinson, & Wilkes, 2010), whilst failing to offset resulting carbon emissions. This attitude-behaviour conflict is undoubtedly problematic because addressing global climate change requires immediate and widespread changes in behaviour and decision-making. This thesis describes an investigation into how climate change information can be communicated in optimally effective ways to increase engagement with climate change and to motivate appropriate actions.

The mass media constitutes critical agency in facilitating the climate change conversation, and in informing individuals about the severity of climate change impacts (Schäfer et al., 2016). The media can shape and influence public debates on climate change and often serves as an extension of social polarisation on highly political topics (Brüggemann & Engesser, 2017; Schäfer et al., 2016). As the mass media is a significant player generating and transforming the meaning of societal risk issues such as climate change, it is important to consider how their framing of climate change information influences audience responses. For instance, studies have identified negative impacts of “balanced” media coverage on topics that have strong medical and scientific consensus (e.g., vaccines; see Dixon & Clarke, 2013, Lewandowsky, Gignac, & Vaughan, 2013). In some cases, balanced reporting, that is, interviewing scientists for and against a debate, may perpetuate the myth that the science is unsettled, reinforcing climate change deniers’ commitment to their beliefs about climate change.

In attempting to capture public attention and drive climate engagement, *inter alia*, sections of the media, environmental advocates, and some policy makers emphasise the most severe consequences of unmitigated climate change. Of course, market pressures on media outlets to deliver compelling and “clickbait” content may also drive motives to increase emotive climate change content (Driedger, 2007; Hulme, 2008; Lester & Cottle, 2009; Smith & Joffe, 2009). Regardless of the motive, the climate change discourse is frequently accompanied by emotional content depicting suffering, helplessness, mortality, blame, and mistrust, in the wake of climate impacts (Driedger, 2007; Höijer, 2010; Hulme, 2008; Lester & Cottle, 2009; Pantti, 2010; Smith & Joffe, 2009). Underscoring the high risks of climate change by creating fear and anxiety has been presumed to act as a prelude to behavioural engagement (Extinction Rebellion, 2018). However, in the face of political polarisation, effectively communicating climate change information to the public requires an understanding of how people attend to, process, and respond to climate change communications, and the key factors that impact these processes.

Research has found that whether, and to what extent, individuals respond to climate change information can depend on how that information is framed (Chapman & Lickel, 2016; Feinberg & Willer, 2011; Harrison & Mallet, 2013; Hine et al., 2016) and certain audience characteristics (Gifford, 2011). Two main factors impacting how an individual processes information about climate change is the level of threat elicited by the information (Witte & Allen, 2000), and the individual’s pre-existing beliefs (Kahan, 2012). The research described in this thesis examines whether these factors interfere when communicating the need for urgent climate action.

Whilst using fearful representations of climate change may be an effective tool for attracting attention, it may not always be effective for increasing personal engagement

(O'Neill & Nicholson-Cole, 2009). Under certain circumstances, emphasising dire climate change outcomes can have unintended consequences (Witte & Allen, 2000). For example, information framed to emphasise the negative outcomes of climate change, compared to a more positive climate change information frame, has been found to increase climate change scepticism (Feinberg & Willer, 2011), and decrease positive attitudes towards climate change mitigation (Spence & Pidgeon, 2010). Illustrating the extensive scale and devastating impacts of climate change may leave some audience members feeling anxious (Gifford & Gifford, 2016; Lee, 2019), fearful (Spence & Pidgeon, 2010), or powerless (Norgaard, 2006; O'Neill & Nicholson-Cole, 2009). At times, fearful emotions triggered following exposure to negatively focused climate change information can serve to increase positive climate change intentions (Spence & Pidgeon, 2010). However, at other times, rather than motivating climate action, emphasising the magnitude of the problem may instead lead to perceptions that individual efforts to mitigate climate change are futile (Hmielowski, Donaway, & Wang, 2019; Norgaard, 2006; Salomon, Preston, & Tannenbaum, 2017). A sense of powerlessness against the threat may render one feeling disengaged from climate action (O'Neill & Nicholson-Cole, 2009). Thus, it is important to understand how individuals respond to threatening climate change information, what types of communication frames can motivate action, and mechanisms that influence threat-protective (e.g., mitigation intent), or threat-avoidant (e.g., minimisation of threat, denial) responses.

It has been suspected that mortality concerns may underlie individual and societal responses to climate change (e.g., disengagement, threat minimisation; Akil, Robert-Demontrond, & Bouillé, 2018; Dickinson, 2009; Wolfe & Tubi, 2019). It is proposed that climate change communications might trigger thoughts about death, because its impacts are associated with events that place people in danger of injury or death. Mortality-related risks will increase as natural weather events and the increased spread of infection diseases are

worsened by climate change (Field et al., 2014; Kovats, Campbell-Lendrum, McMichel, Woodward, & Cox, 2001). As the impacts of climate change become increasingly visible and pervasive, reporting of climate change would presumably contain more death-related content, likely further triggering existential-threat related anxieties. The main theoretical framework in this thesis is terror management theory (TMT), which potentially provides an explanation for unintended attitudinal and behavioural societal responses to existentially threatening information. TMT rests on the premise that most of human behaviour is motivated by the awareness that death is inescapable (Greenberg, Solomon, & Pyszczynski, 1986). Because thinking about death can be unsettling, people are motivated to use strategies that reduce the perceived or actual threat of death (Pyszczynski, Greenberg, & Solomon, 1999). Therefore, the motive to distance oneself from climate change may reflect the desire to avoid or reduce uncomfortable emotions, such as fears or anxieties related to the reminder of one's own mortality. This thesis examines whether TMT can elucidate the cognitive processes (i.e., death-related thoughts) that underlie responses to climate change threat and further, predict outcomes resulting from the exposure to climate change threat information.

Reminders about death have been shown to influence how individuals respond to subsequent threatening information. For example, whilst some individuals are motivated to enhance their health after the exposure to information that emphasises their own mortality risks (Vail, Arndt, Motyl, & Pyszczynski, 2012), others seek to distance themselves from, or deny their mortality risks (Goldenberg et al., 2001; Jessop & Wade, 2008; Koole & Van den Berg, 2005; Martens, Greenberg, Schimel, & Landua, 2004; Taubman-Ben-Ari, Florian, & Mikulincer, 1999). Both these response types operate to reduce the perceived threat of death. Minimising the threat of climate change may serve to psychologically attenuate concerns about mortality-related risks and therefore be a preferred option for some individuals. Thus, the extent to which climate change communications emphasise mortality-related risks may



determine attitudinal or behavioural responses to climate change. As the climate change discourse increasingly reflects mortality-related consequences of worsening climate change, it is imperative that we understand the mechanisms leading to counterproductive responses to threat (e.g., climate change avoidance, disengagement, minimisation, denial). Furthermore, due to the novel coronavirus epidemic, many individuals are frequently reminded about their own vulnerability to disease and death. It becomes increasingly valuable to understand how individuals variously respond to mortality-related threats and to identify ways to alleviate anxieties caused by reminders about death. Therefore, a terror management (TM) framework may be crucial to uncovering how to optimally communicate societal issues related to public health (Courtney, Goldenberg, & Boyd, 2020), and environmental risk (Dickinson, 2009; Wolfe & Tubi, 2019).

The influence of framing effects can be complicated by an individual's worldview. How individuals search for, interpret, and act on information is filtered, in large part, through their cultural worldview. An individual's worldview may predispose them to deny or minimise (e.g., a more individualistic and/or hierarchical worldview orientation, right-wing authoritarian; Leiserowitz, 2005), or to accept and take responsibility (e.g., a more communitarian and/or egalitarian worldview orientation, left-wing liberal) for the threat of climate change. When individuals respond in ways that reinforce their worldviews, it is known as motivated reasoning. Individuals have been observed to engage in identity-protective motivated reasoning in a number of contexts, wherein worldview measures have been successful in predicting polarised political views, such as support for permitting handguns, nuclear waste disposal, embryonic stem cell research, and climate change (Kahan, Jenkins-Smith, & Braman, 2011; Nisbet, 2005).

When climate change is communicated in a way that aligns with an individual's worldview, then they are more likely to be receptive to the information. Alternatively, if the information does not align with their worldview, individuals are more likely to be dismissive (Chapman & Lickel, 2016; Harrison & Mallet, 2013; Hine et al., 2016). Research has found that whether individuals corrected misperceptions on factually incorrect beliefs was influenced by their political affiliation. In some cases, presenting evidence that contradicts previously held beliefs served to strengthen erroneous beliefs (Nyhan & Reifler, 2010). Chapman and Lickel (2016) showed how worldview biases can have secondary effects on how individuals evaluate natural disasters caused by climate change. These researchers investigated whether climate change deniers construed information about a natural disaster and its victims in a biased way when the natural disaster was attributed to climate change. Compared to when climate change was not mentioned as a cause, climate change deniers reported lower support for helping victims by downplaying the severity of impacts and reporting aid as more ineffective. Linking natural disasters to climate change in the aftermath of a natural disaster may unintentionally have negative impacts on public support for relief efforts, amongst some sections of society. Further, Hart and Nisbet (2012) exposed participants to information about possible climate change health impacts on different groups of people. This research found that identification with potential victims was contingent on participants' political affiliation (Republicans vs. Democrats). Political affiliation increased the degree of political polarisation on support for climate mitigation policies which and resulted in a backfiring effect amongst Republicans.

There is strong support in the literature that various societal risk attitudes differ depending on an individual's worldview and values (Kahan et al., 2012) and that these worldview preferences are enhanced under psychological threat conditions (Burke, Martens, & Faucher, 2010). Demonstrating this effect, Selimbegović, Chatard, Er-Rafiy, and Pyszczynski (2016)

observed that amongst individuals with low concerns about environmental protection, exposure to reminders of a nuclear accident led to greater support for nuclear energy (compared with a control condition). Individuals with high concerns for environmental protection exposed to reminders of the nuclear accident demonstrated lower support for nuclear energy. Therefore, it is important to take into account people's worldviews as they likely interfere with information processing.

TMT offers an explanation for why individuals are strongly motivated to reinforce their worldviews. According to TMT, cultural worldviews are one main way in which individuals attenuate the psychological threat of death. When reminded about death, individuals routinely demonstrate a desire to strengthen adherence to important worldviews (Burke et al., 2010). Cultural worldviews supply a number of anxiety-buffering functions, such as providing a way to understand the world and dictating rules for achieving a meaningful and successful life. Therefore, cultural worldviews are a fundamental basis of psychological security, and are used by individuals to maintain their perceived integrity. Research observes threatening one's worldview elicits thoughts about death (Hayes et al., 2008). This may account for why it is difficult to change attitudes that stem from long-standing worldviews.

**In summary, it is posited that climate change may elicit thoughts about death in one of two ways. The first is because climate change conversations conjure images related to death, which is likely to increase in frequency as the mortality-related consequences of climate change impacts worsen. Furthermore, climate change is intrinsically associated with factors linked to death such as uncontrollability, destruction and chaos, likely provoking thoughts about death. The second reason that climate change may elicit thoughts about death is because climate change information may threaten important**

**worldviews, such as those that predispose some individuals to perceive climate change as being low risk (e.g., those who hold individualistic worldviews).**

### **Aims of the Thesis**

This thesis applies a TMT conceptual framework to understand and predict responses to climate change threat communication. The thesis aims to investigate key TM factors impacting effective communication of climate change to foster positive attitudes change, such as increasing perceptions of climate change concern, risk, and mitigation intent and further, whether death anxiety underlies these responses. Also examined are factors that may impede positive attitudes towards climate change, such as backfire consequences (e.g., increased scepticism, perceptions of risk as low, increased materialistic desires) observed when individuals are exposed to threat information (Feinberg & Willer, 2011; Kasser & Sheldon, 2011).

As researchers have only recently applied a TMT framework to understand and predict climate change responses, there have so far been few empirical investigations into whether mortality concerns constitute an impetus, or an additional factor, that can account for differential climate change attitudinal or behavioural responses. TMT has explained a wide range of phenomenon from prejudice towards outgroup members (Das, Bushman, Bezemer, Kerkhof, & Vermeulen, 2009; Greenberg, & Kosloff, 2008), increased support for violent military interventions (Pyszczynski, Abdollahi, Solomon, Greenberg, & Cohen, 2006), the need to uphold cultural heroes (Rosenblatt, Greenberg, Solomon, Pyszczynski, & Lyon, 1989), distancing oneself from animals and nature (Goldenberg et al., 2001; Koole & Van den Berg, 2005), material strivings (Kasser & Sheldon, 2001), and responses to COVID-19 (Courtney et al., 2020). Concerns about death are presumed to underlie these responses. At the time of thesis planning, no empirical studies had been conducted on responses to climate

change using TMT. Since thesis completion, only two empirical studies have been published (Akil et al., 2018; Wolfe & Tubi, 2019). However, neither investigation examined whether an increase in death-related thoughts underlie the outcomes measured.

## **Structure of the thesis**

Chapter 1 of this thesis introduced the rationale for the current research and concluded with a thesis overview. Chapter 2 provides an overview of TMT, which served as the main theoretical framework for the research. A rationale linking TMT to an understanding of societal responses to climate change is provided. Reasons are explored for why climate change may elicit death-related thoughts and underlie predicted TM responses as a reaction to climate change threat information. Chapter 3 examines how the TM model and constructs central to TMT (e.g., death-related thoughts, cultural worldviews, self-esteem) are measured in the TMT literature. Chapter 3 concludes with an overview of studies presented in the thesis.

The next four chapters describe the research conducted for this thesis: Pilot Study (chapter 4), Study 1 (chapter 5), Study 2 (chapter 6), and Study 3 (chapter 7). The Pilot Study investigated whether information about climate change impacts elicited death-related thoughts and motivated TM reduction responses outlined by TMT, such as worldview defence. Study 1, a purely methodological paper, was concerned with testing limitations found in the Pilot Study when using the death-word-fragment task, the most common measure of death-thought accessibility in the TMT literature. Study 1 tested alternative measures to capture unconscious death anxiety. Study 2 examined whether TM responses were elicited depending on the type of climate change outcome information communicated. Study 2 differentiated between an information frame that emphasised the losses of unmitigated climate change (loss-frame) and one that emphasised the gains of climate change mitigation (gain-frame). Study 3 manipulated

outcome framing along with climate change response-efficacy to examine which frame was more effective in increasing mitigation intent, and reducing counterproductive TM responses.

All four studies have been submitted to academic journals for peer-review. These studies are presented in their full form as submitted to the journal in the relevant thesis chapter. The submissions for the Pilot Study, Study 1 and Study 3 (chapters 4, 5, and 7 respectively) were shortened for journal submission. The additional hypotheses and results not included in the submitted papers are provided at the end of the relevant chapter. Chapter 8 summarises and integrates the findings from each study, and discusses implications for research, theory, and practice, as well as making recommendations for future research.

The format of thesis chapters may differ when a chapter comprises a paper that has been submitted to an academic journal. Submitted papers are presented as submitted and are therefore formatted to comply with journal requirements and so differ from the format of other thesis chapters. The thesis is written in UK English, unless a paper has been submitted to a US-based journal. In these instances, the paper is written in US English. Tables and figure numbers are formatted by chapter so that the first figure or table in each chapter begins with the chapter number followed by the number of the figure in that chapter. For example, the first figure presented in chapter 4 will be Figure 4.1. For published and submitted papers (chapters 4b, 5b, 6b, 7b), tables and figures begin at 1 without reference to the chapter, as in the version submitted to a journal. Acronyms in the thesis are introduced on the first occasion and used thereafter. All acronyms have been presented in the Keywords table at the beginning of thesis. Acronym use may differ depending on the submitted paper.

## **Chapter 2: TMT and Climate Change**

### **2.1 TMT**

Cultural anthropologist Ernest Becker (1962, 1973, 1975) synthesized ideas from psychoanalysts (e.g., Freud, Rank, Adler), philosophers (e.g., Nietzsche, Kierkegaard), and sociologists (e.g., Goffman, Berger, Luckmann) in proposing that fear of death is the wellspring from which most human behaviour originates (Greenberg et al., 1986). Derived from Becker's writings, researchers Greenberg, Solomon, and Pyszczynski (1986) developed TMT, which has subsequently guided numerous empirical investigations (Arndt, Solomon, Kasser, & Sheldon, 2004; Leippe, Bergold, & Eisenstadt, 2017; Martens et al., 2004; McGregor et al., 1998; Vail et al., 2012). TMT proposes that awareness of death produces feelings of overwhelming anxiety, or *terror*, subsequently motivating individuals to employ strategies enabling them to distract or distance themselves from experiencing continued threat to the psyche. According to Becker (1962, 1975), awareness of death provides the potential for feelings of overwhelming anxiety because our own mortality conflicts with the evolutionary imperative towards maintaining survival. TMT has stimulated international research, spanning phenomena within, inter alia, psychology, anthropology (Burke et al., 2010), health (Jessop, Albery, Rutter, & Garrod, 2008; Martin & Kamins, 2010), and advertising (McCabe, Vail, Arndt, & Goldenberg, 2014; Sullivan, Jonas, & Jodlbauer, 2011). Recently, TMT has been applied to understand individual and societal responses to climate change (Akil et al., 2018; Dickinson, 2009; Wolfe & Tubi, 2019).

#### **2.1.1 Climate change as a threat to survival**

While ascribing 'most human behaviour' to being motivated by fear of death might seem overly inclusive, specific reference to TMT may be justified where research has determined that a risk genuinely threatens human life, as has been increasingly recognised in the impact

of climate change (Extinction Rebellion, 2018). Climate change communications might trigger thoughts about death because its impacts are associated with events that place people in danger of harm or death. Further, climate change impacts are intrinsically associated with many death-related themes, such as: destruction (e.g., the aftermath of natural disasters; Vail et al., 2012), ageing (e.g., images of fractured Earth, barren landscapes and dehydrated lakes; Marten et al., 2004), uncontrollability (e.g., untameable forces of nature; Agroskin & Jonas, 2013), and loss of life (e.g., mass extinctions, famine, or as a consequence from natural disasters), all of which have been observed to result in higher rates of death-related cognitions, relative to a control condition.

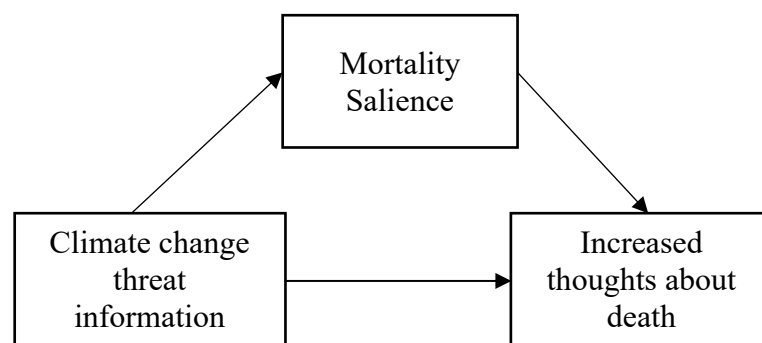
Because death is inevitable, feeling a loss of control may activate TM strategies (Agroskin & Jonas, 2013). Communicating climate change impacts may increase death-related thoughts because it may remind individuals about their inability to control their external surroundings and to escape nature's consequences. Exposure to landscapes without visible human control, such as presenting participants pictures of the wilderness, has been found to increase death-related thoughts when compared with participants exposed to pictures of cultivated or urban environments (Koole & Van den Berg, 2005). Research has revealed a tendency for individuals to separate themselves from, and deny commonalities with, nature (Fritsche & Hoppe, 2019; Koole & Van den Berg, 2005), and animals (Goldenberg et al., 2001). Fritsche and Hafner (2011) found that when people were reminded of death, they displayed lower motivation to protect nature and reported fewer concerns about nature, whilst exhibiting a greater desire to protect humans and greater concern for humans. These responses are presumed to reflect a desire to believe that humans are symbolic beings and not subject to the same natural and uncontrollable laws resulting in death and decay (i.e., such as animals and the natural world).



Research suggests that communicating dire depictions of climate change impacts, especially in the wake of presently occurring natural disasters and their destructive impacts, over which we have little control, may elicit high degrees of fear and existential anxiety (Dickinson, 2009; Fritsche & Hoppe, 2019). Exposure to images of building destruction has been shown to elicit higher death-related thoughts when compared with a control condition (Vail et al., 2012). Through imagery of sea-level rise, extreme weather events, and species extinction as a result of climate change, individuals may be reminded about their vulnerability to death. Climate change depictions may elicit thoughts about death via frequent use of images representing decay and deterioration, such as: fractured earth, dehydrated lakes, and barren landscapes. Such coverage of climate change may serve as powerful symbols of an ageing and dying planet (Nerlich & Jaspa, 2013), reminding individuals of their own physical deterioration and inevitable finite future. Martens et al. (2004) observed that reminders of ageing increased thoughts about death and distancing responses (e.g., prejudicial attitudes towards the elderly), presumably to avoid thinking about their own ageing and proximity to mortality.

Market pressures on media outlets to deliver compelling content often increase emotive content such as illness, death, and mistrust, thereby intensifying anxieties (Driedger, 2007; Höijer, 2010; Hulme, 2008; Lester & Cottle, 2009; Pantti, 2010; Smith & Joffe, 2009). For instance, when communicating impacts of climate change the media often use doomsday representations (Lester & Cottle, 2009; Smith & Joffe, 2009), including words such as “terror”, “catastrophe”, “danger”, and “extinction” to stress the seriousness of the threat (Höijer, 2010; Hulme, 2008). Using emotive imagery that depicts the aftermath of natural disasters exacerbated by climate change have been designed to instil awareness that ‘it could have been me’ (Höijer, 2010; Pantti, 2010).

As climate impacts worsen, and news, which is often optimised for emotional impact, increase in frequency and intensity of negative content, death anxiety may play an increasingly important role underlying individual and societal responses to climate change. It becomes imperative that we investigate whether death anxiety plays a role in responses to climate change, and if so, whether death anxiety works either to facilitate, or acts as a barrier to, climate change action. According to TMT, if exposure to climate change threat information serves as a reminder of death (Figure 2.1), then exposure to climate change threat information would motivate TM reduction responses. Examining TM factors allow for prediction of climate change responses after exposure to climate change information, as well as contributing to an understanding of the motivations behind individuals' responses to climate change. The effectiveness of emphasising or de-emphasising the mortality-related outcomes of climate change information could inform the development of campaigns such that they are optimally effective to increase levels of engagement.



*Figure 2.1.* Hypothesised relationship between climate change threat information eliciting thoughts about death via MS

## 2.2 Proximal and distal defence strategies

An extension of TMT, dual-process theory posits that individuals adopt different TM strategies, depending on whether the threat of death is proximal (within conscious awareness)

or distal (beyond conscious awareness; Pyszczynski, et al., 1999). Dual process theory can be applied to predict TM responses following exposure to climate change information.

### **2.2.1 Proximal defence strategies**

When thoughts of death arise in *proximal* (conscious) attention, people attempt to directly confront psychological implications of the threat. Being consciously aware of the perceived threat, and of thoughts accompanying it, means that the individual is constrained to rationalise the threat by diffusing its impact on the self in a sensible, logical, and rational manner (Pyszczynski et al., 1999). One way an individual can achieve this is to increase health protective behaviours (e.g., increase exercise intentions, quit smoking, apply sunblock; Arndt, Schimel, & Goldenberg, 2003; Bozo, Tunca, & Šimšek, 2009; Morris, Cooper, Goldenberg, Arndt, & Gibbons, 2014; Taubman–Ben-Ari & Findler, 2005), thereby eliminating or reducing threat likelihood. Alternatively, and counter-productively, individuals may use defensive cognitive strategies to distance themselves from the reality of death, such as engaging in denial, avoidance, or minimisation of the perceived threat, or projecting the threat into a distant future (Pyszczynski et al., 1999). These responses, although serving to reduce the *perceived* threat on the self, may paradoxically increase the actual threat.

Evidence for proximal defences is research demonstrating that individuals bias their thinking in a variety of ways to deny their vulnerability to disease or death. Kunda (1987) found that, compared with non-coffee drinkers, coffee drinkers rated fibrocystic disease as less serious when led to believe that caffeine was related to the disease. Greenberg, Pyszczynski, Solomon, Pinel, Simon, and Jordan (1993, study 1) found a bias when participants were required to report on their own levels of emotionality. Self-reports were dependent on whether participants believed that emotionality led to a longer or shorter life, such that self-reports on emotionality were biased in both conditions in favour of a long-life

expectancy. Martens et al. (2004) found evidence that elderly people remind younger people of their own mortality, which may underlie some forms of ageism. Participants exposed to photos of elderly people, compared with photos of younger people, elicited greater accessibility of death-related thoughts (Greenberg et al., 1993, study 1). Subsequently, when compared with control participants, those under MS, showed distancing behaviours from elderly people, whereby their responses exaggerated difference ratings between themselves and of the average elderly person. Compared with controls, participants under MS also showed great derogation towards elderly people, whereby elderly people were assigned more undesirable traits (Greenberg et al., 1993, study 2). Thus, reminders of potential threats to mortality (e.g., early death or ageing) can elicit proximal defence strategies.

***Proximal defence strategies to climate change.*** Dickinson (2009) recognised that reactions to mortality observed within TMT research resembled those seen in public responses to climate change threat. Ways in which individuals attenuate the existential vulnerability they would otherwise feel from climate change impacts may include: persistent climate change denial (Haltinner & Sarathchandra, 2018; Poortinga, Spence, Whitmarsh, Capstick, & Pidgeon, 2011), believing that climate change threats are exaggerated (Whitmarsh, 2011), choosing to view climate change as a low threat to human life (Leiserowitz, 2005), or pushing the threat into a distant future (Dickinson, 2009; Wolfe & Tubi, 2019). Such strategies may alleviate individual concerns about death by reducing an individual's perceived threat of death (Pyszczynski et al., 1999).

Supporting a connection between climate change threat information and counterproductive threat-reducing strategies, is research that demonstrates less positive climate change attitudes after exposure to climate change threat information, relative to climate change information framed more positively (Dickinson, Crain, Yalowitz, & Cherry, 2013; Feinberg & Willer,

2011; Spence & Pidgeon, 2010). Feinberg and Willer (2011) found that communicating climate change via “dire messages” led to increased climate change scepticism, when compared with a more positive climate change information message.

Dickinson et al. (2013) examined whether intentions to reduce carbon emissions were greater after individuals were exposed to a climate change negative frame, which emphasised the dangers of climate change, or a positive frame, which emphasised the positives of climate change mitigation. In addition, the climate change frames either emphasised the danger of climate change to humans or birds. Intentions to reduce carbon emissions was only unsuccessful when individuals were presented with information about the danger of climate change to humans (Dickinson et al., 2013). The authors posited that emphasising negative outcomes of climate change to humans may have activated proximal defences. However, thinking about danger outcomes to another species may have served to distance the threat of death from study participants, thereby alleviating the need to activate biased information processing. Research has also found backfire effects for negative frames in health, advertising, and environmental messaging (Byrne & Hart, 2009; 2011; Cho & Sands, 2011; Quick, Kam, Morgan, Montero Liberona, & Smith, 2015; Spence & Pidgeon, 2010). Figure 2.2 outlines the TM dual process model (adapted from Arndt, Cook, & Routledge, 2004).

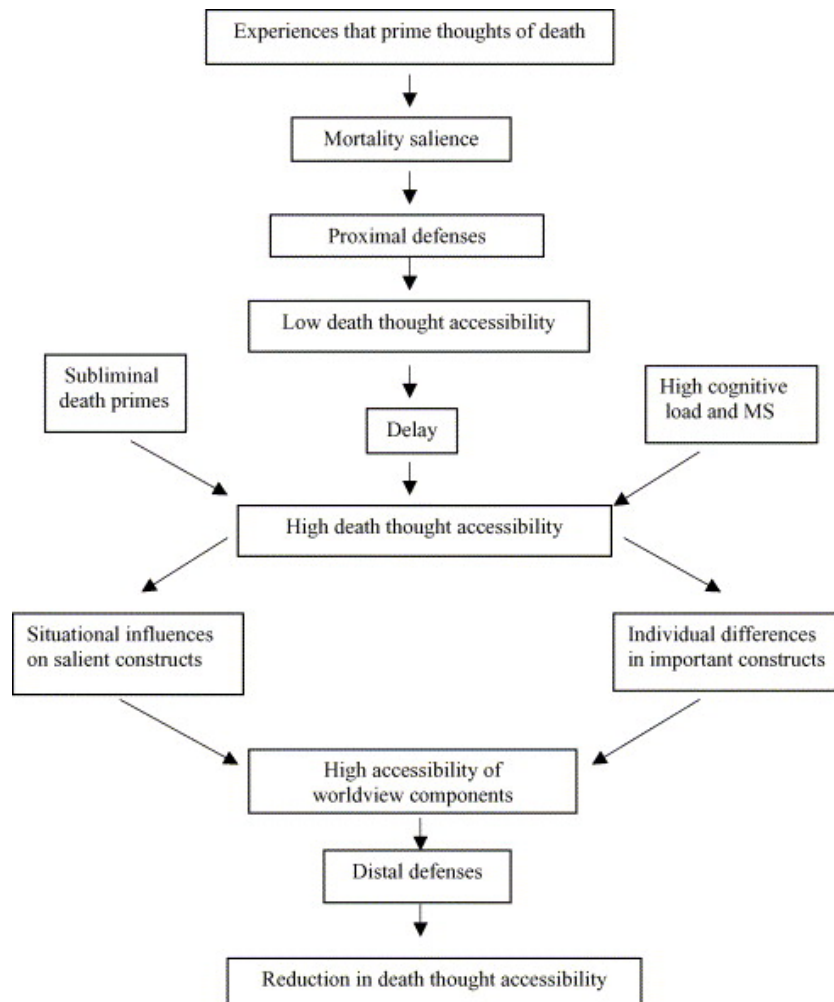


Figure 2.2. TM dual process model (adapted from Arndt et al., 2004).

### 2.2.2 Distal defence strategies

When the problem of death is distal (non-conscious), strategies employed to diffuse the threat become symbolic and not necessarily logically or semantically related to it (Pyszczynski et al., 1999). Distal defences work by enhancing value, meaning, and purpose, thereby positioning the individual within a great and powerful collective pursuit that endures after their biological death. That is, distal defences allow an individual to suppress or discard the notion that their biological death is the end. Psychological structures that defend against distal terror attacks include self-extensions such as, an individual's worldviews, self-esteem, achievements, interpersonal relationships, children, material possessions (Pyszczynski et al.,

1999). As the impacts of climate change become increasingly clear and it becomes no longer plausible for climate change to be perceived as low-risk, individuals may increasingly turn to psychological structures that attenuate mortality concerns beyond conscious awareness. The dual component anxiety buffer proposes that two main psychological structures buffering death anxiety are individuals' investment in cultural worldviews and self-esteem. The TM function of cultural worldviews and self-esteem are examined in more detail and how they may impact response to climate change.

**Cultural worldviews.** Worldviews attenuate concern about death because they communicate how to achieve significance and purpose in life (Harmon-Jones et al., 1997), and offer structure and order in a chaotic, random world. This helps to lower anxieties about the reality that events permitting injury or death are uncontrollable and unavoidable (Greenberg et al., 1992, Harmon-Jones et al., 1997). To reinforce an individual's commitment to their cultural worldviews, people seek consensual validation of their beliefs, cultural practices, and interactions with in-group members. A high level of consensus for one's personal beliefs implies that those beliefs are externally determined and do not arise through personal bias or perspective (Kelley, 1976). This serves to protect people's faith in their internalised cultural worldview, attenuating concerns about death. As there is great variability in worldviews, encounters with different beliefs and values that provide alternate ways of construing reality may serve as a reminder that the worldview one adopts may not be valid in an absolute sense. People therefore resist challenges to their own worldview on the grounds that this would undermine the buffering effectiveness of their cultural worldview as a TM strategy. Supporting the position that worldviews are an important buffer of death anxiety is research demonstrating that criticism or threats to one's worldview elicits death-related thoughts, whilst bolstering one's worldviews dispels such thoughts (Schimel, Hayes, Williams, & Jahrig, 2007).

**Self-esteem.** Self-esteem is defined within a TMT framework as being the belief that one is meeting or exceeding the standards and values outlined by the subscribed worldview (Harmon-Jones et al., 1997; Schmeichel et al., 2009). Thus, cultural worldview adherence and self-esteem are intrinsically linked. Individuals are inclined to respond in ways that align with psychological structures that provide self-esteem (Burke et al., 2010).

**Distal defence strategies and climate change.** Strong evidence shows that individuals are psychologically predisposed to credit and dismiss factual claims about societal harms, such as climate change, in patterns that reflect and reinforce their worldview commitment (Lima & Castro, 2005; Olstedal et al., 2004; Thompson, Ellis, & Wildavsky, 1990). An individual's worldview, or ways in which they have derived self-esteem, can have either positive or negative repercussions for climate change depending on the consequences of worldview affirming responses. Worldviews, values, or goals that conflict with climate action, may motivate a desire to perceive climate change as a benign risk, thereby permitting engagement in activities that threaten the environment as they align with an individual's goals (e.g., relating to commerce, industry, or personal advancement; Harrison & Mallet, 2013; Kahan, 2012). As the meaning and significance of climate change is embedded in people's cultural worldview's (O'Brien & Wolf, 2010), so is the divergence on climate change risk appraisals, solution pathways, and mitigation and adaptation strategies (Witt, 2015).

## **2.3 Hypotheses derived from TMT research**

Three hypotheses have been derived from TMT research that demonstrate support for some of TMT's main tenets are: 1) DTA, 2) MS, and 3) anxiety-buffer. Each hypothesis, shown pictorially in Figure 2.3, is explained with supporting research and applied to an understanding of climate change attitudes.



### 2.3.1 MS hypothesis

This hypothesis posits that if psychological structures defend against unconscious concerns about death (i.e., distal strategies), then reminders of death should intensify the need for these structures. Support comes from observing intensified commitment responses to attitudes consistent with, and in opposition to, personal worldviews and identities from which people derive self-esteem when reminded about death (Burke et al., 2010; Burke, Kosloff, & Landau, 2013; Schimel et al., 2007). Under existential threat, individuals routinely exhibit self-esteem striving behaviours and worldview defence (for a review see: Burke, Martens, & Faucher, 2010). A meta-analysis (Burke et al., 2010) examined 277 experiments to evaluate the strength of the MS hypothesis. The magnitude of MS effects on worldview defence and self-esteem striving was robust ( $r = .35$ ), attaining “the top quartile of effects for psychology in general and the 80th percentile for theories in personality and social psychology” (Burke et al., 2010, p.185). It is examined how worldview defence and self-esteem striving can be applied to understand responses to climate change threat.

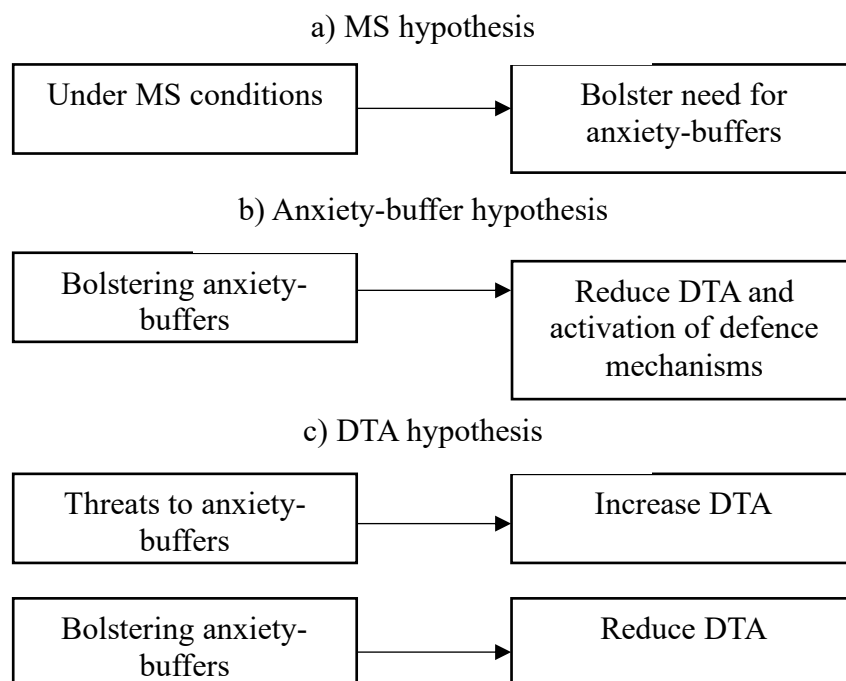


Figure 2.3. The a) MS, b) anxiety-buffer and c) DTA hypotheses derived from TMT research.

**Worldview defence.** Worldview defence is demonstrated when people show an enhanced preference for personal worldview-supporting others and enhanced negative evaluations of personal worldview-challenging others (Arndt et al., 1997; Greenberg et al., 1995). One of the earliest demonstrations of worldview defence was by Rosenblatt et al. (1989), who found that under MS, municipal court judges (study 1) and students (study 2) recommended much higher bonds for an accused prostitute, (i.e., someone who violates group norms or the positive image of the group) compared to a control condition. Conversely, Rosenblatt et al. (1989, study 3) demonstrated that larger rewards were recommended for a hero who upheld cultural values under an MS condition. Worldview defence effects have been observed across a number of countries and in a variety of contexts, such as when making evaluations about others' religious backgrounds (Greenberg et al., 1990), nationality (Schimel et al., 2007), cultural (Rosenblatt et al., 1989; Vess & Arndt, 2008) and environmental values, and political (Burke, Kosloff, & Landau, 2013), and university affiliation (Burke, Martens, & Faucher, 2010).

**Self-esteem striving.** Self-esteem striving is demonstrated when people show an intensified commitment response that aligns with structures providing them with self-esteem – such as commitment to values and worldviews. Whether the TM outcome is beneficial to the individual and/or society depends on the outcome of self-striving reactions. Demonstrating the negative impacts of MS effects is research that shows directing attention to death-related consequences of behaviours, such as binge drinking, or risky driving, counter-intuitively can increase engagement in those behaviours when they are a source of self-esteem (Jessop & Wade, 2008; Taubman–Ben-Ari et al., 1999). Research also reveals positive outcomes after MS, such as increased fitness intentions amongst individuals whose fitness is important to their self-esteem (Arndt, Schimel, & Goldenberg, 2003). Similarly, individuals under MS, for whom environmental action was a source of self-esteem, demonstrated higher

environmental concern than did those not exposed to threat (Vess & Arndt, 2008). The opposite pattern was found for individuals for whom environmental action was not a source of self-esteem. These individuals demonstrated decreased environmental concern under MS, compared with those with no threat exposure (Vess & Arndt, 2008). Likewise, exposure to climate change threat information may motivate similar self-esteem striving responses.

**Applying the MS hypothesis to climate change.** Exposure to climate change threat information has been shown to elicit similar worldview defence and self-esteem striving responses to existential threat (Barth, Masson, Fritzsche, & Ziemer, 2017; Fritzsche, Cohrs, Kessler, & Bauer, 2012). For example, individuals exposed to climate change information exhibit harsher evaluations of those who: violate group norms (e.g., criminals; Fritzsche et al., 2012), exhibit stronger group authoritarianism attitudes (Barth et al., 2017), and for highly nationalistic individuals, greater approval of system supporting groups (e.g., judges; Fritzsche et al., 2012). Thus, similar to instances where existential threat is salient, climate-induced threat can motivate people to uphold important in-group values (Barth, Masson, Fritzsche, & Ziemer, 2018; Fritzsche, Cohrs, Kessler, & Bauer, 2012).

Although highlighting the potentially catastrophic and irreversible consequences of climate change may invoke MS, which research shows can produce counter-productive vulnerability-denying strategies (Feinberg & Willer, 2011; Morton, Rabinovich, Marshall, & Bretschneider, 2011), activating important cultural values that are a source of self-esteem could promote pro-environmental attitudes. Akil et al. (2018) found that an anxiety inducing (vs. informative) climate change information condition followed the same pattern of responses predicted by the MS hypothesis. When exposed to anxiety inducing climate change information, individuals holding pro-materialistic values were more inclined to make pro-materialist consumer choices, whereas individuals with pro-environmental values were more

inclined to make pro-environmental consumer choices. Furthermore, when activating the social norm of environmental protection under MS, participants reported increases in positive environmental attitudes (e.g., liking a hybrid car, Akil et al., 2018 study 1), lower intentions to consume natural resources and more environmentally friendly behaviours (e.g., using a reusable cup; Fritzsche, Jonas, Niesta, Kayser, & Koranyi, 2010). Therefore, under psychological threat (including climate change threat), individuals bolster various psychological structures that provide them with self-esteem.

To date there has not been any investigations into whether information about climate change results in unconscious concerns about death, which could indicate the mechanism driving these responses (e.g., worldview defence, self-esteem striving). Even research that has used a TMT framework to predict and/or understand responses to climate change (Akil et al., 2018; Dickinson et al., 2013) or natural disasters (Mann & Wolfe, 2016) have not tested whether implicit thoughts about death underlie the TM responses tested. With no evidence that climate change threat information increases MS no robust conclusion about the processes that underlie the outcomes observed can be made.

### ***2.3.2 Anxiety-buffer hypothesis***

TMT's anxiety-buffer hypothesis maintains that if psychological structures attenuate concerns about death, then bolstering adherence to these structures should satisfy TM needs and thereby reduce motivation to activate DTA, and subsequent TM responses. Conversely, threats to these beliefs revive the death-related thoughts that these structures served to protect the psyche from. Research supports these structures operating to buffer existential concerns: personal worldviews, self-esteem (Schimel et al., 2009), close relationships (Cox et al., 2008; Hart, Shaver, & Goldenberg, 2005), and attachment style (Mikulincer & Florian, 2000; Mikulincer et al., 2003). Additionally, trait levels of self-esteem, self-regulation and purpose

in life, have been shown to moderate the relationship between MS and DTA (Gailliot et al., 2006; Routledge & Juhl, 2010; Schmeichel et al., 2009). Strengthening anxiety buffers has been found to eliminate increases in DTA routinely observed after MS induction (Cox et al., 2008; Schimel et al., 2009; Zhou et al., 2009).

**Applying the Anxiety-buffer hypothesis to climate change.** Not all individuals may exhibit increased DTA or TM responses after exposure to mortality-related threats. For instance, individuals with high trait self-esteem may be more immune to terror (i.e., eliciting high unconscious concerns about death) and its resultant responses (i.e., worldview defence, or self-esteem striving) after exposure to climate change threat information. Conversely, individuals with low trait self-esteem may be more likely to exhibit DTA and TM responses. Thus, extent to which an individual exhibits TM responses, such as worldview defence, is likely to vary depending on many other anxiety buffers.

### ***2.3.3 DTA hypothesis***

The DTA hypothesis maintains that if psychological structures function to protect against thoughts of death, then: 1) threatening these structures should increase DTA, and 2) bolstering these structures should reduce or prevent activation of DTA. Supporting the DTA hypothesis is research revealing increased DTA following threats to nationalism (Schimel et al., 2007), religious beliefs (Friedman & Rholes, 2007; Hayes, Schimel, Howard, Webber, & Faucher, 2010; Hayes, Schimel, & Williams, 2008; Schimel et al., 2007), and attachment bonds (e.g., to romantic partner, Mikulincer, Florian, Birnbaum, & Malishkevish, 2002; Taubman–Ben-Ari, 2004, study 3, or parental separation, Taubman–Ben-Ari & Katz–Ben-Ami, 2008).

**Applying the DTA hypothesis to climate change.** If people's worldviews predispose them to deny or minimise climate change threats (e.g., individualistic worldviews, right-wing authoritarian politics; Kahan et al., 2011) being presented with evidence for climate change

may undermine and challenge their subscribed worldview. Because threatening worldviews has been linked to higher accessibility of death-related thoughts, climate change information may elicit death-related thoughts amongst climate deniers. Alternatively, exposure to information that validates an individual's worldview offers reassurance that their personal worldview is correct, thereby attenuating concerns about death (Greenberg et al., 2001; Schimel et al., 2007). Therefore, amongst climate change acceptors, exposure to information about the dangerous risks and need for urgent climate change action, would be worldview affirming, which may attenuate concerns about mortality.

This chapter presented evidence for the main tenets of TMT and applied them to understand climate change attitudes and perceptions of risk. As a result, responses to climate change information can be predicted when climate change threat communications elicit concerns about death. The next chapter examines how TM research has measured the main TM processes and hypotheses outlined in this chapter, such as DTA and TM strategies.

## **Chapter 3: Measuring the TM Model**

This chapter examines how research has tested TMT's central constructs and hypotheses. Specifically examined are the how these have been measured: death-thought accessibility (DTA), proximal and distal defences, worldview defence effects, self-esteem striving effects, and the TM mediation model.

### **3.1 Measuring DTA**

Death-related thoughts are thought to be the mechanism by which reminders of death produce TM outcomes. Testing the potential mediating effects of death thoughts requires measuring implicit death-thought activation. To achieve this, Greenberg and colleagues (1994) adapted the word-fragment task used in priming research (Tulving, Schacter, & Stark, 1982), to devise the death-word-fragment task (DWFT) as a measure of death-thought accessibility (DTA). DTA refers to how readily accessible death-related constructs are activated outside conscious awareness (Greenberg et al., 1994). The DWFT is the most commonly used measure of DTA in TMT research (for a comprehensive review of DTA as used in TMT research see: Hayes, Schimel, Arndt, & Faucher, 2010). The DWFT involves completing several word fragments, some of which (e.g., DE \_ \_) can be completed as either a death-related (e.g., DEAD), or a non-death-related (e.g., DESK) word. In studies, the number of word fragments has varied from 2 to 17 for death-related word fragments, and from 3 to 28 for neutral word fragments (Arrowood & Cox, 2020).

Measuring death-thought accessibility has facilitated investigations into cognitive processes involved in managing concerns about death, providing novel insights into diverse aspects of human social behaviour (Hayes et al., 2010). Compared with a control condition, higher death-thought accessibility has been found after participants received a health check-up in the form of a self-administered breast examination (Goldenberg, Arndt, Hart, & Routledge,

2008), were reminded of the death-related consequences of risky behaviours, such as unsafe driving (Jessop et al., 2008, study 1), tobacco use (Hansen et al., 2010), binge drinking (Jessop & Wade, 2008; Shehryar & Hunt, 2005), unprotected sex (Taubman–Ben-Ari, 2004, study 2), when asked to think about cancer (Ardnt et al., 2007), and about the frailty of the human body by observing it in old age (Martens et al., 2004). Reminders of terrorism have also been found to increase DTA (Das et al., 2009; Vail et al., 2012). Landau, Solomon et al. (2004) found that reminders of the September 11, 2001 attacks, as well as simply priming participants with the letters WTC (for World Trade Center) or 9/11, increased death-thought-accessibility.

**Hyper-accessibility of death-related thoughts.** Becker (1973) proposed that because mortality-related thoughts invoke extreme discomfort, the presence of mortality-related thoughts should prompt a suppression response. Thus, after MS induction, individuals would be predicted to engage in effortful suppression, such as distracting themselves, or denying/minimising the importance of the issue (i.e., proximal defences). Following MS induction, accessibility of death-related thoughts should be low, due to such thoughts initiating effortful suppression strategies. Thus, efforts to observe death-related thoughts immediately after MS should be unsuccessful. Investigating neurophysiological correlates of proximal defences, Klackl, Jonas, and Kronbichler (2013) found that exposure to death-related words (e.g., ‘grave’, ‘death’), compared with equally unpleasant but death-unrelated words (‘pain’, ‘accident’), resulted in increased attention allocation, as measured by event-related potentials. These researchers’ findings supported the premise that consciously perceived death-related words prompt processes that require a great amount of attentional resources in order to achieve both suppression and distraction.



It has been argued that undermining an individual's capacity to suppress death-related thoughts would render such thoughts hyper-accessible in the unconscious (Arndt et al., 1997). Consistent with this reasoning, research has reliably reported higher death-related thoughts when a distractor or cognitive load task (vs. no task) is administered after MS induction (Burke et al., 2010). Thus, it is routine that directly after an MS manipulation, participants complete a filler (e.g., Positive and Negative Affect Schedule) or cognitive load task preceding a measure of DTA (Burke et al., 2010). In summary, observing death-related thoughts is only permissible when suppression strategies are interrupted and also beyond conscious awareness.

### **3.2 Measuring Proximal Defences**

Proximal defence strategies are threat-focused strategies motivated by conscious thoughts about death. Threat-focused strategies may include protective strategies that operate to reduce threat likelihood (e.g., increasing health protective behaviours), or cognitive strategies to reduce a perceived threat (e.g., denial). Measuring proximal defences involves asking participants questions related to the threat directly after MS induction. For proximal defences to occur, thoughts about death must be in focal attention and therefore be observed directly after MS and not after a time delay (Arndt et al., 1997). A procedure that distracts from conscious thoughts of death, by rendering them unconscious, would negate the measurement of proximal defences, and instead measure distal defences.

### **3.3 Measuring Distal Defences**

Most TMT research has focused on measuring distal (unconscious) concerns about death. Under MS conditions, procedures that distract participants from death-related thoughts produce stronger distal effects (Arndt et al., 1997; Burke et al., 2010). This is because measuring distal defences requires death-related thoughts to be beyond conscious awareness.

For this reason, distal defence strategies are measured following a distractor or cognitive load task after MS induction (Greenberg et al., 1994; Greenberg, Arndt, Simon, Pyszczynski, & Solomon, 2000). The research described in this thesis, addresses two main distal defences and how they are commonly measured in TMT research: worldview defence, and self-esteem effects.

### ***3.3.1 Worldview defence***

Worldview defence is defined as intensified commitment responses aligned with one's worldview. A prototypical MS experiment measures worldview defence by assessing participants' attitudes toward an essay or author who disagrees with their worldview (Burke et al., 2010). A common measure is to examine reactions to an author who writes either positively or negatively about the values of a participant's country (Greenberg et al., 1994; Vail et al., 2012). Research has found that under MS, compared with controls, experimental participants demonstrate worldview defence effects: more positive attitudes to in-group members, and greater derogation of out-group members (Burke et al., 2010).

The US college student population has provided prototypical samples in MS studies, and has yielded strong MS effects (compared with participants from other countries and age groups; Burke et al., 2010). The null finding for the MS effect in this large-scale study prompts a number of questions. For instance: "Do the necessary conditions to produce the same worldview defence outcomes no longer exist within a US population?" It was reasoned that following Donald Trump's election as US President, a pro-US essay may threaten worldviews of more liberal individuals (Klein et al., preprint). Changes in the political environment may have therefore affected MS outcomes. The researchers emphasised the need for investigations into the boundary conditions of worldview defence effects.

### **3.3.2 Self-esteem striving**

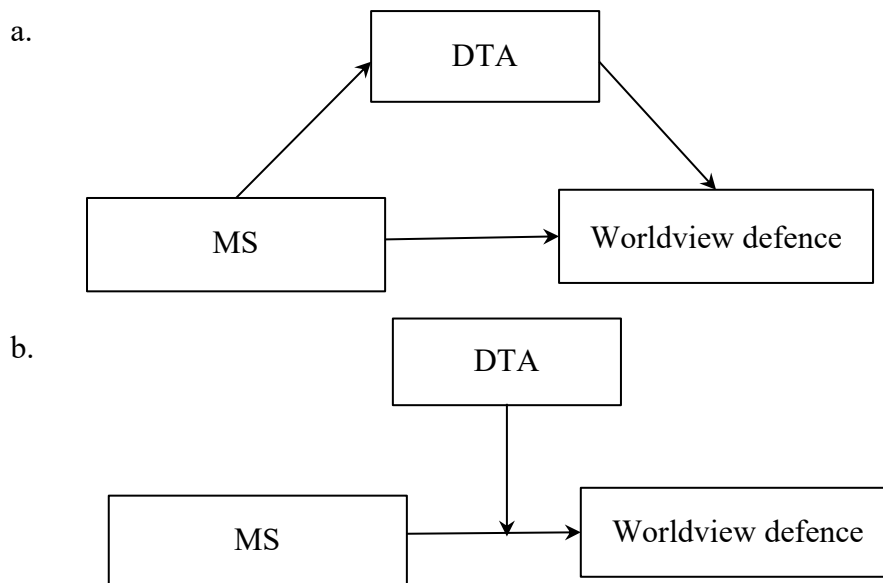
Self-esteem is defined as how someone perceives themselves to be meeting the standards prescribed by their worldview. TMT research testing self-esteem striving measures the importance of a particular value (e.g., materialism, environmentalism; Akil et al., 2018; Kasser & Sheldon; Vess & Arndt, 2008). After MS, participants are measured on outcomes that affirm or contradict that value.

### **3.4 TMT Mediation Model**

Although research shows strong support that after MS induction people display increased self-esteem striving and cultural worldview defence reactions (i.e., distal defences; Burke et al., 2010), few studies have tested the full TM mediation model. That is, that death-related thoughts (mediator M) are the mechanism by which MS (explanatory variable X) produces proximal or distal defences (criterion Y; see Figure 3.1). Some evidence that death-related thoughts mediate this association comes from research showing that directly manipulating the accessibility of death-related thoughts can increase distal effects (Arndt, Greenberg, Solomon, Pyszczynski, & Simon, 1997).

Contrary to the theoretical model that death-related thoughts mediate reminders of death and proximal and distal effects (Figure 3.1), most research testing the full TM model has found that death-related thoughts operate in a moderating rather than mediating role (Agroskin & Jonas, 2013; Das et al., 2009; Golec de Zavala, Cichocka, Orehek, & Abdollahi, 2012; Hayes & Schimel, 2018). Only one study appears to support a mediation model (Vail et al., 2012). These researchers exposed individuals to images of destruction, such as destroyed and collapsed buildings, to elicit thoughts about death. Death-related thoughts mediated responses towards militaristic defence of the US, revealing worldview defence outcomes. The

lack of strong evidence for the mediation model calls into question whether DTA mediates reminders of death and TM outcomes, or whether DTA has a moderating function.



*Figure 3.1.* Model (a) how MS is proposed to mediate worldview defence according to TMT: (b) alternative moderation model showing how MS may influence worldview defence.

### **Study Research Aims and Rationale**

The main aim of this thesis is to investigate how to communicate climate change information to audiences more effectively using a TM framework. Four studies were conducted. A Pilot Study investigated whether information about climate change elicited death-related thoughts and subsequent TM responses, such as worldview defence. Second, a methodological study investigated the effectiveness of a number of implicit measures of DTA to uncover sensitive measures that can reveal differences between MS and control conditions (Study 1). This study directly follows on from weaknesses apparent in the DWFT observed in the Pilot Study. A third study examined whether climate change information framed to emphasise the gains of climate change mitigation (gain-frame), and the losses of unmitigated climate change (loss-frame), would reveal differences in eliciting DTA and resultant TM strategies (Study 2). In this study material strivings were observed as a TM strategy post

exposure to climate change threat information. Material strivings has been observed after MS, and is considered to be an anxiety-buffer (Kasser & Sheldon, 2001). The final study examined the effects of reporting climate change response-efficacy information (high or low) combined with an outcome frame (loss vs. gain) on climate change mitigation intentions and reported pro-environmental behaviour and TM outcomes (Study 3). Together these studies inform research on climate change communication and TMT.

## Chapter 4a: Pilot Study

The first empirical study tested whether climate change attitudinal responses could be understood within a TM conceptual framework. The Pilot Study investigated whether exposure to information about climate change elicited death-related thoughts and a TM response – worldview defence. Participants were exposed either to information about the impacts of climate change (climate change salience), or to the ineffectiveness of multi-tasking – serving as a no-threat control condition. Examined were whether differences in information exposure (climate change salience vs. control condition) resulted in differences in DTA, and in turn, climate change risk perceptions and worldview defence responses. According to the MS hypothesis, under threat individuals respond in ways that more strongly align with their worldview. It was expected that larger discrepancies between ratings of two climate change authors endorsing differential risk perception of climate change (high vs. low), reflecting worldview defence, would be observed in the climate change salience condition (vs. control condition).

Also examined was whether an individual's position on the grid–group cultural worldviews dimension (Douglas, 1970, 1997) would be associated with different levels of DTA. The DTA hypothesis was tested, that is, that threats to a person's worldview should increase DTA, whilst bolstering someone's worldview should prevent DTA activation. Thus, climate change information should elicit differential DTA depending on whether climate change information supports (e.g., for egalitarian and communitarian), or threatens (e.g., for hierarchical and individualistic) a participant's worldview. This study also included a measure of explicit death anxiety for explanatory investigations into links between explicit death anxiety and climate change attitudes and perceptions of risk, and cultural worldview

adherence. Chapter 4c presents the literature review for the grid-group cultural worldview and explicit death anxiety.

Findings that were consistent with predictions would indicate that a TM framework may be fruitful in understanding differences in attitudinal (and behavioural) responses to climate change. As TMT has a wide scope in understanding various responses to threat, it can be useful in predicting responses to climate change threat information. Importantly, TMT may provide valuable insights into how communications can be framed to be more acceptable to an audience. At the time of planning the Pilot Study, there had been no published empirical work investigating climate change using TMT.

This chapter includes a co-authored paper submitted for publication. The paper is currently under review with the *Journal of Risk Research*. The bibliographic details accepted for publication are: Naidu, P. A., Hine, T. J., & Glendon, A. I. (2020) Climate change risk and terror management theory. *Under review*. The paper is included in its complete and original form before revisions suggested by anonymous reviewers. Table 4.1 indicates the relevant contributions of the research team to the paper. The submitted paper did not include all the hypotheses and results of the Pilot Study. Specifically, results related to the grid and group worldviews, and explicit death anxiety. The literature review, method, results, and discussion in relation to testing these predictions are listed directly following the submitted paper (see Chapter 4c). The research questions and hypotheses (H<sub>1</sub>-H<sub>4</sub>) from the pilot study are presented below. Hypotheses not included in the submitted paper are denoted using letters (H<sub>A</sub>-H<sub>D</sub>).

The first research question investigated the existence of an association between climate change communications and death anxiety, as follows:

*Q1: Does climate change threat information elicit elevated death-related thoughts?*

Two main reasons why climate change communications may trigger thoughts about death were proposed. First, climate change information may invoke concerns about mortality because its impacts are associated with events that place people in danger of harm or death ( $H_1$ ). Presenting information about the seriousness of climate change may also threaten psychological structures that attenuate concerns about death – for example, an individual's personal worldview (Harmon-Jones et al., 1997;  $H_2$ ,  $H_A$ ). Three hypotheses why climate change may elicit death-related cognitions were:

**$H_1$ :** Exposure to information about climate change impacts will be associated with elevated death-related thoughts.

**$H_2$ :** Exposure to information about the dangerous impacts of climate change will invoke more death-related thoughts for climate change deniers, compared with thoughts of climate change deniers in a control condition (testing the DTA hypothesis).

**$H_A$ :** After exposure to information about climate change, participants whose cultural worldview reflects a more hierarchical (vs. egalitarian) and individualistic (vs. communitarian) orientation will show greater levels of DTA, compared with control condition participants.

*Q2: Does climate change threat information elicit TM strategies?*

The second research question examined the existence of the TM outcome: worldview defence, specifically examining worldview defence via differences in credibility ratings of two climate change authors, one endorsing climate change as high-risk and the other as low-risk ( $H_3$ ). Examining the difference in ratings between two people of opposing opinions that reflect different worldviews is a common way to measure worldview defence in TM research (Burke et al., 2010). Greater differences in ratings between the two authors indicates higher



worldview defence. According to TMT, DTA is the mechanism by which MS produces TM outcomes, such as worldview defence. This study tested the mediation model (H<sub>3</sub>).

**H<sub>3</sub>:** Exposure to climate change information (X) will elicit greater worldview defence (i.e., greater differences between author ratings, Y) via high death-related thoughts (M).

The study also examined perceptions of climate change threat as a result of motivations to defend one's worldview. Climate change risk perceptions are important to investigate as higher perceived risk is often linked with greater willingness to take action (van der Linden, 2015; Xie, 2019). Risk perceptions of climate change deniers and acceptors respectively were examined separately. This is because amongst those in the climate change salience condition, the information about climate change for deniers would have threatened their worldview (H<sub>4a</sub>), whilst for acceptors, the information would align with their worldview (H<sub>4b</sub>), likely resulting in different responses. H<sub>4</sub> tests the MS hypothesis.

**H<sub>4a</sub>:** Exposure to climate change information for climate change deniers will elicit responses consistent with their worldview, such as lower climate change threat perceptions, as a function of increased DTA.

**H<sub>4b</sub>:** Exposure to climate change information for climate change acceptors will elicit responses consistent with their worldview, such as higher climate change threat perceptions, as a function of increased DTA.

The same pattern of responses observed amongst climate change deniers should be found for participants high in either hierarchical and/or individualistic worldviews (H<sub>B1</sub>). An equivalent pattern of responses should be found for climate change acceptors who are high in either egalitarian and/or communitarian worldviews (H<sub>B2</sub>).

**H<sub>B1</sub>:** Exposure to climate change information for individuals high in either hierarchical and/or individualistic worldviews will elicit responses consistent with their worldview, such as lower climate change threat perceptions, as a function of increased DTA.

**H<sub>B2</sub>:** Exposure to climate change information for individuals high in either egalitarian and/or communitarian worldviews will elicit responses consistent with their worldview, such as higher climate change threat perceptions, as a function of increased DTA.

*Q3: Is adherence to cultural worldviews related to implicit and explicit death anxiety?*

Also tested was the TMT tenet that strength of adherence to cultural worldviews (e.g., reflected in extreme positions) is related to fears about death. According to TMT, extreme positions for any worldview reflects greater death anxiety. The pattern between death anxiety and cultural worldviews should be different depending on whether participants were exposed to the control (H<sub>C1</sub>) or climate change threat condition (H<sub>C2</sub>). For instance, under no threat greater adherence to worldview should reflect in greater death anxiety, in either direction. However, exposure to climate change information should change this association depending on whether climate change affirms (e.g., for climate change acceptors) or threatens (e.g., climate change deniers) their worldview.

**H<sub>C1</sub>:** For control participants, strength of adherence to their cultural worldview will be positively associated with DTA and trait death anxiety. Thus, an inverted U-curve is predicted between death anxiety and grid-group worldview adherence.

**H<sub>C2</sub>:** In the climate change salience condition, individuals with more hierarchical (as opposed to egalitarian), and individualistic (as opposed to communitarian) worldviews will exhibit high DTA and higher trait death anxiety. This is because information about climate change

serves to threaten those with more hierarchical and individualistic worldviews, thereby reducing the extent to which their worldview offers them an anxiety buffer.

*Q4: Is trait death anxiety related to climate change attitudes and perceptions of climate risk?*

Greater levels of trait death anxiety may reflect a propensity to exhibit death-avoidant responses.

**H<sub>0</sub>:** High trait death anxiety will be associated with climate change denial and lower perceptions of climate change risk. Also explored was whether this moderated by condition.

Table 4.1.

*Statement of Contribution for the Pilot Study.*

| Contributor                  | Contribution               |
|------------------------------|----------------------------|
| Naidu, P. A. (PhD candidate) | Designed study (100%)      |
|                              | Interpreted results (100%) |
|                              | Conducted study (100%)     |
|                              | Wrote paper (90%)          |
|                              | Edited paper (70%)         |
| Hine, T. J. (Supervisor)     | Wrote paper (5%)           |
|                              | Edited paper (10%)         |
| Glendon, A. I. (Supervisor)  | Wrote paper (5%)           |
|                              | Edited paper (20%)         |

(Signed) \_\_\_\_\_ (Date) \_\_\_\_\_

Priyanka A. Naidu

(Countersigned) \_\_\_\_\_ (Date) \_\_\_\_\_

Supervisor: Trevor J. Hine

(Countersigned) \_\_\_\_\_ (Date) \_\_\_\_\_

Supervisor: A. Ian Glendon

## Chapter 4b: Climate Change Risk and Terror Management Theory

### Abstract

As climate change impacts are intrinsically associated with death-related themes (e.g., decay, destruction, lack of control, chaos), communicating climate change risks may elicit thoughts about an audience member's own mortality – thereby inviting terror management reduction responses. This study examined individual differences in death-thought accessibility (DTA) amongst Australian participants ( $N=241$ ) after exposure to information about climate change impacts, to predict climate change risk perceptions. A terror management conceptual framework was used to structure research questions and understand study findings. Participants completed: 1) a death-word-fragment task measuring DTA, 2) climate change beliefs [acceptors ( $n=178$ ), deniers ( $n=35$ )], attitudes, and risk perceptions, and 3) an evaluation of two climate authors' credibility, to measure worldview defence. Although climate change salience did not invoke DTA, there was evidence that choosing not to complete word fragments in a death-related manner reflected a high death-defensive response, rather than low DTA. However, climate deniers exposed to information about climate change (vs. a no-threat control condition) demonstrated low DTA (or high death defensiveness). Testing terror management outcomes revealed that when compared with the control condition, climate change salience participants demonstrated a liberal shift in risk perceptions, especially amongst high DTA (or low death defensiveness) participants. Exposure to climate change information even motivated some climate deniers to perceive climate change as high-risk. A general implication was that climate change communications that elicit thoughts about death may not produce counterproductive terror management outcomes traditionally observed in the terror management literature. Rather they may motivate

more realistic attitudes, such as perceiving climate change as high-risk, even amongst climate deniers. From a policy perspective, to maximise acceptance, climate change information may benefit from being presented within frameworks that support individuals' important personal worldviews.

Keywords: risk perception, risk communication, death thought accessibility, worldviews

## Overview

The world is entering a climate and ecological emergency. Without immediate and widespread action, global climate change will result in catastrophic and potentially irreversible damage to human and natural systems (Field et al., 2014). Preventing some of the worst consequences of global climate change requires widespread acceptance and policy action to promote urgent mitigation and adaptation responses. Therefore, understanding mechanisms driving public perceptions of climate change risk is crucial if governments and other agencies are to achieve reduction targets for greenhouse gas emissions, and reduce their projected devastating impacts. In efforts to mitigate the worst effects of climate change, campaigns are designed to highlight dire consequences of current climate change trajectories. Such negatively focused appeals may emphasise the worst outcomes, relaying themes of chaos, destruction, illness, and death. As climate risks rise, and news and educational appeals about climate change impacts increase in frequency and intensity, it becomes more important to investigate how climate change communications affects climate change risk perceptions.

Terror management theory (TMT) is premised on most human behaviour being motivated by fears of death (Becker, 1973; Greenberg, Pyszczynski, & Solomon, 1986). This study used TMT to investigate whether individuals' motivations to assuage fears of death operated as either a psychological barrier or facilitator in perceiving climate change as a serious risk. To manage such existential anxiety, the human psyche is motivated to generate reactions that minimise perceived threats (e.g., denying, or distancing oneself from the threat), or conversely constructing psychological structures (e.g., worldviews) that provide meaning and purpose to life (Pyszczynski et al., 1999). Dickinson (2009) recognised that reactions to mortality observed within the TMT literature resembled those seen in public responses to climate change threats. Individuals may attenuate the existential vulnerability they would

otherwise feel from climate change impacts by engaging in persistent denial, believing risks are exaggerated, perceiving climate change as a low-risk to human life, or pushing associated alleged threats into a distant future. Emphasising negative consequences of climate change has been shown to decrease individual intentions to behave in an environmentally sound manner (Morton, Rabinovich, Marshall, & Bretschneider, 2011), as well as increase climate change scepticism, particularly amongst those who believe in a *just world* (i.e., that the world is safe and orderly; Feinberg & Willer, 2011). The psychological motivation to distance oneself from the dangers of climate change may lead people to dismiss the need for mitigation and adaptation measures.

While ascribing ‘most human behaviour’ to being motivated by fear of death might seem overly inclusive, specific reference to TMT may be justified where research has determined that a risk genuinely threatens human life, as has been increasingly recognised in the impact of climate change death (‘Extinction Rebellion’, 2018). We proposed that climate change communications might trigger thoughts about death, because its impacts are associated with events that place people in danger of injury or death. Before considering strategies that may diffuse the threat of death subsequent to exposure to climate change information, we examine further why appraising climate change impacts may elicit thoughts about mortality triggering TM strategies.

## **Climate Change Communication Elicits Death-related Thoughts**

### ***Climate change as a threat to survival***

Global climate change exacerbates the extremity and duration of hazardous weather events (e.g., floods, cyclones, droughts, bushfires; Field et al., 2014). These hazards result in increased spread and exposure to vector-borne diseases like malaria (Kovats, Campbell-Lendrum, McMichel, Woodward, & Cox, 2001), food shortages due to crop damage



(Wheeler & von Braun, 2013), and loss of life. Exposure to such information may invoke anxieties about increased risks associated with death, illness, destruction, and loss. Market pressures on media outlets to deliver compelling content increase emotive content, intensifying such anxieties (Driedger, 2007; Hulme, 2008; Lester & Cottle, 2009; Smith & Joffe, 2009). For instance, the use of emotive imagery that depicts the aftermath of natural disasters can be designed to instil the idea that ‘it could have been me’ (Höijer, 2010; Pantti, 2010). Furthermore, climate change depictions frequently use images representing decay and deterioration such as: fractured earth, dehydrated lakes, and barren landscapes. Such communication of climate change may serve as powerful symbols of an ageing and dying planet (Nerlich & Jaspa, 2013), reminding individuals of their own physical deterioration and inevitable finite future.

Because death is inevitable, feeling a loss of control may be the impetus for activating terror management (TM) strategies (Agroskin & Jonas, 2013). People have been found to exhibit more death-related cognitions following exposure to landscapes without visible human influence such pictures of the wilderness, compared with cultivated or urban environments (Koole & Van den Berg, 2005). Hence, exposure to climate information may trigger thoughts about death by signalling humans’ inability to control their environment. Through imagery of sea-level rise, extreme weather events, and species extinction as a result of climate change, individuals may be reminded that they themselves cannot escape nature’s consequences.

This study used death-thought-accessibility (DTA) to measure the extent to which exposure to information about climate change and its impacts may invoke mortality concerns. If exposure to climate change risk information increased DTA, then exposure to climate change risk information could motivate terror management reduction responses. The first

hypothesis (**H1**) is that exposure to information outlining climate change impacts will be associated with greater DTA.

## **TM strategies**

### ***Mortality salience hypothesis***

According to TMT, unconscious awareness of our own impermanence motivates construction of psychological structures such as personal worldviews (Greenberg, Pyszczynski, Solomon, Simon, & Breus, 1994). By providing people with coherent rules that delineate how to attain meaning and purpose in life, personal worldviews are postulated to attenuate unconscious concerns about death (Harmon-Jones et al., 1997). Divergences in climate change attitudes and perceptions of societal risk occur through a person's worldview (Fielding, Head, Laffan, Western, & Hoegh-Guldberg, 2012; Joslyn & Haider-Markel, 2014; Kahan et al., 2012). Derived from TMT research, the mortality salience (MS; that is., the conscious awareness of one's own death) hypothesis proposes that reminders of death intensify the need for psychological structures that attenuate concerns about death. Research has found that defending one's worldview can lead to death-related thoughts being dissipated (Greenberg, Arndt, Schimel, Pyszczynski, & Solomon, 2001; Schimel et al., 2007).

This study examined distal (unconscious) defence strategies employed as a result of exposing individuals to climate change threat information. As the impacts of climate change become increasingly difficult to dismiss and avoid, it is likely that people will progressively adopt distal, rather than proximal (conscious) strategies to deal with the enduring threat (Dickinson, 2009). When thoughts of death are in focal attention, procedures that distract cognitive resources used for active suppression allow death-related thoughts to become more accessible, producing stronger distal defence outcomes (Arndt et al., 1997; Greenberg et al., 1994). Thus, before DTA is measured, most MS inductions are followed by a cognitive load

or distractor task. Under such conditions, individuals routinely exhibit self-esteem striving behaviours and worldview defence (WVD; Burke, Martens, & Faucher, 2010).

Under MS, individuals demonstrate intensified commitment responses to intentions to behave in an environmentally sound manner, depending on whether environmental action was/not a source of self-esteem (Morton, Rabinovich, Marshall, & Bretschneider, 2011). Similar to instances where existential threat is salient, climate-induced threat can motivate people to uphold important in-group values, which we propose could be an existential threat-related response (Barth, Masson, Fritsche, & Ziemer, 2018; Fritsche, Cohrs, Kessler, & Bauer, 2012). Similar to WVD outcomes, individuals exposed to climate change information exhibit harsher evaluations of those who: violate group norms (e.g., criminals; Fritsche et al., 2012), exhibit stronger group authoritarianism attitudes (Barth et al., 2017), and for highly nationalistic individuals, greater approval of system supporting groups (e.g., judges; Fritsche et al., 2012). Unconsciously activated death-related thoughts could be related to how vehemently an individual defends their position on a number of issues, especially those directly impacting life. For example, extreme attitude polarization is often observed in politically charged topics such as, attitudes towards gun violence, military efforts (Kahan, Jenkins-Smith, & Braman, 2011), abortion, and climate change, which have consistently been found to be related to ideological beliefs, and also represent death-related themes.

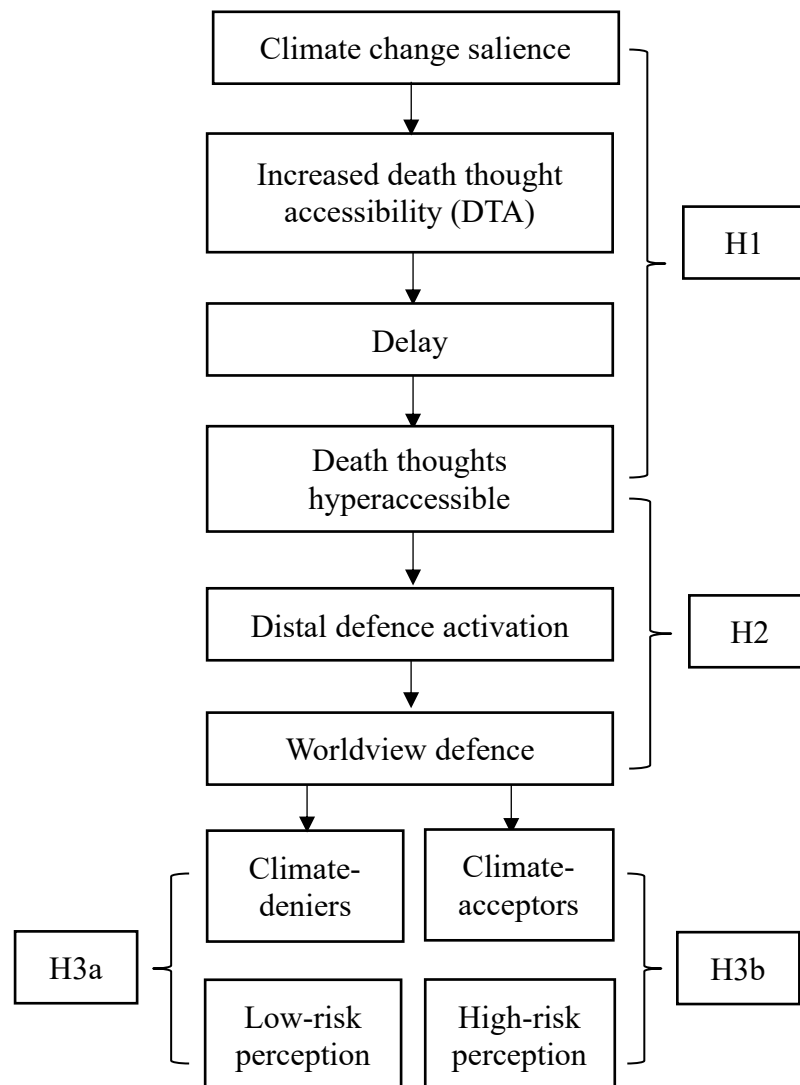
To test the influence of WVD, we used two excerpts, each associated with a divergent worldview (Kahan et al., 2011); framing climate change as either high- or low-risk. We examined: 1) differences between how participants rated the authors of both excerpts on perceptions of trustworthiness and knowledge (measuring WVD), and 2) the extent to which participants agreed with the low- and high-risk passages (measuring climate change risk

perception). Figure 1 displays hypothesised relationships between climate change eliciting DTA and expected WVD outcomes. From this follows a number of hypotheses:

**H2:** Among individuals with high-DTA, exposure to climate change information will elicit greater WVD (i.e., greater differences between climate author ratings).

**H3a:** For climate-deniers, exposure to climate change information will elicit responses consistent with their worldview, such that high-DTA would be related to lower climate change risk perceptions.

**H3b:** For climate-acceptors, exposure to climate change information will elicit responses consistent with their worldview, such that high-DTA would be related to higher climate change risk perceptions.



*Figure 1.* Hypothesised relationships between climate change information eliciting death anxiety and distal defence outcomes.

Although a traditional focus of TMT has been to explore the dark side of terror management responses (e.g., increased reckless behaviour, defensive distortions, aggression towards outgroup members), research has also explored positive and beneficial trajectories that MS can foster (Arndt, Schimel, & Goldenberg, 2003; Routledge, Arndt, & Goldenberg, 2004). Exposure to information about climate change impacts could facilitate pro-environmental responses through raising awareness of the risk. However, little research has

explored conditions under which MS leads to such positive, preventive attitudes and behaviours.

## **Aims**

Exposure to climate-induced risks to our existence can result in attitudes inconsistent with climate science (e.g., denial; low climate change concern; Feinberg & Willer, 2011). Similarly, increased WVD has been associated with exposure to climate change information (Barth et al., 2017). The present study offers novel contributions by being the first to explicitly examine whether exposure to climate change information elicits terror management responses. Specifically, we examined whether climate change threat elicits higher death-related thoughts, or whether higher accessibility could explain divergences in climate change risk perceptions. Further we sought to determine whether higher DTA intervened between these threat-denial responses. A test of these relationships within a TMT framework could yield further insights into the nature of a perceived psychological (i.e., existential) risk. Evidence supporting the hypotheses based on a TMT framework would indicate that some people's motivations to assuage fears of death may constitute a psychological barrier to accepting that climate change poses a high risk to their lives and livelihoods. First, we examined whether exposure to climate change communication invoked unconscious thoughts about death (H1). Second, we examined whether exposure to climate change information (salience condition) would elicit psychological threat-reduction responses among high-DTA participants (H2 & H3).

## **Method**

### ***Participants***

In part fulfilment of a course requirement, first-year psychology students ( $N=241$ , 196 females, age range 17-45 years,  $M=20.34$ ,  $SD=4.53$ ) were randomly assigned to a climate

change salience condition (CCS,  $n=123$ , 100 females,  $M=20.28$  years,  $SD=4.07$ ), and a control condition ( $n=118$ , 96 females,  $M=20.40$ ,  $SD=4.99$ ).

### ***Procedure***

The authors' University Human Research Ethics Committee approved the study. Participants were informed that this was a 'study investigating personal values and attitudes', that participation required completing a number of questionnaires and viewing a short video, to be completed online.

### ***Measures***

The measures are outlined below in presentation order.

*Video presentations.* Participants were randomly assigned to watch a video on global climate change (CCS condition, 4:27 min.), or multi-tasking (comparison no-threat condition, 4:18 min.). Both presentations were uploaded onto YouTube as silent videos requiring participants to read the on-screen information. In the CCS condition participants were presented with information concerning evidence for, and causes and threats of, global climate change, taken from the NASA website *Global climate change: Vital signs of the planet*<sup>1</sup>. The presentation included fire, cyclone, flood, and drought images. Control condition participants viewed information about the ineffectiveness of multi-tasking, this topic being chosen so as not to invoke any threat-related fear responses. To test comprehension and attentiveness, participants were asked five post-video true/false questions about their presentation, the results from which were used as a basis for participants' inclusion in the study.

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<sup>1</sup> <https://climate.nasa.gov/>

*Distractor task.* To circumvent possible active suppression of death-related thoughts, after each presentation participants received a distractor task involving cognitive load. The distractor task required participants to complete ten mathematical problems (e.g.,  $1001 - 973$ ).

*DTA.* We used the most common DTA measure in the TMT literature – the death-word-fragment task (DWFT; Hayes, Schimel, Arndt, & Faucher, 2010). The DWFT involves completing word fragments with the first word that comes to mind, including word fragments that can be completed: 1) only as neutral words, or 2) either as a death-related or a non-death related word. For example, the word fragment DE \_\_ can be completed as either DEAD or DEED. How a word fragment is completed is intended to reflect thoughts on the fringe of consciousness (Greenberg et al., 1994). Participants were presented with 38 word fragments in randomised order and instructed to complete them with the first word that came to mind. These eight word fragments could be completed as either a neutral or a death-related word: *grave, dead, buried, killed, skull, corpse, coffin, murder*. Participants' DTA score was the total number of death-related words completed for the death-related word fragments.

*Climate change question.* Four climate change questions (from: Reser, Bradley, Glendon, Ellul, & Callaghan, 2012) measured attitudes towards climate change. One measured climate change belief: *Do you personally think the world's climate is changing?* required a 'yes' (acceptance) or 'no' (denial) response. Three questions pertained to overall climate change attitudes, reflecting perceived concern, seriousness of climate change as a future problem, and personal preparedness to reduce energy use. These three questions were scored on a 4-point scale from 1 *very concerned/serious/prepared*, to 4 *not at all concerned/serious/prepared*. Lower scores reflected higher perceived concern, seriousness, and preparedness to reduce energy (MS,  $\alpha = .70$ ; control,  $\alpha = .80$ ).



*Author rating task measuring WVD, author preference and risk perception.* To measure WVD participants were instructed to read passages from two books on climate change, adapted from Kahan et al. (2011, p. 155). One passage framed climate change as high-risk, while the other framed it as low-risk. Presentation order and information about the author's university affiliation was counterbalanced. Participants rated each of the passage's authors on whether they believed the author was a trustworthy and knowledgeable expert on climate change using the same 6-point scale (High-risk author ratings: MS,  $\alpha = .87$ ; control,  $\alpha = .92$ ; Low-risk author ratings: MS,  $\alpha = .89$ ; control,  $\alpha = .90$ ). WVD scores reflected rating differences for the author endorsing climate change as low- vs. high-risk.

We also calculated author preference scores to examine the existence of liberal or conservative shifts by taking mean ratings of trust and knowledge for the author endorsing climate change as high-risk from equivalent ratings for the author endorsing climate change as low-risk. Positive scores indicated preference for the author endorsing climate change as high-risk, and negative scores indicated preference for the author endorsing climate change as low-risk.

To assess risk perception, participants were asked about the extent to which they agreed with the two passages from 1 *strongly agree* to 6 *strongly disagree*. Scores were derived by subtracting each participant's high-risk passage agreement score from their low-risk passage agreement score. Higher scores reflected greater agreement with the passage endorsing climate change as high-risk, thereby revealing participants' perception of climate change risk.

## Results

### *Preliminary analyses and descriptive statistics*

Participants who incorrectly answered more than one out of the five post-video true/false comprehension questions were excluded from further analyses. Twenty-four participants were excluded on this criterion: 20 made two errors (10 CCS condition; 10 comparison condition), two made three errors (both in comparison condition), and two made four errors (both in comparison condition). Of the remaining 213 participants, 110 were in the CCS condition (89 female;  $M = 20.37$ ,  $SD = 4.26$ ), and 103 in the comparison condition (86 female;  $M = 20.67$ ,  $SD = 5.27$ ). As seen in Table 1, we computed inter-scale correlations between DTA, Climate change belief, biased author ratings, low-risk and high-risk author ratings and risk preference for MS and control condition participants separately.

Table 1.

*Correlations between DTA, Climate Change Belief, Author ratings and risk preference for Control (n = 103) and CCS (n = 110) conditions (Upper diagonal = Control condition, Lower diagonal (shaded) = CCS condition).*

|                            | 1      | 2    | 3      | 4       | 5      | 6       |
|----------------------------|--------|------|--------|---------|--------|---------|
| 1. DTA                     |        | .03  | .10    | -.07    | .01    | .08     |
| 2. Climate change belief   | -.26** |      | -.21** | .10     | -.02   | -.10    |
| 3. Biased author ratings   | -.20   | .20* |        | -.57*** | .21*   | .72***  |
| 4. Low-risk author rating  | .13    | .23* | .74*** |         | .39*** | -.60*** |
| 5. High-risk author rating | -.12   | -.03 | .39    | .20*    |        | .50***  |
| 6. Risk preference         | -.20*  | .21* | .92*** | -.70*** | .56*** |         |

Note \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

## ***Hypothesis testing***

### *Climate change communication eliciting death-related thoughts*

No differences between conditions were found for number of death-word completions,  $F(1,212) = 0.04, p = .835, \eta^2 < .01$ .

### *TM strategies*

The lack of a direct effect of condition on DTA precluded testing for possible mediation. Consistent with other research, we instead tested whether DTA moderated the association between condition and WVD (Agroskin & Jonas, 2013; Das et al., 2009).

We found a moderate association between WVD and author preference (control,  $r = .61, p < .001$ ; CCS,  $r = .69, p < .001$ ). Although there was a significant Condition  $\times$  WVD interaction,  $b = 0.14, t(205) = -2.05, 95\% \text{ CIs } [-0.56, -0.01], p = .042, \Delta R^2 = .03$ , the positive relationship between WVD and author preference indicated that WVD ratings favoured the high-risk climate change author (vs. low-risk climate change author). Hence, to test the MS hypothesis (H2), we used author preference as the outcome variable instead of WVD.

Exploratory analyses revealed a Condition  $\times$  DTA interaction for predicting author preference,  $b = 0.14, t(209) = -2.20, 95\% \text{ CIs } [-5.90, -0.59], p = .029, \Delta R^2 = .02$ . There was an association between condition and author preference when DTA was low,  $b = 0.27, t(209) = 2.94, 95\% \text{ CIs } [0.27, 1.34], p = .004$ , and moderate,  $b = 0.19, t(209) = 1.96, 95\% \text{ CIs } [-0.01, 0.76], p = .051$ . However, when DTA was high, there was no association between condition and author preference,  $b = 0.28, t(209) = -0.17, 95\% \text{ CIs } [-0.59, 0.49], p = .861$  (Figure 2: DTA represents one *SD* above or below the mean of 2.97). As internal reliabilities for the DTA measure in both conditions were unacceptably low (CCS,  $\alpha = .21$ , control  $\alpha = .50$ ), these findings were only indicative of associations.

We tested whether climate-deniers ( $n = 35$ ) under CCS (versus a control condition) would elicit differential risk perceptions as a function of increased DTA (H3a). In the CCS condition, 17 participants were classified as climate-deniers, and in the control condition 18 participants were classified as climate-deniers. The Condition  $\times$  DTA interaction showed a large effect in explaining risk perceptions amongst climate-deniers,  $b = 0.52$ ,  $t(31) = 2.65$ , 95% CIs [0.32, 2.44],  $p = .013$ ,  $\Delta R^2 = .30$ . When DTA was low, there was a large association between condition and risk perception,  $b = 0.76$ ,  $t(31) = -2.38$ , 95% CIs [-3.37, -0.26],  $p = .024$ . There was no association between condition and risk perception for moderate levels of DTA,  $b = 0.42$ ,  $t(31) = -0.51$ , 95% CIs [-1.09, 0.65],  $p = .615$ . However, there was a large association when DTA was high,  $b = 0.71$ ,  $t(31) = 1.93$ , 95% CIs [0.08, 2.84],  $p = .062$  (Figure 3: DTA represented as one *SD* above or below the mean of 2.66). We tested the same model on climate-acceptors ( $n = 177$ , H3b). The overall model,  $F(3,173) = 0.96$ ,  $p = .412$ ,  $R^2 = .02$ , and Condition  $\times$  DTA interaction did not predict risk perceptions,  $b = 0.21$ ,  $t(172) = -0.96$ , 95% CIs [-0.63, 0.22],  $p = .341$ ,  $\Delta R^2 = .01$ .

### *Exploratory analyses*

Because no differences were found between condition in DTA (H1), we tested whether greater DTA would be observed only amongst climate-deniers under CCS. This is because research has found that threatening a person's worldview can elicit death-related thoughts (Schimel et al., 2007). The overall model using condition as the predictor and climate belief (denial/acceptance) as the moderator, predicted DTA,  $F(3,209) = 5.17$ ,  $p = .002$ ,  $R^2 = .03$ . The Condition  $\times$  Climate Belief interaction predicted DTA,  $b = -0.43$ ,  $t(205) = -2.35$ , 95% CIs [-1.88, -0.17],  $p = .020$ ,  $\Delta R^2 = .02$  (See Figure 4). Amongst climate-acceptors, there was no association between DTA and condition,  $b = 0.20$ ,  $t(205) = 0.93$ , 95% CIs [-0.22, 0.62],  $p =$

.351. However, amongst climate-deniers, there was an association between DTA and condition,  $b = -0.82$ ,  $t(205) = -2.17$ , 95% CIs  $[-1.56, -0.08]$ ,  $p = .031$ .

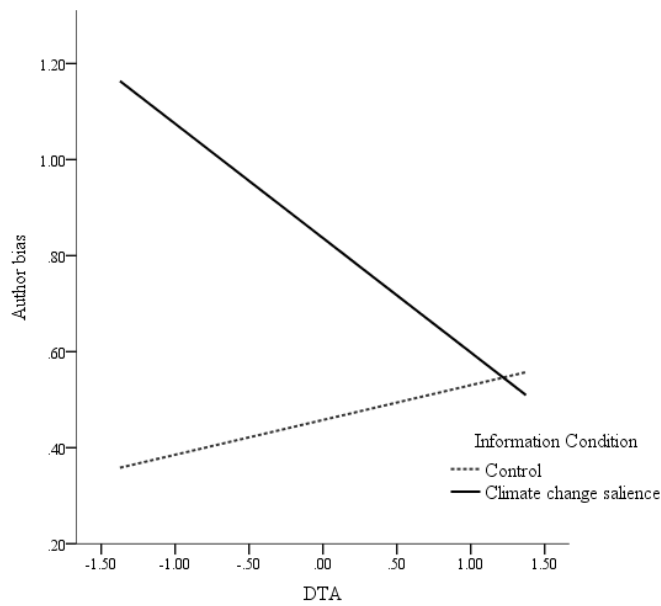


Figure 2. Regression lines for association between DTA and author preference between control and CCS conditions (testing H2).

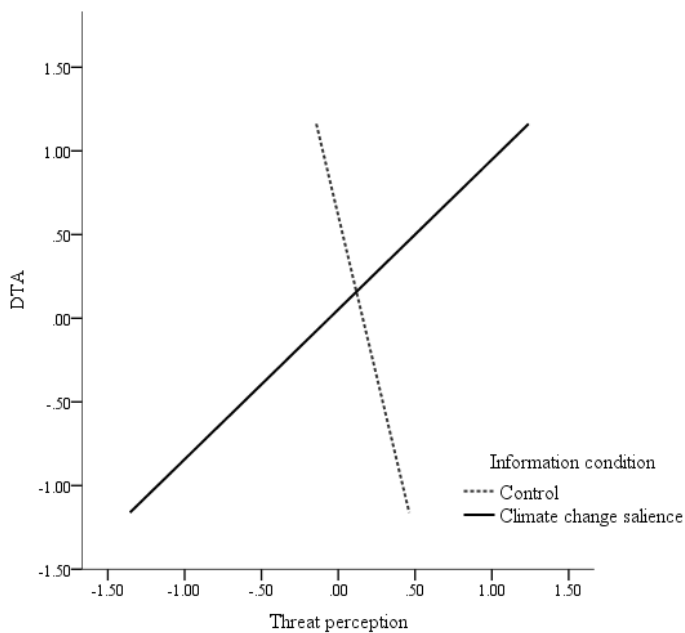


Figure 3. Regression lines for association between DTA and threat perception for climate change deniers ( $n = 35$ ) between control and CCS conditions (testing H3a).

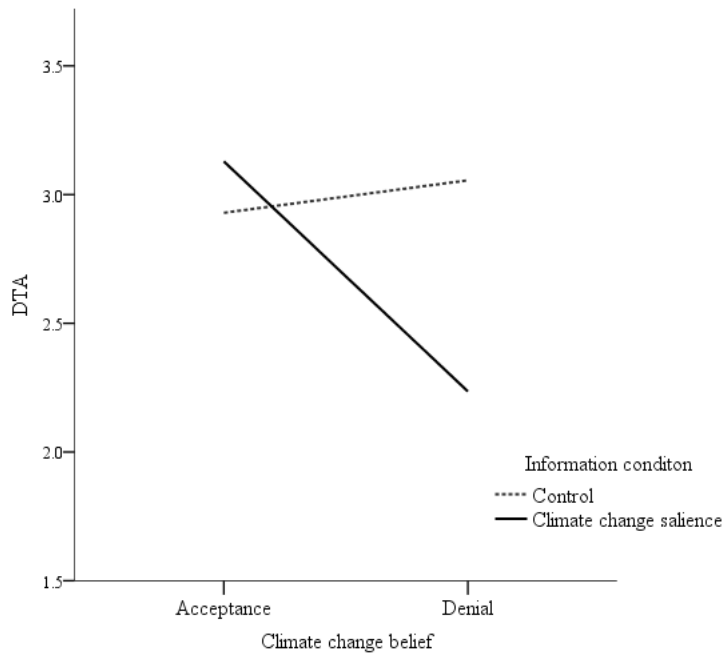


Figure 4. Regression lines for DTA in: 1) control, and 2) CCS condition, for climate-acceptors ( $n = 178$ ), and climate-deniers ( $n = 35$ ).

#### *Methodological issues concerning the DWFT*

We investigated the likelihood of inherent floor and ceiling effects within the DWFT, which could attenuate the measure's sensitivity in revealing between-condition differences, and also account for the low internal reliabilities. An example of each type of effect is considered. It was observed that the death-word fragment COFF\_ \_ , was more likely to be completed as 'coffee' than the death-related word, 'coffin' (control condition, 7.90%; CCS, 10.30%), representing a floor effect. All other word-fragment completions were coffee. The death-word fragment KI\_ \_ ED on the other hand was reasoned as more likely to be completed as 'killed' (control condition, 84.10%; CCS, 73.50%), than as 'kissed', representing a possible ceiling effect.

To test whether word dimensions (obtained from the SUBTLEX<sub>UK</sub> database) might confound word completions, we calculated the proportion of word completions for the

fragments that could be completed in a death-related way. In both conditions, death-word completions ( $n=8$ ) showed a large positive relationship with arousal (CCS,  $r = .80, p = .017$ ; control condition,  $r = .81, p = .015$ ), and concreteness ratings (CCS,  $r = .81, p = .014$ ; control condition,  $r = .86, p = .006$ ). Word usage frequency (Zipf-value) showed a moderate strength, positive association with the probability of words completed as death-related words (CCS,  $r = .57, p = .144$ ; comparison condition,  $r = .56, p = .151$ ).

## Discussion

In examining whether divergences in climate change risk perceptions could be explained using a TMT framework, this study had two main aims. First, we tested whether exposure to climate change information resulted in higher activation of DTA and second, whether individual differences in DTA could explain divergent WVD and risk perception outcomes. The study yielded the first empirical evidence that DTA could be a psychological driver towards greater climate change risk evaluations. Some results deviated from initial predictions based on a traditional TMT methodology, as will be discussed.

### *Climate Change Communication Eliciting Death-related Thoughts*

Exposure to climate change risk information did not invoke higher death-related thoughts when compared with the control condition across all participants, probably due to the lack of sensitivity in the DWFT. Because we found evidence that the DWFT was contaminated by explicit retrieval strategies (addressed further below), this places suspicion on the extent to which this task captures an automatic *implicit* process. Unlike previous research, which used a paper and pencil version of the DWFT (Greenberg et al., 1994), the current study used a computerised version, which may have reduced response automaticity. Compared with reading from a computer screen, paper-based tasks have higher speed, accuracy, and comprehension rates (Noyes, Garland, & Robbins, 2004; Mayes et al., 2001). Therefore,



presenting word fragments as a computerised task may have led to greater encoding and cognitive appraisal of the word completions, reflecting a less ‘automatic’ response when completing word fragments compared with a paper-based equivalent. Low-DTA, conceptualised by small numbers of death-word completions on the DWFT, could have instead reflected a defensive death-denial/avoidance response. When death-thought activation is high, participants may have preferred to complete the death-word fragments in a non-death related manner. Thus high-DTA may have reflected low death-avoidance responses, whilst low-DTA reflected high death-avoidance responses. This is unsurprising given the link between avoidance and distancing responses to death-related stimuli when under existential threat (Martens et al., 2004).

Because threats to an individual’s personal worldview elicits DTA, we explored whether exposure to climate change information elicited high-DTA only amongst climate-deniers. Derived from TMT, the DTA-hypothesis posits that if psychological structures attenuate concerns about death, then weakening these structures (e.g., exposure to evidence counter to one’s worldview) should increase accessibility of death-related thoughts. As a consequence of exposure to prior climate change information, climate-deniers exhibited low-DTA, whilst climate-acceptors exhibited high-DTA. It could be that compared with climate-deniers, acceptors were more receptive to the climate change video, thereby making the climate change risk information more likely to invoke death-related thoughts among the latter group. Alternatively, this finding (i.e., that under CCS, acceptors were more likely to have higher DTA) aligns with the conceptualisation of high-DTA reflecting a low defensive response. According to a TMT framework, for participants whose worldviews psychologically predisposed them to evaluate environmental harm and climate change as a serious threat (i.e., climate-acceptors), exposure to climate change information would have affirmed their worldview, thereby validating and increasing the protection that their personal worldview

offered over concerns about death (Greenberg et al., 2001; Schimel et al., 2007). Research has demonstrated that whilst threatening worldviews are linked to higher accessibility of death-related thoughts, being given an opportunity to defend one's worldview can lead to dissipation of death-related thoughts (Greenberg et al., 2001; Schimel et al., 2007).

### *TM strategies*

Under CCS, high-DTA (or low death-defensive) climate-deniers perceived climate change as high-risk, and conversely low-DTA (or high death-defensive) climate-deniers perceived climate change as lower-risk. Consistent with the conceptualisation of high-DTA representing low-defensiveness, high-DTA-climate-deniers (vs. low-DTA climate-deniers) may not have been motivated to attenuate concerns about death, thereby negating efforts to align their own attitudes with their worldview (i.e., climate change perceived as a low-risk). High-DTA climate-deniers may have engaged in an unbiased mode of processing the climate threat information. Consistent with De Boer, Botzen, and Terpstra (2016), it is possible to increase participants' climate risk perception despite some climate change denial.

The study found no evidence to support the WVD hypothesis. Instead, participants exposed to climate change information demonstrated a liberal attitude shift. Research has not always found that MS changes people's reported political views to be more consistent with the WVD hypothesis (Burke, Kosloff, & Landau, 2013). The motivated social cognitive framework posits that people adopt ideological beliefs systems that satisfy their psychological needs and motives in the current context (Jost, Glaser, Kruglanski, & Sulloway, 2003). Under psychological threat, adopting a liberal (vs. conservative) ideology may have satisfied psychological needs and motives to attenuate terror management concerns, achieving cognitive consistency and closure between the climate change information presented and subsequent threat appraisals (Jost et al., 2003, 2007).

For climate-deniers, one way to diffuse worldview threats may be to accommodate appeals from an alternative worldview into one's own (Luckman, 1967; Solomon, Greenberg, & Pyszczynski, 1991). Under psychological threat, people have been shown to shift their views towards majority opinions, even on societal issues (Renkema, Stapel, & Van Yperén, 2008, Study 2). Conforming to what is perceived as a majority view, may help to provide meaning and coherence to conflicting information. Participants in the present study were Australian psychology students, whose worldviews are more likely to be predominantly liberal; hence approving of climate change warnings. Responses that align with dominant values may also be a way to bolster self-esteem, a terror management reduction strategy, as it increases the likelihood of being liked by others (Cialdini & Goldstein, 2004). Under CCS, greater difference between author preferences that favoured the author endorsing climate change as high-risk, were related to low-DTA, compared with the control condition. Amongst high-DTA individuals, condition revealed no differences on author preference. If low-DTA reflects a high death-defensive response, then the results could be interpreted as greater unconscious thoughts about death motivating distal defence strategies consistent with liberal attitudes.

Contrary to traditional TMT research, this study's findings aligned with research demonstrating the positive trajectory that exposure to threat-related information can have in motivating health protective and sustainable attitudes (Arndt et al., 2003). The findings are therefore encouraging for environmental advocates, wherein results showed that exposure to climate change information motivated a liberal-shift in attitudinal responses that reflected higher perceived climate change risk, even amongst some climate-deniers.

### ***Limitations and future research***

A methodological limitation of this study (and others using this methodology) was the low sensitivity of the DWFT in measuring DTA. This is concerning, especially considering its wide usage within TMT research (Hayes et al., 2010). However, we noted that administration differences (i.e., computer vs. paper presentation) could have influenced respective results. The likelihood of a death-word fragment being completed as a death word was probably, at least partly, influenced by explicit retrieval strategies, specifically the word's level of concreteness, arousal, and word frequency. Floor and ceiling effects may have diminished the measure's sensitivity to discern differences between conditions, when differences may have existed (i.e., a Type II error). This reveals a methodological flaw within a widely-used measure in the TMT literature in need of further exploration.

The act of measuring DTA has been shown to interfere with, and prevent the observation of, terror management outcomes (Hayes & Schimel, 2018; Spencer, Zanna, & Fong, 2005). Completing a word fragment as a death-related word in itself may elicit thoughts about death, thereby, at least partly, explaining a lack of discrimination between information conditions. Future research should investigate the reliability, validity, and effectiveness of the DWFT as a DTA measure. For instance, the DWFT could be compared with other implicit measures that can capture death-related thoughts, such as the lexical decision task (LDT), which has yielded successful results in TMT research (Schimel et al., 2007). The LDT may be a better alternative as the words used can be matched on word dimensions, thereby controlling for their impact on implicit responding.

Further research should test whether climate change information elicits DTA. This study failed to find evidence for this effect, which might be because climate change information does not of itself invoke implicit thoughts of death, or because its operationalisation here was

insufficiently emotive to invoke a detectable fear-related response. We deliberately did not use words directly relevant to death in the climate change information video. However, contemporary conversations about climate change may be more emotive (Nerlich & Jaspa, 2013; O'Neill & Nicholson-Cole, 2009), and emphasize the impacts, for example, on future generations (an important immortality symbol; Fritzsche & Häfner, 2012), which may further dilute terror management processes. The different ways in which climate change information can be framed (e.g., outcome and distance frames) could impact the level of existential threat posed, and psychological distancing strategies employed (Spence, Poortinga, & Pidgeon, 2012). As the impacts of climate change become increasingly visible, destructive, and pervasive, climate change reporting is likely to contain more death-related content, possibly further triggering existential anxieties in exposed populations.

Unequal climate-acceptors and deniers in the population meant that the sample in this study included only a small number of climate-deniers. The small sample reduces the confidence in study findings applicable to climate-deniers. Future studies could recruit larger numbers of climate-deniers and investigate whether DTA levels predict positive or maladaptive terror management responses.

After exposure to climate change risk information, differences in DTA were related to differences in reported perceptions of climate change risk. This finding warrants further investigation into how to promote the influence of productive threat-removing strategies that result from climate change communications. In this regard, a TMT framework can be useful in understanding how to resolve threat-denial or avoidance strategies. Amongst other things, people adopt worldviews to reduce uncertainty in their perceived world, and to provide answers to complex issues that may be determined from within their worldview. This means that many people's attitudes towards climate change may be driven at least as much, if not

more, by personal ideology, in the form of worldviews than by scientific evidence. As such, effective climate communication is often complicated by an individual's worldview (Feinberg & Willer, 2011), predisposing them to perceive climate change as either high- or low-risk (Kahan et al., 2012). An important task for policy makers and scientists with a responsibility for influencing public attitudes and behaviours on climate change, is to adopt change frameworks that do not directly challenge entrenched worldviews, which could serve as a refuge in the face of any perceived threat. Instead, activating important cultural identities can increase the removal of threat-denying responses (Fritzsche et al., 2010; Vess & Arndt, 2008). Feygina, Jost, and Goldsmith (2010) found that framing pro-environmental change as being patriotic dissolved associations between system justification and decreased willingness to take action against environmental problems. Thus, by crafting climate change communications in a way that upholds rather than challenges important worldviews, it may be possible to transform resistance towards accepting the seriousness of climate change, towards more pro-environmental attitudes and behavioural engagement. Pyszczynski et al. (2012) found that imagining consequences of global climate change, as opposed to a local catastrophe, removed higher support for violence that has been found in response to existential threats (Vail et al., 2012), instead increasing support for international peaceful reconciliation. Hence, emphasising the shared threat faced by humanity may help to promote intentions to work together as a community.

## ***Conclusion***

This study is the first to provide empirical evidence that individual differences in thoughts about death may be a psychological facilitator in increasing climate change risk perceptions. A TMT framework provided a new avenue for understanding and researching mechanisms behind climate change risk perceptions. For participants with low activation of implicit death-

related thoughts (or high-defensiveness), exposure to climate change information showed the highest perceptions of risk, even amongst climate-deniers. Understanding the antecedents of climate change attitudes and death anxiety as a psychological facilitator/barrier to attitude change may provide insights into more effective ways to communicate climate change information so as to increase acceptance, and act as a prelude to initiate mitigation and adaptation behaviours. Individuals may be even more receptive to climate change appeals if they are constructed in ways that uphold structures that have been shown to attenuate concerns about death (Pyszczynski et al., 2012).

#### **Chapter 4c: Additional hypotheses, measures and analyses not in the submitted paper**

The Pilot Study included two measures not discussed in the submitted paper to the *Journal of Risk Research* “Climate Change Risk and Terror Management Theory” (Chapter 4b).

These measures were group–grid cultural worldviews, and an explicit measure of death anxiety. The rationale, method, and results for the hypotheses tested are outlined. The first aim was to test for an association between trait death anxiety and cultural worldviews. Also examined was whether this association changed when participants were exposed to information about climate change. For example, for participants with worldviews that would be expected to predispose them to perceive climate change as low-risk, exposure to information about climate change impacts may elevate concerns about death as a result of threatening their worldview. Alternatively, exposure to climate change information for participants with high climate change risk perceptions, may serve to uphold their values and beliefs, thereby acting as a buffer to concerns about death. The second aim was to investigate whether explicit death anxiety moderated any association between condition and risk perceptions, and whether this was similar to, or different from, the association between DTA and risk perceptions (see Pilot Study results in Chapter 4b).

#### **Cultural cognition theory**

To measure and define cultural worldviews, Kahan, Braman, Monahan, Callahan, and Peters’ (2010) cultural cognition theory (CCT) was used. CCT is based on, and designed to empirically test, Douglas’s (1970) cultural theory of risk. Cultural worldviews are measured using two continuous attitudinal scales: group (communitarian–individualistic), and grid (hierarchical–egalitarian) dimensions. Individuals’ cultural worldviews can be categorized as either high or low on group and grid dimensions. Position on the group–grid matrix is determined by the extent to which a person is absorbed by, and participates in, a group (group



worldview), and the degree of regulation and restriction they maintain in their social roles (grid worldview; Douglas, 1970, 1997).

The group worldview pits economic interests (individualistic) against social interests (communitarian). An individualist worldview incorporates the belief that one should “fend for themselves”, and that collective assistance is a sign of weakness (Douglas, 1970, 1982). Individualists are predisposed to dismiss claims about climate change as they perceive mitigation and adaptation actions as restricting commerce, industry, and individual autonomy (Douglas, 1970; Douglas & Wildavsky 1982; Oltedal et al., 2004). Furthermore, they are predisposed to dismiss environmental threats because they see nature as self-preserving and robust to environmental damage (Douglas, 1970, 1982). People with an individualistic worldview would be motivated to perceive climate change as low threat, and not requiring responses that could undermine actions maximising personal gain.

The grid worldview on the other hand, pits ranking-based constraints (hierarchical) against social equality (egalitarian) interests. A hierarchical worldview honours the maintenance of rank-based constraints, whereas an egalitarian worldview denies preventing participation in social roles because of certain characteristics, such as age, gender, or ethnicity. The grid categorization may be important for investigating climate change mitigation and adaptation behaviours that are community or collective action driven, as opposed to government driven (Oltedal et al., 2004). Climate change’s more detrimental impacts are likely to be felt to a greater extent in developing nations due to their lack of infrastructure, for example, in dealing with extreme weather events, and their vulnerable geography, such as low-lying Indian and Pacific Ocean islands (IPCC, 2014). Thus, individuals with a more egalitarian worldview could be expected to be more likely to exhibit pro-climate change mitigation attitudes as they perceive the unequal distribution of impacts to be unfair – especially when first world

countries produce the majority of GHG emissions. Leiserowitz (2005) demonstrated that climate change policies were strongly associated with egalitarian values, while disagreement was associated with hierarchical values. Individual's position on group and grid worldview has been linked to a number of polarised political attitudes, including climate change (Kahan, Jenkins-Smith, & Braman, 2011).

Using TMT's insights on cultural worldviews as an anxiety buffer, these hypotheses were forwarded. After being exposed to information about climate change, participants whose cultural worldview reflects a more hierarchical (vs. egalitarian) and individualistic (vs. communitarian) orientation will show higher DTA, when compared with those in a control condition (**H<sub>A</sub>**). This is because exposure to information that threatens worldview beliefs, increases DTA (Hayes, Schimel, & Williams, 2008; Schimel et al., 2007), as would be the case for participants with a more hierarchical and/or individualistic worldview after climate change threat information.

The study also examined perceptions of climate change threat as a result of motivations to defend one's worldview:

**H<sub>B1</sub>**: Exposure to climate change information for participants high in either hierarchical and/or individualistic worldviews will elicit responses consistent with their worldview, such as lower climate change threat perceptions, resulting from increased DTA.

**H<sub>B2</sub>**: Exposure to climate change information for participants high in either egalitarian and/or communitarian worldviews will elicit responses consistent with their worldview, such as higher climate change threat perceptions, resulting from increased DTA.

## Explicit death anxiety

Dispositional (trait) death anxiety may also influence whether participants prefer to perceive climate change as a low threat to human life. Moreover, examining whether climate change information invokes DTA (implicit state measure), as well as trait death anxiety, could reveal whether trait or state death anxiety is more important when considering climate change attitudes and risk perceptions.

The TMT tenet that strength of adherence to cultural worldviews (e.g., reflected in extreme positions) is related to fears about death was tested. For control participants, strength of adherence to their cultural worldview (e.g., reflected in extreme positions) will be positively associated with DTA and trait death anxiety (**H<sub>C1</sub>**). Thus, an inverted U-curve is predicted between death anxiety and grid–group worldview adherence. In the climate change salience condition, participants with more hierarchical (as opposed to egalitarian), and individualistic (as opposed to communitarian) worldviews will exhibit high DTA and high trait death anxiety. This is because information about climate change serves to threaten those with more hierarchical and individualistic worldviews, thereby reducing the extent to which their worldview offers them an anxiety buffer (**H<sub>C2</sub>**).

It was also examined whether high trait death anxiety was related to climate change denial and lower perceptions of climate change risk, and whether this was moderated by condition (**H<sub>D</sub>**). As higher levels of trait death anxiety has been linked positively to political conservatism, and a preference for order and control (Jost et al., 2003), it is likely that individuals with high trait death anxiety will also show a preference for climate change as low-risk.

## Measures

The cultural cognition worldview scale (CCWS) was administered after collecting demographic data and prior to the video conditions (Pilot Study). To measure explicit concerns about death, the Death Anxiety Inventory (DAI) was administered last to ensure that completing questions about death would not contaminate other measures, such as measures of DTA and worldview defence in the Pilot Study.

*CCWS.* The CCWS (Kahan et al., 2012) measures relative position along two continuous scales: individualism–communitarianism (group worldview, 17 items – e.g., *The government interferes far too much in our everyday lives*, Cronbach's  $\alpha$  .63 control; .71 CCS), and hierarchism–egalitarianism (grid worldview, 13 items – e.g., *We have gone too far in pushing equal rights in this country*,  $\alpha$  .58 control; .59 CCS). Degree of agreement is indicated on a 6-point scale. Both dimensions form separate and reliable scales (Kahan et al., 2011). Higher scores reflect respectively more individualistic and hierarchical worldviews.

*DAI.* Trait death anxiety was measured using the 20-item DAI (Tomás-Sábado & Gómez-Benito, 2005). This scale was positioned last, so as not to invoke prior mortality concern. Participants indicated their degree of agreement on a 5-point scale from 1 *strongly disagree*, to 5 *strongly agree*. The DAI gives an overall score (Cronbach's  $\alpha$  .85 control; .86 CCS), as well as scores on five scales: 1) externally generated death anxiety (5 items, e.g., *The sight of a corpse deeply shocks me*;  $\alpha$  .67 control; .66 CCS), 2) meaning and acceptance of death (5 items, e.g., *I think I am more afraid of death than most people*;  $\alpha$  .81 control; .81 CCS), 3) thoughts about death (4 items, e.g., *I frequently think about my own death*;  $\alpha$  .74 control; .80 CCS), 4) life after death (3 items, e.g., *I am worried about what is after death*;  $\alpha$  .79 control; .85 CCS), and 5) brevity of life (3 items e.g., *The certainty of death makes life meaningless*;  $\alpha$  .41 control; .59 CCS). Higher scores represented higher trait death anxiety.

## Results

*Worldviews and death anxiety.* Partially supporting  $H_A$ , DTA amongst control participants was associated linearly with grid,  $F(1,98) = 4.50, p = .026, R^2 = .044$ , but not group worldviews. High DTA was associated with a more egalitarian worldview; low DTA was associated with a more hierarchical worldview. The quadratic term between DTA and grid worldviews was not significant ( $p = .113$ ). Regression analyses tested whether stronger adherence to cultural worldviews (criterion variable) was related to higher trait death anxiety (predictor variable) in the control condition (**H<sub>C1</sub>**). The quadratic term,  $F(2,97) = 5.06, p = .008, R^2 = .095$ , explained significant incremental variance over that explained by a linear association,  $F(1,98) = 4.80, p = .031, R^2 = .047$ , for the association between the grid worldview and death anxiety. As shown in Figure 4.1.a, extreme positions on the grid worldview (higher egalitarian and hierarchical positions), was associated with high trait death anxiety. However, no association was found between group worldview and trait death anxiety.

For participants in the climate change salience condition, DTA was not associated with either grid or group worldviews (**H<sub>C2</sub>**). As expected, a significant linear association between grid worldview and trait death anxiety was found,  $F(1,101) = 6.04, p = .016, R^2 = .056$ , (**H<sub>2b</sub>**; see Figure 4.1.b). A quadratic association between grid worldview and trait death anxiety was not observed,  $F(2,100) = 3.01, p = .054, R^2 = .057$ . No association was found between group worldview and trait death anxiety.

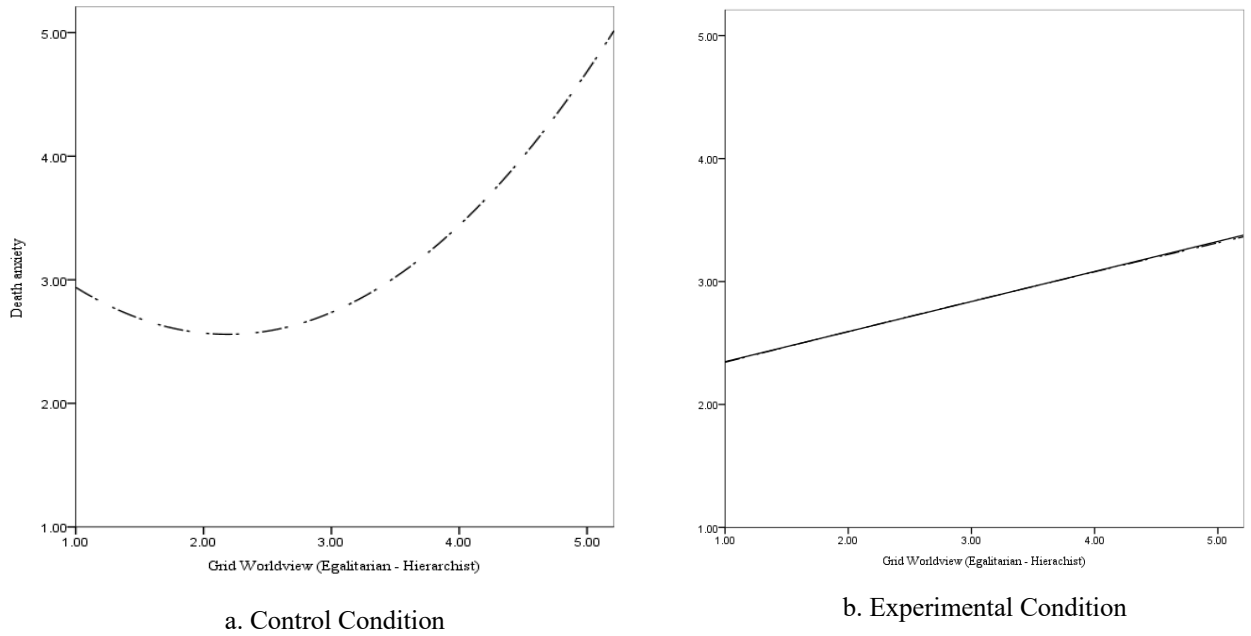


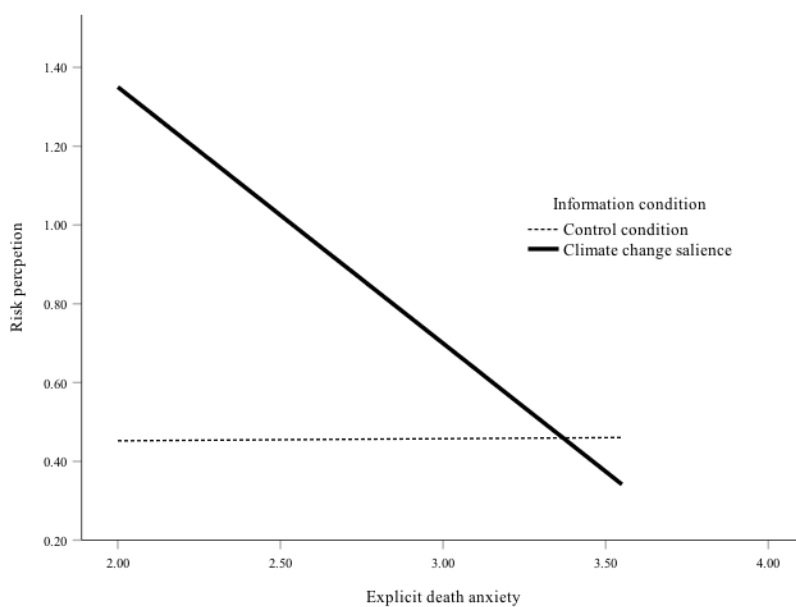
Figure 4.1. Association between grid worldview and death anxiety in: a) control, and b) experimental conditions.

A hierarchical multiple regression analysis tested whether trait death anxiety was associated with perceptions of climate change risk (**H<sub>B1-B2</sub>**). Condition and explicit DA was entered at Step 1, with the condition  $\times$  explicit DA interaction, entered at Step 2. In Model 1, condition and explicit death anxiety predicted risk perception,  $F(2,207) = 5.23, p = .006, R^2 = .049$  (adjusted  $R^2 = .039$ ; see Table 2). Including the interaction term in Model 2,  $F(3,207) = 5.81, p = .001, R^2 = .079$  (adjusted  $R^2 = .065$ ), explained an additional 6.5% of variance for risk perceptions. Amongst control participants, there was no association between risk perceptions and explicit death anxiety,  $b = 0.18, t = 0.03, 95\% \text{ CIs } [-0.353, 0.364], p = .976$  (**H<sub>B1</sub>**). However, for climate salience condition participants, there was an association between risk perceptions and explicit death anxiety,  $b = 0.18, t = -3.67, 95\% \text{ CIs } [-1.001, -.301], p < .001$  (**H<sub>B2</sub>**). As seen in Figure 4.2, the highest risk perceptions were observed for participants who reported low explicit death anxiety after exposure to climate change information (vs. control condition). Exploratory analyses found that that trait death anxiety was not associated with climate change denial in either condition.

Table 2.

*Summary of Hierarchical Regression Analysis for Predicting Risk Perception*

| Predictor              | $\beta$ | $B$   | $t$    | $p$  | $sr^2$ | 95% CIs        |
|------------------------|---------|-------|--------|------|--------|----------------|
| Step 1                 |         |       |        |      |        |                |
| Condition              | .137    | .386  | 2.012  | .045 | .019   | 0.008, 0.764   |
| Explicit death anxiety | -.175   | -.330 | -2.568 | .011 | .031   | -0.584, -0.077 |
| Step 2                 |         |       |        |      |        |                |
| Condition              | .785    | 2.210 | 3.024  | .003 | .041   | 0.769, 3.652   |
| Explicit death anxiety | .003    | .005  | 0.030  | .976 | .000   | -0.353, 0.364  |
| Interaction            | -.697   | .254  | -2.584 | .011 | .030   | -1.157, -0.155 |



*Figure 4.2.* Regression lines for association between explicit death anxiety and risk perceptions between control and CCS conditions.

## Discussion

A critical finding was that appraisal of climate change risk may depend on trait death anxiety. For participants with high explicit death anxiety there was no condition difference in risk perceptions. However, when explicit death anxiety was low, participants exposed to climate change information reported higher climate change risk perceptions, compared with control participants. Thus, participants with low-trait death anxiety may be less likely to activate cognitive distancing strategies observed after mortality-related information. It was expected that high explicit death anxiety would reveal lower risk perceptions after exposure to climate change information because research has shown high trait death anxiety to be associated with avoidance of death reminders. Instead, this study findings suggested that differences in risk perceptions occurred amongst those who reported low explicit concerns about death. Individuals with low concerns about death may be less likely to process information in a biased way.

When examining the moderating role of high DTA, risk perceptions were highest amongst participants exposed to the climate change information with high DTA. It was posited that due to interference effects, high DTA may be more accurately conceptualised as low death defensiveness and low DTA as high death defensiveness (see Discussion section in Chapter 4b). Thus, consistent with the finding that low explicit DA is linked with higher risk perceptions, high DTA was more likely to reflect low death defensiveness and therefore also be associated with higher risk perceptions.

Another focus was to investigate the role that cultural worldviews played as a death anxiety buffer to predict climate change risk perceptions. Study results were consistent with TMT's tenet that high death anxiety individuals would seek protection via mechanisms that defend against such death anxiety (i.e., their worldview; Greenberg et al., 1995). Control



condition participants who identified strongly with their grid worldview (i.e., a stronger hierarchical and/or egalitarian position) reported high death anxiety. Thus, worldview adherence in either direction was related to greater DA. That a linear association also existed in the control condition supported research showing an association between conservative worldviews and fears of death (Jost, Glaser, Kruglanski, & Sulloway, 2003). On average, when reminded about death, individuals show a preference towards conservative (e.g., hierarchical) worldviews (Jost et al., 2003). For example, Nail and McGregor (2009) found that self-identified liberals and conservatives demonstrated more conservative attitudes one to two months following the September 11 terrorist attacks, compared to a year before the attacks. The greatest conservative shifts involved support for George W. Bush and increased military spending.

Research has shown that holding conservative values is associated with high fears about death, intolerance of ambiguity, resistance to change and need for order, structure, and closure (Jost et al., 2003). Thus, holding more conservative values may offer more protection than espousing liberal values. However, TMT suggests no association between MS and conservative ideologies, rather positing that death motivates people to hold strongly to their beliefs – whatever they may be (Greenberg et al., 1992). Our findings suggest that grid worldviews, in either direction, operate so as to attenuate fears about death (Castana et al., 2010), but also that a hierarchical and more conservative worldview may be more effective than an egalitarian and more liberal worldview in attenuating fears about death.

When examining the association between worldviews and trait death anxiety for participants exposed to the climate change salience condition, a different pattern emerged. Only a linear association was revealed, whereby a more hierarchical grid worldview was associated with high trait death anxiety, as expected. Egalitarians were more likely, whilst

hierarchists were less likely, to endorse the position advocated by the information promoting the view that climate change was a serious risk, warranting urgent action (Douglas & Wildavsky, 1982; Leiserowitz, 2005; Lima & Castro, 2005). Low trait death anxiety for individuals with a more egalitarian worldview may result from the climate change video upholding their worldview beliefs, thereby increasing the effectiveness of their cultural-anxiety buffer (Schimel et al., 2007). For participants with a hierarchical worldview, however, these views could threaten their worldview beliefs, thereby reducing the effectiveness of their cultural-anxiety buffer (Schimel et al., 2007).

There was an association between DTA and grid worldview adherence only for control participants. Specifically, high DTA was associated with a more egalitarian worldview, whilst low DTA was associated with a more hierarchical worldview. As research shows that concerns about death is linked with more conservative values (Jost et al., 2003), the conceptualisation of high DTA as low death defensiveness, aligns with past research. No association was found between trait death anxiety and group worldview adherence in either condition. This finding would imply that the values communicated in the grid worldview were more important than were those in the group worldview in buffering concerns about death. The finding was unexpected, as it might be assumed that a way of life that emphasizes maximizing personal gains through commerce and industry pursuits would incline motives to perceive climate change as a low threat, more so than a worldview that attached importance to constraints on social ranking and equality. Explaining this finding is a poll study (Pew, 2014), which found that values most important to the millennial generation (18 to 33 years of age), to which a majority (92%) of this study's participants belonged, were equality, opportunity, personal responsibility, accountability, and fairness. These values are consistent with those drawn upon in an egalitarian (grid) worldview. Of least importance were competition, patriotism, and innovation, which are values more consistent with an

individualistic (group) worldview. This may also explain why the grid worldview had a stronger association with participants' overall climate change attitudes than did the group worldview.

Overall, including cultural worldviews and trait death anxiety allowed further testing of hypotheses derived from TMT to examine whether they were supported when using climate change threat information as an MS induction. Two main findings emerged from the additional hypotheses. First, support was found for cultural worldviews (in either direction) being associated with high trait death anxiety, providing further support that cultural worldviews are a buffer for death anxiety. However, the association between these two constructs changed after exposing participants to climate change information. Second, high risk perceptions were observed for participants reporting low trait death anxiety, after exposure to climate change information. Thus, lower proximal concerns about death may allow for non-directional information processing of societal risk information.

## Chapter 5a: Study 1

Study 1 follows from methodological questions arising from the pilot work. Pilot Study results suggested that inherent DWFT issues compromised the task's ability to reveal differences between low or high death-word accessibility. Study 1 is a methodological investigation into the DWFT's capability to capture unconscious concerns about death after an MS induction, over other word dimensions that are likely to impact recall.

The Pilot Study found no evidence that climate change information elicited concerns about death. However, because a traditional MS condition was not used alongside the climate change and control conditions, the Pilot Study could not determine whether the null findings resulted from the climate change salience condition not eliciting concerns about death, or were due to floor and ceiling effects inherent within the DWFT methodology. As a result, a death prime was employed to test whether the DWFT could successfully distinguish between MS and a comparison condition, beyond word dimensions that impact recall (e.g., word frequency, valence, arousal). Such priming has been used successfully to invoke conscious thoughts of death to induce MS (Arndt et al., 1999; Greenberg et al., 1997, 1999; Van den Bos & Miedema, 2000). The death prime involves asking participants to write about the emotions they feel when they think about their own death, and what they think will happen to their physical body when they die. The common accompanying comparison condition asks participants to “describe the emotions that the thought of dental pain arouses” (Burke et al., 2010).

This study also examined whether other implicit measures, not commonly used in TMT research, might more effectively capture concerns about death, when compared with the DWFT. These were: 1) a lexical decision task (LDT), measuring construct accessibility, 2) a dot probe task, measuring attentional bias (AB), and 3) an ambiguous pictures task, which

measured interpretation bias. Construct accessibility refers to how accessible and readily activated a concept is. Both the death-word-fragment and lexical decision tasks in this study measure construct accessibility of death-related words, or DTA. For the LDT, DTA is measured by calculating participants' reaction times (RTs) for each correctly identified word from each category of words (e.g., death, threat, positive, neutral). When quicker and more accurate judgements are made towards a specific category of words (e.g., threat-related vs. neutral), then it can be inferred that the category construct has been activated and is highly accessible for that individual (Bargh & Chartrand, 2000).

The dot probe paradigm reveals how task performance (i.e., detection of the probe) is facilitated or inhibited due to the presentation of a stimulus being related to the concerns of the individual. The three subcomponents comprising AB are: 1) facilitated attention towards threat (reflecting faster detection of threat-related, compared with neutral stimuli), 2) difficulty disengaging from threat (reflecting slow responses due to slow disengagement from a threat stimulus relative to a neutral stimulus) and, 3) attentional avoidance of threat (where attention is allocated towards the location opposite to the threat stimulus location; Cisler & Koster, 2010; Ruiter & Brosschot, 1994; Salemink et al., 2007). Interpretations of ambiguous pictures are measured to shed light on the emotional state and thoughts of an individual when exposed to death-related stimuli (Mihura et al., 2013; Weiner, 2006). The way the ambiguous pictures are perceived and interpreted are expected to reveal an individual's unconscious concerns about death. Participants completed all measures in person in a computer laboratory. All four measures (DWFT, LDT, dot probe task, ambiguous pictures task), were used to test the TMT mediation model and compared to determine which were: 1) most sensitive in revealing differences between MS induction and control conditions, and 2) best able to predict TM outcomes (e.g., worldview defence).

This chapter includes a co-authored paper, bibliographic details which, including all authors are: Naidu, P. A., Hine, T. J., & Glendon, A. I. (2020) Methodological weakness of the death-word-fragment task: Methodological weakness of the death-word-fragment task: Alternative implicit death anxiety measures, *Death Studies*, doi:10.1080/07481187.2020.1846228. The paper is included in its published form after revisions suggested by anonymous reviewers. The published paper included hypotheses related to testing whether the implicit measures could differentiate between MS and control conditions (RQs 1-3, H<sub>1</sub>-H<sub>4</sub>). Table 5.1 indicates the relevant contributions of the research team to the paper. Hypotheses related to testing the TM outcomes (RQ4, H<sub>A</sub>) were excluded from the paper submitted for publication. The rationale, method, results, and discussion investigating RQ4 are presented directly following the submitted paper. The overarching research questions and hypotheses of Study 1 are presented in further detail below.

*Q1: Can the DWFT successfully differentiate between MS and control conditions?*

H<sub>1a</sub>: MS participants will make more death-related word completions than will control participants.

*Q2: Do word dimensions impact word completion rates in the DWFT, beyond assignment to MS and control conditions?*

These word dimensions were examined: 1) everyday usage (word frequency), 2) perceived pleasantness (valence), 3) arousal level of the provoked emotion, and 4) extent to which the word denotes power or control (dominance). These word dimensions have been shown to impact word recall and therefore could skew word completions (Balota & Chumbley, 1984; Brysbaert & New, 2009; Donkin, Heathcote, Brown, & Andrews, 2009; Perea, Rosa, & Gómez, 2002; Yao, Wang, Zhu, Guo, & Wang, 2016).

H<sub>1b</sub>: The rate of word completion for death-related words would be associated with specific word dimension scores (usage frequency, valence, arousal, dominance), beyond that accounted for by MS.

H<sub>1c</sub>: Higher word frequency ratings for each possible death-word fragment would be associated with faster mean completion time.

*Q3: Can the lexical decision, dot probe, and ambiguous pictures tasks successfully differentiate between MS and control conditions?*

H<sub>2</sub>: MS participants will make faster lexical responses to death-related words than will control participants.

H<sub>3</sub>: MS participants will display facilitated attention towards death-related words compared with control participants.

H<sub>4</sub>: MS participants will make more death-related interpretations than will control participants.

*Q4: Do these processes mediate or moderate the relationship between condition (vs. a no-threat control condition) and TM responses?*

H<sub>A</sub>: Implicit DA will mediate (H<sub>A1</sub>) or moderate (H<sub>A2</sub>) the association between condition (MS vs. control) and worldview defence.

Table 5.1.

*Statement of Contribution for Study 1.*

| Contributor                          | Contribution   |
|--------------------------------------|--|
| Naidu, P. A. (PhD candidate)         | Designed study (90%)   |
|                                      | Interpreted results (100%)   |
|                                      | Conducted study (100%)   |
|                                      | Wrote paper (90%)  |
|                                      | Edited paper (70%)   |
| Hine, T. J. (Supervisor)             | Designed study (10%)   |
|                                      | Wrote paper (10%)  |
|                                      | Edited paper (10%)   |
| Glendon, A. I. (Supervisor)          | Wrote paper (10%)  |
|                                      | Edited paper (20%)   |
| Connor Reid (University programmer)  | Programmed the lexical decision and dot probe tasks using Presentation |
| Heidi Travers (Research assistant)   | Data collapsing responses from the lexical decision and dot probe task |
| Daniel Cummings (Research assistant) | Coding of ambiguous pictures   |

(Signed) \_\_\_\_\_ (Date) \_\_\_\_\_

Priyanka A. Naidu

(Countersigned) \_\_\_\_\_ (Date) \_\_\_\_\_

Supervisor: Trevor J. Hine

(Countersigned) \_\_\_\_\_ (Date) \_\_\_\_\_

Supervisor: A. Ian Glendon



## **Chapter 5b: Methodological weakness of the death-word-fragment task: Alternative implicit death anxiety measures**

### **Abstract**

We examined the efficacy of different implicit death anxiety measures. In Study 1 ( $N = 133$ ), the death-word-fragment-task (DWFT), commonly used to test death-thought-accessibility in terror management theory (TMT) research, did not differentiate between mortality salience (MS) and control conditions. Instead, death-related word completions were associated with word dimensions other than MS induction. Study 2 ( $N = 155$ ) tested three implicit measures (lexical-decision task, dot-probe task, ambiguous pictures task), which differentiated between conditions, revealing greater sensitivity than the DWFT. As TMT research widens its scope, investigating measures to capture implicit death concerns is important.

*Keywords:* death-thought accessibility, mortality salience, lexical decision task, dot probe task, ambiguous picture task, terror management

Terror management theory (TMT, Greenberg, Solomon, & Pyszczynski, 1986) is predicated on the inevitability of death invoking terror about one's own annihilation, thereby unconsciously motivating much of people's daily behavior, including using strategies to distance themselves from continued threats to the psyche (Pyszczynski, Greenberg, & Solomon, 1999). Thus, when thoughts of death arise proximally (consciously perceived), individuals might increase protective behaviors (e.g., increase exercise, quit smoking), or adopt cognitive strategies to distance themselves from the reality of death by denying, avoiding, or minimizing perceived threats (Pyszczynski et al., 1999).

Most TMT research has focused on measuring distal (unconscious) concerns about death. When concerns about death are outside conscious awareness, individuals are motivated to believe that meaningful (e.g., worldview), and valued (e.g., self-esteem) aspects of themselves will continue beyond biological death. Exposure to a mortality salience (MS) induction – an experimental procedure designed to elicit conscious awareness of one's mortality – results in various worldview defence and self-esteem strivings responses when compared with a control condition (Burke, Martens, & Faucher, 2010). TMT maintains that death-related thoughts produce proximal and distal terror management (TM) responses.

To test for unconscious death-related thoughts, Greenberg and colleagues (1994) adapted the word-fragment task used in priming research (Tulving, Schacter, & Stark, 1982), to devise the death-word-fragment task (DWFT). In the TMT literature the DWFT is the most common measure of death-thought accessibility (DTA; Hayes, Schimel, Arndt, & Faucher, 2010). DTA refers to how readily accessible death-related constructs are activated outside conscious awareness (Greenberg et al., 1994). The DWFT involves completing several word-fragments, some of which (e.g., DE \_\_) can be completed as either a death-related (e.g.,

DEAD) or a non-death-related (e.g., DESK) word. How the word fragment is completed is deemed to reflect thoughts on the fringe of consciousness (Greenberg et al., 1994).

Although experimentally induced changes in DTA should correspond with changed DWFT responses, these may not be immediately apparent. Immediately after an MS induction, individuals are predicted to engage in effortful suppression (proximal defence) strategies (e.g., distracting oneself from a perceived threat; Arndt et al., 1997) leading to lower and less observable DTA. It was reasoned that undermining an individual's capacity to suppress death-related thoughts would render them unconsciously *hyperaccessible* (Arndt et al., 1997). Consistent with this prediction, higher death-related thoughts are measured when a distractor task (vs. no distractor task) with some cognitive load is administered after MS induction, but before a DTA measure (Burke et al., 2010). Thus, death-related thoughts can be detected when suppression strategies are interrupted and beyond conscious awareness. The ability to capture DTA has enhanced understanding of TMT by enabling indirect observation of unconscious processes thought to underlie psychological threats (Hayes, Schimel, Faucher, & Williams, 2008; Schimel, Hayes, Williams, & Jahrig, 2007).

This study examined methodological weaknesses of the DWFT (Study 1) and tested three alternate implicit measures to capture unconscious concerns about death: (a) lexical-decision task, (b) dot-probe task, and (c) ambiguous pictures task (Study 2). Although TMT traditionally measures death thoughts, which are deemed to mediate TM outcomes, we investigated different ways to capture death anxieties by measuring alternative implicit processes (i.e., attentional bias, picture interpretation). Additionally, we examined whether these measures would be more sensitive and could be used to capture unconscious concerns about death instead of (or in addition to), the DWFT.

Determining sensitive measures to capture unconscious death anxiety is important when widening TMT's scope to understand behaviours not directly linked to death. For instance, unconscious concerns about death is thought to be a critical psychological variable underlying worldview defence (Burke et al., 2010), material strivings (Kasser & Sheldon, 2000), mental health (Arndt, Routledge, Cox, & Goldenberg, 2005), and responses to climate change (Akil, Robert-Demontrond, & Bouillé, 2018).

DWFT weaknesses include low internal reliability ( $\alpha$  .21 & .50), and possible contamination by explicit retrieval strategies (paper under review; authors removed for masked review), thereby attenuating the extent to which the DWFT is an implicit measure. Studies using the DWFT do not match possible word completions on word dimensions that determine recall, for example: a word's everyday usage (word frequency), perceived pleasantness (valence), arousal level of the provoked emotion, and the extent to which the word denotes power or control (dominance; Warriner, Kuperman, & Brysbaert, 2013). High frequency use words are likely completed more often and quickly, compared with lower familiarity words. Due to word completion rates being skewed, the DWFT may not be sufficiently sensitive to reveal differences that could exist (resulting in Type II errors).

Another methodological weakness is that potential death-related word fragments can have multiple meanings. For instance, the word "grave" has (at least) two meanings; the death-related one and also "serious". A more rigorous DWFT might exclude all fragments that could be completed as an ambiguous death-related word. Even the word "dead" may be used more frequently in non-death than in death-related contexts – for example, colloquially meaning that something is extremely funny (e.g., "to die laughing"; Urban dictionary).

Word completions are also influenced by long-lasting priming, or familiarity effects (Gardner, Rothkopf, Lapan, & Lafferty, 1987). For instance, the death-word-fragment DE \_ \_

could be completed using words relating to study such as DESK or DEAN (familiar to students), rather than non-study words such as DEER or DEAL. Thus, numerous potential influences considered above may interfere with measuring unconscious concerns about death using the DWFT, thereby reducing the extent that the DWFT measures the intended target implicit process.

Another measure of construct accessibility, the lexical-decision task, requires participants to determine quickly and accurately whether a briefly presented letter string is a word or a non-word (Meyer & Schvaneveldt, 1971). If participants make quicker and more accurate judgements towards a specific category of words (e.g., threat-related vs. neutral), then it can be inferred that the category construct has been activated and is highly accessible (Bargh & Chartrand, 2000). By presenting different construct category words (e.g., positive, threat, death-related), accessibility of these constructs can be compared. The lexical-decision task has been used in TMT research to measure DTA. TMT studies have revealed *faster* reaction times (RTs) for death-related words after reminders of death when compared with a control condition (Fritsche, Jonas, & Fankhänel, 2008, study 4; Vail et al., 2012, study 4). Schimel et al. (2007, study 3) found that when confronted with a threat to psychological structures that attenuated concerns about death (e.g., to one's worldview), individuals exhibited *faster* lexical responses for death-related words (e.g., dead), relative to negative (e.g., suffer), and neutral words (e.g., chair).

Similar to the DWFT, the effect of word dimensions in the lexical-decision task result from decisional processes inherent in the task, which limit its ability to show how the mental lexicon is organized (Perea, Rosa, & Gómez, 2002; Yao, Wang, Zhu, Guo, & Wang, 2016). Demonstrating the cognitive component inherent within the lexical-decision task, primed words are identified as words faster and more accurately than are non-primed words (Bentin,

McCarthy, & Wood, 1985). For instance, faster lexical decisions were observed when “nurse” was preceded by “doctor”, compared to “butter”. Like the DWFT, mere exposure to death-related words in the lexical-decision task may bring death-thoughts into consciousness. However, unlike the DWFT, the impact of such factors was diminished in the current study by exposing participants to threat and non-threat stimuli matched on dimensions like word frequency, valence, and arousal.

The visual dot-probe task is an implicit measure that can capture unconscious concerns about death. This task is commonly used as an experimental measure of differences in attentional bias (AB) associated with emotional condition differences (MacLeod, Matthews, & Tata, 1986). It involves simultaneous presentation of briefly displayed neutral and threat-related words, immediately followed by detection of a probe (\*) at one of the word’s locations. AB is inferred from differences in RTs to probes replacing threatening stimuli compared with probes replacing neutral stimuli (MacLeod et al., 1986).

Compared with DTA measures, the dot-probe task may better reflect unconscious processing because it does not require accessing the internal lexicon either in completing the word (as in the DWFT), or determining its existence in the lexicon (as in the lexical-decision task). Although the dot-probe task does not measure the level of death-thoughts, it can reveal the type of thoughts via AB, thereby revealing the presence of DTA.

We examined whether MS participants would show faster RTs compared to control participants. TM research using the dot-probe task has examined effects of MS on how socially anxious patients allocate their attention to threat (Finch, Iverach, Menzies, & Jones, 2016), fear-relevant animals (e.g., snakes, spiders; MacDonald & Lipp, 2008), and facial expressions amongst combat veterans (Anaki, Brezniak, & Shalombut, 2012), but not specifically to capture concerns about death. Finch et al. (2016) found that, relative to

controls, socially anxious participants under MS demonstrated increased vigilance towards socially threatening facial expressions.

Another implicit measure that can be used to investigate unconscious concerns about death is how people interpret ambiguous pictures. The ambiguous pictures task we used included the Rorschach inkblot test (Rorschach, 1921/1975) and five pictures of a skull overlaying a non-death related image (Gailliot, Schmeichel, & Baumeister, 2006). The Rorschach test involves presenting ten inkblot stimuli and asking respondents what they see. From responses, the test administrator assesses such constructs as affective features, interpersonal perception, and self-perception. The Rorschach test has helped to identify the emotional state and traits of a person, and signs of underlying motives, conflicts, and attitudes (Mihura, Myer, Dumitrascu, & Bombel, 2013).

Advantages of using the ambiguous pictures task over the other measures include allowing for multiple and multi-dimensional responses, and greater likelihood of masking what is being tested as, unlike the previous measures, death-related words are not used. We expected how participants perceived and interpreted the inkblots and pictures to reveal whether their responses reflected unconscious concerns about death. We expected that compared with controls, MS participants would make more death-related interpretations (e.g., Gailliot, Schmeichel, & Baumeister, 2006).

## **Study 1**

Study 1 examined whether DTA using the DWFT differentiated between MS and control conditions (**H1a**). We hypothesized that the rate of word completion for death-related words would be related to specific word dimension scores (usage frequency, valence, arousal, dominance), over and above that accounted for by MS (**H1b**). Additionally, we hypothesized that higher word frequency ratings for each possible death-word fragment would be

associated with faster mean completion time (**H1c**). Evidence for H1c would reveal that bypassing the impact of word frequency to measure activation of death-related thoughts likely confounds results. Support for H1b and H1c would be evidence respectively for floor and ceiling effects, and hence the measure's low sensitivity and reliability.

## **Study 1 Method**

### ***Participants***

An a priori power analysis for a one-way ANOVA with moderate effect size ( $f = .25$ ; Steinman & Updegraff, 2015),  $\alpha = .05$ ,  $1-\beta = .08$ , revealed that a minimum of 128 participants would be required for a high-powered test. Participants were first-year psychology students ( $N = 133$ , 101 women, 30 men, 2 identifying as other) participating in partial fulfilment of a requirement for their psychology courses. They were randomly assigned to MS and control conditions.

### ***Procedure***

The authors' University Human Research Ethics Committee approved the study, which we advertised as "investigating the measurement of emotions." Consistent with TMT studies, MS instructions were: "Briefly describe the emotions that the thought of your own death arouses in you", and "Jot down, as specifically as you can, what you think will happen to you as you physically die and once you are physically dead" (Burke et al., 2010; Greenberg et al., 1994). Control instructions were: "Briefly describe the emotions that the thought of dental pain arouses in you."

A filler task (Burke et al., 2010) was administered to diminish participants' capacity to suppress death-related thoughts, thereby rendering them hyperaccessible (Arndt et al., 1997).



It was the 60-item positive and negative affect schedule-X (PANAS-X; Watson & Clarke, 1994).

The DTA task was 37 word fragments presented in random order on a computer screen with instructions to complete the fragments “as quickly as possible with the first word that comes to mind.”. Eight could be completed as death-related words: grave (GRA \_\_), dead (DE \_\_), buried (BUR \_\_ D), killed (KI \_\_ ED), skull (SK \_\_ L), corpse (CO \_\_ SE), coffin (COFF \_\_), and murder (M \_\_ R \_\_ ER). In previous TMT research, the number of word-fragments varied from 2 to 17 for death-related word fragments, and from 3 to 28 for neutral word-fragments (Arrowood & Cox, 2020).

## Study 1 Results

Each death-word fragment was coded as either a death-related or a non-death-related word. To be included in analyses, participants had to correctly spell 95% of all words completed (no participants were excluded on this criterion). No differences occurred between MS and control conditions for death-related word completions,  $F(1,132) = 0.63$ ,  $p = .430$ ,  $\eta^2 < .01$  (**H1a**), except for the fragment DE \_\_ (completed as either “DEAD” or as a non-death-related word), which differentiated between conditions. MS participants completed the word-fragment as “DEAD” more frequently ( $M = 0.51$ ,  $SD = 0.50$ ) than did control participants ( $M = 0.24$ ,  $SD = 0.43$ ). Similar to a previous study (authors removed for masked review), internal consistency was unacceptably low for the eight death-related word completions for both control ( $\alpha = .20$ ) and MS ( $\alpha = .06$ ) conditions.

A hierarchical multiple regression tested whether word dimensions could predict DTA above and beyond MS condition assignment (**H1b**). Condition was entered at Step 1, with word frequency, valence, arousal, and dominance scores entered at Step 2. For word frequency scores we used the Zipf value (larger values indicate greater everyday frequency

use) from the SUBTLEX<sub>UK</sub> database (Brysbaert & New, 2009). Valence (from unhappy to happy), arousal (from calm to excited), and dominance (from controlled to in control) ratings were from Warriner, Kuperman, and Brysbaert (2013). We omitted word completions not found in the databases and some non-English words (see Table 1).

**Table 1.** *Study 1 DFWT completions*

| <i>Word<br/>fragment</i> | <i>n</i> | <i>incorrect<br/>/missing</i> | <i>Completions (%)</i>   | <i>Excluded</i>   |
|--------------------------|----------|-------------------------------|--|---|
| DE __                    | 115      | 30                            | <b>dead(43.48)</b> deal(9.57) deer(7.83)<br>deep(6.09) dent(6.09) deaf(5.22)<br><i>dear(4.35)</i> desk(4.35) debt(3.48)<br>deck(2.61) deed (2.61) <i>dean(1.74)</i><br>dell(1.74) deem(0.89) | <i>dear; dean</i> (no valence, arousal, or dominance ratings)       |
| GRA __                   | 123      | 22                            | grace(19.51) grape(17.89)<br>grade(15.45) grass(10.57)<br>grand(8.94) grate(8.13) grain(6.50)<br><b>grave(4.07)</b> <i>grant(3.25)</i><br>graph(3.25) gravy(1.63) graft(0.81)                | <i>grant</i> (no frequency, valence, arousal, or dominance ratings) |
| M _ R _ ER               | 92       | 29                            | <b>murder(72.82)</b> marker(16.30)<br>merger(5.43%) <i>mercier(5.43)</i>   | <i>mercier</i> (no valence, arousal, or dominance ratings)          |
| SK __ L                  | 133      | 12                            | skill(74.44) <b>skull(25.56)</b>   | none  |
| BUR __ D                 | 94       | 51                            | <b>buried(81.91)</b> burned(17.02)<br>burped(1.06)   | none  |

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|          |     |    |  |  |
|----------|-----|----|--|--|
| CO __ SE | 94  | 51 | course(62.77) <b>corpse(27.66)</b><br>coarse(9.57) | no valence, arousal<br>or dominance ratings<br>for <i>course</i> ; ratings<br>for “subject” used |
| COFF __  | 133 | 12 | coffee(95.5) <b>coffin(4.50)</b>                   | none   |
| KI __ ED | 129 | 16 | killed(72.1) kissed(21.7)<br>kicked(6.20)          | none   |

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In Model 1, condition did not predict DTA score,  $F(1,894) = 0.70, p = .405, R^2 = .001$ ,  $\text{adj}R^2 < .001$ , accounting for 2.8% of variance. Including word dimensions in Model 2,  $F(5,894) = 52.60, p < .001, R^2 = .228, \text{adj}R^2 = .224$ , explained an additional 40% of DTA score variance. Foremost predictors of DTA score were word frequency (13.54% variance explained), and arousal (14.51% variance explained). We timed a small random sample of participants’ responses (12 MS, 11 Control) to determine whether response speed was associated with a word’s frequency rate (Zipf value). A word’s Zipf value was negatively associated with time taken to respond ( $n = 23, r = -.23, p = .038$ ), indicating that participants more quickly completed fragments as words with higher usage frequency (**H1c**).

## Study 1 Discussion

The DWFT’s failure to differentiate possible DTA between MS and control conditions revealed some predicted methodological weaknesses. Evidence of the measure’s low sensitivity was that death-word completions were strongly related to word dimensions that impacted recall (e.g., usage frequency). For example, COFF \_\_, was completed as “coffee” more than the death-related word “coffin”, likely due to its higher natural language usage rate (ceiling effect). Death-word fragments KI \_\_ ED and M \_\_ R \_\_ ER, exhibited an opposite

(floor) effect, whereby their respective death-related words “killed” and “murder” were more familiar in everyday language than “kissed” or “merger” respectively (Brysbaert & New, 2009). These findings question the efficacy of DWFT as a reliable implicit DTA measure.

However, valence ratings did not predict word completions. Although we posited that greater intensity of both happy and unhappy words would increase word recall likelihood, only DE \_\_ differentiated between conditions. Compared with all other death-related word-fragments, DE \_\_ had in the highest number, and the greatest spread of valid completions. It may be that this word fragment can be completed using words that are roughly matched on dimensions that impact recall, thereby maximizing its access to the mental lexicon. To circumvent floor and ceiling effects, future studies could use measures that allow matching death-related words with non-death-related words on important word dimensions that impact word recall. As DE \_\_ was the only word-fragment sensitive to detect between-condition differences, reliance would be better placed on using other measures (see Study 2).

## Study 2

Study 2 investigated different ways to capture death anxiety by measuring alternative implicit processes: (a) a lexical-decision task, measuring DTA, (b) the dot-probe task, measuring AB, and (c) an ambiguous pictures task, measuring biased interpretation. Study 2 aimed to test whether these measures would be more sensitive than the DWFT in differentiating between MS and control conditions. We had three hypotheses. One, on the **lexical-decision task**: Compared with controls, MS participants would exhibit faster lexical decisions to death-related words (**H2a**), but there would be no condition differences between accessibility of threat and positive category words (**H2b**). Two, on the **dot-probe task**: compared with controls, MS participants would show facilitated attention to death-related stimuli (**H3a**), but there would be no condition differences for threat- and positive-related

words (**H3b**). Three, on the **ambiguous pictures task**: MS participants would make more death-related interpretations than control participants (**H4**).

## Study 2 Method

### *Participants*

First-year students ( $N = 150$ , 105 women,  $M_{\text{age}} = 22.01$ ,  $SD = 6.15$ ), who were independent of Study 1 participants, participated in partial fulfilment of a psychology course requirement. They randomly received the lexical-decision, dot-probe, or ambiguous pictures task.

### *Procedure and Materials*

Instructions for the MS and control condition and the PANAS-X were as for Study 1. Participants completed one of the death anxiety measures.

#### *Go/no-go lexical-decision task*

The lexical-decision task stimuli included the same eight death-related words as the DWFT, eight threat-related words (Larsen, Mercer, & Balota, 2006), and eight positive-related words (Buhlman, McNally, Wilhelm, & Florin, 2002). Each of the 24 words was paired with a neutral word, matched on word length, word frequency (Zipf scale) of the SUBTLEX<sub>UK</sub>, and arousal (Brysbaert & New, 2009). Non-words were matched with each word on word length and number of syllables using the Wuggy pseudo-word generator (Keuleers & Brysbaert, 2010).

Participants were instructed to indicate whether each stimulus was a word or non-word as quickly and accurately as possible, by pressing the spacebar when the stimulus was a word and not to respond to non-word stimuli. Compared with standard yes/no lexical-decision tasks, the go/no-go task has elicited more accurate responding, and fewer processing demands

(Perea et al., 2002). Stimuli were presented for 500ms; participants had 1000ms to respond. Correct responses were followed by a 500ms pause before the next trial. Incorrect responses were followed by a red X for 600ms, with the next trial appearing after 150ms. Participants completed 15 practice trials using neutral words not included in the 96 critical trials.

### *Dot-probe task*

Using the same stimuli from the lexical-decision task, 24 word pairs were formed, one from the word categories, and a neutral word matched on word length and frequency. Each trial began with a central fixation display (+) for 500ms, followed by a word pair presented simultaneously, one word to the upper-middle and the other on the lower-middle of the screen. Then a probe appeared for 500ms in the location of either the death-, threat- or, positive-related word (congruent presentation), or the neutral word (incongruent presentation). Displayed probes were either \* or \*\*. Participants were instructed to differentiate between the two probes by pressing the left or right arrow key when they saw either one or two probes respectively (Salemink, van den Hout, & Kindt, 2007) as quickly and accurately as possible. Participants completed 192 critical trials, with the 24 word pairs presented eight times, 2 (upper vs. lower screen presentation)  $\times$  2 (one vs. two probes)  $\times$  2 (repeated trials). An AB index was computed by subtracting RTs for congruent (probe at presentation category location) from incongruent presentations (probe at neutral word location). A positive AB index reflected facilitated attention, a negative AB index reflected attentional avoidance of the presentation category.

### *Ambiguous pictures interpretation task*

Participants were presented with the ten Rorschach inkblots in random order. To minimize possible priming effects, the five more explicitly death-related images were presented next. These images can be interpreted as either death-related or non-death related (Gailliot et al.,

2006), and were sourced from Google images using the search term “ambiguous skull figures”. These images contained a picture of a skull embedded within a more neutral image. Participants were presented with each image for 500ms and instructed to interpret all images using between one and ten words. We posited that brief presentation of the images would render them more implicit. Participants had 20 seconds to provide a written response for each image, after which the next image automatically appeared.

Rorschach inkblots were coded into one of four categories: neutral, positive, negative, or death related. Interpretations were categorized as death related if they contained any of these words: dead, death, dying, murder, skull, coffin, grave, skull, and kill, or their derivatives (e.g., killed, killing). The other five images were coded as either death-related (using the same criteria), non-death-related, or both. “Both” referred to instances where a participant reported seeing both the intended death-related image (skull), and the non-death related image (e.g., two people on a swing). Responses were coded by two individuals blind to participant assignment condition. Inter-observer agreement was very high for the Rorschach ( $\kappa = .96$ ), and for the other five images ( $\kappa = .97$ ). We discussed and recoded inconsistencies, and omitted 21 because of difficulties in assigning them to a valence category.

## **Study 2 Results**

RTs on the lexical-decision task and dot-probe task were excluded from analyses if participants made more than 10 errors for critical trials, and/or if responses were deemed to be “anticipatory” (<200ms; Salemink et al., 2007), or “timed-out” (>1500ms after stimulus onset). Participants’ responses with fewer than four words in each category meeting the above inclusion criteria were excluded from analyses. Lexical-decision task analyses retained 23 control, and 26 MS participants. Dot-probe task analyses retained 24 control and 29 MS participants. The ambiguous pictures task analyses retained 23 control, and 25 MS

participants. G\*Power post hoc analyses (alpha .05) for group sizes and sample means for each measure are shown after each analysis below.

Large differences between conditions occurred for lexical decisions on death-related words,  $F(1,48) = 9.62, p = .003, \eta^2 = .17$ . Compared with controls ( $M = -14.70, SD = 36.22$ ), MS participants ( $M = 18.14, SD = 37.46$ ) made slower responses to death-related words (**H2a**). No between-condition effect occurred for lexical decisions in the positive, or threat-word categories (**H2b**).

Dot-probe task results revealed differences for AB towards death-related words between conditions,  $F(1,57) = 6.13, p = .016, \eta^2 = .10$ . Compared with controls ( $M = -4.05, SD = 22.21$ ), MS participants ( $M = 11.38, SD = 25.12$ ) made slower responses to death-related words (**H3a**). No between-condition effects were observed for AB towards positive, or threat-word categories (**H3b**).

Death-related ambiguous pictures interpretations were moderately higher in the MS ( $M = 0.11, SD = .09$ ) compared with the control condition ( $M = 0.06, SD = 0.06$ ),  $F(1,46) = 4.35, p = .043, \eta^2 = .09$  (**H4**). However, examining the Rorschach images, and the five explicit ambiguous pictures, separately revealed no condition effect. MS participants made more death-related interpretations for both the Rorschach and five explicit ambiguous pictures (Rorschach;  $M = 0.06, SD = 0.10$ , ambiguous pictures;  $M = 0.19, SD = 0.20$ ) than did controls (Rorschach;  $M = 0.04, SD = 0.06$ , ambiguous pictures;  $M = 0.10, SD = 0.16$ ).

## Study 2 Discussion

All Study 2 measures differentiated between MS and control conditions. The lexical-decision and dot-probe tasks revealed large differences, the ambiguous pictures task demonstrated moderate differences. The finding that MS participants demonstrated *slower*



lexical decisions and attentional avoidance for death-related words, compared with controls, contrasts with TMT research using the lexical-decision task, which has found *faster* RTs elicited towards death-related words under MS (Fritsche et al., 2008; Vail et al., 2012). Slower responses to death-related words for MS participants in the lexical-decision and dot-probe tasks may reveal evidence for a threat-avoidant response, shown by participants being motivated to cast their attention away from threat stimuli. The current findings support research observing an avoidance response from individuals who ruminated over death (Eisma et al., 2014), or who had experienced prolonged grief (Yu et al., 2017).

This pattern of slower responses may also reflect characteristics of the predominantly young adult sample. Compared with older people, younger people may demonstrate higher attentional avoidance effects for death-related stimuli (De Raedt, Koster, & Ryckewaert, 2013), presumably due to the focus on their inevitable demise conflicting with future-oriented goal pursuits. Thus, slower RTs might reflect strategic rather than automatic responses. Attentional avoidance responses to threatening stimuli may attenuate habituation and emotional processing of threatening information (Mogg, Mathews, & Weinman, 1987), thereby continuing to elicit anxiety (Rachman, 1998). Hence, individuals demonstrating avoidance rather than hypervigilance towards existential threat may be more likely to exhibit TM reduction responses. This could be an avenue for future research.

Another possibility is that slower responses to death-related stimuli reflect an inability to capture the intervening process because these measures instead allowed observation of behavioral (rather than cognitive) process resulting from MS. For instance, the automatic-vigilance and vigilance-avoidance hypotheses propose that whilst threatening stimuli are visually detected very rapidly, due to a secondary process that more thoroughly evaluates the threat, ongoing activity (e.g., lexical responses) is temporarily interrupted, resulting in a

slower behavioral response to threat-related stimuli (Wentura, Rothermund, & Bak, 2000). It is presumed that anxious individuals direct attention away from the threat as a strategic attempt to reduce anxiety elicited by threatening stimuli (Estes & Adelman, 2008). This pattern (i.e., initial vigilance and subsequent avoidance response) has been observed amongst individuals with high trait anxiety (Mogg, Bradley, Miles, & Dixon, 2004), and disorders such as social anxiety (Vassilopoulos, 2005), PTSD (Adenauer et al., 2010), and phobia (Pflugshaupt et al., 2005), in response to threatening stimuli. Automatic-vigilance and vigilance-avoidance hypotheses may account for disparate findings on attentional processes after threat exposure.

As expected, MS participants completing the ambiguous-picture task made more death-related interpretations than did control participants. Comparing this to the direction of responses found for the lexical-decision and dot-probe tasks provides support for both automatic-vigilance and vigilance-avoidance interpretations. It is likely that the required response for the ambiguous pictures task bypasses the cognitive system more so than in the lexical-decision and dot-probe tasks. For instance, the high cognitive component required for the lexical-decision task, which involves determining whether the presented stimulus is a word or a non-word, confounds the extent to which responses are purely implicit.

fMRI research examining processes engaged when someone responds to the Rorschach, has shown activation of limbic structures associated with emotional processing, and parts of the pulvinar associated with non-conscious perceptions of visual emotional signals (Giromini, Viglione, Zennaro, & Cauda, 2017). Thus, the ambiguous pictures task may allow measurement of unconscious processing of death-related thoughts. Analyzing responses to the Rorschach and the skull overlay images separately resulted in reduced sensitivity. Thus, under some circumstances, MS effects may be subtle and therefore effectively captured by

more automatic methods (e.g., lexical-decision or dot-probe tasks), or when supplemented alongside additional measures (e.g., Rorschach and skull overlay images together).

### **General Discussion**

This study made two important contributions to TMT. First, it identified weaknesses in the DWFT. By demonstrating the influence of word dimensions (e.g., frequency, arousal) on word completions, we demonstrated that floor and ceiling effects can attenuate the DWFT's sensitivity in capturing concerns about death. Reducing the impact of explicit retrieval strategies when capturing DTA will be an important challenge for TMT research. To reduce Type II error likelihood when using the DWFT, other implicit measures could be used, such as those tested here, to find convergent evidence for MS effects.

Second, when compared with the DWFT, the lexical-decision, dot-probe, and ambiguous pictures tasks were more sensitive in differentiating between MS and control conditions, demonstrating their potential efficacy in capturing unconscious concerns about death in TMT research. As these measures successfully differentiated between groups, null findings between MS and control conditions when using the DWFT may well result from the measure's low sensitivity, rather than the absence of an effect.

Although all three alternative measures successfully differentiated between MS and control conditions, they may capture different processes. The lexical-decision and dot-probe tasks may reveal differences between conditions by measuring MS responses, such as death-avoidance, to death-related stimuli, rather than the intervening process leading to MS. Using the ambiguous pictures task as a measure of implicit DTA on the other hand, may capture underlying thoughts about death.

A limitation of the current research was relatively small samples, increasing the margin of error. Despite Study 1 being slightly underpowered, thereby reducing confidence in the observed null effect, there was evidence that responses were sensitive to word dimensions, thereby impacting recall rates. Future replications would benefit from larger samples to increase confidence in findings. As MS effects are sensitive to TMT methodology, testing variations of death-related word-fragments – e.g., number of death-related word fragments, and the word-fragment itself, could have influenced DTA scores. However, results suggested that the DWFT is not robust, and that responses are influenced by other factors, thereby reducing the measure's ability to differentiate between MS and control conditions.

As death-anxiety measures, the lexical-decision and dot-probe tasks can be used to test the automatic-vigilance and vigilance-avoidance hypotheses. To test whether death-related words were first detected more quickly by MS than by control participants, followed by subsequent slower responses than other category words, the lexical-decision task could be used with eye-tracking technology (Armstrong & Olatunji, 2012). This would allow comparison between initial detection (indicated by a saccade) then behavioral responses (on the keyboard) to death-related words. Examining AB at both short and longer intervals would reveal whether participants responded first with hypervigilance and then with avoidance.

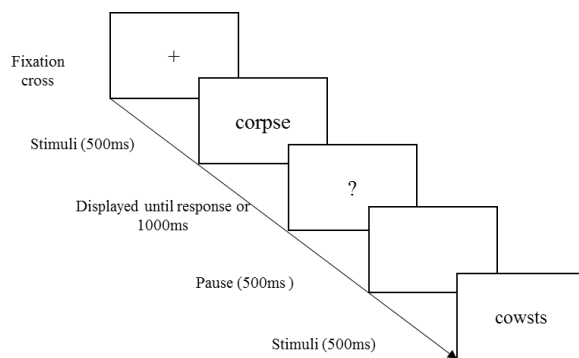
These measures may also be better than the DWFT at capturing proximal (i.e., consciously perceived) concerns about death. Completing the DWFT immediately after MS (with no distractor task to thwart suppression strategies) has revealed no differences between MS and control conditions (Greenberg et al., 1994), presumably because participants are still actively suppressing death-related content. However, more nuanced measurements (i.e., lexical-decision, dot-probe tasks) may permit observation of condition differences. Using ambiguous inkblots, Shackelford and Agostinelli (2003) found that proximal concerns were linked to

lower numbers of death-related interpretations of ambiguous stimuli. This is expected as conscious thoughts about death initiate threat-focused suppression (e.g., distraction or avoidance responses) from conscious thoughts about death (Pyszczynski et al., 1999).

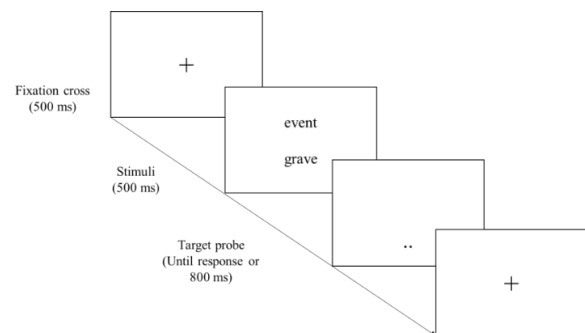
Future research may benefit from using sensitive tasks when measuring testing the full TM mediation model in the literature – i.e., that death-related thoughts are the mechanism by which MS produces TM strategies, such as worldview defence and self-esteem striving responses. Contrary to the theoretical model, most research has found that death-related thoughts play a moderating role (Hayes & Schimel, 2018). Only one study appeared to support a mediation model tested at a single time point (Vail et al., 2012). Lack of evidence for a mediation model could be due to difficulty in capturing the intervening process without eliciting death-related thoughts, as the mere act of measuring such thoughts may increase DTA. For instance, TM outcomes (e.g., self enhancement, worldview defence) have been absent when administering a DWFT (Hayes & Schimel, 2018, study 1) and a word puzzle that included death-related words (Greenberg et al., 1994). However, not administering these tasks revealed expected TM outcomes. Using more implicit measures of death anxiety such as those used in this study, may reduce spill-over effects, permitting observation of the full mediation model predicting TM responses. As a final cautionary note, individual differences influencing the strength of the MS effect ought to be included in the model: trait levels of self-esteem, self-regulation, and low levels of purpose in life, moderate the association between MS and DTA (Gailliot et al., 2006; Routledge & Juhl, 2010; Schmeichel et al., 2009).

## Chapter 5c: Appendix to the submitted paper “Methodological weakness of the death-word-fragment task: Alternative implicit death anxiety measures”

The supplemental material in this chapter was not supplied with the published paper. Below represents the programmed lexical decision task (Figure 5.1.a) and dot probe task (Figure 5.1.b). Figure 5.2 shows examples of the more explicit death-related images used for the ambiguous picture task. These images were sourced from Google using the search term “ambiguous skull figures”. All images contained a picture of a skull embedded within a more neutral image.



*Figure 5.1a.* Example of a death-related word and its matched non-word word in the lexical decision task.



*Figure 5.1.b.* Congruent trial example for the death-related word category (probe located behind the death-related word, grave) in the dot probe task.



*Figure 5.2.* Pictures with embedded skull

Table 5.3 displays the hierarchical multiple regression results testing whether word dimensions could predict DTA beyond MS condition assignment (**H1b**). Condition was entered at Step 1, with word frequency, valence, arousal, and dominance scores entered at Step 2. This regression output was not included in the paper published in *Death Studies*, as requested by the journal editor.

Table 5.3. *Hierarchical Regression Analysis for Variables predicting Word Completions*

| Predictor      | <i>B</i> | <i>SE(B)</i> | $\beta$ | <i>t</i> | <i>p</i> | <i>sr</i> <sup>2</sup> | 95% <i>CI</i> s( <i>B</i> ) |
|----------------|----------|--------------|---------|----------|----------|------------------------|-----------------------------|
| Step 1         |          |              |         |          |          |                        |                             |
| Condition      | -0.975   | 1.170        | -.028   | -0.834   | .405     | -.028                  | -3.271, 1.320               |
| Step 2         |          |              |         |          |          |                        |                             |
| Condition      | -0.936   | 1.032        | -.027   | -0.907   | .365     | -.030                  | -2.962, 1.090               |
| Word frequency | 9.225    | 0.781        | .379    | 11.817   | <.001    | .368                   | 7.693, 10.757               |
| Valence        | -0.001   | 0.509        | .000    | -0.002   | .999     | .000                   | -0.999, 0.998               |
| Arousal        | -7.283   | 0.592        | -.424   | -12.292  | <.001    | -.381                  | -8.445, -6.120              |
| Dominance      | -0.984   | 0.744        | .081    | -1.323   | .186     | -.044                  | -2.444, 0.476               |

#### **Additional hypotheses, measures and analyses not in the submitted paper**

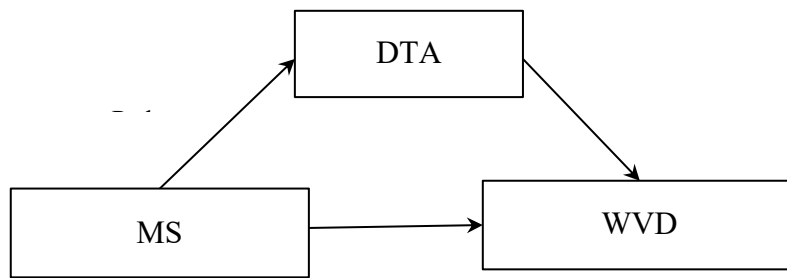
A further research question for Study 1 was to examine evidence that death-related thoughts would mediate or moderate the association, between condition (MS vs. control) and worldview defence (RQ4). There is an overall lack of evidence supporting the TM mediation model – i.e., that death-related thoughts (mediator; M) are the mechanism by which MS

(explanatory variable; X) produces proximal or distal defences (criterion; Y). Although research shows strong support that under MS participants display increased self-esteem striving and cultural worldview defence (WVD) reactions (Burke et al., 2010), few studies have tested the full TM mediation model. Some evidence that death-related thoughts mediate this association comes from research showing that directly manipulating the accessibility of death-related thoughts increases distal effects (Arndt et al., 1997). Contrary to the theoretical model, most research testing the full TM mediation model has found that death-related thoughts play a moderating role (Agroskin & Jonas, 2013; Das et al., 2009; Golec de Zavala, et al., 2012; Hayes & Schimel, 2018). Only a single study appears to support a mediation model (Vail et al., 2012). These researchers exposed individuals to images of destruction, such as destroyed and collapsed buildings to elicit thoughts about death. Death-related thoughts mediated responses towards militaristic defence of America, revealing WVD outcomes.

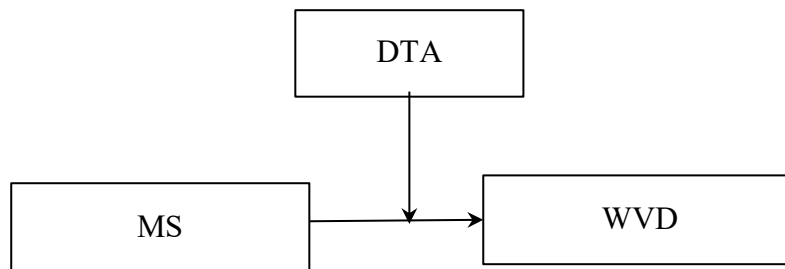
Due to a lack of evidence for the mediation model, it has been suggested that death-related thoughts may not be the psychological process by which MS affects TM reduction responses (Agroskin & Jonas, 2013). Alternatively, the lack of evidence may be due to the difficulty in capturing the intervening process (death-related thoughts) without eliciting death-related thoughts itself, thereby attenuating any differences between MS and control conditions. More sensitive measures that can better mask the intended reason for testing may negate the interference effects found previously with a word fragment task or word puzzle with death-related words (Greenberg et al., 1994; Hayes & Schimel, 2018, study 1). This study examined whether measures of implicit DA could capture the intervening process between MS and worldview defence, or alternatively the moderation process (see Figure 5.3).



(a)



(b)



*Figure 5.3.* (a) Mediation model outlining how MS is proposed to influence WVD according to TMT; (b) Moderation model showing how MS may influence WVD.

Many studies measure WVD by examining people's reactions to an author who writes either positively or negatively about the values of a participant's country (Greenberg et al., 1994; Vail et al., 2012). However, these measures have been used predominantly within cultures (e.g., the US), where patriotism is seen as inherently valuable, thereby indicating a possible measurement bias (Burke et al., 2010). Furthermore, the WVD hypothesis has not been supported amongst Norwegian (Saetrevij & Sjastad, preprint) or Australian participants (Kashima, Beatson, Kaufmann, Branchflower, & Marques, 2014). For example, under MS, Australian participants were more likely to evaluate their country modestly and to reject high praise of their country, representing a "cringe", rather than a patriotic, cultural script.

In this study worldview defence was measured as in the Pilot Study, by exposing participants to passages from two books on climate change that had been shown to be associated with divergent worldviews (Kahan et al., 2011). One passage framed climate

change dangers as high-risk, while the other framed them as low-risk. Participants were required to rate the author of each passage on trust and knowledge, with greater differences between author ratings (for high- vs. low-risk passage) reflecting WVD.

Examined was whether death-related thoughts, as measured by the DWFT, were the mechanism by which MS produced distal defences ( $H_{A1}$ ). As research has found moderating, rather than mediating effects for DA, we examined whether death-thoughts would moderate the association between MS and WVD ( $H_{A2}$ ). We also examined whether DTA, as measured by the lexical-decision task, attentional bias as measured by the dot-probe task, and picture interpretation measured by the ambiguous pictures task, could mediate ( $H_{A1}$ ) or moderate ( $H_{A2}$ ) the association between MS and worldview defence. As these measures are more sensitive than the DWFT, they may be more likely to capture the process leading to worldview defence.

## **Method**

### **Participants**

Participants were first-year psychology students ( $N = 55$ , 37 females) participating in partial fulfilment of a requirement for their psychology courses. They were randomly assigned to MS ( $n = 27$ , 17 females,  $M$  age 23.30,  $SD = 10.20$ ), and control conditions ( $n = 28$ , 18 females,  $M$  age 21.96,  $SD = 7.36$ ).

### **Procedure**

The worldview defence and explicit measure of death anxiety measures below were taken after those outlined in the submitted paper “Methodological weakness of the death-word-fragment task: Testing alternative death anxiety measures”. Participants read two passages, one endorsed climate change as high-risk and another endorsed climate change as low-risk

(Kahan et al., 2011). Participants rated both authors' trust and knowledge on a 6-point scale from 1 *strongly agree*, to 6 *strongly disagree*. Presentation order was counterbalanced.

Worldview defence was calculated by taking the difference score between mean ratings of trust and knowledge for the author endorsing climate change as high-risk from equivalent ratings for the author endorsing climate change as low-risk. The greater the difference, the greater the bias exhibited.

Participants finally completed the Collett-Lester fear of death anxiety inventory (DAI) to measure dispositional death anxiety (DA; Lester, 1990). Distinguishing between fear of death and dying, as well as between self- and other-death, the fear of death scale yields scores on four subscales: 1) fear of death of self, 2) fear of death of others, 3) fear of death of dying for self, and 4) fear of death of dying of others.

## Study Results

**DWFT.** No differences were found between MS and control conditions for death-related word completions,  $p = .872$ ,  $\eta^2 < .01$ , not satisfying the requirement for testing mediation. There was no difference between condition and WVD,  $p = .362$ ,  $\eta^2 = .02$ . DTA did not moderate WVD,  $\Delta R^2 < .01$ ,  $p = .649$ . Positive evaluations of the author endorsing climate change as high-risk were moderately higher for control ( $M = 4.52$ ,  $SD = 1.09$ ) than for MS participants ( $M = 3.85$ ,  $SD = 1.15$ ),  $F(1,54) = 4.85$ ,  $p = .032$ ,  $\eta^2 = .08$ . Evaluations of the author endorsing climate change as low-risk did not differ between conditions ( $p = .390$ ,  $\eta^2 = .01$ ).

**Lexical decision task.** Worldview defence was not related to condition ( $r = .16$ ,  $p = .277$ ) or lexical responses to death-related words ( $r = .02$ ,  $p = .916$ ), which precluded testing for mediation. Testing for moderation effects, no DA  $\times$  condition interaction was found when explaining worldview defence ( $\Delta R^2 = .017$ ,  $p = .377$ ). Examining ratings for the author

endorsing climate change as high-risk revealed small condition differences, whereby MS participants rated the author slightly higher ( $M = 4.03$ ,  $SD = 1.39$ ) than did control participants ( $M = 3.47$ ,  $SD = 1.41$ ),  $F(1,34) = 1.368$ ,  $p = .251$ ,  $\eta^2 = .04$ . No between-condition differences were found in ratings for the author endorsing climate change as low-risk ( $p = .909$ ,  $\eta^2 < .01$ ).

**Dot probe task.** Testing for mediation, worldview defence was not related to condition ( $r = -.09$ ,  $p = .565$ ), nor to AB ( $r = .17$ ,  $p = .275$ ). Testing for moderation revealed no interaction between death AB  $\times$  MS to explain WVD ( $\Delta R^2 < .001$ ,  $p = .982$ ). Examining author ratings separately revealed no differences between condition ( $p < .05$ ,  $\eta^2 < .02$ ).

**Ambiguous pictures task.** Number of death-related interpretations did not account for variations in worldview defence ( $r = -.05$ ,  $p = .732$ ), not satisfying requirements for mediation. Testing for moderation, the death-related interpretation  $\times$  Condition interaction was significant in explaining worldview defence, but only for the Rorschach images ( $\Delta R^2 = .083$ ),  $F(1,44) = 4.44$ ,  $p = .041$ , and not whilst using all 15 ambiguous images ( $p = .084$ ), or when using only the five more explicitly death-related pictures ( $p = .683$ ). Frequency of death-related interpretations of the Rorschach images were related to differences between conditions on worldview defence ( $b = 0.50$ ),  $t(48) = 2.96$ ,  $p = .005$ . Whilst moderate levels of death-related interpretations showed some difference between worldview defence ( $b = 0.42$ ),  $t(48) = 1.95$ ,  $p = .058$ , high levels of death-related interpretations did not reveal a conditions effect worldview defence ( $b = 0.67$ ),  $t(48) = -0.30$ ,  $p = .765$ . Figure 5.4 plots Condition  $\times$  DA (Rorschach inkblot interpretations only) interaction for predicting worldview defence. Examining author ratings separately revealed no differences between conditions ( $p < .05$ ,  $\eta^2 < .02$ ).

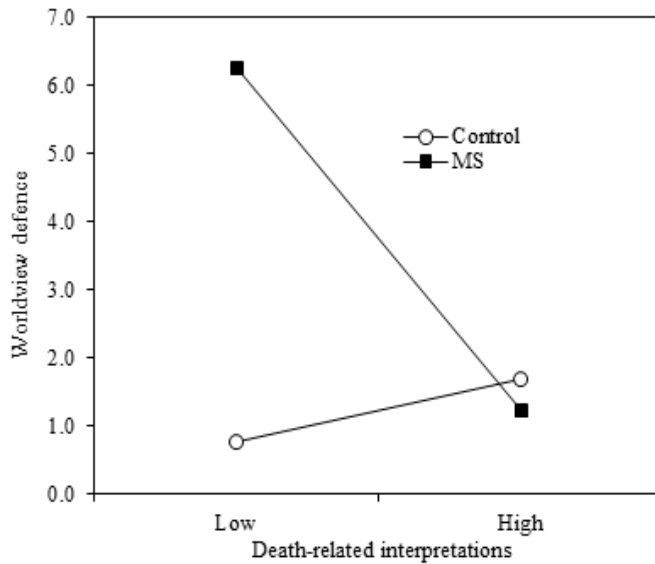


Figure 5.4. Regression lines for WVD in control and MS conditions for participants with low and high death-related interpretations of Rorschach inkblots.

### Exploratory analyses

**Lexical decision task:** No between-condition differences were found for own death and own dying ( $p < .05$ ,  $\eta^2 < .02$ ). Fear of others' death,  $F(1,47) = 3.03$ ,  $p = .088$ ,  $\eta^2 = .06$ , and others' dying,  $F(1,47) = 2.97$ ,  $p = .091$ ,  $\eta^2 = .06$  differed moderately between conditions, where MS participants ( $n = 26$ ) reported lower concerns for others' death ( $M = 2.26$ ,  $SD = 0.73$ ), and for others' dying ( $M = 2.53$ ,  $SD = 0.75$ ) than did control participants ( $n = 22$ ) for others' death ( $M = 2.68$ ,  $SD = 0.91$ ), and for others' dying ( $M = 2.96$ ,  $SD = 0.99$ ).

**Dot probe task:** A moderate condition effect was found in others' dying,  $F(1,56) = 4.02$ ,  $p = .050$ ,  $\eta^2 = .07$ , where MS participants reported higher levels ( $M = 2.71$ ,  $SD = 0.86$ ) than did control participants ( $M = 2.23$ ,  $SD = 0.93$ ). Only small between-condition differences were found between own death ( $p = .171$ ,  $\eta^2 = .03$ ), own dying ( $p = .127$ ,  $\eta^2 = .04$ ), and others' death ( $p = .265$ ,  $\eta^2 = .02$ ). Although effects were small, MS participants reported greater fears of death in each DAI subscale than did control participants, except for own

death. Own death in both conditions was negatively associated with scores on own dying (MS:  $r = -.65, p < .001$ ; Control:  $r = -.61, p = .001$ ), others' death (MS:  $r = -.51, p = .004$ ; Control:  $r = -.55, p = .003$ ), and others' dying (MS:  $r = -.38, p = .048$ ; Control:  $r = -.73, p < .001$ ).

**Ambiguous pictures task.** No differences were found between conditions and DAI subscales ( $p > .05, \eta^2 < .01$ ).

**Differences between measures on distal effects.** We examined whether author ratings differed depending on the DA measure administered to participants. A moderate effect in ratings for the author who endorsed climate change as low-risk was found between DA measures for MS participants,  $F(3,103) = 4.37, p = .006, \eta^2 = .12$ . A post hoc Tukey test revealed that MS participants who completed the dot probe task rated the author endorsing climate change as low-risk higher ( $M = 4.15, SD = 1.22$ ) than did MS participants who completed the DWFT ( $p = .030, M = 3.13, SD = 1.45$ ), LDT ( $p = .016, M = 3.04, SD = 1.09$ ), and APT ( $p = .018, M = 3.04, SD = 1.50$ ). There were no differences between measures and ratings for the author who endorsed climate change as high-risk,  $F(3,103) = 0.15, p = .928, \eta^2 < .01$ . No differences were found for control participants for author ratings between measures administered ( $p > .05, \eta^2 < .01$ ).

## Discussion

### Worldview defence effects

Critically, we could not replicate WVD effects – i.e., that differences existed on responses to the two (low- vs. high-risk) climate change author ratings between conditions. It has been posited that the necessary conditions to produce the same WVD outcomes no longer existed (Klein et al., Preprint). For instance, the authors noted that following Donald Trump's

election as US President, a pro-US essay may in fact threaten worldviews of those who tend to be more liberal. Changes in the current political environment may therefore have affected MS outcomes when participants were US college students studying psychology, who tend to have liberal political attitudes. Furthermore, the WVD hypothesis has not been supported amongst Norwegian (Saetrevij & Sjastad, preprint) or Australian participants (Kashima et al., 2014) when asked to evaluate their country. Even when measuring worldview defence using individual attitudes on climate change, this study did not find a consistent pattern of author rating differences between the measures administered, and observed effects were small.

However, the present study cannot rule out the possibility of a WVD effect after MS, because research finding WVD after an MS induction has done so only without measuring the intervening process. Evidence suggests that the mere act of measuring DTA may increase death-thought activation (Spencer, Zanna, & Fong, 2005). Research shows that TM outcomes (e.g., self enhancement, WVD) are absent when administering a DWFT (Hayes & Schimel, 2018, study 1), and a word puzzle that included death-related words (Greenberg et al., 1994). Alternatively, not administering the DWFT, or replacing the measure with a neutral-word task, revealed expected TM outcomes (Hayes & Schimel, 2018). That research has successfully employed a death-related word puzzle to induce MS (Maxfield et al., 2007, 2014) suggests that mere exposure to the DWFT may elicit death-related thoughts amongst control condition participants, thereby masking potential condition differences when measuring distal effects.

Consistent with this interpretation, under MS, TM outcomes were shown to differ depending on the measure administered, possibly due to the measure itself eliciting differential intensities (and awareness) of death-related thoughts. For instance, ratings for the author endorsing climate change as low-risk was higher amongst MS participants who were

administered the dot probe task compared with those administered the other implicit measures. Furthermore, MS participants who completed the DWFT reported less favourable ratings for the author endorsing climate change as high-risk, whilst MS participants exposed to the lexical decision task reported the opposite response pattern (i.e., more positive ratings for the author endorsing climate change as high-risk). Thus, it is probable that measuring the intervening process impacts subsequent responses.

### **Testing the TM model**

We did not find any support for the TM mediation model. Instead, we examined whether DA moderated TM reduction responses (Agroskin & Jonas, 2013; Hayes & Schimel, 2018). This study only found worldview defence effects when the ambiguous pictures task was administered, and only whilst using the number of death-related interpretations on Rorschach inkblots as the measure of the possible mediator. This is in comparison to the other five more explicitly death-related picture interpretations. The Rorschach inkblots may have been more sensitive in detecting MS effects, when compared with the more explicit death-related images, whilst concomitantly not invoking death-related thoughts in the process. The moderation model showed that higher worldview defence was observed amongst MS participants making fewer death-related interpretations of the Rorschach inkblots, when compared with control participants. MS participants who demonstrated the highest distal effects (e.g., via increased worldview defence), were those demonstrating higher cognitive avoidance as observed by the low number of death-related interpretations, possibly as an attempt to suppress death-related thoughts. This pattern of findings aligns with the interpretation (see Study 1 discussion) that the task intended to measure implicit DA, instead captures the outcome response from DA (i.e., attentional avoidance). There was no evidence of moderation when using the lexical-decision and dot-probe tasks. Because this study and



previous research has found evidence for moderation (vs. mediation), thoughts about death may not play a critical mediational role in distal defences (Agroskin & Jonas, 2013; Das et al., 2009; Golec de Zavala et al., 2012; Hayes & Schimel, 2018), casting doubt on the TM theoretical model.

### **Future research directions, suggestions and limitations**

We found no evidence for a TM mediation model. However, neither could the study rule out the possibility of mediation effects because the DA measure could have produced interfering effects. The reason behind the lack of a mediation effect of death-thoughts should be ascertained in future research; either that death-thoughts are not the intermediate process by which MS leads to distal defence strategies, or separate experimentation to examine the existence of spill-over effects from the DA measure (Greenberg et al., 1994; Hayes & Schimel, 2018). Hence, a limitation of this experiment was that the entire model (i.e., IV – Mediator – DV) was tested at a single time point. Testing each pathway separately using a within-participants design may reveal a mediator effect, or if not, stronger moderator effects, as the measure by which we captured DA would not itself impact on subsequent response tasks. The absence of having a condition that examined TM responses without also measuring the intervening process prevented ascertaining the extent to which including a measure to capture death anxiety influenced worldview defence reactions.

Although we used the Rorschach inkblots along with five more explicit death-related pictures, future research could examine whether the measures used separately (Rorschach inkblots vs. skull overlay images) might reveal differential spill-over effects. Compared with Rorschach inkblots, more explicit pictures of death may influence subsequent tasks, because they could prime thoughts about death for control participants, thereby not serving as a non-threat exposed control condition. Furthermore, research has found evidence of differences in

an Australian sample on DA measures (Schumaker, Warren, & Groth-Marnat, 1991), and WVD effects (Kashima et al., 2014). Future research could examine responses to MS and how it varies amongst samples from other cultures.

## **Conclusion**

The lack of support for a mediation effect for DTA challenged the TM model. Findings using the DWFT and lexical decision task suggested that either: 1) death thoughts may not be the vehicle by which MS invokes TM reduction responses, and/or 2) including a measure of DA produces interference effects that negate differences in TM reduction responses between MS and control conditions. This study has revealed the methodological challenges faced when attempting to capture unconscious concerns about death. One important endeavour for researchers seeking evidence for the full TM model will be devising a measure that captures the vehicle through which MS elicits proximal and distal effects in a way that does not impact subsequent responding. This study has therefore sparked potential research ideas designed to test methodological and theoretical assumptions behind TMT.

## Chapter 6a: Study 2

Study 2 had two aims. First to examine whether climate change information elicited greater concerns about death, and second, whether climate change information elicited terror management responses. In the Pilot Study and Study 1, the DWFT demonstrated low internal consistency, as well as floor and ceiling effects for word completion rates, suggesting interference from explicit retrieval strategies. Also the Pilot Study did not reveal any DTA differences between the climate change salience and control conditions. It was undetermined whether this was due to floor and ceiling effects and/or whether climate change information as presented in the Pilot, did not elicit thoughts about death. Therefore, we opted to use a more sensitive measure to reveal the presence of unconscious death anxiety – the dot probe task. In Study 1, the dot probe task demonstrated a strong ability to differentiate between MS and control conditions. Climate change information elicited attentional avoidance response to death-related stimuli, indicative of unconscious death-related thoughts.

Study 2 tested whether manipulating climate change outcome information elicited differential DTA and TM responses. Climate change outcome information can be manipulated to emphasise losses of not performing climate change mitigation behaviours (loss-frame), or to emphasise gains of performing climate change mitigation behaviours (gain-frame). As climate change reporting frequently uses a loss-frame (Hulme, 2008; Nisbet, 2009; O'Neill et al., 2014) it is important to investigate responses after exposure to such information. It was posited that loss-framed climate change information would elicit more death-related thoughts and hence, TM responses, when compared with a gain-frame. Loss-framed climate change information may be more likely than a gain-frame to elicit MS because of the greater emphasis on threatening and mortality-related consequences of climate change (Shehryar & Hunt, 2005). In comparison, a gain-frame may allow participants to

perceive the threat as more manageable, negating the elicitation of mortality-related thoughts, or at least to a lesser extent than with loss-framed climate change information. A no climate change threat condition provided a baseline measure.

This study examined reported material/consumer strivings as a TM response after exposure to climate change information. As consumer behaviour is embedded within industrialised society, of interest was how material strivings might conflict with efforts towards a low carbon society. As most consumer purchases have a carbon footprint, excessive desire for consumer and luxury goods has potentially devastating consequences for climate change. This study acknowledged that consumer purchases may play an important role in an individual's identity. For instance, material possessions can signal achievement, success and status, establish group membership, and attenuate existential anxiety. Consequently, sustainability initiatives like curbing material purchases may prove challenging amongst individuals for whom material goods function as an important source of identity and meaning.

Under psychological threat, including that posed by climate change, individuals show amplified commitment responses to important cultural values. As the threat of climate change increases, emphasising its dire consequences may prompt individuals to restore a greater sense of meaning, control, and predictability in their lives. Participation in consumer culture by purchasing consumer goods has been shown to mitigate feelings of threat by reinstating meaning and order to one's life. Thus, it is important to understand whether climate change communications can elicit similar threat reduction motivations that are detrimental to sustainability (e.g., increased desire for consumer goods). This study examines two outcomes: material strivings and greediness – both responses that conflict with a low carbon

society. Research has found increases in both outcomes under conditions of existential threat, compared with no-threat conditions (Kasser & Sheldon, 2001).

Because TM responses may be affected by measuring the intervening process (e.g., due to spill-over effects, Greenberg et al., 1994; Hayes & Schimel, 2018) we first examined whether climate change elicited DTA (manipulation check) before measuring resultant TM responses. A limitation of this study design is that evidence for climate change eliciting DTA and TM responses does not allow us to test the mediation model. The overarching research questions and hypotheses of Study 2 are presented below:

### **Manipulation check**

*Does exposure to climate change information elicit attentional bias to death-related stimuli, and is there a difference between loss- and gain-framed climate change information?*

It is hypothesised that compared with gain-framed information and a no-threat control condition, exposure to loss-framed information will heighten attentional avoidance. Further, there will only be evidence of AB toward death-related stimuli and not towards other categories (e.g., other threat- and positive-related stimuli), indicating a unique concern towards death-related stimuli.

### **Study 2**

*Q1: Will exposure to loss-framed climate change information elicit material strivings and greediness tendencies (TM responses) when compared with the climate change gain-frame and no-threat control conditions?*

**H<sub>1</sub>:** Compared with those in the climate change gain-frame and control conditions, participants exposed to climate change loss-framed information will report higher consumption desires.

**H<sub>2</sub>:** Compared with those in the climate change gain-frame and control conditions, participants exposed to climate change loss-framed information will report greater greediness in a resource dilemma task.

*Q2: Will the association between threat exposure (from loss-framed information) and material strivings be strengthened for participants with higher extrinsic values, relative to participants with higher extrinsic values exposed to other information conditions?*

**H<sub>3</sub>:** Self-esteem striving behaviours, such as increased desire for material possessions, will be observed amongst participants with strong extrinsic values when exposed to the loss-frame (exposure to threat), compared with the gain-frame and control conditions (testing the MS hypothesis). NB This hypothesis was omitted from the submitted paper. Findings related to this hypothesis are presented following the submitted paper.

*Q3: Will exposure to the climate change outcome frames yield differential attitudes and perceptions of risk towards climate change?*

No specific hypotheses were forwarded due to mixed prior findings regarding loss vs. gain frame advantage.

This chapter includes a co-authored paper submitted for publication. The paper is currently under review with the *Journal of Consumer Psychology*. Bibliographic details, if accepted for publication are: Naidu, P. A., Glendon, A. I., & Hine, T. J. (2020) Consumption desires, climate change framing, and mortality concerns. *Under review*. The paper is included in its

complete and original form before revisions suggested by anonymous reviewers. Table 6.1 indicates the relevant contributions of the research team to the paper.

Table 6.1.

*Statement of Contribution for Study 2.*

| Contributor                  | Contribution               |
|------------------------------|----------------------------|
| Naidu, P. A. (PhD candidate) | Designed study (100%)      |
|                              | Interpreted results (100%) |
|                              | Conducted study (100%)     |
|                              | Wrote paper (85%)          |
|                              | Edited paper (75%)         |
| Glendon, A. I. (Supervisor)  | Wrote paper (15%)          |
|                              | Edited paper (15%)         |
| Hine, T. J. (Supervisor)     | Wrote paper (10%)          |
|                              | Edited paper (10%)         |

(Signed) \_\_\_\_\_ (Date) \_\_\_\_\_

Priyanka A. Naidu

(Countersigned) \_\_\_\_\_ (Date) \_\_\_\_\_

Supervisor: A. Ian Glendon

(Countersigned) \_\_\_\_\_ (Date) \_\_\_\_\_

Supervisor: Trevor J. Hine



## **Chapter 6b: Climate change loss- and gain-frame associations with material desires**

### **Abstract**

We examined whether exposure to climate change information emphasising negative consequences of unmitigated climate change (loss-frame) elicited terror management TM responses, compared with information emphasising mitigation benefits (gain-frame), and a no threat (control) condition. A manipulation check ( $N = 60$ ) confirmed that, compared with other conditions, exposure to loss-framed climate change information elicited concerns about death. Exposure to loss-framed climate change threat motivated threat reduction strategies found when individuals were reminded about their own mortality ( $N = 139$ ). Increased material desires (e.g., expensive houses, cars) was posited as a TM strategy because material possessions can signify successful existence. Only loss-frame exposure (compared with other frames) motivated increased desire for material possessions, especially for participants with strong extrinsic values. Material strivings may reflect a compensatory strategy to reinstate feelings of order, predictability and meaning when living in an unpredictable world. Results suggested that loss-framed societal risk communications (e.g., about climate change) may impact certain life domains (e.g., managing outward impressions of wealth and success) as a result of countering psychological threat. Developing information frames that motivate urgency towards climate action without providing an opportunity to elicit threat-avoidant responses will be important for future research in ‘nudging’ different groups towards greater climate action.

*Keywords:* terror management, death anxiety, information framing, self-esteem, mortality salience

## Climate change loss- and gain-frame associations with material desires

Growing public concern about effects of climate change has yet to incite significant changes in consumer behavior. Many individuals continue to increase their carbon footprint (e.g., consumer purchases, transportation; Hares, Dickinson, & Wilkes, 2010) whilst failing to offset resulting carbon emissions. As most consumer purchases have a carbon footprint, either by their production or transportation, excessive desire for consumer and luxury goods has devastating long-term consequences for environmental degradation and climate change (Durning, 1992; Mollica & Campbell, 2009). Consumer goods manufacture, marketing, and distribution make an enormous contribution to global carbon emissions. Without large-scale reductions, consumption-based emissions (e.g., from food, clothing, urban building constructions) are projected to nearly double by 2050. This is concerning as meeting global emission targets set by the 2015 Paris Agreement requires current consumption-based emissions to be reduced by at least 50% by 2030, and 80% by 2050 (C40 Cities, 2019).

Hindering efforts towards sustainability efforts is “consumption culture”, characterised by beliefs that acquiring material possessions is the primary means to a happy, meaningful, and successful life (Eckhardt, Belk, & Wilson, 2015; Wearing & Lyons, 2016). Pursuing material goods may not only play a functional role, but also fulfil consumers’ symbolic, social, and personal goals. For instance, material possessions may demonstrate achievement and status, establish group membership, increase desirability and feelings of belonging, and create feelings of accomplishment (Firat, Kutucuoğlu, Arikan Saltik, & Tuncel, 2013; Jackson, 2005). Thus, sustainability initiatives like curbing material purchases may prove challenging amongst individuals for whom material goods are an important source of identity and meaning.

When exposed to psychologically threatening information, including climate change threat, individuals may demonstrate *intensified* commitment to important sources of identity such as, their dominant cultural worldviews and values (Barth, Masson, Fritsche, & Ziemer, 2018; Fritsche, Cohrs, Kessler, & Bauer, 2012; Schimel, Hayes, Williams, & Jahrig, 2007). Whether an individual's worldview has positive or negative repercussions for climate change depends on the consequences of worldview affirming responses. For example, worldviews or values that conflict with climate action (e.g., increased resource use), may motivate a desire to perceive climate change as a benign risk, thereby permitting activities aligning with an individual's goals (e.g., relating to personal advancement; Kahan et al., 2012). People's differing worldviews and values makes it important to investigate how to communicate the need to tackle climate change without motivating counter-productive behaviors.

Within a consumer culture, intensified commitment responses may be seen as boosting desire for material pursuits and other status symbols (e.g., luxury car, larger house, designer clothing). Compounding the detrimental effect of consumption culture on the environment is the operating principle that many industries rely upon: rapid obsolescence of their products, especially in the fashion and technology sectors. When faced with various psychological threats (e.g., to one's existence, feelings of control, intelligence) individuals may respond with increased desire for material/consumer possessions (Cutright, 2012; Gao Wheeler, & Shiv, 2009; Kasser & Sheldon, 2011; Mandel & Heine, 1999; Mandel & Smeesters, 2008; Mead, Baumeister, Stillman, Rawn, & Vohs, 2011). For example, in the months immediately following the September 11, 2001 terrorist attacks, goods such as furniture, electronics, and nationalist flags, were purchased in record-breaking quantities (Zuckerman, 2002). Increased desires for material possessions in response to threat is presumed to reflect a compensatory strategy to reinstate feelings of control, order, predictability, meaning, and existential security when living in an unpredictable and

uncontrollable world (Allen, Fournier, & Miller, 2008; Fournier, 1998; Jonas et al., 2014; Rindfleisch, Burroughs, & Wong, 2009; Swaminathan, Page, & Gurhan-Canli, 2007).

Elucidating mechanisms underlying individual and societal responses to climate change include the suspicion that mortality concerns drive the need to reinstate feelings of psychological security (Akil, Robert-Demontrond, & Bouillé, 2018; Dickinson, 2009; Wolfe & Tubi, 2019). Climate change news coverage may elicit thoughts about death because consequences of a changing climate are associated with events that place people in danger of injury or death (e.g., natural disaster impacts). The present study applied a terror management theory (TMT) framework to understand and predict different attitudes towards climate change and potential backfire responses – operationalized here as material strivings, after exposure to climate change threat information. As consumption culture participation has dramatically accelerated (C40 Cities, 2019) as a means of signifying a successful and meaningful life, threats to ontological security via climate change threat information may increase material strivings, consequently hindering efforts towards sustainability.

As researchers have only recently applied a TMT framework to understand and predict climate change responses, there have been few empirical investigations into whether mortality concerns constitute an impetus or factor that can account for differential climate change attitudinal or behavioral responses (Akil et al., 2018). Studies have linked materialism to worsening climate change, and as a terror management (TM) buffer (Arndt, Solomon, Kasser, & Sheldon, 2004; Maheswaran & Agrawal, 2004; Kasser & Sheldon, 2000) and climate change to TMT (Dickinson, 2009; Wolfe & Tubi, 2019). The novelty of the present study lies in bringing all three ideas together (climate change information exposure, materialism, TM). To the authors' knowledge no prior research has examined whether

exposure to climate change threat information elicits material strivings as a type of security response brought on by concerns about death.

## **Literature review**

### ***Climate change and mortality salience***

TMT (Greenberg, Solomon, & Pyszczynski, 1986) was formulated as an attempt to formalise and test the writings of cultural anthropologist, Ernest Becker (1962, 1973, 1975). Becker proposed that much of human behavior is motivated by unconscious fears about one's own mortality, with subsequent psychological and behavioral responses serving to distance oneself from this reality (Greenberg et al., 1986). It is posited that exposure to information about climate change impacts may elicit MS, as climate change impacts are intrinsically associated with themes of death, such as: destruction (e.g., aftermath of natural disasters; Vail, Arndt, Motyl, & Pyszczynski, 2012), aging (e.g., images of fractured Earth, barren landscapes, and dehydrated lakes; Martens, Greenberg, Schimel, & Landau, 2004), uncontrollability (e.g., untameable forces of nature; Agroskin & Jonas, 2013), and loss of life (e.g., mass extinctions, famine, consequences of natural disasters), all of which have been found to result in more death-related cognitions.

Communicating climate change impacts may increase death-related thoughts by reminding individuals about their inability to control their external surroundings and escape nature's consequences. Research has shown a tendency for individuals to separate themselves from, and deny commonalities with, nature (Koole & Van den Berg, 2005), and animals (Goldenberg et al., 2001). This response is presumed to reflect a desire to believe that as symbolic beings, humans are not subject to the same natural laws resulting in death and decay. Even exposure to landscapes without visible human control, such as wilderness pictures, has been found to increase death-related thoughts (Koole & Van den Berg, 2005), as

has exposure to images of destroyed buildings (Vail et al., 2012). Therefore, communicating dire depictions of climate change impacts, especially in the wake of natural disasters, over which humans have little control over (e.g., drought, flood) as well as their destructive impacts, may elicit high fear and existential anxiety (Dickinson, 2009).

### ***Loss vs. gain framed climate change frame***

Not all climate change communication frames may elicit death anxiety and therefore TM outcomes. In this study we identify two climate change outcome frames: 1) loss-frame: emphasizes losses of not performing climate change mitigation behaviors (e.g., “Failing to take action will cause rising sea levels that will pose a significant risk to coastal communities. This would mean that people’s houses would be permanently under water”), and 2) gain-frame: emphasizes gains of performing climate change mitigation behaviors (e.g., “By lessening climate change we can reduce further increases to rising sea levels that pose a significant risk to coastal communities. This lessens the occurrence or reduces the impact that people’s houses would be permanently under water”). Much climate change discourse focuses on dangerous consequences currently experienced due to climate change, or those that will follow without urgent mitigation (Hulme, 2008), akin to a loss-frame. Illustrating the extensive scale and devastating impacts of climate change may leave some audience members feeling anxious (Gifford & Gifford, 2016; Lee, 2019), fearful (Spence & Pidgeon, 2010), or powerless (Norgaard, 2006).

Whilst research has found that, under some circumstances, loss-frames are more effective than gain-frames (e.g., Davis, 1995; Spence & Pidgeon, 2010), loss-frames have typically been found to be either ineffective, or less effective than gain-frames (e.g., Byrne & Hart, 2009; Cho & Sands, 2011; Quick, Kam, Morgan, Montero Liberona, & Smith, 2015; Spence & Pidgeon, 2010). To highlight the imminent threat of climate change, statements for both

loss- and gain-framed conditions in the current study emphasized local impacts relevant to Australia, Queensland, and Brisbane. Maximizing psychological closeness to a threat, in this instance framing information as a local rather than distant threat, has been shown to increase concern and preparedness to act against climate change (Spence & Pidgeon, 2010). Exposure to information about local impacts of climate change will increase as climate change impacts worsen in the nation, state, and region. An example is the coverage of the extensive 2019/20 bushfires in New South Wales, Victoria, and Queensland.

We posited that loss-framed climate change information would be more likely than a gain-frame to elicit mortality salience (MS), because of the emphasis on threatening and mortality-related consequences of climate change (Shehryar & Hunt, 2005). Climate change information framed to emphasize local and loss outcomes may situate audience members more closely to threats posed by climate change. On the other hand, by allowing the threat to be perceived as more manageable, a local and gain-frame may not elicit fear from climate change impacts (Spence & Pidegon, 2010). Shehryar and Hunt (2005) suggest that it is important to differentiate fear appeals that use the threat of death as a consequence from those that do not. Fear appeals including death as a consequence vs. arrest or injury as consequence, resulted in different responses (e.g., increased worldview commitment), even when level of reported fear was the same. For this reason, the current study examined whether loss- (vs. gain-) framed communications about climate change would be more likely to elicit thoughts about death and TM responses to attenuate concerns about death. It remains possible that both loss- and gain-frames elicit MS. Hence, we also compared TM responses with a no- climate change threat control condition. The control condition presented information about the ineffectiveness of multi-tasking.

### ***TM strategies***

An extension of TMT, dual-process theory, posits that strategies that reduce perceived or actual threat of death differ depending on whether the threat is perceived proximally (consciously) or distally (unconsciously; Pyszczynski, Greenberg, & Solomon, 1999). Dual-process theory has been applied to predict TM responses resulting from climate change information exposure (Dickinson, 2009; Wolfe & Tubi, 2019). Applying proximal defences when exposed to climate change information may explain some climate change denial (Feinberg & Willer, 2011; Haltinner & Sarathchandra, 2018), including minimizing perceived climate risk, supporting claims of exaggeration, or pushing climate risks into a distant future (Dickinson, 2009; Wolfe & Tubi, 2019). Thus, while proximal defences may reduce *perceived* climate change threat to the self, they may increase actual threat.

As climate change impacts increasingly manifest, making perceiving climate change as low-risk increasingly implausible, individuals may attenuate mortality concerns beyond conscious awareness (Dickinson, 2009). When the problem of death is distal (beyond conscious awareness), strategies employed to diffuse the threat become symbolic and not necessarily logically or semantically related to it (Pyszczynski et al., 1999). Distal defences work by enhancing value, meaning, and purpose, thereby positioning the individual within a great and powerful collective pursuit that endures after their biological death. That is, distal defences allow an individual to suppress or discard the notion that their biological death is the end (Pyszczynski et al., 1999).

TMT posits that investment in cultural worldviews and self-esteem are two principal buffers against death anxiety. Cultural worldviews suppress existential concerns by fostering a belief that the world has order and a set of rules, thereby enabling a belief that death is not an immediate possibility. An important function of worldviews is to provide rules for achieving



a meaningful and successful life. The TMT self-esteem buffer defines how well an individual meets or exceeds standards outlined by their prescribed worldview (Harmon-Jones et al., 1997). Gravitating towards such psychological structures may attenuate existential anxiety caused by reminders about negative outcomes of climate change.

### ***Materialistic pursuits as a TM function***

Participation in a consumer society via continual pursuit of material objects can demonstrate identity, achievement, and status, thereby serving a TM function (Arndt et al., 2004). Becker (1973) proposed that material objects may attenuate existential concerns because they represent “time opposing monuments”, that continue to exist past the point of biological death, thereby serving as an immortality symbol. Research has linked reminders of death with increased materialistic pursuits. For example, individuals exposed to images of violence and death reported higher materialist values (Arndt et al., 2003; Solomon et al., 2003).

Pursuit of material objects may also reflect an individual’s desire to turn their attention away from themselves when reminded about death (Mandel & Smeesters, 2008). Reminders of death may increase one’s self-awareness (Arndt, Greenberg, Simon, Pyszczynski, & Solomon, 1998; Silvia, 2001), which has been linked to alcohol abuse (Baumeister, 1990), buying and eating larger quantities of food (Mandel & Smeesters, 2008), and watching more television (Moskalenko & Heine, 2003). These behavioral responses may reflect strategies to avoid thoughts about the self, especially when mortality is salient. Similarly, increasing consumer purchases may reflect a desire to distract oneself from reminders of death.

Kasser and Sheldon (2000) observed that participants under MS reported greater material strivings than did controls. Specifically, MS participants wanted to spend more

money on houses, travel, clothes, investments, and entertainment, and reported higher expected salaries for themselves and their partner (Kasser & Sheldon, 2000). Furthermore, Mandel and Hein (1999) observed that under MS, participants reported higher purchase intentions towards luxury cars and watches than did control participants. If climate change information elicits mortality related concerns, then evidence for increased death salience and material strivings should be observed. Because loss-framed climate change information emphasizes the threat posed, eliciting more fear (Spence & Pidgeon, 2010), it is likely that loss-framed information would produce TM responses (if not stronger), when compared with gain-framed information.

**H1:** Compared with those in a climate change gain-frame and control information conditions, participants exposed to loss-framed climate change information will report higher consumption desires.

Kasser and Sheldon (2000) observed that when individuals were exposed to reminders of their own mortality, they demonstrated higher greediness. Participants' consumption decisions were explored in a forest-management resource dilemma task. This measure was designed to tap into an aspect of the capitalist cultural worldview, that is, desire to consume many resources (Kasser & Sheldon, 2000). Participants were asked how much they wished to harvest (resource use), and their subjective motivations for their decisions, such as greediness (wanting to profit more than others), and fear (wanting to ensure that they are not left out). Participants under MS, reported wanting to harvest more and demonstrated greater greediness and fear outcomes (Kasser & Sheldon, 2000). The present study examines whether climate change information elicits similar outcomes found after MS in Kasser and Sheldon's (2000) study.

**H2:** Compared with those in the climate change gain-frame and control information conditions, participants exposed to climate change loss-framed information will exhibit greater: a) harvest intentions, b) greediness, and c) fear responses in a resource dilemma task.

### ***MS hypothesis***

Derived from TMT research, the MS hypothesis posits that reminders of death should strengthen the need for psychological structures that defend against concerns about death (Arndt, Greenberg, Solomon, & Pyszczynski, 1997; Greenberg et al., 1994). There is strong evidence for intensified commitment responses to cultural worldviews after reminders of death (Burke et al., 2010; Burke, Kosloff, & Landau, 2013; Schimel et al., 2007). Individuals within a consumer culture place varied importance on material possessions and therefore, materialistic strivings under MS are expected to be more evident amongst individuals who are highly materialistic to begin with. Concomitantly, those with high environmental values would not be expected to respond in a materialistic way, in fact they would likely respond in the opposite way – by expressing low materialistic desires. Examining MS effects on materialism, Choi, Kwon, and Lee (2007) found that individuals with greater fears of becoming a terrorism victim demonstrated higher brand name and compulsive consumption. Consistent with the MS hypothesis, the association between MS and consumption was strongest when material possessions were a source of self-esteem.

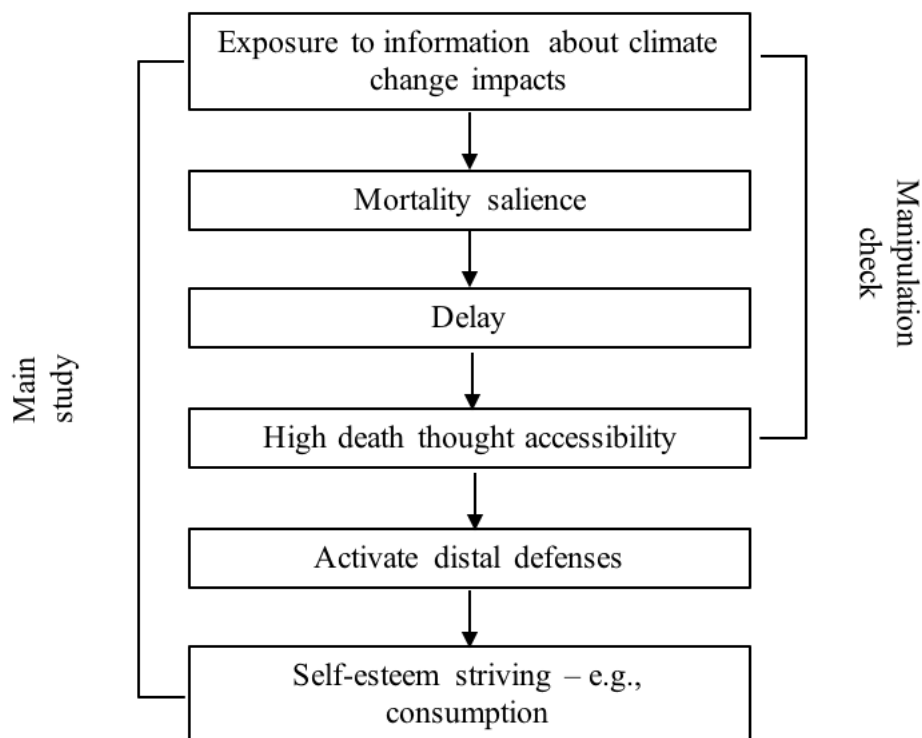
Consistent with the MS hypothesis, when environmental action was a source of self-esteem, individuals under MS demonstrated higher environmental concern than did those not exposed to threat (Vess & Arndt, 2008). As expected, the opposite pattern was found for individuals for whom environmental action was not a source of self-esteem, whereby they demonstrated lower environmental concern under MS, compared with counterparts not

exposed to threat (Vess & Arndt, 2008). Further, Akil et al. (2018) found that for individuals holding pro-materialistic values, exposure to an anxiety inducing (vs. informative) climate change information condition, inclined them to make pro-materialist consumer choices. However, individuals with pro-environmental values were more inclined to make pro-environmental consumer choices.

Exposure to climate change threat information has prompted similar TM responses to existential threat (Barth et al., 2018; Fritsche et al., 2012). That is, under climate change threat, individuals demonstrate greater adherence to psychological structures that provide them with meaning and rules for understanding the world (e.g., Feinberg & Willer, 2011; Fritsche et al., 2012). The current study examined whether participants with strong extrinsic values would show greater material pursuits when under threat (loss-frame), compared to participants with strong extrinsic values exposed to other less threatening (gain-frame) and non-threatening conditions. Individuals with strong extrinsic (vs. intrinsic) values place importance on financial success, material wealth, appearance, social recognition, and on others' approval (Kasser & Ryan, 1993, 1996). They are more likely to act in self-interested ways and to compete with others, compared with individuals who have low extrinsic values. Individuals with strong intrinsic values place importance on self-acceptance, affiliation, and health (Sheldon, Ryan, Deci, & Kasser, 2004). Compared with individuals endorsing strong intrinsic values, those endorsing strong extrinsic values demonstrate less concern for the environment, and lower willingness to donate to protect the environment (Ku & Zaroff, 2014). If individuals under psychological threat respond via domains that are important sources of self-esteem, then those with strong extrinsic values should demonstrate the greatest desire in material pursuits (Ferraro, Shiv, & Bettman, 2005). Participants placing higher value on intrinsic value orientation would not be expected to show an association with materialistic endeavors when under threat (e.g., Akil et al., 2018).

**H3:** Self-esteem striving behaviors, such as increased desire for material possessions, will be observed amongst participants with strong extrinsic values when exposed to the loss-frame (exposure to threat), compared with those exposed to the gain-frame and control information conditions.

Due to mixed prior findings, no specific hypotheses were made relating to whether a loss- or gain-frame would be more likely to motivate positive climate change attitudes (Byrne & Hart, 2009; Cho & Sands, 2011; Davis, 1995; Spence & Pidgeon, 2010; Quick et al., 2015). Consistent with the MS hypothesis, individuals should report attitudes consistent with their worldviews. As the current sample comprised first-year university psychology students, who typically have liberal attitudes towards societal risk issues, exposure to threat information may motivate greater positive attitudes towards climate change and intentions to mitigate when exposed to the loss-framed (vs. gain-framed) condition. However, this is complicated when integrating research that demonstrates a backfire effect even amongst individuals whose behavior already reflects the intended behaviour change (Schultz, Nolan, Cialdini, Goldstein, & Grisevicius, 2007). Appeals to increase energy efficiency have been found to elicit a backfire effect amongst energy efficient households and increased average energy use for this population segment (Schultz et al., 2007). Further observation of contradictory findings are that loss-frames were more persuasive when consumer concerns about climate change were low (Newman, Howlett, Burton, Kozup, & Heintz Tangari, 2012). Individuals with high climate change concern, were less susceptible to framing effects on decision outcomes. Thus, we explore how climate change loss- and gain-frames influence climate change attitudes and mitigation intentions. Figure 1 outlines the predicted pathway for eliciting TM responses resulting from exposure to negatively-focused climate change information.



*Figure 1.* TM model of predicted pathway to eliciting TM responses resulting from exposure to negatively-focused climate change information.

### **Present study**

The present study examined how different climate change communication frames may motivate possible existential threat-removing or self-protecting responses, which either help or hinder motivations towards environmental sustainability. A manipulation check was first performed to ensure that loss-framed climate change information, versus gain-framed climate change information and a no-threat control condition, elicited concerns about death. To date there has not been any empirical investigations into whether information about climate change results in unconscious concerns about death, which might indicate the mechanism driving these responses. Even research that has used a TMT framework to predict TM responses to climate change (Akil et al., 2018), or natural disasters (Mann & Wolfe, 2016),

have not tested whether implicit thoughts about death underlie the TM responses tested. Therefore, we first establish whether loss-framed climate change information elicits thoughts about death, when compared to other frames.

The main study examines TM responses as a result of climate change information exposure. These processes are examined separately as there is evidence that in testing the full TMT mediation model (i.e., that unconscious death-related thoughts intervene between MS and TM outcomes), thoughts about death are rendered conscious, consequently not eliciting distal effects, such as worldview defense or self-esteem striving outcomes (Greenberg, Pyszczynski, Solomon, Simon, & Breus, 1994; Hayes & Schimel, 2018; Spencer, Zanna, & Fong, 2005). Thus, to avoid such interference effects, we first tested for the prescience of death anxiety (manipulation check) before examining TM responses (main study). The study examined whether climate change threat information (loss- vs. gain-frame) would elicit material strivings and greater greediness observed when individuals were reminded about death (Kasser & Sheldon, 2000). To test the MS hypothesis, we also examined the extent of material strivings as a function of extrinsic values.

## **Method**

### **Manipulation check**

We performed a manipulation check for the premise that loss-framed climate change communications would elicit evidence of MS, when compared with the gain-frame and control conditions. To measure attentional bias (AB) towards death-related stimuli we used the dot probe task, which has been shown to be more effective than the more traditional death-word-fragment task to capture concerns about death (Naidu, Hine, & Glendon, 2020). Appendix A details participants, materials, procedure, and data exclusion criteria for the manipulation check.

Dot probe stimuli were categorised as: death-, threat-, and positive-related words. We used eight death-related words commonly used in TMT research to test death-thought accessibility (dead, grave, buried, coffin, murder, killed, skull, and corpse; Hayes, Schimel, Arndt, & Faucher, 2010). We also used eight threat- (e.g., criticism, betrayal) and positive-related (e.g., miracle, victory) words (Naidu et al., 2020). All death-, threat- and positive-related words were matched with 24 neutral words (e.g., phrase, broad) in length and word frequency.

An analysis of variance (ANOVA) on AB to death-related stimuli revealed a large condition effect,  $F(2,56) = 5.587, p = .006, \eta^2 = .17$ . A post hoc Tukey test demonstrated that reaction times (RTs) towards death-related stimuli in the loss-frame were slower than for the gain-frame ( $p = .038$ , Hedges'  $g = .83$ ), and control frame ( $p = .007$ , Hedges'  $g = .97$ ). As expected, the gain-frame and control frames did not differ in death AB ( $p = .914$ , Hedges'  $g = .13$ ). A post hoc power analysis using G\*Power showed sufficient power to detect an effect,  $1-\beta = 1.00$ . Thus, the manipulation check was deemed successful in confirming that only the loss-frame elicited attentional avoidance from death-related stimuli. This result suggested that participants directed their attention away from subsequent reminders of existential threat, possibly to reduce anxiety elicited by climate change threats. This finding is consistent with research showing slower response to death-related stimuli when testing AB (Eisma et al., 2014; Naidu et al., 2020; Yu et al., 2017), and threat-controlling responses (avoidance) in reaction to fear appeals (Witte & Allen, 2000).

There was a medium between-conditions effect for positive AB,  $F(2,56) = 2.431, p = .097, \eta^2 = .08$ , where AB to positive stimuli was fastest in the loss-frame and slowest in the gain-frame. There was no association between conditions for threat AB,  $F(2,56) = 0.907, p =$



.410,  $\eta^2 = .03$ . Table 1 shows descriptive statistics of reaction times (ms) to death-, threat-, and positive-AB stimuli by information frame.

Table 1. *Reaction times (ms) to death-, threat-, and positive- stimuli by information frame.*

| Measure     | Information frame       |           |                         |           |                      |           |
|-------------|-------------------------|-----------|-------------------------|-----------|----------------------|-----------|
|             | Loss-frame ( $n = 18$ ) |           | Gain-frame ( $n = 16$ ) |           | Control ( $n = 23$ ) |           |
|             | <i>M</i>                | <i>SD</i> | <i>M</i>                | <i>SD</i> | <i>M</i>             | <i>SD</i> |
| Death AB    | 13.77                   | 24.41     | -6.13                   | 22.20     | -9.15                | 22.21     |
| Threat AB   | 0.98                    | 37.11     | 0.80                    | 31.73     | -9.91                | 20.39     |
| Positive AB | -24.46                  | 54.25     | 3.23                    | 27.86     | -14.03               | 22.82     |

AB = Attentional bias

## Main study

### *Participants*

Participants were first-year psychology students ( $N = 136$ , 96 females, age range 17-56 years,  $M = 20.32$ ,  $SD = 5.86$ ) randomly assigned to a climate change loss-frame ( $n = 48$ , 36 females,  $M = 20.54$  years,  $SD = 5.66$ ), gain-frame ( $n = 45$ , 30 females,  $M = 20.36$  years,  $SD = 6.64$ ), and control ( $n = 43$ , 30 females,  $M = 20.02$  years,  $SD = 5.30$ ) conditions. There was no participant overlap between this study and the manipulation check. Participants completed all measures in person in a computer laboratory.

## ***Measures and procedure***

After providing demographic information, participants rated 42 possible aspirations on a 5-point scale (from 1 *not at all important* to 5 *very important*). Aspirations represented seven life domains: 1) self-acceptance, 2) affiliation, 3) community feeling, 4) physical fitness (health), 5) financial success (money), 6) social recognition, and 7) appealing appearance. Intrinsic versus extrinsic aspirations was calculated by averaging aspiration domains 1-4 (intrinsic value-orientation) and subtracting this from the average of aspiration domains 5-7 (extrinsic value-orientation). Higher scores reflected a stronger focus on extrinsic aspirations. This scale was used to determine the extent of participants' extrinsic and intrinsic values.

Participants were randomly assigned to one of three information conditions: 1) climate change loss-frame: "Failing to take action will cause rising sea levels that will pose a significant risk to coastal communities. This would mean that people's houses would be permanently under water"; 2) climate change gain-frame: "By lessening climate change we can reduce further increases to rising sea levels that pose a significant risk to coastal communities. This lessens the occurrence or reduces the impact that people's houses would be permanently under water." (Appendix B gives all loss- and gain-frame information statements), and 3) the ineffectiveness of multi-tasking as a neutral information control condition, "Multi-tasking more than two tasks means that the brain performs these tasks less effectively and is prone to make errors". The nine climate change loss- and gain-framed statements were matched in content and length. To maintain attention to the material, each statement was followed by a "Did you know?" with "Yes", "No", and "Unsure" responses.

Five true/false questions about each presentation were administered to test participants' comprehension and attention levels.

A distraction or cognitive load task is required to bypass suppression of death-related thoughts, thereby making it more likely to reveal distal TM outcomes (Burke, Martens, & Faucher, 2010). A commonly used distractor task in TMT research is the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). Participants were next asked to think 15 years into the future and to answer questions about their expected financial status in today's dollars (adapted from Kasser & Sheldon, 2000). They were asked to report expectations about their own salary, the worth of their home, possessions, and vehicles. These scores were averaged to create a materialism score. Participants then completed a resource dilemma task, which asked them to imagine they owned a timber company (adapted from Sheldon & McGregor, 2000). After reading the resource dilemma, participants indicated how many acres they wanted to harvest (measure of resource use) and on a 7-point scale (from 1 *not at all* to 7 *very much*), how much they would like to profit more than other companies (measure of greed), and how much they expected other companies to try and cut large amounts each year (measure of fear), taken from Kasser and Sheldon (2000).

Fourteen items revealed participants' concern (e.g., "How concerned are you about climate change?"), and perceived seriousness of climate change (e.g., "How serious of a threat do you believe that climate change is, to you personally?"). Participants rated each question using a 5-point scale (from 1 *extremely* to 5 *not at all*). Personal mitigation behavior was measured by eleven yes/no questions, taken from Ortega-Egea, García-de-Frutos, and Antolín-López (2014); (e.g., "You have chosen an environmentally friendly way of transportation – by foot, bicycle, public transport"). How likely participants were to report

continuing or starting each mitigation action, were measured using a percentage (0 = definitely not, 100 = definitely yes).

## Results

### Preliminary analyses

No differences existed between information conditions for age, sex, self-esteem, personal mitigation behavior, positive or negative affect, extrinsic-value-orientation ( $p > .05$ ,  $\eta^2 < .01$ ) and intrinsic-value-orientation ( $p = .145$ ,  $\eta^2 = .03$ ). Examining the PANAS items separately revealed a difference in reported attentiveness,  $F(2,104) = 3.786$ ,  $p = .026$ ,  $\eta^2 = .07$ . A post-hoc Tukey test revealed that participants exposed to the loss-framed climate change information reported feeling more attentive ( $M = 3.46$ ,  $SD = 1.12$ ) than did those exposed to the control frame ( $M = 2.71$ ,  $SD = 1.01$ ),  $p = .019$ , Cohen's  $d = 0.70$ . Reported attentiveness for participants exposed to the gain-frame ( $M = 3.12$ ,  $SD = 1.09$ ) was similar to both the control,  $p = .276$ , Cohen's  $d = 0.39$ , and loss-framed conditions,  $p = .368$ , Cohen's  $d = 0.31$ .

A logarithmic transformation was performed for the materialism score due to positive skewness. Three outliers ( $z$ -scores  $> 3SD$ ) remained post transformation. To reduce skewness and retain these data points, we used the winsorisation method: two outliers from the loss-frame and one from the gain-frame were changed to reflect the highest score in the distribution that was not an outlier. Some participants did not respond to all survey questions, and therefore some analyses included fewer data points than the total number of participants. In these instances, participant numbers are reported after each analysis.

## Hypothesis testing

An ANOVA including information frames as the between-participants factor, and materialism scores as the within-participants factor resulted in a moderate materialism effect,  $F(2,125) = 4.976, p = .008, \eta^2 = .07, 1-\beta = 1.00$ . A post-hoc Tukey test revealed that loss-frame participants demonstrated greater materialistic desires than did those exposed to the gain-,  $p = .048$ , Cohen's  $d = 0.47$ , and control frames,  $p = .010$ , Cohen's  $d = 0.65$  (**H1**).

Figure 2 displays a bar graph for materialistic strivings for each information frame. As expected, the gain and control information conditions did not differ in materialism responses,  $p = .805, \eta^2 < .01$ , Cohen's  $d = 0.16$ . A small effect of condition was found for harvest,  $p = .115, \eta^2 = .04$ , with participants exposed to the gain-frame reported wanting to harvest less ( $M = 29.38, SD = 24.27$ ) than those in the loss-frame ( $M = 34.56, SD = 22.13$ ), and control ( $M = 40.98, SD = 26.60$ ) conditions (**H2a**). However, no differences were found on reported greediness,  $p = .962, \eta^2 < .01$ , or fear, in the resource dilemma task,  $p = .370, \eta^2 = .02$ , not supporting **H2b** or **H2c**.

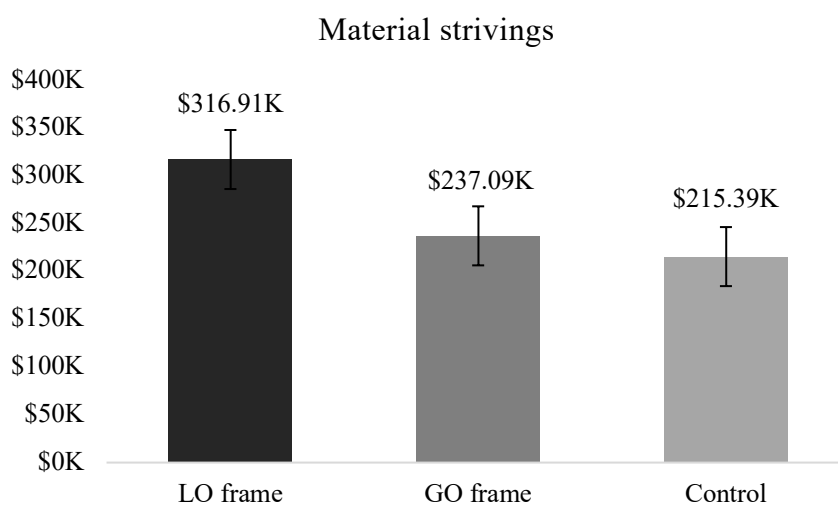
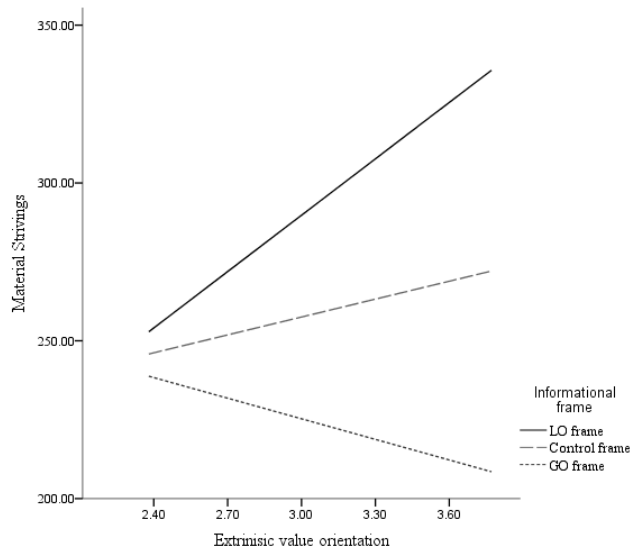


Figure 2. Materialistic strivings in the loss-outcome (LO;  $n = 44$ ), gain-outcome (GO;  $n = 43$ ), and control ( $n = 39$ ) informational frames.

To test **H3**, moderation analysis was run using the PROCESS Macro for SPSS (Hayes, 2013). Using materialism scores as the outcome variable, information frames as the predictor, and extrinsic-value orientation as the moderator, the overall model, including the interaction, showed a moderate effect,  $F(3,121) = 3.82, p = .012, R^2 = .087$ . Frame  $\times$  Value orientation explained a small amount of variance in materialistic tendencies ( $\Delta R^2 = .033$ ),  $F(1,121) = 4.346, p = .039$ . Simple slopes analyses revealed that the association between information frame and materialistic tendencies had an effect when participants' extrinsic-value-orientation was high ( $b = 23.87$ ),  $t(121) = -3.20$ , 95% CIs [-123.63, -29.13],  $p = .002$ , and moderate ( $b = 16.88$ ),  $t(121) = -2.51$ , 95% CIs [-75.83, -9.01],  $p = .013$ . Supporting **H3**, participants assigned to the loss-framed climate change information with strong extrinsic values, reported greatest material strivings compared with participants with strong extrinsic values assigned to the other information frames. There were no differences between information conditions for participants with a low extrinsic value-orientation ( $b = 23.04$ ),  $t(121) = -0.37$ , 95% CIs [-54.07, 37.16],  $p = .714$ . Figure 3 shows the Frame  $\times$  Extrinsic value-orientation interaction for predicting materialistic tendencies. As expected, testing for a Frame  $\times$  Intrinsic-value-orientation effect was almost zero ( $\Delta R^2 < .001$ ),  $F(1,103) = 0.014, p = .905$ , indicating no differences between frame conditions for materialistic desires at different levels of intrinsic value-orientation.



*Figure 3.* Regression lines showing associations between materialistic tendencies and extrinsic-value-orientation for each information frame.

There was little difference between all information frames and attitudes towards climate change (concern,  $p = .339$ ,  $\eta^2 = .02$ ; seriousness,  $p = .386$ ,  $\eta^2 = .01$ ), and intentions to engage in mitigation behavior ( $p = .463$ ,  $\eta^2 = .01$ ). Although differences were small ( $\eta^2 = .01-.02$ ) and non-significant ( $p < .05$ ), loss-frame condition participants reported higher climate change concern ( $M = 2.48$ ,  $SD = 1.27$ ), seriousness ( $M = 2.37$ ,  $SD = 1.36$ ), and mitigation intent ( $M = 2.37$ ,  $SD = 1.36$ ), than did those in the gain (concern:  $M = 2.81$ ,  $SD = 1.74$ ; seriousness:  $M = 2.41$ ,  $SD = 1.32$ ; mitigation intent:  $M = 2.41$ ,  $SD = 1.32$ ), and control (concern:  $M = 2.97$ ,  $SD = 1.70$ ; seriousness:  $M = 2.78$ ,  $SD = 1.72$ ; mitigation intent:  $M = 2.78$ ,  $SD = 1.72$ ) conditions.

### Exploratory analyses

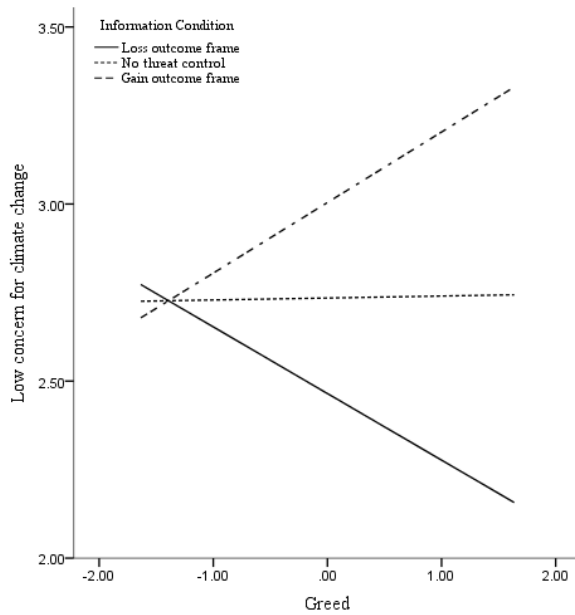
Post hoc exploratory analyses were conducted to examine other trends in the data. It should be noted however that with exploratory analyses comes an increase in finding an effect when none exists – i.e., a Type 1 error. Therefore, caution is advised when interpreting

the following exploratory findings. Evidence for the direction of findings found in the current study requires a further test of these specific variables and results to confirm the direction of results. However, out of interest the association between climate change variables was explored (e.g., concern), mitigation intent, and outcomes from the resource dilemma task (e.g., greediness and fear). Two potentially interesting associations were found.

Consistent with pre-existing attitudes, it was expected that those showing less climate change or mitigation intent would report higher greediness and fear. The first exploratory analysis found that the association between greed and climate change concern differed between information frames. The overall model, including the interaction term,  $F(3,110) = 3.208, p = .026, R^2 = .069$ , and interaction term by itself: Condition  $\times$  Greed, had a small effect on lack of climate change concern ( $\Delta R^2 = .041$ ),  $F(1,110) = 4.851, p = .030$  (see Figure 4). Simple slopes analysis revealed differences between information frames for climate change concern when greed was high ( $b = 0.24$ ),  $t(110) = 3.02$ , 95% CIs [0.25, 1.21],  $p = .003$ , and moderate ( $b = 0.18$ ),  $t(122) = 1.91$ , 95% CIs [-0.01, 0.69],  $p = .059$ . There were no between-condition effects for low greed ( $b = 0.26$ ),  $t(122) = -0.23$ , 95% CIs [-0.58, 0.46],  $p = .821$ . Unexpectedly, participants exposed to the loss-frame reporting highest greed also showed greatest concern for climate change, when compared with those in other information frames also reporting high greed.



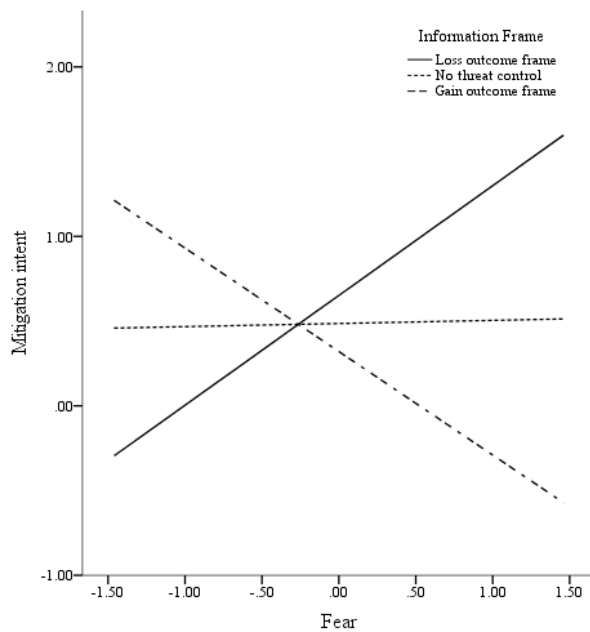
A second post-hoc analysis found a moderating effect between fear responses to a hypothetical resource dilemma task and climate change mitigation intent, between information frames. The overall model, which included the interaction term,  $F(3,110) = 3.24$ ,



$p = .025$ ,  $R^2 = .062$ , and the interaction term by itself: Frame  $\times$  Fear, had a small effect on mitigation intent ( $\Delta R^2 = .058$ ),  $F(1,110) = 8.16$ ,  $p = .005$ . Simple slopes analysis revealed differences between information frames for mitigation intent that were apparent when fear was high ( $b = 0.48$ ),  $t(110) = -2.71$ , 95% CIs  $[-2.27, -0.35]$ ,  $p = .008$ , but not when fear was moderate ( $b =$

$0.40$ ),  $t(110) = -0.50$ , 95% CIs  $[-0.99, 0.59]$ ,  $p = .618$ , or low ( $b = 0.62$ ),  $t(110) = 1.46$ , 95% CIs  $[-0.32, 2.14]$ ,  $p = .147$ . More specifically, participants exposed to the loss-frame who demonstrated the highest fear responses, reported greatest intentions to mitigate, when compared with those in other information frames with equal high fear responses. Figure 5 plots the simple slopes.

*Figure 4.* Regression lines for the association between climate change concern and greed for each information frame.



*Figure 5.* Regression lines for the association between fear and climate change mitigation for each information frame.

## Discussion

As climate impacts worsen, and news – often optimized for emotional impact – grows in frequency and intensity of negative content, TM responses to climate change coverage become increasingly important to research. This study sought to test the idea that using more alarming climate change language to promote action can lead to a backfire effect: an increased desire for status-showing symbols (e.g., expensive cars, houses), due to unconscious concerns about death. Such materialistic desires are antithetical to curbing climate change. It was reasoned that to understand the attitude–behavior gap as it relates to climate change and consumer behavior, it may be important to consider psychological underpinnings of material goods consumption. This is because curbing consumer

consumption to reduce greenhouse gas emissions may conflict with a desire to showcase success and worth, giving material possessions a TM function. Findings revealed the complex and sometimes counterintuitive nature of negatively focused framing effects on climate change attitudes and mitigation intentions.

When compared with gain-framed climate change information, participants exposed to loss-framed information reported increased materialistic desires (e.g., higher salary, expensive house/car). Materialistic desires were more pronounced when participants with strong extrinsic values were exposed to climate change threat (loss-framed information), compared with less threatening information (gain-framed and control information). This response pattern aligns with research examining MS effects on material strivings, TMT's MS hypothesis (Kasser & Sheldon, 2000), and with threat-reactance responses more broadly (Witte & Allen, 2011).

The manipulation check revealed that, relative to the other conditions, exposure to loss-framed climate change information elicited slower responses to death-related stimuli, revealing biased emotional attention to these stimuli. While threat detection is likely to be a mostly fast automatic process, attentional avoidance may be mostly a strategic response to death reminders. Exposure to negatively focused climate change information may motivate individuals to bolster impressions of the self as successful (Main study), which may result from motivations to attenuate concerns about mortality (manipulation check). In attempting to promote climate change action, communications relying on emotional and fear-based appeals could increase engagement with some of the very behaviors (e.g., increased desire for material/consumer goods) that increase greenhouse gas emissions. This is unsurprising given the link between negatively focused information and subsequent elicitation of avoidance and reactance responses (Witte & Allen, 2011). While loss-frame climate change communication

elicited greater materialistic desires, it did not motivate greediness tendencies – of which materialism is a prototypical feature (Seuntjens, Zeelenberg, Breugelmans, & Van de Ven, 2015). It could be that whilst climate change threat bolsters the desire to acquire status seeking symbols (material goods), it does not induce desires of wanting more (greed) when “more” does not fulfil motives of wealth and status display – operationalized here as a resource dilemma task.

Although the findings might initially suggest that loss-framed climate change information can elicit a backfire effect, the association between the threat-avoidance and threat-reactance hypotheses becomes less straightforward when considering how greed, fear, and materialistic desires interact with climate change attitudes and mitigation intentions. Post-hoc analyses revealed two interesting associations. After exposure to the loss-frame, participants with the greatest greed and fear responses during the hypothetical resource dilemma showed greater attitudinal shifts towards higher reported climate change concern and intentions to perform individual level mitigation, respectively. This was not observed in participants with high greed and fear responses exposed to other information frames. Thus, the present findings were counterintuitive as it was expected that participants reporting less positive attitudes towards climate change would show higher greed and fear-based responses. This is because individuals typically respond so as to reinforce pre-existing attitudes and worldviews, especially following exposure to psychological threat (Burke et al., 2010, 2013). Higher greed would also be presumed to motivate a desire to perceive climate change as low-risk, thereby justifying tendencies towards greed.

Overall, findings indicated that exposure to loss-framed climate change information motivated participants to reduce feelings of psychological threat. This may be achieved symbolically, such as through increased self-esteem striving (e.g., pursuit of status showing

symbols, greed), *and* by engaging in threat-focused strategies (e.g., higher climate change concern and greed, higher fear & mitigation intentions). Thus, when presented with opportunities to attenuate threat (existential or otherwise), individuals may be motivated to use these opportunities. These findings support the motivated social cognition framework, suggesting that people gravitate towards attitudinal or ideological shifts that fulfil psychological motives, even when they do not align with cultural worldviews (Jost, Glaser, Kruglanski, & Sulloway, 2003). This framework provides an explanation for conflicting research findings for TM responses, whereby research finds both worldview defence effects (exaggerated commitment responses; Burket et al., 2010), and conservative shifts (even amongst liberals) under MS conditions (Jost et al., 2003). Thus, individuals may adopt strategies that are seemingly contradictory (e.g., respond both with high greed and high climate change concern), in order to attenuate feelings of climate change threat. Overall, findings indicated it may be important that climate change appeals that elicit psychological threat are directly followed by opportunities that attenuate the perceived threat in ways that help rather than hinder environmental sustainability efforts.

Climate change concern, seriousness, and intentions to mitigate showed very few differences between conditions. Nevertheless, there was a consistent pattern of findings whereby loss-frame condition participants reported greater concern and seriousness for climate change than did those exposed to gain- and control frames. This suggests that, compared with a gain-frame, a loss-frame may motivate more positive attitudes towards climate change. However, as participants were first-year university psychology students, who often already tend to have liberal attitudes towards societal risk issues, this may have weakened the study's ability to detect larger meaningful shifts in positive climate change attitudes. Furthermore, the small differences could reflect research observing that individuals with greater climate change concern are less susceptible to framing effects (Newman et al.,

2012). Reported attentiveness was also higher for participants exposed to the loss-framed condition, compared to other frames.

## **Implications**

Study implications relate to how climate change information is communicated, and for consumer product advertising. Individuals have been shown to increase consumer purchase intentions after exposure to psychological threat (Cutright, 2012; Gao et al., 2009; Mandel & Heine, 1999; Mead et al., 2011). Consideration is advised for product advertising when audiences have been exposed to information conveying existential or worldview threat information, both of which may activate TM responses (Pyszczynski et al., 1999; Schimel et al., 2007). If exposure to existential threat information increases purchase intentions that reinforce important values (Ferraro et al., 2005), this may mean that some individuals increase their desire for products whose production, packaging, and distribution is harmful to the environment (pro-materialistic), whilst others may increase purchase intentions for sustainable products (pro-environmental; Akil et al., 2018).

Using Thaler and Sunstein's (2008) 'nudge theory', research has demonstrated that positive reinforcement, indirect and often unconscious priming, leads to decision simplification (for example, 'opting out' rather than 'opting in'), and to higher rates of non-forced compliance (Raihani, 2013). To reduce the likelihood of producing effects opposite to intended outcomes, interventions requiring a single decision (e.g., photovoltaic "solar" panel installation, recycling) are more likely to be successful than communications requiring a number of decisions. Following news segments or television programs that include death-related themes, advertisements for green consumer products could be presented to audience members, rather than advertisements for carbon increasing products (e.g., luxury cars and appliances). In this way, it may not be necessary to challenge entrenched values and attitudes

directly in order to achieve behavior change. Research is warranted to test whether these findings have wider practical implications.

### **Future directions and study limitations**

One limitation of cross-sectional research is that it is unclear how long framing impacts last. Longitudinal research might detect long-term consumption shifts in response to different framings. Whether this has impacts on behavior is another important research avenue. Frequent short-term threats from exposure to climate change information, combined with events that have been shown to invoke concerns about death (e.g., news media, peer discussions), may elicit distal defense strategies. Over time, consistent exposure to climate change threat could promote more lasting attitudinal shifts, thereby increasing cultural and self-esteem striving responses. This may result in continuing efforts to bolster appearance of worth and success by means of material consumption, especially for individuals with materialistic values. Results related to the exploratory analyses, although interesting, should be viewed with caution, as increasing the number of statistical tests also increases Type I error likelihood.

Although loss-framed climate change communication elicited an AB to death-related stimuli (manipulation check) and material strivings, relative to the gain-frame and control conditions, it was not ascertained whether the mechanism by which loss-framed climate change communication motivated material strivings was death-related concerns. This is a gap in the TMT literature at large, with few studies having tested the full mediation model. One reason for this may be that testing for death-related thoughts impacts subsequent responses, negating condition differences (Greenberg et al., 1994; Hayes & Schimel, 2018; Spencer et al., 2005).

This study did not control for psychological ‘closeness’ of climate change impacts, a variable known to influence attitudes and mitigation intentions towards climate change (Spence & Pidgeon, 2012). The information frames emphasized local, rather than distal effects of climate change, thereby eliciting higher psychological closeness of climate change impacts. Future research could investigate whether manipulating local and distal outcome frames differentially elicits death anxiety, and outcome responses. For greater practical utility, research could also investigate psychological responses to current news media representations of climate change.

## **Conclusion**

This study makes important contributions to the climate change, consumer research, TM, framing, and environmental communication literatures. First, a link between differential responses to biased attention of death-related stimuli between two climate change outcome frames was demonstrated. To the authors’ knowledge this study was the first to find empirical evidence that climate change information elicits unconscious concerns about death. A TMT framework may be useful in researching and predicting TM outcomes relating to coverage of climate change information.

As the threat of climate change increases, emphasizing its dire consequences may prompt individuals to reinstate a greater sense of meaning, control, and predictability in their lives. Climate change media coverage, especially focusing on mortality-related risks, may motivate individuals to attenuate feelings of threat by bolstering feelings of success and worthiness. This study observed a negative consequence of worldview affirming responses under climate change threat, whereby participants exposed to the loss-frame (vs. gain-frame) reported greater desires for material possessions. Climate change risk announcements may impact various life domains as a result of managing psychological threat.



Studies investigating how climate change reporting can impact climate change attitudes and risk perception should also investigate worldview affirming responses that may impact pro-environmental behaviors (e.g., consumer purchases). People's differing worldviews and values makes it important to investigate how to communicate the need to tackle climate change without motivating counter-productive behaviors, such as increased material strivings. Paradoxically, when exposed to climate change threat, participants reporting higher materialism and greed in a resource dilemma task were more likely to report the highest intent to mitigate climate change, and the greatest concern about climate change. Although exposure to climate changes emphasizing threat can motivate people to gravitate towards symbols of success and worth in material goods, especially when they have an extrinsic-value-orientation, these individuals may also show increased positive climate change attitudes. Even though individuals seek to reinforce their worldview beliefs, especially after threat, climate change responses may be able to bypass this system if the response option can alleviate threat.

## Appendix A:

### Manipulation check method

#### Participants

In part fulfilment of a course requirement, first-year psychology students (March–May 2018,  $N = 60$ , 43 females, age range 17-65 years,  $M = 23.85$ ,  $SD = 10.37$ ) were randomly assigned to the loss-frame ( $n = 20$ , 15 females,  $M = 23.60$  years,  $SD = 10.50$ ), gain-frame ( $n = 17$ , 13 females,  $M = 22.88$  years,  $SD = 9.78$ ), and multi-tasking (control) information conditions ( $n = 23$ , 16 females,  $M = 24.78$  years,  $SD = 11.05$ ). This protocol was approved by the authors' University Human Research Ethics Committee.

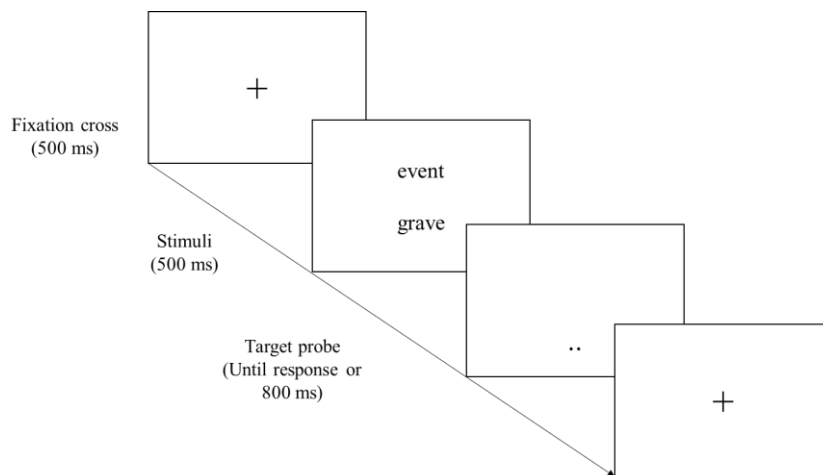
#### Measures and procedure

Participants were randomly assigned to one of three information conditions (see Appendix B for all loss- and gain-frame information statements). To maintain attention to the material, each statement was followed by a “Did you know?” with “Yes”, “No”, and “Unsure” responses. Five true/false questions about each presentation tested participants' comprehension and attention levels. Following this, the 20-item PANAS (Watson et al., 1988) was administered to bypass suppression of death-related thoughts, rendering them more accessible (Arndt, Greenberg, Solomon, Pyszczynski, & Simon, 1997; Greenberg et al., 1994). Following this, a dot probe task (Cisler & Koster, 2010; MacLeod, Matthews, & Tata, 1986) programmed using Presentation® software, was administered. The dot probe task has recently been shown to be a more superior measure of capturing concerns about death than the commonly used death-word-fragment task (Naidu, Hine, Glendon, 2020). Participants sat at a viewing distance of 70cm from the screen.

Dot probe stimuli were categorized as: death-, threat-, and positive-related words. We used eight death-related words commonly used in TMT research to test death thought

accessibility (dead, grave, buried, coffin, murder, killed, skull, and corpse; Hayes, Schimmel, Arndt, & Faucher, 2010). We also used eight threat- (e.g., criticism, betrayal) and positive-related (e.g., miracle, victory) words (Naidu et al., 2020). All death-, threat- and positive-related words were matched with 24 neutral words (e.g., phrase, broad) in length and word frequency.

Each trial began with a central fixation display (+) for 500ms, followed by a word pair presented simultaneously, one word to the top-middle and the other on the bottom-middle of the screen. A probe appeared for 500ms in the location of the death-, threat-, or, positive-related word (congruent presentation) or the neutral word (incongruent presentation). Figure 6 displays a congruent example trial for the death-related word category. Participants were instructed to differentiate between the two probes as quickly as possible by pressing the left or right arrow key when they observed one “.” or two “..” probes respectively. AB is inferred from difference in detection times to probes replacing threatening stimuli compared with probes replacing neutral stimuli (MacLeod et al., 1986). Participants initially completed 30 practice trials, which included all neutral word pairs, before completing the critical trials. Each 24-word pair was presented eight times, 2 (top vs. bottom screen presentation)  $\times$  2 (one vs. two probes)  $\times$  2 (repeated trials), resulting in 192 experimental trials completed in random order.



*Figure 6.* Congruent trial example for the death-related word category (probe located behind the death-related word, grave) in the dot-probe task.

### **Manipulation check results**

Participant responses were excluded if they were deemed to be “anticipatory” (below 200ms; Salemink, van den Hout, & Kindt, 2007), or “timed-out” (1500ms after stimulus onset), and if more than 10% of responses were incorrect. Three outliers ( $>3SDs$  beyond mean) were removed prior to analyses (two responses were from the loss-frame condition and one from the gain-frame). An AB index was computed by subtracting reaction times (RTs) for congruent presentations (probe located at positive-, threat- or death-related word) from incongruent presentations (probe located at neutral word). A positive AB index reflected facilitated attention towards the presentation category, while a negative AB index reflected attentional avoidance of the presentation category.

## Appendix B

Table 1. Loss- and gain-framed information statements

| Loss-frame  | Gain-frame  |
|---|---|
| Leading scientists advise that if we do not take action against climate change we will cause further increases to the frequency and intensity of extreme weather events. This may mean more dangerous flooding, bushfires, heat waves, droughts, and cyclones in Australia. | Leading scientists advise that by taking urgent measures to mitigate climate change we reduce further increases to the frequency and intensity of extreme weather events. This means a reduction to dangerous flooding, heat waves, bushfires, droughts, and cyclones in the future in Australia. |
| Failing to take action will cause rising sea levels that will pose a significant risk to coastal communities. This would mean that people's houses would be permanently under water.  | By lessening climate change we can reduce further increases to rising sea levels that pose a significant risk to coastal communities. This lessens the occurrence or reduces the impact that people's houses would be permanently under water.  |
| Failing to take action against climate change could mean that the world's oceans could become too acidic to support coral reefs and other calcifying marine organisms.  | By lessening climate change we can reduce the chance or damage of the world's oceans becoming too acidic to support coral reefs and other calcifying marine organisms.  |

|   |   |
|---|---|
| <p>Mosquito-borne diseases, such as dengue can lead to serious and sometimes life-threatening illnesses. Under moderately warmer and wetter climate conditions, there may be an increase in the prevalence of some mosquito-borne diseases in some parts of Queensland.</p> | <p>Mosquito-borne diseases, such as dengue can lead to serious and sometimes life-threatening illnesses. By mitigating climate change we can reduce the instances of moderately warmer and wetter climate conditions, which may lessen the prevalence of mosquito-borne diseases in some parts of Queensland.</p> |
| <p>A 2 degrees Celsius rise in average temperatures could force all endemic (i.e. unique to the region) Australian tropical rainforest vertebrates (such as ringtail possums, tree kangaroos and many insects) to extinction.</p>   | <p>Preventing a 2 degrees Celsius rise in average temperatures would reduce the likelihood of an endemic (i.e. unique to the region) of Australian tropical rainforest vertebrates (such as ringtail possums, tree kangaroos and many insects) to extinction.</p>   |
| <p>Without effective mitigation efforts, climate change is projected to cause an increase in the number of days in Brisbane above 35 degrees Celsius from 1 per year to up to 21 per year by 2070.</p>  | <p>With climate change mitigation, we can reduce the increase in the number of days in Brisbane above 35 degrees Celsius from 21 per year to 1 per year by 2070.</p>  |
| <p>Without mitigation climate change will increase the likelihood that Queensland will experience an increase in the proportion of</p>  | <p>Reducing further changes to the climate will reduce the likelihood that Queensland will experience an increase in the proportion of</p>  |

|   |   |
|---|---|
| tropical cyclones in the more intense categories (3-5).   | tropical cyclones in the more intense categories (3-5).   |
| With no mitigation, there may be thousands of total temperature-related deaths in Queensland, compared to a world with no human-induced climate change. | Reducing the impacts of climate change can prevent or reduce total temperature-related deaths in Queensland, potentially saving thousands of lives. |

### Chapter 7a: Study 3

One reason that climate change information is posited to elicit death anxiety is because climate change impacts are a reminder that nature is uncontrollable and so are its consequences. Because death is inevitable, reminders that we have no control over life events are likely to elicit death anxiety (Agroskin & Jonas, 2013; Koole & Van den Berg, 2005). Study 2 found evidence that exposure to loss-framed climate change information elicited attentional avoidance of death-related stimuli. Study 3 tests the idea that high climate change-response efficacy messages (i.e., the belief that one's actions can be effective in reducing climate change threat) may counteract TM responses found when participants are exposed to high threat communications (e.g., material strivings in Study 2). High climate change-response efficacy messages may increase the perceived control an individual feels that they have over the threat. Therefore, a message that individual action can have positive and significant impacts may serve a death-attenuating function. This study pairs outcome frames from Study 2 with a climate change-response efficacy message.

The extended parallel processing model (EPPM; Witte, 1992) was used to predict whether the loss-framed climate change threat information would elicit productive or counterproductive responses to climate change. According to the EPPM a danger control response is elicited when high-efficacy information accompanies high threat information. Danger control responses operate to reduce the actual threat by engaging in threat protective behaviours such as climate change mitigation. However, when low-efficacy information accompanies high threat information, a fear control response is elicited. A fear control response works to reduce the perceived psychological threat on the self. This can be achieved by choosing to perceive the threat as low.



The outcomes examined were differences in climate change mitigation intent and TM responses, worldview defence and material strivings, after exposure to one of the four climate change frame combinations: 2 [outcome frame: loss vs. gain]  $\times$  2 [efficacy frame: high vs. low]. Also examined was whether the framing manipulation (T1) impacted reported pro-environmental behaviours (PEBs): at T2 (3-5 days post manipulation), and at T3 (6-8 days post manipulation). PEBs are volitional behaviours, mostly taken at individual or household level, that minimise the negative impact of one's actions on the environment and that contribute to environmental sustainability. This design would allow for examining whether the more effective climate change frame for increasing mitigation intent observed in Study 1 had a sustained impact at these post-message exposure time periods.

This chapter includes a co-authored paper submitted for publication. The paper did not include all a priori hypotheses. Specifically, hypotheses related to TMT were not supported by study findings and so the submitted paper excluded these hypotheses and did not use a TM framework to interpret study findings. The submitted paper is currently under review with the *International Journal of Communication*. Bibliographic details, if accepted for publication, are: Naidu, P. A., Glendon, A. I., & Hine, T. J. (2020) Communicating response-efficacy to motivate climate mitigation intent. *International Journal of Communication*. The paper is included in its complete and original form before revisions suggested by anonymous reviewers. Table 7.1 shows research team contributions to the paper. Research questions and hypotheses (H<sub>1</sub>-H<sub>4</sub>) for Study 3 are presented below. Hypotheses not included in the submitted paper are denoted using letters (H<sub>A</sub>-H<sub>B</sub>).

*Q1: Which communication frame (2 [outcome frame: loss vs. gain]  $\times$  2 [efficacy frame: high vs. low] information frames) will motivate the greatest intentions to mitigate climate change?*

**H<sub>1</sub>:** Participants exposed to loss-framed climate change information, paired with a high response-efficacy message, will show higher mitigation intent (demonstrating a danger control response), compared with participants exposed to other climate change frames.

**H<sub>2</sub>:** Participants exposed to loss-framed climate change information, paired with a low response-efficacy message, will show lower mitigation intent (demonstrating a fear control response), compared with participants exposed to other climate change frames.

*Q2: Is climate change response efficacy the mechanism leading to mitigation intention?*

**H<sub>3</sub>:** Climate change-response efficacy (mediator; M) is the mechanism leading to higher degrees of mitigation intent (criterion; Y) after the efficacy manipulation (high or low efficacy message; explanatory variable; X).

Also examined was whether the T1 framing manipulation impacted reported PEBs: at T2 (3-5 days post manipulation), and at T3 (6-8 days post manipulation). This design allowed for examining whether the superior climate change frame observed immediately after exposure to the information had a sustained impact at these post-message exposure time periods.

**H<sub>4</sub>:** There will be a main effect for climate change response-efficacy, whereby participants exposed to the high response-efficacy condition will report higher PEBs at T2 and T3.

*Q3: Which communication frame (2 [outcome frame: loss vs. gain] × 2 [efficacy frame: high vs. low] information frames) will motivate the TM outcomes?*

**H<sub>A</sub>:** Individuals exposed to climate change information framed as a loss-outcome, paired with a low climate change response-efficacy message, will elicit the greatest level of TM responses such as worldview defence, when compared with individuals exposed to other climate change frames.

**H<sub>B</sub>:** Participants exposed to climate change information framed as a loss-outcome, paired with a low climate change response-efficacy message, will elicit the greatest level of TM responses such as material strivings, when compared with individuals exposed to other climate change frames.

Table 7.1.

*Statement of Contribution for Study 3.*

| Contributor                  | Contribution               |
|------------------------------|----------------------------|
| Naidu, P. A. (PhD candidate) | Designed study (90%)       |
|                              | Interpreted results (100%) |
|                              | Conducted study (100%)     |
|                              | Wrote paper (80%)          |
|                              | Edited paper (75%)         |
| Glendon, A. I. (Supervisor)  | Designed study (5%)        |
|                              | Wrote paper (10%)          |
|                              | Edited paper (15%)         |
| Hine, T. J. (Supervisor)     | Designed study (5%)        |
|                              | Wrote paper (10%)          |
|                              | Edited paper (10%)         |

(Signed) \_\_\_\_\_ (Date) \_\_\_\_\_

Priyanka A. Naidu

(Countersigned) \_\_\_\_\_ (Date) \_\_\_\_\_

Supervisor: A. Ian Glendon

(Countersigned) \_\_\_\_\_ (Date) \_\_\_\_\_

Supervisor: Trevor J. Hine

## **Chapter 7b: Communicating response-efficacy to motivate climate mitigation intent**

### **Abstract**

Despite public perceptions that climate change is currently the greatest threat to human life, individual behavioral mitigation engagement remains low. One reason for the disconnect between climate concern and action may be that individuals see their own behavior as having very little direct impact on climate change. In part 1 of this study, Australian participants ( $N=341$ ) were exposed to either information stressing consequences of unmitigated climate change (loss-frame) or to information emphasising advantages of mitigation (gain-frame). These outcome frames were paired with a message communicating individual-level engagement as having either a high or low impact on climate change (high vs. low climate change response-efficacy). Participants exposed to the high response-efficacy messages showed large increases in mitigation intent immediately after message exposure, beyond initial attitudes towards climate change, and independently of exposure to either a loss- or a gain-frame. Response-efficacy beliefs post-manipulation mediated the association between message frame and mitigation intent. Part 2 investigated whether the high response-efficacy message maintained its advantages in respect of reported pro-environmental behaviors (PEBs). There were no observable differences in PEBs between information conditions at 3-5 days or at 5-7 days post-information exposure. Overall findings suggested that messages promoting high climate change response-efficacy may be critical for increasing motivation for climate-related action. However, repeated message exposure may be needed for enduring impacts. As public responses will be essential in meeting global emission targets, study findings could benefit environmental advocates, risk communication researchers, media, and policymakers seeking to communicate the need for effective and urgent climate action.

Keywords: climate change, response-efficacy, outcome frame, helplessness, pro-environmental behaviors

## **1.0 Introduction**

The world is in the midst of a climate crisis (Ripple, Wolf, Newsome, Barnard, & Moomaw, 2020). Without urgent and collective action, anthropogenic (human-induced) climate change will result in catastrophic and potentially irreversible damage to human (e.g., public health, infrastructure, national security) and natural systems (Field et al., 2014; Masson-Delmotte, 2018; Pörtner et al., 2019). Impacts of natural disasters and extreme weather patterns aggravated by climate change are already being experienced across the world (Melillo, Richmond, & Yohe, 2014; Romero-Lankao et al., 2014; Yu, Xu, Abramson, Li, & Guo, 2020). The extensive 2019-20 bushfires across Australia, estimated to have burned 18.6 million hectares, is one example of a natural disaster exacerbated by climate change (Yu et al., 2020). These bushfires contributed to the loss of human life, the loss of more than one billion vertebrates, and the destruction of thousands of buildings and homes (University of Sydney, 2020). These bushfires emitted an estimated 306 million tonnes of CO<sub>2</sub>, representing over half of Australia's annual carbon emissions (Lee, 2019). Without preventive action, increases in the spread of deadly diseases (e.g., malaria, dengue, bluetongue, hanta viruses) can also be expected (Waltner-Toews, 2020), as well as extensive continuing species extinctions, mass population migrations, food shortages, and uninhabitable land (Field et al., 2014; Pörtner et al., 2019). To prevent a climate catastrophe, forecasts show that Earth's mean temperature must remain below a 1.5°C increase over the pre-industrial era (Masson-Delmotte, 2018; Ripple et al., 2020).

Scientific evidence clearly identifies humans' unsustainable high-carbon lifestyle as bearing primary responsibility for the mean rise in global temperatures (Cook et al., 2016).

To meet global emissions targets, drastic individual-level lifestyles changes will be necessary, alongside coordinated international climate response and robust government policies. The role of the public in addressing climate change risks will be instrumental (Dietz, Gardner, Gilligan, Stern, & Vandenberg, 2009). For example, household energy consumption alone contributes approximately 72% of greenhouse gas emissions globally (the remainder is attributed to government consumption & non-governmental financial sources; Hertwich & Peters 2009; Wilson et al., 2013). As electricity and heat production, agriculture, and transportation are the largest sources of global greenhouse gas emissions (Barker et al., 2007), actionable steps at individual and household levels can significantly reduce greenhouse-gas emitting behaviors (e.g., limit use of domestic cooling/heating systems, reduce meat/dairy consumption, increase use of public transport/carbon free alternatives; Edenhofer, 2014). Thus, the public's potential in reducing greenhouse gas emissions warrants increased policy attention.

### **1.1 Climate change communication**

Despite growing public perceptions that climate change is currently the greatest threat to human life, individual behavioral engagement remains low (Leiserowitz et al., 2019; Poushter & Huang, 2019). Yet whether and how individuals respond to climate change information can depend on how this is framed (Chapman & Lickel, 2016; Feinberg & Willer, 2011; Harrison & Mallet, 2013; Hine et al., 2016). Climate change communication can be optimized to increase action likelihood (Spence & Pidgeon, 2010), reduce reactance responses, such as increasing skepticism (Feinberg & Willer, 2011), and behavioral disengagement (Salomon, Preston, & Tannenbaum, 2017). As the public has an enormous potential in reducing climate risks, understanding psychological mechanisms driving climate

change action, and how to enhance climate change reporting to increase behavioral engagement is imperative.

**1.1.1 Climate change outcome framing.** Frequently used within climate change reporting is *loss-framed* information – manipulated to emphasize losses resulting from unmitigated climate change (Hulme, 2008; Nisbet, 2009; O’Neill et al., 2014; Spence & Pidgeon, 2010). In the attempt to capture public attention and drive climate engagement sections of the media, environmental advocates, and some policy makers emphasise the most severe consequences of unmitigated climate change. In doing so, climate change discourse is frequently accompanied with thematic content depicting mortality, suffering, and devastation in the wake of climate impacts (Höijer, 2010; Hulme, 2008; Lester & Cottle, 2009; Pantti, 2010; Smith & Joffe, 2009). Conversely, information can be framed to emphasize benefits of climate change mitigation (*gain-frame*). Manipulating outcome frames to emphasise for example, lives lost (loss-frame) vs. lives saved (gain-frame) has been shown to influence decision making (Davis, 1995).

Loss-framed climate change information is frequently used to persuade the public. However, there have been mixed findings regarding the utility of loss-framed climate change information. On one hand, compared to gain-frames, loss-frames have been found to be more effective in influencing more positive climate change attitudes and behaviors (e.g., Davis, 1995; Spence & Pidegon, 2010; Witte & Allen, 2000). On the other hand, loss-frames can be ineffective or produce a boomerang effect to generate attitudes or behaviors opposite to those intended (e.g., Byrne & Hart, 2009; Cho & Sands, 2011; Quick, Kam, Morgan, Montero Liberona, & Smith, 2015; Spence & Pidgeon, 2010). The extent to which a gain or loss frame is more effective may depend on a number of moderating or mediating factors (e.g., feelings of fear, guilt, hope, and uncertainty, information processing or psychological distance;

Bilandzic, Kalch, & Soentgen, 2017; Morton, Rabinovich, Marshall, & Bretschneider, 2011; Spence & Pidgeon, 2010).

**1.1.2 Combating climate change helplessness.** Illustrating the extensive scale and devastating impacts of climate change may leave some audience members feeling anxious (Gifford & Gifford, 2016; Lee, 2019), fearful (Spence & Pidgeon, 2010), or powerless (Norgaard, 2006, 2011). Rather than motivating climate action, emphasising the magnitude of the problem may instead lead to perceptions that individual efforts to mitigate climate change are futile (Hmielowski, Donaway, & Wang, 2019; Norgaard, 2006, 2011). Messages about societal threat that trigger fear (e.g., loss-framed climate information; Spence & Pidgeon, 2010), without also offering a solution to reduce the threat, may result in *climate change helplessness* – the belief that climate change is beyond personal control and/or that individual action will have little or no impact (Salomon et al., 2017). Ironically then, rather than encouraging behavioral engagement, emphasising the worst consequences of climate change may backfire by increasing disengagement. Thus, one key factor determining loss-frame success may be individuals' experience of climate change helplessness.

Climate change helplessness expands a term borrowed from Seligman (1975), who introduced the concept of *learned helplessness*. Seligman posited that beliefs in a lack of control over aversive events leads to deficits that may be motivational/behavioral (e.g., unwillingness to take action), cognitive (e.g., believing that circumstances are not under one's control), or emotional (e.g., anxiety, depression). Public responses to climate change resemble Seligman's proposed deficits for learned helplessness, such as the discrepancy between climate concern and climate action (motivational), feeling powerless over the changing climate (cognitive), and climate-related anxiety and depression (emotional; Norgaard, 2006, 2011; Salomon et al., 2017). Trait learned helplessness, a domain-free



disposition to behave helplessly, has been shown to moderate the association between environmental concern and positive attitudes and behaviors towards environmental engagement (Landry, Gifford, Milfont, Weeks, & Arnocky, 2018). Environmental concern most strongly predicted behavior when learned helplessness scores were low, whilst controlling for depression, anxiety, and stress symptoms.

A characteristic of climate change that lends itself more easily to the experience of climate change helplessness is that the impact of individuals' own mitigation efforts are not observable. As the negative consequences of one's own high-carbon lifestyle on climate change are not discernable, neither are the impacts of deciding to reduce one's carbon footprint. For instance, it is difficult to witness our own actions (e.g., acting on a decision to decrease domestic cooling/heating) as having a direct impact on increasing global temperatures and its associated consequences.

Despite considerable media commentary on climate change impacts and the need for immediate action, there has been relatively less discussion about the impact of human behavior in meeting emission targets. Climate change coverage in widely read US newspapers (e.g., *New York Times*, *Wall Street Journal*) reveals limited discussion regarding individual actions to mitigate climate change (Feldman, Hart, & Milosevic, 2017). In the small number of articles in which mitigation was discussed, this was often separated from information about climate impacts (Feldman et al., 2017; Hart & Feldman, 2014). Therefore, information about climate change's extensive and dangerous impacts, which may cause high levels of distress (Gifford & Gifford, 2016), are often not paired with information educating readers on how they can reduce those impacts, thereby forgoing a potential opportunity to combat climate change helplessness (Hart & Feldman, 2014). This is especially important given that a 2019 Yale University survey found that more than half the respondents reported

feeling “helpless” about climate change (Leiserowitz et al., 2019). Such a state may increase the likelihood of behavioral disengagement (Hmielowski et al., 2019).

One way to address climate change helplessness is by linking individual-level behavioral engagement to its impact on climate change. Salomon et al. (2017, Study 1) found that higher climate change *response-efficacy* was associated with greater intentions to conserve energy. – Response-efficacy is the belief that one’s own individual action (e.g., reducing domestic electricity consumption) can be effective in reducing climate threat. Salomon et al. (2017, Study 2) further examined whether response-efficacy could be manipulated. The climate change messages communicated either: i) that individual-level mitigation was easy to implement and would have a strong impact on climate change (high-response efficacy), or ii) was difficult to implement and had very little impact on climate change (low-response efficacy). Participants exposed to the high response-efficacy message showed greater energy conservation intentions, and lower energy consumption one week later (Study 3) compared with those exposed to the low response-efficacy message, thereby demonstrating a sustained advantage for climate change high response-efficacy. Climate change news stories provide inconsistent efficacy messaging, often including both positive and negative efficacy cues (Hart & Feldman, 2014). Coverage of climate change information communicating high response-efficacy may be critical to driving climate action.

## **1.2 Theoretical framework**

The extended parallel process model (EPPM; Witte, 1992) is applied as an interpretative framework to predict responses as a result of exposing individuals to negatively focused climate change information and differential response-efficacy messages. Witte (1992) developed the EPPM as a response to the literature demonstrating differential post-exposure responses to fear appeals. He sought to understand why communicating threat information is

sometimes effective (e.g., threat removal responses) and ineffective at other times (e.g., threat denial responses) in motivating positive attitudes and behaviors related to a threat. For instance, exposure to personally threatening information can motivate removal of a threat by engaging in protective behaviors (e.g., increase exercise, quit smoking, apply sunblock, green behavior), *or* alternatively, motivate adoption of cognitive strategies allowing individuals to defend themselves psychologically from the threat by perceiving it as low – such as by denial, avoidance, or minimisation (Pyszczynski et al., 1999; Witte & Allen, 2011). Using the EPPM can enhance understanding and prediction of the association between exposure to loss-framed climate change threat information and subsequent (adaptive or maladaptive) responses to threat (Popova, 2012).

The EPPM proposes that fear is elicited after an individual appraises the threat in question as moderate-to-high. Spence and Pidgeon (2010) found that when compared with exposing individuals to gain-framed climate change threat information, loss-framed information elicited higher fear. Language used in a loss frame is often more emotive (compared with that used in a gain-frame) and has been referred to as “fear framing” (Spence & Pidgeon, 2010). The EPPM posits that once a fear response is elicited, individuals are motivated to evaluate the efficacy of the recommended response.

Witte (1992) differentiated between two types of efficacy: *self-efficacy* – an individual’s belief in their competency to take an action, and *response-efficacy* – an individual’s belief that the action will be effective in reducing the threat (Witte, 1992). The present study focuses on manipulating levels of climate change response-efficacy. Whether perceived efficacy is high or low is posited to impact which control processes are executed, these processes being danger control or fear control response.

**1.2.1 Danger control response.** A danger control response is activated when both perceived threat and efficacy are high. Danger control responses include engagement in protective behaviors (e.g., reducing carbon emitting behaviors), increased intentions to perform behavior (e.g., high mitigation intent), and greater threat perceptions (e.g., climate change as high-risk). Therefore, exposure to information about societal risk issues such as climate change threat may increase mitigation intent and *pro-environmental behaviors* (PEBs) but only if strong threat information (loss-framed; Spence & Pidgeon, 2010) is accompanied by information communicating the efficacy of relevant individual-level action (Kim, Jeong, & Hwang, 2013; Witte, 1992). PEBs are volitional behaviors, mostly taken at individual or household level, that minimize the negative impact of one's actions on the environment and that contribute to environmental sustainability (e.g., reducing energy consumption, recycling, environmental activism; Kollmuss & Agyeman, 2002).

**1.2.2 Fear control response.** A fear control response is activated when the perceived threat is high, but perceived efficacy is low. Activated by exposure to the threatening information, the fear control response is thought to intensify when individuals believe that it is not within their power to counter the threat (e.g., low climate change response-efficacy). This motivates maladaptive defensive psychological responses to reduce the perceived threat. Individuals may use cognitive strategies such as threat denial, avoidance, minimization, or projecting the threat into the distant future. The EPPM provides an explanation as to why climate change commentary that emphasizes dire consequences may lead people to reduce the perceived threat by using counterproductive fear control responses (e.g., increased levels of climate change skepticism; Feinberg & Willer, 2011; Kellstedt, Zahran, & Vedlitz, 2008). Gain-frame messages are not expected to induce fear and therefore unlikely to produce sufficient motivation to engage either of the control (danger vs. fear) processes.

The EPPM has received considerable support, including cross-culturally (Kim et al., 2013; Lewis, Watson, & White, 2013; Peters, Ruiter, & Kok, 2013; Xue et al., 2016). Among American and Korean students, when climate change was perceived as high threat, greater self-efficacy and response-efficacy were associated with higher mitigation intent (Kim et al., 2013). Xue et al. (2016) found full support for a mediated EPPM, whereby differential perceived efficacy (response and self) was the mechanism that led to either a danger or fear processing response. The high threat – high efficacy message elicited higher perceived efficacy, which in turn predicted: i) greater intent to seek out more information and to take action (danger control response), as well as ii) lower levels of message rejection and threat denial (fear control response).

Outside the realm of sustainability, high self-efficacy and/or response-efficacy has been linked with increased adaptive intentions and behaviors, such as eating more fruit and vegetables (Napper, Harris, & Klein, 2013), engaging in sports activity (Yun & Berry, 2018) hand-washing (Botta, Dunker, Fenson-Hood, Maitarich, & McDonald, 2008), and behaviors that reduce the likelihood of contracting human papilloma virus (Carcinopolo et al., 2013), and other sexually transmitted diseases (Block & Keller, 1995).

### **1.3 The current study**

The rationale for this study was to investigate whether information about climate change that communicates individual action (i.e., communicating high climate change response-efficacy – e.g., turning down the thermostat) can increase mitigation intent (Part 1), and increase reported PEBs (Part 2). Increased behavioral engagement is associated with beliefs that engaging in PEBs will have positive mitigating consequences for climate change (Bradley, Babutsidze, Chai, & Reser, 2020; Salomon et al., 2017; Xue et al., 2016), and therefore communications that empower individuals by priming high climate change

response-efficacy are likely to be important. Since climate change reporting has consistently employed a loss-frame (Hulme, 2008; Nisbet, 2009; O'Neill et al., 2014; Spence & Pidgeon, 2010), we investigate whether loss-frame success is dependent on individuals' response-efficacy beliefs.

The present study investigates the most effective information condition (outcome frame: loss vs. gain-frame, and response-efficacy: low vs. high) for motivating mitigation intentions. Figure 1 outlines expected responses post climate change threat information. Using insights from EPPM (Witte, 1992), and past research (Salomon et al., 2017; Witte & Allen), these hypotheses were tested.

**H1:** Participants exposed to loss-framed climate change information, paired with a high response-efficacy message, will show higher mitigation intent (demonstrating a danger control response), compared with participants exposed to other climate change frames.

**H2:** Participants exposed to loss-framed climate change information, paired with a low response-efficacy message, will show lower mitigation intent (demonstrating a fear control response), compared with participants exposed to other climate change frames.

**H3:** Climate change-response efficacy (mediator; M) leads to higher degrees of mitigation intent (the outcome; Y) after the efficacy manipulation (high or low efficacy message; the explanatory variable; X).

Also examined was whether the T1 framing manipulation impacted reported PEBs: at T2 (3-5 days post manipulation) and T3 (6-8 days post manipulation). This design allowed for examining whether the superior climate change frame observed immediately after exposure to the information had a sustained impact at these post-message exposure time periods.

**H4:** There will be a main effect for climate change response-efficacy, whereby participants exposed to the high response-efficacy condition will report the highest PEBs at T2 and at T3.

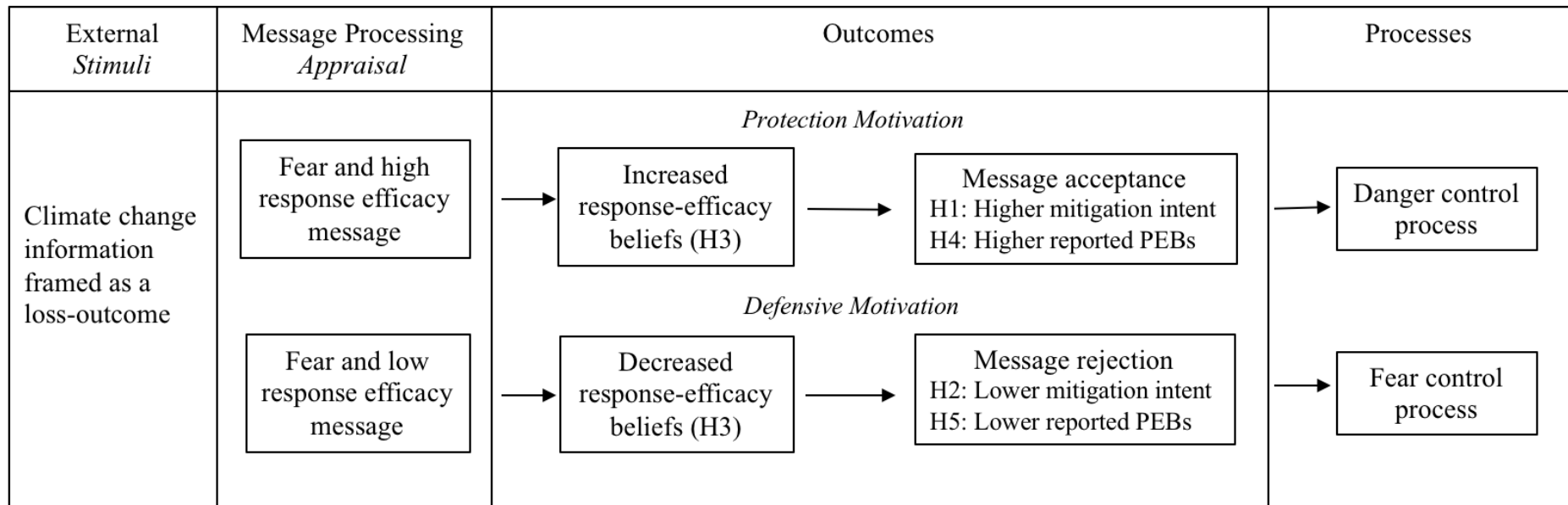


Figure 1. Study hypotheses based on the Extended Parallel Processing Model



## 2.0 Method

### 2.1 Participants

An a priori power analysis was performed for a one-way ANOVA for four conditions. Using G\*Power these parameters were entered: medium effect size ( $f = .25$ ),  $\alpha = .05$  and  $1-\beta = .95$ . For a high-powered test, a minimum sample size of 280 was required (70 participants per information condition). First-year psychology students participated for course credit, and a convenience sample was recruited through social media ( $N = 341$ , 249 females, 89 males, 3 identifying as 'other'; age range 17-69 years,  $M = 23.84$ ,  $SD = 10.58$ ). Data were collected February-September 2019, spanning two teaching periods. Participants were randomly assigned to receive one of the climate change outcome frame manipulations: 1) loss-frame, low-efficacy ( $n = 88$ ), 2) loss-frame, high-efficacy ( $n = 86$ ), 3) gain-frame, low-efficacy ( $n = 84$ ), and 4) gain-frame, high-efficacy ( $n = 83$ ).

Part 1 participants were invited to participate in two follow-up studies. Part 2 included 197 participants from part 1 (overall attrition rate 42.23%): loss-frame, low-efficacy ( $n = 44$ ), 2) loss-frame, high-efficacy ( $n = 44$ ), 3) gain-frame, low-efficacy ( $n = 52$ ) and, 4) gain-frame, high-efficacy ( $n = 57$ ) conditions. There were no differences in mitigation intent scores for participants across T1-T2,  $F(1,342) < .001$ ,  $p = .989$ ,  $\eta^2 < .01$ .

Part 3 included 168 Study 1 participants (attrition rates: part 1 = 50.70%; part 2 = 14.7%): loss-frame, low-efficacy ( $n = 41$ ), 2) loss-frame, high-efficacy ( $n = 39$ ), 3) gain-frame, low-efficacy ( $n = 39$ ) and, 4) gain-frame, high-efficacy ( $n = 49$ ) conditions. There were no differences in mitigation intent scores for participants across T1-T3  $F(2,310) = 0.621$ ,  $p = .538$ ,  $\eta^2 < .01$ , and T2-T3  $F(1, 200) = 1.233$ ,  $p = .268$ ,  $\eta^2 = .01$ . Two participants did not complete all PEB items at T3 and these participants scores were removed ( $n = 168$ ). When looking at each PEB item separately, all participants' scores were used ( $ns = 169$  or 170).

## 2.2 Procedure

The study was described as “investigating climate change attitudes and energy behavior”. Participation consisted of an online survey completed at participants’ convenience. Measures for Part 1 comprised: climate change attitudes, random assignment to one of four information conditions (2 [outcome frame: loss vs. gain]  $\times$  2 [efficacy message: high vs. low]), self-efficacy manipulation check, climate change behavioral intentions, and demographic data.

Participants were informed that parts 2 and 3 extended the initial study. They were emailed the Part 2 link three days after completing Part 1, and (for those participating in Part 2) the Part 3 link three days after completing Part 2, in both instances being informed that responses were required within two days of receiving the link. Thus, Part 2 responses were from participants completing the survey 3-5 days (T2) after Part 1. Part 3 responses were from participants completing the survey 6-8 days (T3) after Part 1. The survey measured general motivations to conserve, mitigation behavior, and climate change attitudes (as Study 1; concern, seriousness, and preparedness to take action).

## 2.3 Measures for Part 1

**2.3.1 Climate change attitudes.** To ascertain participants’ climate change beliefs, we distinguished between different perceived causes of climate change: “natural” (non-human-induced), and “anthropogenic”. Questions were from Greenhill, Leviston, Leonard, and Walker (2013; See Appendix A). Participants were then asked about their climate change attitudes, (adapted from Reser, Bradley, Glendon, Ellul, & Callaghan, 2012): “How concerned, if at all, are you about climate change, sometimes referred to as “global warming?”, “If nothing is done to reduce climate change in the future, how serious a problem do you think it will be for the world?” and, “I am prepared to greatly reduce my energy use to

help tackle climate change.” Participants responded by selecting options 1 (*Very concerned/serious/prepared*) to 4 (*Not at all concerned/serious/prepared*).

### **2.3.2 Manipulations**

**Outcome frame.** Participants were randomly assigned to either: 1) Loss-framed climate change information or, 2) Gain-framed climate change information (see Appendix B for loss- and gain-framed information). To maintain attention to the material, each statement was followed by a “Did you know?” with either “Yes”, “No”, or “Unsure” response options. Participants’ comprehension and attention were tested with five true/false questions about each presentation.

**Efficacy message.** Adapted from Salomon et al. (2017, Part 2), participants were randomly assigned to information that either described climate change mitigation at the individual-level as easy and impactful (high response-efficacy message) or as inconvenient and having little, if any, impact on climate change (low response-efficacy message (See Appendix B). Four questions on climate change efficacy, taken from Salomon et al. (2017, Part 2), were used as a manipulation check.

**2.3.3 Climate change behavioral intentions.** Participants were presented with ten energy conservation behaviors (See Appendix C for all items) and were instructed to rate how strongly they intended to take the action described in the next year on a scale from 1 (*Not at all*) to 7 (*Definitely*).

**2.3.4 Demographic data.** Participants indicated their age, sex, and education level.

## 2.4 Measures for Part 2 and 3

**2.4.1 General motivation to conserve.** Adapted from Salomon et al. (2017) participants were asked to rate these items on a scale from 1 (*Strongly disagree*) to 7 (*Strongly agree*): 1) “In general, I have been more aware of my energy use and waste in the last week”, 2) “I have made an effort to conserve energy in the last week”, 3) “I have made an effort to reduce waste in the last week” and, 4) “In general, I am motivated to reduce my energy use and waste in the future.”

**2.4.2 PEBs.** Participants were asked to report the frequency with which they had performed certain behaviors over the past week, compared with a typical week. This measure was adapted from Salomon et al. (2017). Scale items are in Table 4. Options were “much less than normal, same as normal, and much more than normal”. Items 1, 3, 5, and 6 were reverse scored to provide a total PEB measure (Appendix D shows scale items).

## 3.0 Results

### 3.1 Preliminary statistics for T1

There were no univariate differences between information conditions on perceived causes of climate change,  $F(1,342) = 0.16, p = .690, \eta^2 < .01$ , climate change attitudes,  $F(1,342) < 0.001, p = .997, \eta^2 < .01$ , age,  $F(1,340) = 1.77, p = .185, \eta^2 = .01$ , sex,  $F(1,340) = 1.09, p = .298, \eta^2 = .01$ , or education,  $F(1,340) = 0.14, p = .905, \eta^2 < .01$ .

### 3.2 Manipulation check

The manipulation check ( $\alpha = .82$ ) demonstrated a large effect on reported climate change efficacy between information conditions,  $F(3,342) = 55.57, p < .001, \eta^2 = .33$ . A post hoc Tukey test found significant differences between high and low efficacy messages on reported

climate change response-efficacy, indicating a successful manipulation (see Table 1). Response-efficacy between the loss-frame (low efficacy vs. high efficacy, 95% CIs [-1.338, -.777],  $p < .001$ ) and gain-frames were evident (low efficacy vs. high efficacy, 95% CIs [-1.217, -.645],  $p < .001$ ). As expected, there were no differences for climate change efficacy between outcome frames when the efficacy message was the same ( $p = .324$ ,  $\eta^2 < .01$ ).

### 3.3 Initial climate change attitudes

“I think that climate change is happening”, and “I think that human activities are largely causing it” was the most common option selected. Most participants indicated that they were very concerned about climate change and perceived it as a very serious problem. Smaller percentages expressed preparedness to reduce energy use to tackle climate change, whereby the most common option selected was “Somewhat prepared” (Appendix A shows descriptive statistics for climate change attitudes and perceptions).

### 3.4 Hypothesis testing

**3.4.1 Behavioral intentions.** We performed a 2 (outcome frame)  $\times$  2 (response-efficacy message) ANOVA (H1) to examine the effect of information condition on differences in climate change behavioral intentions ( $\alpha = .78$ ). There was no significant response-efficacy  $\times$  outcome frame interaction for predicting behavioral intentions,  $F(3,342) = 0.08$ ,  $p = .784$ ,  $\eta^2 < .01$ . There was no main effect for outcome frame on behavioral intentions,  $F(3,342) = 0.26$ ,  $p = .871$ ,  $\eta^2 < .01$ . However, there was a main effect for response-efficacy on behavioral intentions,  $F(1,342) = 12.22$ ,  $p = .001$ ,  $\eta^2 = .04$ . Compared with exposure to the low response-efficacy messages, behavioral intentions were higher post-exposure to the high response-efficacy messages (see Table 1). Participants exposed to the loss-framed high efficacy message showed greater behavioral intentions than did those exposed to the loss-framed low

efficacy message (95% CIs [.010, .480],  $p = .037$ ) and to a lesser extent, the gain-framed low efficacy message (95% CIs [-.001, .476],  $p = .051$ ).

Examining intentions to engage in each pro-environmental behavioral separately revealed some condition effects (descriptive statistics are in Appendix C). Post hoc comparisons using the Tukey HSD test indicated that intentions to recycle items at home,  $F(3,342) = 4.96$ ,  $p = .002$ ,  $\eta^2 = .04$ , was higher amongst participants exposed to the gain-frame, high-efficacy message ( $M = 4.83$ ,  $SD = 0.41$ ) when compared to the loss-framed, low-efficacy ( $M = 4.48$ ,  $SD = 0.85$ ,  $p = .006$ ) and gain-frame, low-efficacy conditions ( $M = 4.54$ ,  $SD = 0.86$ ,  $p = .029$ ), but not to the loss-framed, high-efficacy condition ( $M = 4.74$ ,  $SD = 0.54$ ,  $p = .836$ ). Although, a one-way ANOVA indicated differences in intentions to buy recycled paper,  $F(3,342) = 2.79$ ,  $p = .040$ ,  $\eta^2 = .02$ , post hoc comparisons showed no differences between conditions (at  $p < .05$ ). Despite this, results showed that exposure to the gain-frame, high-efficacy message revealed greater intentions to buy recycled paper ( $M = 4.29$ ,  $SD = 1.03$ ) then did the other information frames (loss-framed, low-efficacy  $M = 3.90$ ,  $SD = 1.06$ ; gain-framed, low-efficacy  $M = 3.88$ ,  $SD = 1.11$ ; loss-framed, high-efficacy  $M = 4.12$ ,  $SD = 1.06$ ).

Participants exposed to the loss-framed, high-efficacy message ( $M = 4.64$ ,  $SD = 0.76$ ) showed greater intentions to drink tap water than bottled beverages,  $F(3,342) = 3.98$ ,  $p = .008$ ,  $\eta^2 = .03$ , when compared to the loss-framed, low-efficacy condition ( $M = 4.19$ ,  $SD = 1.17$ ,  $p = .008$ ), but not compared to the gain-frame, low-efficacy condition ( $M = 4.54$ ,  $SD = 0.92$ ,  $p = .857$ ) or the gain-framed, high-efficacy condition ( $M = 4.56$ ,  $SD = 0.88$ ,  $p = .998$ ).

Furthermore, greater intentions to write to representatives about environmental concerns,  $F(3,342) = 2.72$ ,  $p = .045$ ,  $\eta^2 = .02$ , were found in the loss-framed, high-efficacy condition ( $M = 2.93$ ,  $SD = 1.24$ ) compared to the gain-frame, low-efficacy condition ( $M = 2.40$ ,  $SD = 1.28$ ,

$p = .038$ ), but not compared to the loss-framed, low-efficacy ( $M = 2.52$ ,  $SD = 1.14$ ,  $p = .141$ ) or the gain-framed, high-efficacy condition ( $M = 2.57$ ,  $SD = 1.22$ ,  $p = .259$ ).

Table 1.

*Reported efficacy, mitigation intent, and behavioral engagement at three time periods for each information frame*

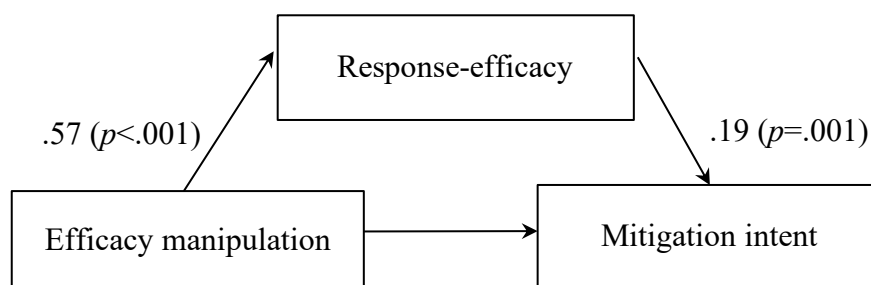
| Information condition                | Loss/Low     | Loss/High    | Gain/Low     | Gain/High    |
|--------------------------------------|--------------|--------------|--------------|--------------|
|                                      | <i>M(SD)</i> | <i>M(SD)</i> | <i>M(SD)</i> | <i>M(SD)</i> |
| Efficacy* ( $n=343$ )                | 2.32(0.82)   | 3.38(0.55)   | 2.47(0.89)   | 3.40(0.54)   |
| Mitigation intent T1* ( $n=343$ )    | 3.96(0.70)   | 4.21(0.56)   | 3.97(0.62)   | 4.18(0.51)   |
| Behavioral engagement T2 ( $n=197$ ) | 1.95(0.17)   | 1.98(0.20)   | 1.96(0.22)   | 1.98(0.18)   |
| Behavioral engagement T3 ( $n=168$ ) | 2.03(0.19)   | 1.95(0.23)   | 1.97(0.16)   | 1.96(0.18)   |

*Note \* Indicates difference between response variable and information frame*

To examine the extent to which efficacy and outcome information conditions predicted behavioral intentions beyond individual beliefs in climate change, attitudes prior to information exposure-climate concern, seriousness, and preparedness to act, a hierarchical multiple regression analysis was performed with behavioral intentions as the criterion variable. Climate change attitudes were entered at Step 1, and information condition at Step 2. In model 1, climate change attitudes accounted for substantial variance in mitigation intentions,  $F(1,342) = 113.40$ ,  $p < .001$ ,  $R^2 = .25$ . Information conditions accounted for an

additional 3.3% of the variance in mitigation intention,  $\Delta F(3,342) = 44.95, p < .001, \Delta R^2 = .29$ . In model 2, all predictors accounted for 53.3% of the variance in mitigation intent,  $R^2 = .29$  (adjusted  $R^2 = .28$ ). Examining each unique predictor for model 2 showed that whilst climate change attitudes,  $\beta = -.519, t = 12.53, p < .001, 95\% \text{ CIs } [-.925, -.642]$  and efficacy frames predicted mitigation intent,  $\beta = .182, t = 2.39, p < .001, 95\% \text{ CIs } [.118, .338]$  outcome frame did not,  $\beta = -.020, t = -0.47, p = .636, 95\% \text{ CIs } [-.122, .099]$ .

Testing H3, the association between efficacy frame and mitigation intent was mediated by climate change response-efficacy (demonstrated by Sobel test,  $z = 6.08, p < .001$ ). Figure 2 illustrates the standardized regression coefficients for the mediation model. Unstandardized indirect effects were computed for each of 10,000 bootstrapped samples. There was a significant indirect effect of efficacy frames on mitigation intent through climate change response-efficacy, 95% CIs [.200, .393],  $b = 0.30$ , supporting H3.



*Figure 2.* Standardized regression coefficients for the association between efficacy frames and mitigation intent, mediated by climate change response-efficacy. Standardized regression coefficients are listed and p-values are provided in parentheses.



### 3.5 Preliminary statistics for T2 and T3

One outlier ( $z > 3.00$ ) was found for mitigation intentions at T3 in the loss-outcome, low-efficacy message information condition. The winsorization principle was used to assign this value (2.64) to the next highest score that was not an outlier (2.45).

### 3.6 PEBs at T2 and T3

No climate change information condition effect was observed for PEBs at T2 ( $\alpha = .46$ ),  $F(3,196) = 1.38$ ,  $p = .252$ ,  $\eta^2 = .02$ , or at T3 ( $\alpha = .62$ ),  $F(3,167) = 1.74$ ,  $p = .160$ ,  $\eta^2 = .03$ . G\*Power post hoc analyses (alpha .05, effect size = .25,  $n = 197$ , groups = 4) revealed sufficient power to detect an effect  $1 - \beta = .84$  for T2. Power was lower for T3 (alpha .05, effect size = .25,  $n = 168$ , groups = 4)  $1 - \beta = .77$ . PEB did not differ when examining efficacy messages (T2:  $p = .920$ ,  $\eta^2 < .01$ ; T3:  $p = .911$ ,  $\eta^2 < .01$ ), and outcome frames (T2:  $p = .638$ ,  $\eta^2 < .01$ ; T3:  $p = .444$ ,  $\eta^2 < .01$ ) separately (Appendix D shows reported PEBs at T2 and T3).

Examining each PEB by itself revealed a condition effect for walking as transportation at T2,  $F(3,196) = 4.80$ ,  $p = .003$ ,  $\eta^2 < .07$ ,  $1 - \beta = 1.00$ . A post-hoc Tukey test revealed a moderate-to-large difference, whereby participants reported higher levels of walking in the gain-outcome, high efficacy condition ( $M = 2.28$ ,  $SD = 0.56$ ), then in the gain-outcome, low efficacy condition ( $M = 1.88$ ,  $SD = 0.58$ ),  $p = .001$ ,  $d = 0.70$ . Moderate differences were also found between the gain-outcome, low efficacy condition and the loss-outcome, low efficacy condition ( $M = 2.16$ ,  $SD = 0.53$ ),  $p = .077$ ,  $d = 0.50$ . At T3, a moderate condition effect was found for laundry loads,  $F(3,169) = 3.05$ ,  $p = .030$ ,  $\eta^2 < .05$ ,  $1 - \beta = 1.00$ . A post-hoc Tukey test revealed that participants reported doing less laundry in the gain-outcome, high efficacy condition ( $M = 1.43$ ,  $SD = 0.50$ ), than in the gain-outcome, low efficacy condition ( $M = 1.75$ ,  $SD = 0.44$ ),  $p = .021$ ,  $d = 0.68$ . Table 1 displays reported PEB levels at T2 and T3.

### 3.7 Differences between information conditions at T2 and T3

Efficacy beliefs at T1 were associated with motivations to conserve at T2 ( $\alpha = .86$ ;  $r = .18$ ,  $p = .012$ ,  $n = 197$ ), and at T3 ( $\alpha = .90$ ;  $r = .24$ ,  $p = .001$ ,  $n = 169$ ). Reported PEBs at T2 was associated with motivations to conserve at T2 ( $r = .17$ ,  $p = .015$ ,  $n = 197$ ). Reported PEBs at T3 was strongly associated with motivations to conserve at T2 ( $r = .65$ ,  $p < .001$ ,  $n = 165$ ), and to a lesser extent, with motivations to conserve at T1 ( $r = .24$ ,  $p = .001$ ,  $n = 169$ ). However, PEBs at T3 was not associated with motivations to conserve at T3 ( $r = .08$ ,  $p = .338$ ,  $n = 167$ ).

Motivations to conserve at T2:  $F(1,196) = 0.65$ ,  $p = .779$ ,  $\eta^2 < .01$ , and at T3:  $F(1,168) = 0.54$ ,  $p = .465$ ,  $\eta^2 < .01$ , did not differ depending on the efficacy message that participants were exposed to at T1. Motivation to conserve was moderately higher at T3 ( $M = 5.56$ ,  $SD = 1.08$ ) when compared with T2 ( $M = 5.26$ ,  $SD = 1.09$ ),  $t(164) = -4.19$ ,  $p < .001$ ,  $d = 0.28$ . However, no condition effect was observed for motivations to conserve at either T2 ( $p = .830$ ,  $\eta^2 < .01$ ) or T3 ( $p = .670$ ,  $\eta^2 < .01$ ).

We further examined whether there was congruence between behaviors reported in the response-efficacy manipulation and their association with self-reported behaviors (items 1, 2, 3, 4, 5, & 8, see Appendix D) in Parts 2 and 3. However, no differences between frame conditions at T2,  $F(3,196) = 0.49$ ,  $p = .690$ ,  $\eta^2 < .01$ , nor at T3,  $F(3,168) = 1.50$ ,  $p = .216$ ,  $\eta^2 = .03$ , were found.

## 4.0 Discussion

Preventing some of the worst consequences of climate change requires urgent mitigation and adaptation responses (Ripple et al., 2020). Therefore, understanding mechanisms driving public engagement on climate change action is crucial if we wish to meet emission targets to

reduce the most severe impacts of climate change. When seeking to motivate immediate action, environmental advocates (e.g., Extinction Rebellion) frequently frame information about climate change impacts by depicting doomsday type representations. Ironically, such negatively focused frames may elicit feelings of climate change helplessness, possibly reducing the extent to which at least some people engage in mitigation behaviors (Salomon et al., 2017). The present research paired these two frames: outcomes of climate change (loss vs. gain), and level of response-efficacy (high vs. low), extending research in this field (e.g., Salomon et al., 2017; Spence & Pidgeon, 2010). Using the EPPM as a theoretical framework, the present study sought to investigate which message condition(s) were superior in increasing mitigation intent immediately post-climate change information (Part 1) and reported PEBs sometime later (Part 2).

#### **4.1 Climate change mitigation intent**

This study found evidence that communicating high response-efficacy for individual-level climate action could be effective in enhancing reported mitigation intent immediately after message exposure. Further, we found that communicating climate change mitigation at the individual-level as being easy and impactful, increasing climate change response-efficacy beliefs, which led to reported increased intentions to mitigate against climate change. The superior effect of the high climate change response-efficacy message on mitigation intent was greater than initial belief and attitudes about climate change prior to message exposure. Therefore, information communicating that individual actions are not in vain, is likely to be important in increasing mitigation intent, even when initial perceptions of climate concern, seriousness, and preparedness to take action are relatively high, as in the current study. These findings, supporting response-efficacy research, are important precursors to protective

behaviors engagement, beyond perceived threat levels (Bradley et al., 2020; Kim et al., 2013; Lewis et al., 2013; Peters et al., 2013; Witte & Allen, 2000; Xue et al., 2016).

Unexpectedly, mitigation intent was similar between climate change outcome frames, that is, information emphasizing losses of unmitigated climate change or gains associated with climate change mitigation. When consequences of health or environmental risks have been communicated using either a loss or gain frame, differing outcomes on risk perceptions have been observed (Quick et al., 2015). Consistent with the EPPM, it was expected that loss-framed climate change information would elicit higher degrees of threat than would a gain-framed climate change message, in turn directing the type of control processes executed (i.e., protective vs. defensive actions). One reason for the lack of findings with the effect of outcome frame (loss vs. gain) on response-efficacy to predict mitigation intent may be due to the manipulation not being effective. Potentially, both outcome frames induced moderate to high levels of threat, which according to the EPPM would elicit danger control processes. Alternatively, both frames may have elicited low levels of threat, thereby not activating the need for a response.

Although outcome frames did not reveal a main effect on mitigation intentions, the data tended to support what would be expected from the EPPM. The highest mitigation intentions were reported by participants exposed to the loss-frame, high response-efficacy message, when compared with other climate change frames (H1). This was consistent with the expected danger control response as the high-threat information also communicated practical actions to successfully mitigate against the feared outcome. When no such option is presented (low-efficacy scenario), and individuals are still motivated to reduce the perceived threat, they may do so by denying or minimizing the threat. Consistent with the expected fear control, participants exposed to the loss-frame, low response-efficacy message, reported lowest

mitigation intent, when compared with those exposed to other climate change frames (H2). This is concerning considering that information about climate change's extensive and dangerous impacts, which may cause high levels of distress, are rarely paired with information educating readers on actions they can take to reduce those impacts (Feldman et al., 2017). Although participants exposed to the loss-frame, high response-efficacy message showed the highest mitigation intent, this did not differ from mitigation intentions expressed by participants exposed to the gain-framed messages, and only differed from responses to the loss-frame, low response-efficacy message.

Overall, our findings suggest that climate change information stressing that individual action can make a difference, is likely to be more important than how the outcome (loss vs. gain) of climate change impacts are framed. When communicating climate change information, compared with gain-framed messages, loss-framed messages have been pervasive (Hulme, 2008; O'Neill et al., 2014). The impacts of this on mitigation intentions will be beneficial or detrimental, depending on an individual's response-efficacy beliefs (Witte, 1992). It is encouraging that climate change information can be framed in ways that increase response-efficacy beliefs, thereby potentially attenuating climate change helplessness (Salomon et al., 2017).

## **4.2 PEBs**

Using a longitudinal design, we found that reported PEBs did not differ between information conditions when tested at two time periods post information exposure. It may be that positive impacts of communicating high climate change response-efficacy weakens over time. Although reported climate change response-efficacy differentiated between response-efficacy messages immediately after message exposure, reported climate change response-efficacy at T2 and T3 revealed no difference between response-efficacy messages that

participants were exposed to. Thus, there was no evidence that the climate change response-efficacy manipulation sustained its influence at two time points after participants were exposed to either high or low response-efficacy messages. This did not support Salomon et al. (2017), who found that participants exposed to high response-efficacy communication reported greater intentions (Study 2) and lower energy consumption one week later (Study 3). It might be that whilst the attitude-intention gap is more stable over time, the intention-behavior association weakens over time (Chatzisarantis, Hagger, Biddle, & Smith, 2005).

One reason that reported PEBs did not differ between information conditions at T2 and T3, may be that we were unable to control for information about climate change that participants were exposed to after T1, thereby masking possible frame effects. Another reason that differences were not observed may be that mitigation intent did not translate to mitigation action. Response efficacy manipulations may only have affected expressed mitigation intentions, rather than actual behavior. A number of barriers to continued behavioral engagement exist (e.g., habit formation, willingness to sacrifice; and conflicting goals, responsibilities, and priorities; Carrington, Neville, & Whitwell, 2014; Kollmuss & Agyeman, 2002; Mittal, 1988; Sheeran & Webb, 2016). The influence of such factors may be stronger than the response-efficacy manipulation in the current study. As most participants' attitudes aligned with scientific evidence (i.e., that climate change is happening, results from anthropogenic causes, and its consequences pose a concerning and serious problem), they may have already been engaging in some PEBs. As a result, any changes might have been too small to detect.

There were some differences between information condition and types of PEB. The gain-outcome, high-efficacy information condition showed increased intentions (T1) and reported behavioral engagement (T2 & T3) for a number of behaviors when compared to the low-

efficacy frames. Although, findings were not significantly different to the loss-frame, high-efficacy, they could point towards the gain-framed messages having a greater impact when the PEB is easier to curtail (Karlin et al., 2014). Specifically, participants were more persuaded to increase recycling behaviors (e.g., buy more recycled paper; recycle domestic items) immediately after exposure to the gain-framed, high-efficacy climate change condition. Post information exposure, participants reported higher levels of walking (T2) and doing less laundry (T3) in the gain-outcome, high-efficacy condition.

It may be that whilst loss-framed, high-efficacy messages increase mitigation intent, gain-framed, high-efficacy messages increase behavioral engagement. In fact, compared with all other information conditions, the attrition rate from T1 to T2 was lowest for participants exposed to the gain-frame, high-efficacy information condition so that both T2 and T3 samples included more participants in this condition. This outcome may reflect a gain-frame advantage for commitment to climate change. While the evidence from T2 and T3 was not strong, further research could be fruitful for increasing behavioral engagement and commitment to PEBs. Future research could also examine whether outcome frames differentially impact motivation levels for different PEBs (e.g., differing on dimensions such as efficiency and curtailment; Karlin et al., 2014).

#### **4.3 Limitations and future research directions**

Three methodological limitations of the current study became apparent in examining effects of climate change communication frames on mitigation intentions and actual behavior. The first is to have a baseline condition from which climate change frame effects can be compared. This would allow observation of the overall consequences of climate change communication on intentions and/or behaviors relative to not exposing individuals to information likely to induce some level of psychological threat. A second limitation was that

we could not control for information that participants were exposed to about climate change after participating in Study 1. So, it is likely that there existed interference effects on the study manipulations. A third study design limitation was the absence of examining reported mitigation behaviors performed prior to and immediately after post-message. This study examined reported mitigation behaviors only at T2 and T3, not allowing an equivalent comparison from baseline. A baseline measure of response-efficacy beliefs prior to the manipulation would demonstrate the extent of change in response-efficacy beliefs and individual variability. Future research would benefit by pairing high response-efficacy messages with other framing techniques shown to work. A framing technique that has been shown to increase positive environmental behaviors is messages that convey social approval (Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007).

Most participants reported believing that climate change is happening, is a result of anthropogenic causes, and that its consequences pose a concerning and serious problem. As most participants were first-year psychology students, who tend to have liberal attitudes towards the environment, this finding was unsurprising. These percentages are consistent with other contemporaneous national survey data (Leiserowitz et al., 2019), revealing a fairly close representation of study participants' attitudes with those in the general population. However, among some societal demographics the proportion of people who deny or minimize the risks of climate change, is much greater than in this study sample. It is important to examine how different communication frames can motivate action amongst those from other sections of society – for example, those who choose to deny climate change, or who perceive climate change risks to be minimal. Ideological biases can interfere with how individuals respond to climate change information (Chapman & Lickel, 2016; Xue et al., 2016).



## 4.4 Conclusion

It is imperative that both structural and psychological barriers that result in the mismatch between climate concern and behavioral engagement (see Gifford, 2011 for a review) are urgently addressed. It is suggested that one critical psychological factor deterring individual-level climate action is climate change helplessness (Salomon et al., 2017). Exacerbating such an emotional state is frequent exposure to information about the alarming consequences of climate change. Although emphasizing the most threatening consequences of climate change could, for some individuals, lead to attitudinal or behavioral consequences contrary to the original intent (Feinberg & Willer, 2011), it may also be necessary to motivate attitudinal and behavioral responses to accord with climate change mitigation attempts (Witte & Allen, 2011). To ensure that loss appeals motivate protective behaviors (due to a danger control response) rather than a contrary response (due to a fear control response), messages communicating that individual-level actions to curb carbon emissions can make a great deal of difference to climate change could be very important. Doing so was shown to boost levels of mitigation intent in the present study. It was less important to levels of mitigation intent whether the response-efficacy message was paired with a frame that emphasised the loss-outcomes of unmitigated climate change or the gains of climate change mitigation. However, given that the superiority of the high response-efficacy frame was only found immediately after message exposure, the messages' impact may be short-term, suggesting that repeated exposure may be required. On the basis of these findings, environmental advocates and policy makers could usefully ensure that future climate change commentaries communicating negative impacts of climate change also communicate large positive impacts of individual-level mitigation in reducing those impacts, which may help to combat climate change helplessness and increase mitigation intent.

## Appendix A

### *Climate change attitudes and perceptions (n=343)*

| Statement  | n (%)        |
|--|--------------|
| <b>Climate change belief</b>   |              |
| I think that climate change is happening, and I think that human activities are largely causing it   | 302 (88.04)  |
| I think that climate change is happening, but it's just a natural fluctuation in Earth's temperature | 31 (9.04),   |
| I have no idea whether climate change is happening   | 7 (2.04)     |
| I don't think climate change is happening  | 3 (0.87).    |
| <b>Climate change concern</b>  |              |
| Very concerned   | 156 (45.48)  |
| Fairly concerned   | 142 (41.40)  |
| Not very   | 40 (11.67)   |
| Not at all   | 5 (1.46)     |
| <b>Climate change as a serious problem</b>   |              |
| Very serious   | 289 (84.26). |
| Somewhat serious   | 38 (11.08),  |
| Not so serious   | 14 (4.08),   |
| Not at all serious   | 2 (0.58)     |
| <b>Preparedness to reduce energy use to tackle climate change</b>                                    |              |
| Very prepared  | 122 (35.56), |
| Somewhat prepared  | 172 (50.15)  |
| Not very prepared  | 43 (12.54)   |
| Not at all prepared  | 6 (1.75)     |

## Appendix B

| Outcome manipulation  |   |
|---|---|
| Loss  | Gain  |
| Leading scientists advise that if we do not take action against climate change we will cause further increases to the frequency and intensity of extreme weather events. This may mean more dangerous flooding, bushfires, heat waves, droughts, and cyclones in Australia. | Leading scientists advise that by taking urgent measures to mitigate climate change we reduce further increases to the frequency and intensity of extreme weather events. This means a reduction to dangerous flooding, heat waves, bushfires, droughts, and cyclones in the future in Australia. |
| Failing to take action will cause rising sea levels that will pose a significant risk to coastal communities. This would mean that people's houses would be permanently under water.  | By lessening climate change we can reduce further increases to rising sea levels that pose a significant risk to coastal communities. This lessens the occurrence or reduces the impact that people's houses would be permanently under water.  |
| Failing to take action against climate change could mean that the world's oceans could become too acidic to support coral reefs and other calcifying marine organisms.  | By lessening climate change we can reduce the chance or damage of the world's oceans becoming too acidic to support coral reefs and other calcifying marine organisms.  |
| Mosquito-borne diseases, such as dengue can lead to serious and sometimes life-threatening illnesses. Under moderately  | Mosquito-borne diseases, such as dengue can lead to serious and sometimes life-threatening illnesses. By mitigating climate change we   |

|  |  |
|--|--|
| warmer and wetter climate conditions, there may be an increase in the prevalence of some mosquito-borne diseases in some parts of Queensland.  | can reduce the instances of moderately warmer and wetter climate conditions, which may lessen the prevalence of mosquito-borne diseases in some parts of Queensland.   |
| A 2 degrees Celsius rise in average temperatures could force all endemic (i.e. unique to the region) Australian tropical rainforest vertebrates (such as ringtail possums, tree kangaroos and many insects) to extinction. | Preventing a 2 degrees Celsius rise in average temperatures would reduce the likelihood of an endemic (i.e. unique to the region) of Australian tropical rainforest vertebrates (such as ringtail possums, tree kangaroos and many insects) to extinction. |
| Without effective mitigation efforts, climate change is projected to cause an increase in the number of days in Brisbane above 35 degrees Celsius from 1 per year to up to 21 per year by 2070.                            | With climate change mitigation, we can reduce the increase in the number of days in Brisbane above 35 degrees Celsius from 21 per year to 1 per year by 2070.  |
| Without mitigation climate change will reduce the likelihood that Queensland will experience an increase in the proportion of tropical cyclones in the more intense categories (3-5).                                      | Reducing further changes to the climate will reduce the likelihood that Queensland will experience an increase in the proportion of tropical cyclones in the more intense categories (3-5).  |
| With no mitigation, there may be thousands of total temperature-related deaths in Queensland, compared to a world with no human-induced climate change.  | Reducing the impacts of climate change can prevent or reduce total temperature-related deaths in Queensland, potentially saving thousands of lives.  |

|   |  |
|---|--|
| <p>Leading scientists advise that if we do not take action against climate change we will cause further increases to the frequency and intensity of extreme weather events. This may mean more dangerous flooding, bushfires, heat waves, droughts, and cyclones in Australia.</p>  | <p>Leading scientists advise that by taking urgent measures to mitigate climate change we reduce further increases to the frequency and intensity of extreme weather events. This means a reduction to dangerous flooding, heat waves, bushfires, droughts, and cyclones in the future in Australia.</p> |
| <p>Efficacy manipulation<br/>(taken from Salomon et al. 2017)</p> <p>“Climate change is a phenomenon widely accepted by scientists. Within only a few years, scientists have made substantial progress in predicting climate change and understanding its causes. It is now known that a recent increase in severe weather, including severe floods, prolonged heatwaves, and cyclones, is due to global climate change. Scientists have also made major progress in pinpointing the causes of global climate change. The likelihood that climate change is due to human activity is now considered certain. Scientists point specifically to the increase in fossil fuel usage in manufacturing and transportation over the last century. This increase has been accelerating at an exponential rate, with greater and greater increases each year.”</p> |  |
| Low   | High   |
| <p>Unfortunately, there is not much that you can do to make a real difference. Small changes like moving the thermostat by a few degrees, using the washer and dryer less, and reducing waste will not make a real difference in your local environment. Most</p>   | <p>Fortunately, there are things that you can do to make a real difference. Simply raising the temperature setting on your thermostat in summer can make a difference in your home environment. Similarly, using the washing machine only when it is full, and drying your</p>                           |

|   |   |
|---|---|
| <p>people find it inconvenient to incorporate these changes into their everyday lives. In fact, the average person who begins regularly recycling later realizes that they notice it taking more time and effort than simply throwing their bottles in the garbage. None of these actions will make a huge impact on the environment. Just recycling bottles over the course of a year will not make a noticeable dent in your local landfill. By making the changes discussed here, you might save about 2750 kilograms of carbon emissions, which is practically nothing compared to the over 30,000 billion tons of carbon emissions produced annually across the globe. The simple changes you might make at home will not have a meaningful impact on global climate change.</p> | <p>clothes naturally outside by not using a tumble dryer saves substantial energy. Reducing waste by recycling, drinking tap water instead of bottled water, and using reusable plastic bags can also help. Most people are easily able to incorporate these changes into their everyday lives. In fact, the average person who begins regularly recycling later realises that they don't notice it taking any more time or effort than throwing their bottles in the garbage. All these actions can make a huge impact on the environment. Just recycling bottles over the course of a year can make a noticeable dent in your local landfill. By making the simple changes outlined here, you can save over 2750 kilograms of carbon emissions. This is a substantial saving for incorporating such easy changes.</p> |
|---|---|

## Appendix C

### *Climate change behavioural intentions T1 (N=343)*

|  | <i>M(SD)</i> |
|--|--------------|
| Recycle items at home*   | 4.65(0.71)   |
| Dry my clothes outside instead of using a tumble dryer when possible | 4.57(0.89)   |
| Use the washing machine only when I have a full load                 | 4.50(0.89)   |
| Drink tap water rather than bottled beverages whenever possible*     | 4.48(0.96)   |
| Vote for politicians who support environmental initiatives           | 4.06(1.12)   |
| Buy recycled paper*  | 4.04(1.07)   |
| Set my thermostat/heater no higher than 18° in the winter            | 4.02(1.15)   |
| Replace light bulbs in my home with more energy efficient bulbs      | 3.94(1.19)   |
| Set my thermostat/air conditioning no lower than 24°C in summer      | 3.92(1.21)   |
| Write to my representatives about environmental concerns*            | 2.61(1.28)   |

*Note \* Indicates difference between response variable and information frame*

## **Chapter 7c: Additional hypotheses, measures and analyses not in the paper**

Study 3 was initially designed to test whether different climate change communication frames would be associated with reported TM strategies. It was posited that communicating high individual-level climate change response efficacy would negate motivations to attenuate concerns about death and also TM outcomes, apparent after exposure to loss-framed messages in Study 2. One driver of mortality-related concerns may be reduced control over climate change outcomes (Agroskin & Jonas, 2013; Koole & Van den Berg, 2005). Thus, communicating that engaging in PEBs at an individual level can have an impact, may increase feelings of control, thereby reducing the perceived existential threat. Conversely, messages communicating that engaging in PEBs at an individual level will have no substantial impact, may decrease feelings of control, thereby increasing the perceived existential threat. This study examined two TM distal defences: worldview defence and impression management.

### **Worldview defence**

This study tested worldview defence by examining ratings of two authors, one pro-Australian (worldview affirming), and the other, anti-Australian (worldview threatening). Evidence that climate change framed as a loss-outcome is associated with a greater TM response (e.g., worldview defence or self-esteem striving), may produce either adaptive *or* backfire consequences. For instance, when environmental action is a source of self-esteem, individuals under MS report higher concern for the environment than do their counterparts not exposed to threat (Vess & Arndt, 2008). The opposite pattern is found for individuals for whom environmental action is not a source of self-esteem. These individuals report lower environmental concern under MS, compared with those not exposed to threat. This study measured worldview defence of one's nationality as using climate change perceptions as a



worldview measure (as in the Pilot Study) may be impacted by exposure of climate change information in different and unpredictable ways.

### **Impression management**

Another strategy that people are motivated to use when reminded about death is managing positive self-impression. What others think of us is deemed important because we are heavily dependent on others for maintaining our conceptions of self and world. Other people validate the fragile social fiction that is our private sense of meaning and value. Because in capitalist cultures, success and worth is often showcased by material goods, one way in which people may attenuate concerns about death is by gravitating towards material possession. Material worth provides one way of fostering positive impressions of oneself, demonstrating success, quantifying worth, and serves group membership functions (Jackson, 2005). These functions may serve to attenuate concerns about death (Kasser & Sheldon, 2001) brought on by climate change threat information.

When mortality is salient, individuals report greater materialistic and greediness tendencies, when compared with those in a control condition (Kasser & Sheldon, 2001). Likewise, communicating loss outcomes of unmitigated climate change has been shown to increase attentional avoidance of death-related stimuli (Study 1), and motivate material strivings (Study 2), when compared with gain outcomes of climate change mitigation. Because the pursuit of status driven items (e.g., bigger cars, houses) has counterproductive consequences for emitting greater greenhouse gas emissions, it is examined whether exposure to climate change threat information elicits material strivings, as found Study 2. Study 3 investigated whether eliciting high response efficacy attenuates the need for TM outcomes, such as worldview defence and self-esteem strivings (see Figure 1). Using TMT and past research findings, these hypotheses were put forward.

H<sub>A</sub>: Participants exposed to climate change information framed as a loss-outcome, paired with a low climate change response-efficacy message, will elicit the greatest level of TM responses: 1) worldview defence, and 2) material strivings, when compared with participants exposed to other climate change frames.

### ***Method***

After a measure of behavioural intentions in Study 3 (see Method section in submitted paper), these measures were taken to test worldview defence and materialistic desires.

**Worldview defence.** Two essays were presented, in counterbalanced order, with participants instructed to rate the character of the person who wrote the article. One article was framed as a pro-Australian essay, praising Australian characteristics, whilst the anti-Australian essay threatened Australian values. The text was adapted from an Australian study by Emiko et al. (2014). After reading each passage, participants were asked these questions: 1) How much do you like the author of the above passage? 2) How trustworthy do you find this author? 3) How knowledgeable do you think this author is? 4) How much do you agree with the author's opinion? Participants rated each author on a 5-point scale from 1 (very likeable/ trustworthy/ knowledgeable/ strongly agree) to 5 (not at all likeable/ untrustworthy/ not knowledgeable/ strongly disagree).

**Materialistic desires.** Adapted from Kasser and Sheldon's (2000) study, participants were asked to think 15 years into the future and answer questions about their expected financial status at that time. Participants were asked to report, in today's dollars, their expectations about their own salary, their spouse's salary, the worth of their home, the value of the possessions in their home, the worth of their vehicles, the amount they would spend each year on travel, their entertainment and leisure expenses, their clothing expenses, and the worth of their investments. Scores of all these variables were added to provide a materialism score.

## Results

*Worldview defence.* Worldview defence did not differ between information frames,  $p > .05$ ,  $\eta^2 < .01$  ( $H_{A1}$ ). There were no differences between information frames and ratings for the anti-Australian author,  $p = .673$  or pro-Australian author,  $p = .654$ . Overall means showed that participants rated the pro-Australian author more highly on trust and knowledge ( $n = 340$ ,  $M = 2.85$ ,  $SD = 0.86$ ) than the anti-Australian author ( $n = 340$ ,  $M = 4.12$ ,  $SD = 0.94$ ).

*Materialistic desires.* Materialistic tendencies did not differ between information frames  $p = .261$ ,  $\eta^2 = .01$  ( $H_{A2}$ ). Testing whether materialistic tendencies differed between outcome,  $p = .904$ ,  $\eta^2 < .01$  and efficacy frame, a small efficacy frame effect was found for materialistic tendencies,  $F(3, 340) = 3.43$ ,  $p = .065$ ,  $\eta^2 = .01$ . Participants exposed to the low climate change response-efficacy message reported fewer materialistic tendencies ( $n = 172$ ,  $M = 8.06$ ,  $SD = 3.76$ ) than did participants exposed to the high response-efficacy message ( $n = 169$ ,  $M = 8.86$ ,  $SD = 4.19$ ). Examining each question separately revealed differences between response-efficacy frames for expectations on the worth of their home,  $F(1,340) = 4.89$ ,  $p = .028$ , and vehicles,  $F(1,340) = 8.26$ ,  $p = .004$ . Participants assigned to high efficacy frames ( $n = 172$ ) reported higher values for future worth of homes ( $M = 8.59$  [800,000 to 899,999],  $SD = 4.57$ , Median = 8.00), and vehicles ( $M = 7.10$  [60,000 to 69,999],  $SD = 7.07$ , Median = 5.00) than did participants assigned to low efficacy frames ( $n = 169$ ) for worth of homes ( $M = 7.52$  [700,000 to 799,999],  $SD = 4.35$ , Median = 6.00) and vehicles ( $M = 5.27$  [40,000 to 49,999],  $SD = 4.39$ , Median = 4.00). Although differences between information conditions were small, all responses (e.g., expectations on salary, partners salary, possessions, entertainment and leisure) were higher for participants receiving the high (compared with low) climate change response efficacy message.

## Discussion

This study did not find expected TM responses after exposure to the climate change loss-framed, low response-efficacy condition when compared with the loss-framed, high-response efficacy condition. It was expected that because climate change increases the risk of death, communicating climate impacts may elicit thoughts about mortality, thereby activating TM defences. Further, it was posited that messages that communicate individual mitigation actions cannot make much of a difference may further disrupt the TM process. Messages that communicate individual actions can make a big difference, was expected to attenuate terror otherwise elicited from loss-framed climate change information. However, the study found no evidence of differential TM effects, such as worldview defence and impression management, between outcome or efficacy information frames.

Three reasons for the absence of an effect are put forward. First, it may not have been possible to find TM responses between frames because all frames communicated information about climate change, so that all invoked some degree of existential threat. TM defences, such as worldview defence, may therefore have been observed in all climate change frame conditions. Due to the absence of a no-threat control condition, it was not possible to test whether this was the case. Furthermore, the outcome frame and the response-efficacy message pairing may have been impacted by the manipulation or individual characteristics in unexpected ways. A larger scale study could tease out specific framing effects by including each manipulation frame as a stand-alone (i.e., outcome vs. response-efficacy manipulation) alongside the combination frames (outcome [gain vs. loss]  $\times$  response-efficacy [low vs. high]).

Alternatively, the climate change information in this study may not have elicited MS, and therefore not generated TM responses. It may be that in this study, written text alone was

insufficient to generate MS. However, as Study 2 used the same information for the loss and gain outcome frame manipulation, and found that the loss- (vs. gain-) framed information elicited AB to death-related stimuli, this is less likely. Further, Study 2 found that exposure to the gain-framed information revealed no ABs, and instead was no different to participants' responses assigned to the no-threat control condition. News about climate change is regularly accompanied by imagery including destruction and death caused by climate change impacts, presumably increasing the likelihood that some real-world coverage of climate change would elicit higher degrees of death-related thoughts, thereby motivating TM reduction strategies.

A third possibility is that worldview defence effects no longer exist in the same form as in previous TMT research. Alternatively, Australian participants may not show worldview defence in the same pattern as American students do (e.g., Emiko et al., 2014), on which most worldview defence effects have been reported. In addition, no framing effect was found on material strivings. However, there was a small effect between the low and high climate change response-efficacy messages on material strivings. Inconsistent with TMT based predictions, material strivings were higher for participants exposed to the high-, compared with the low-response efficacy messages. Thus, no backfire symbolic defence response was observed. Instead, it may be that the high response-efficacy message, that individual-level mitigation can make a difference, allowed individuals to justify their material desires. Pairing different frame conditions together such as outcome and efficacy information, may interact in unexpected ways.

## **Limitations**

The study did not include a baseline condition for comparing climate change frames. This would have allowed observation of the overall consequences of climate change communication on intentions and/or behaviours relative to not exposing individuals to

information likely to induce psychological threat. Doing so may have revealed worldview defence (Barth et al., 2017; Fritsche et al., 2012), or material strivings (Study 2) as a result of climate change threat exposure, as found in previous research.

## **Chapter 8 –Research Summary, Implications and Future Research Directions**

The primary aim of the current research was to investigate how individuals respond to climate change information. It was examined whether exposure to information about the impacts of climate change elicited death-related concerns and TM outcomes that have either beneficial or detrimental consequences for climate change. Three studies were undertaken to understand individual responses to climate change using a TMT framework (Pilot Study, Study 2, Study 3). Another study was conducted to address methodological concerns in testing implicit measures of death anxiety, a central construct within the TM literature (Study 1). This chapter begins by summarising the main findings of each study in the thesis. Key results from each study are then integrated for an overview of the main overall findings. The chapter ends with a discussion of practical and theoretical implications of the research, limitations, recommendations for practice, and future research directions.

### **8.1 Summary of Main Findings**

**Pilot Study.** The Pilot Study's primary focus was to examine whether climate change information could elicit thoughts about death and resultant TM outcomes (i.e., worldview defence). The findings were complicated by evidence that the measure used to assess death-related thoughts, the DWFT, contained confounds that led to word completion floor and ceiling effects, not enabling the measure to be sufficiently sensitive to ascertain whether differences in DTA existed between conditions. The pattern of findings was consistent with TMT hypotheses when low-DTA was conceptualised as reflecting a defensive death-denial/avoidance response, and high-DTA as reflecting a low death-avoidance response. It was posited that the encoding and cognitive appraisal process when completing a computer-based word-fragment task could have resulted in a less 'automatic' response than an equivalent pencil-and-paper task. This may have resulted in more explicit thoughts about

death, and therefore explicit psychological strategies to reduce death anxiety. Previous research had not documented the use of a computerised DWFT. Both interpretations (i.e., low-DTA or high death-defensiveness) were used to interpret the study findings.

One important Pilot Study finding was that climate-deniers exposed to information about climate change (vs. a no-threat control condition) demonstrated low-DTA (or high death-defensiveness), whilst climate-acceptors exhibited high-DTA (or low death-defensiveness). This could be interpreted as the climate change video only eliciting death-related thoughts for those who accept climate change, as they are more receptive to the information. Alternatively, exposure to climate change information for climate-acceptors may have affirmed worldview beliefs, in turn buffering concerns about death and revealing low death-defensiveness.

The association between explicit death anxiety and strength of adherence to grid (egalitarian-hierarchical) cultural worldviews may also provide some insight into the conceptualisation of the DWFT. Whilst there was a curvilinear relationship between worldviews and death anxiety in the control condition, only a linear relationship between grid worldview and death anxiety existed for climate change salience participants. A more hierarchical worldview was associated with higher levels of explicit death anxiety in both conditions. Although the presence of a linear relationship for both conditions supports there being trait differences in death anxiety for individuals with egalitarian vs. hierarchical worldviews (Jost et al., 2003, 2007), the absence of a curvilinear relation in the climate change salience condition suggested that the information about climate change may have served to bolster egalitarians' worldview. Presenting information that is consistent with important worldviews increases the buffering effectiveness of that worldview against concerns about death, and in turn, could explain the lower reports of fears about death amongst individuals with greater egalitarian values. If high trait DA reflects a propensity to



elicit higher levels of state DA (e.g., DTA), then the conceptualisation of low-DTA as reflecting high death defensive, is supported by the explicit DA and worldview findings.

A second key Pilot Study finding was that for participants with high activation of implicit death-related thoughts (or low-defensiveness), exposure to climate change information was associated with the highest perceptions of risk, even amongst climate-deniers. Aligning with the conceptualisation of high DTA as low-defensiveness, low levels of explicit death anxiety for individuals exposed to climate change information was also linked to higher perceptions of climate change risk, compared with control participants. Thus, low explicit concerns about death may allow for non-directional information processing and lower the likelihood that cognitive distancing strategies are activated (e.g., low perceptions of climate change risk).

Overall, findings indicated that thoughts about death may be a psychological barrier to greater climate change risk perceptions and attitude change. However, it should be noted that the methodological concerns in the DWFT and uncertainty in the direction of interpretation of the DWFT (i.e., high-DTA vs. low death defensiveness) does not provide strong confidence in the interpretation for the direction of DTA results. Hence, future research should examine measures of implicit death anxiety more closely to identify measures that are more robust and sensitive to differentiating between conditions.

**Study 1.** Study 1 followed from key methodological questions arising from the Pilot. Study 1 investigated DWFT's ability to capture unconscious concerns about death and further, whether other implicit measures, not traditionally used in TMT research, could more effectively capture concerns about death. The Pilot Study suggested that issues inherent within the DWFT might make it difficult to find differences between low or high death word accessibility. As a traditional MS condition was not used alongside the climate change and control conditions, the Pilot Study was unable to establish whether the null findings resulted

from the climate change salience condition not eliciting concerns about death, or were due to floor and ceiling effects inherent in using the DWFT. As a result, Study 1 examined the efficacy of different implicit death anxiety measures using traditional MS and control conditions from TMT research.

Study 1a results revealed that the DWFT did not differentiate between MS and control conditions. Instead, death-related word completions were strongly associated with word dimensions, such as word frequency in natural language and arousal ratings, above and beyond assignment to MS induction. In addition, participants more quickly completed fragments with words that had higher natural language usage frequency. Together these results may point towards the DWFT being low in validity, sensitivity and therefore, of limited utility. Word stems should not be used as a single measure to assess construct accessibility. Research efforts should continue to identify suitable word sets in terms of criteria known to influence word completions for death- and non-death-related words.

Publication bias may provide one explanation for why the Pilot and Study 1 findings differed from TMT research using the DWFT. There is a tendency to place greater time and effort towards writing and publishing findings that reveal differences, or that are consistent with prior research and theory, and therefore more easily explicable (Dickersin, 2005; Shields, 2000; Torgerson, 2006). Researchers may be less willing expend effort in seeking to publish research that does not show expected differences, especially in the absence of previous findings or with no theoretical explanation for its findings. Journal editors also contribute to publication bias, by being less enthusiastic and willing to publish studies with null findings. There can be an imbalance in published findings, with bias directed in favour of positive and “statistically significant” results. It is important that research using robust methods, regardless of the direction of findings, are available so that effects can be more

precisely estimated. The movement towards pre-registration of studies is one attempt to overcome this type of publication bias. This could be an aim in the current research domain in the journals that primarily publish in this field. However, that both the Pilot and Study 1 observed no differences, yields some evidence that the DWFT is low in sensitivity, especially when compared with other implicit measures of DA (Study 1b).

Study 1b investigated different ways to capture DA by using a lexical decision task as a measure of death-thought-accessibility, the dot-probe task as a measure of AB, and an ambiguous pictures task as a measure of biased interpretation. All three implicit measures differentiated between MS and control conditions, revealing greater sensitivity than the DWFT. When compared with control participants, MS participants demonstrated slower lexical decisions and attentional avoidance for death-related words, and a greater number of death-related interpretations in the ambiguous pictures task. Thus, null findings between MS and control conditions when using the DWFT may result from the measure's low sensitivity, rather than the absence of an effect. Future TM research would benefit from using more sensitive measures, such as those tested in Study 1. These measures could also be used as a guide to determine the degree of success for word stems that more effectively control for factors that impact word completion.

It should be noted that TMT research has found greater accessibility of death thoughts or faster responses to death-related stimuli in a LDT (indicative of facilitated attention), after either a MS condition or worldview threat (Schimel et al., 2007). Study 1 and Study 2 revealed slower responses after an MS condition and climate change threat condition, which pointed towards mortality-related information eliciting an avoidant response to death-related stimuli. Research has found an avoidance response after individuals ruminated over death (Eisma et al., 2014), or those experiencing prolonged grief (Yu et al., 2017). This response is

thought to reflect a desire to avoid further processing of stimuli that matches an individual's own concerns (Mogg et al., 2004). Although slower responses to death-related stimuli have not been observed in TMT research, the consistencies in the direction of effects across multiple studies and measures (i.e., Study 1 for the LDT and DPT, and Study 2's manipulation check using the DPT) provides one line of evidence for mortality-related information eliciting slower reactions to death-related stimuli than control stimuli. However, it is less clear whether the direction of responses indicate attentional avoidance or difficulty in disengaging. Difficulty in disengaging is characterised by facilitated attention, followed by slow disengagement from a threat stimulus relative to a neutral stimulus (Cisler & Koster, 2010). Thus, in the absence of testing initial attention (i.e., via eye tracking), we cannot determine whether the slower responses were due to attentional avoidance or to difficulty in disengaging from the mortality threatening stimuli.

An additional aim of Study 1 was to examine which measure/s could capture the mediation or moderation process between MS and worldview defence. There was no evidence of mediation from any of the four implicit measures. Only responses from the Rorschach inkblot test showed evidence of moderation, whereby MS participants (vs. control) who made lower death-related interpretations, reported higher worldview defence. Low death-related interpretations may represent higher cognitive avoidance and attempts to suppress death-related thoughts. Reasons for the absence of mediation may be due to death-related thoughts not being the mechanism by which MS elicits worldview defence, or that the mere act of measuring DTA increases death-thought activation in both MS and control conditions, negating the ability to observe differences in subsequent measured outcomes (Hayes et al., 2018).

**Study 2.** The first aim of Study 2 was to examine whether climate change information elicited concerns about death. Informed by Study 1, the dot probe task was used to measure implicit death anxiety. Because previous research had shown that that measuring the proposed intervening process (i.e., unconscious death-related cognitions) may impact subsequent responding (Greenberg et al., 1994; Hayes & Schimel, 2018; Spencer et al., 2005), whether climate change elicited attentional bias towards death-related stimuli (manipulation check) and whether climate change information elicited TM responses (main study) were tested separately. It was posited that climate change information emphasising the loss outcomes of climate change (loss-frame) versus the gain outcomes of engaging in mitigation (gain-frame) would be more likely to elicit death anxiety and therefore TM outcomes. Also tested was whether exposure to loss-framed climate change information increased material strivings (e.g., desire for expensive houses, cars), behaviour that conflicts with efforts towards a low carbon society. Participation in consumer culture by purchasing consumer and material goods has been shown to mitigate feelings of threat (including existential; Cutright, 2012; Gao et al., 2009; Kasser & Sheldon, 2011; Mandel & Heine, 1999; Mandel & Smeesters, 2008; Mead et al., 2011) by reinstating meaning and order to one's life (Allen et al., 2008; Fournier, 1998; Jonas et al., 2014; Swaminathan et al., 2007; Rindfleisch et al., 2009).

The manipulation check was successful as exposure to loss-framed (vs. gain-frame) climate change information elicited concerns about death. In fact, the gain-frame and no climate change threat control condition showed no differences in AB toward death-related stimuli. Results therefore suggested that emphasising the loss-outcomes of climate change may elicit concerns about death, which is negated when communicating the gain-outcomes of climate change mitigation. Furthermore, higher death avoidance was found for low self-esteem participants exposed to the loss-frame, compared with their counterparts exposed to the gain-frame. This finding partially supported TMT's anxiety-buffer hypothesis, that when

psychological structures that attenuate concerns about death are weakened (e.g., low self-esteem), death-related concerns are greater. However, we did not observe a difference between frame conditions on death AB amongst high self-esteem participants.

In Study 2, loss-framed climate change information (but not gain-framed) exposure motivated increased desire for material possessions, especially amongst participants with strong extrinsic values. Increased material strivings (e.g., desire for expensive houses, cars) was posited to manage terror because material possessions can signify successful existence. This association with material desires was more apparent after exposure to climate change information amongst individuals with high extrinsic values. This supported the MS hypothesis that reminders of death (e.g., climate change information) amplifies the need for psychological structures (e.g., material possessions) that buffer concerns about death. Study 2b demonstrated that societal risk announcements around climate change may impact various life domains (e.g., managing outward impressions of wealth and success) as a result of managing existential threat. This study's uniqueness lay in measuring responses to climate change information on domains other than attitudes towards this global phenomenon, which have been largely absent from extant literature.

**Study 3.** The final study investigated whether communicating high climate change response-efficacy (vs. low climate change response-efficacy) would mitigate TM outcomes observed after exposure to loss-framed climate change information in Study 2. This is because communicating high climate change response-efficacy may increase feelings of control over the threat, which may be one reason that climate change elicits thoughts about death. However, Study 3 findings did not support predictions based on TMT. There was no difference in worldview defence or materialistic strivings between information conditions.

Thus, this study did not find any evidence of TM responses between different climate change frames.

Main findings indicated that participants exposed to the high response-efficacy messages showed large increases in mitigation intent immediately after message exposure, beyond initial attitudes towards climate change. Exposure to either a loss- or a gain-frame did not have any impact on mitigation intentions in Study 3. Although, loss-framed climate change information elicited concerns about death in Study 2, manipulating additional framing messages, such as communicating high or low response efficacy, may interact in unpredictable ways. One reason for the null effects when testing TM outcomes may be that all climate change frames elicited death anxiety and hence TM strategies or alternatively, none of the frames elicited death anxiety. Hence, a weakness in Study 3 was the absence of a no climate change threat control condition.

## **8.2 Integrating Findings**

Together the findings from this research demonstrated that responses to climate change may be influenced by existential concerns and can therefore be understood within TMT to predict psychological and attitudinal outcomes. Climate change can bring feelings of fear, dread, and a sense of helplessness to individuals (Lee, 2019; Norgaard, 2006; O'Neill & Nicholson-Cole, 2009; Salomon et al., 2017). These reactions may be a direct consequence of climate change being associated intrinsically with themes of death (e.g., uncontrollability, degradation, destruction), or to death itself (e.g., victims of natural disasters). Research has found that exposure to natural environments, compared with human-made environments, elicit concerns about death (Koole & Van den Berg, 2005). Unsurprisingly then, information about the destructive consequences of climate change to the natural world can elicit concerns about death (Study 2).

Findings from this research suggest that death anxiety is an individual-difference variable that probably moderates individual response to climate change information (Pilot, Study 2). How the presence of death anxiety impacts responses to climate change may depend on the initial stance taken by the individual on climate change, and subsequently their worldview and important values (Pilot, Study 2). This is observed when death anxiety moderated risk perceptions for climate change deniers and acceptors differently in the Pilot Study. For instance, climate acceptors with greater levels of DTA, or low death-defensiveness, reported higher risk perceptions after exposure to climate change information, compared with no exposure to climate change information. On the other hand, amongst climate deniers, higher DTA, or low death-defensiveness, was linked with lower perceptions of climate change risk after exposure to climate change information, compared with no exposure. Additionally, in Study 2, material striving responses to loss-framed climate change information were observed more strongly amongst participants with greater extrinsic values. Thus, taking into account pre-existing beliefs and values that either helps or hinders sustainability goals may increase predictive power for responses to climate change information. Interventions designed to promote climate change action may be more effective if communications target different perceptions for different individuals. This is important given that individuals respond differently depending on their pre-existing beliefs.

Not all climate change information elicits death anxiety or TM strategies. For instance, climate change information framed to emphasise the loss of unmitigated climate change was associated with higher attentional avoidance from death-related stimuli, compared with information emphasising gains to climate change mitigation (Study 2). However, additional or competing frames may have unintended impacts (Study 3). Further, the type of message frame may differentially impact responses to climate change. For instance, manipulating loss



and gain-frame climate change information did not influence climate change mitigation intentions, compared with a no climate change threat control information condition (Study 2).

Adding response-efficacy information to the climate change message, resulted in differences between information conditions when the climate change attitudes was the outcome measured (Study 3). Whether a loss or gain climate change frame was more effective, was impacted by the outcome in question. For instance, a loss-framed climate change appeal was more likely to be associated with higher use of impression management strategies, which was greatest amongst individuals with an extrinsic value orientation. Although this points towards a reactance type response from individuals as a result of threat exposure (loss vs. gain-framed climate change threat information), instances were identified where a loss-outcome was the superior frame for increasing attitudes beneficial to climate change (Study 2). For example, when a loss-outcome frame was paired with information communicating high response-efficacy, participants demonstrated the greatest motivation towards behavioural engagement (Study 3).

A loss-outcome, low-response-efficacy frame was associated with the lowest reported intentions to mitigate against climate change (Study 3). Exposure to loss-framed climate change information was not by itself associated with differences for climate change attitudes and willingness to take action compared with the gain-frame and control conditions (Study 2). It may be that the type of proximal defences activated (e.g., protective vs. defensive) depend on whether the individual feels they have some control over the outcome of the threat (high vs. low response-efficacy (Witte, 1992)).

There was also evidence suggesting that motives to attenuate threat were not unidirectional. This aligns with the motivated social cognition model (Jost et al., 2003). After exposure to loss-framed climate change information, participants who reported the highest

greediness and materialistic desires also showed increases in climate change concern and willingness to mitigate (Study 2). Given the opportunity, individuals may attenuate the perceived threat in multiple ways, even when these ways seem strategically counterintuitive (e.g., not aligning with dominant worldviews). Thus, responses to loss-framed information can encourage both productive and counterproductive response, all of which presumably restore feelings of security, control and safety when reminded of existential threat.

In the absence of strong evidence that death thoughts are the means by which mortality or climate change threat produces terror management responses, alternative theoretical explanations for worldview defence findings are proposed. As most TMT research has not measured the assumed intervening mechanism – thoughts about death (Hayes & Schimel, 2018), it is difficult to ascertain whether worldview defence effects are due to MS or motivated by other threats. The Meaning Maintenance Model (MMM; Heine, Proulx, & Vohs, 2006), uncertainty-identity theory (Hogg, 2000), and the unconscious vigilance hypothesis (Holbrook, Sousa, & Hahn-Holbrook, 2011) provide alternative explanations for worldview defence responses.

According to the MMM, individuals are driven towards obtaining meaning in their life, and therefore seek ways to continually perceive themselves and the world as being meaningful (Heine et al., 2006). The occurrence of a meaning violation – i.e., an experience that violates an expected association - motivates the individual to restore meaning. Reinstating meaning can occur by affirming various meaning domains, not only to the domain that has been violated; this is referred to as fluid compensation. According to this model, worldview defence and self-esteem striving responses result from meaning violations rather than anxieties about mortality, which occurs after MS condition, as reminders of death is an experience that disrupts meaning (e.g., threat of relations between the self and the external

world; (Proulx & Heine, 2008). Bolstering cultural worldviews and self-esteem striving responses may occur as a compensatory response to threats to meaning, rather than due to the threat of death.

It is also possible that climate change threat elicits worldview defence as a way to reduce feelings of uncertainty, especially as they are relevant to self. According to uncertainty-identity theory (Hogg, 2000), experiencing feelings of uncertainty is aversive, motivating individuals to reinstate feelings of predictability and control in areas in life that are important to them. Thus, the need for individuals to reduce uncertainty in their perceptions of self and others (e.g., their identity, their beliefs, and behaviour), can motivate group membership. Offering an alternative explanation, Holbrook et al. (2011) posit that worldview defence results from unconscious vigilance, which is the increased sensitivity occurring from unconscious emotional stimuli that elicits cues of the presence of a threat. Supporting this, threat manipulations unrelated to mortality or uncertainty (e.g., angry faces, Study 3, subliminal prime to the word pain) have been observed to elicit worldview defense responses (Holbrook et al., 2011). Thus, the presence of terror management responses - such as worldview defence, may result after threats to meaning (Heine et al., 2006), certainty (Hogg, 2000), or unconscious vigilance (Holbrook et al., 2011), which are all induced when reminded about mortality and threat of climate change. In the absence of observing the full mediation model, the mechanism by which terror management responses occur (e.g., material strivings, Study 2), should be further investigated.

### **8.3 Research Implications**

As climate change impacts worsen and increase in frequency and intensity, it is imperative that we understand how to optimise message effectiveness to inspire climate action. Most climate change appeals emphasise the dire consequences of climate change. Together with

negatively focused reporting of climate change, a failure to discuss the effectiveness of mitigation strategies (Feldman et al., 2017; Hart & Feldman, 2014), and news about local natural disasters exacerbated by climate change, may depress and demoralise the public into further inaction. One way to increase willingness to take action is communicating that mitigation at the individual level can make a difference (Study 3). Relative effectiveness of framed messages (loss vs. gain outcomes; low vs. high response-efficacy) could inform how environmental campaigns are developed such that they are optimally effective.

The TM and fear appeal literature demonstrates that people respond to threat-based communications with behaviours aimed at reducing perceived risk and vulnerability. This may be through either productive behaviours aimed at reducing actual threat, or counterproductive attitudes towards reducing psychological threat. Whether individuals adopt productive or counterproductive strategies to climate change threat can depend on a number of factors, such as the proximal nature of the threat, or worldview affirming responses to threat. Although individuals seek to reinforce their worldview beliefs, especially after threat, climate change responses may be able to bypass this system if the response option can alleviate threat (as observed in Study 2).

Following sufficiently threatening risk communications such as coverage of climate change information, it may be important to immediately offer individuals an option to attenuate the perceived threat in a way that concomitantly assists in reducing climate change threat. For example, an effective climate change appeal may emphasise the dire consequences of not mitigating against climate change (e.g., loss-outcome frame), followed by advertisements of products or services to curb GHG use, such as installing solar panels. In addition to offering pro-environmental options as a way of attenuating mortality concerns, it may be equally important not to offer carbon increasing options. That is, making a conscious

effort not to position advertisements for carbon increasing products such as luxury cars, high fashion lifestyles, after a display of mortality threatening information. This may be especially important in individualistic cultures, as many worldview and self-esteem strivings are antithetical to curbing climate change.

Overall, the research described in this thesis adds value to the TM, threat communication, and environmental psychology literatures. Already explaining many phenomena, TMT has only recently been applied to understand climate change attitudes and public responses (Akil et al., 2018; Dickinson, 2009; Wolfe & Tubi, 2019). Using a TMT framework has sparked novel research ideas and questions that have allowed for increased understanding of underlying concerns influencing attitudes towards, and risk perceptions of, climate change. A greater understanding of the nature of the psychological threat that information about climate change imposes (i.e., existential) may equip us to better predict how climate change communications can impact individuals' responses and be framed to optimise message effectiveness.

## **8.4 Limitations**

Some general limitations should be remedied in future research. Study specific limitations were addressed after each study. No evidence was found for the full TMT mediation model, which may have been due to interference effects (Pilot Study, Study 1). This meant that it is not possible to state confidently whether the observed outcomes were a by-product of climate change information eliciting death-related thoughts. It was observed that loss-framed climate change communication elicited an AB to death-related stimuli (Study 2a) and material strivings (Study 2b), relative to the gain-frame and control conditions. However, it was not ascertained whether the mechanism by which loss-framed climate change communication

motivated material strivings was death-related concerns. This is a gap in the TMT literature, with few studies having tested the full mediation model.

The literature to date has identified strong support that: 1) various reminders of death increase accessibility of thoughts about death (Arndt et al., 2007; Das et al., 2009; Landau et al., 2004; Martens et al., 2004), 2) under MS people demonstrate a need to defend their worldview and self-esteem striving behaviours (Burke et al., 2010), and 3) threatening psychological structures that attenuate concerns about death elicits greater activation of death thoughts (Hayes et al., 2008; Schimel et al., 2007). However, TMT research to date has lacked a test of the indirect effect of these associations.

In the pilot study, the absence of a pre-measure of climate change attitudes is a potential limitation. However, it is posited that participants' beliefs about whether the world's climate is changing (measuring climate change acceptance/denial) may have been less likely to change after the manipulation when compared with measuring attitudes on a continuum (e.g., the extent of climate change concern, seriousness, mitigation intent). Providing both pre-and post- measures would have allowed observation of any influence of the climate change video on climate change attitudes and perceptions of risk and should be included in future research.

Another potential methodological flaw, and therefore associated interpretational uncertainty in the Pilot Study, comes from positioning the climate change questions before measuring worldview defence, after exposure to the climate change video. Measuring climate change attitudes after the climate change video may have captured worldview defence. If so, this could subsequently reduce the need for participants to defend their worldviews by showing exaggerated responses to the two authors endorsing climate change as either a low or high risk, which was the measure of worldview defence in this study. Hence, asking participants about their attitudes towards climate change immediately after the distractor task

may have provided an opportunity to affirm their worldview, reducing the subsequent need to defend their worldview in the author rating task (Arndt, Cook, Goldenberg, & Cox, 2007; Schmeichel & Martens, 2005).

A limitation of Study 3 was the lack of a control group, which did not provide a baseline for comparing framing effects and responses. However, the composition of the control group and which experimental manipulations ought to be controlled, are issues for future research. Larger sample sizes would have allowed greater confidence in the findings. This study did not include participants with diverse demographics. The relatively homogeneous sample weakens the generalisability of study findings. Future research would benefit from using samples drawn from more diverse populations (e.g., ethnic/racial/cultural background, political views, religion, socioeconomic status) to test for possible variations based on psychological responses to mortality reminders and subsequent reduction responses. For instance, mediated by such cultural traits as fatalism, cultural background and religion could impact how mortality is perceived and therefore responded to by individuals from different cultures. Doing so would reveal differences within the population on mortality effects as well as increase generalisability of experimental findings.

It is also important to address the total number of statistical tests conducted in the course of the research described in the thesis and any potential drawbacks of this number. Increasing tests and variables also increases the Type 1 error rate (i.e., a false-positive; Simmons, Nelson, & Simonsohn, 2011). To increase confidence in this thesis' findings, future research should seek to test the findings described. Future research would ideally use a more direct approach to test hypotheses. This is most apparent in the exploratory analyses section in Study 2, where the association between a number of variables as a point of interest was examined. Greater confidence in these exploratory results requires replication, using only the

variables of interest to reduce the likelihood of Type 1 errors. For the most part, the studies in this thesis attempted to test the association between variables on multiple occasions across different studies, or by using different measures. The consistency in the results within the studies in this thesis increases reliability and therefore confidence in the direction of findings when using similar methods.

## **8.5 Future research directions**

**Testing various outcomes.** The literature shows strong evidence that framing of climate change information can impact responses or response strength (Akil et al., 2018; Feinberg & Willer, 2011; Fritsche et al., 2012; Spence & Pidgeon, 2010). However, less well researched is the variety of responses from threat communications that may impact climate change. Because information about climate change may elicit psychological threat, either because its impacts are severe or because accepting climate change impinges on one's worldview (Pilot Study), people seek to ameliorate the resulting discomfort. Motivations to alleviate threat may be wide ranging and not necessarily logically or semantically related to the threat in question (Pyszczynski et al., 1999; Study 2) and therefore, not well researched. Individuals may bolster various and diverse psychological structures or ways of responding that provide them with comfort in the given moment, which may have positive or negative consequences on the individual and/or the environment. An example is the findings from Study 2, which demonstrated that loss-framed climate change information elicited material strivings, especially amongst individuals whose self-esteem was contingent on extrinsic values. This was compared with equivalent individuals exposed to the gain-frame and no threat control information condition. Studying the variety of ways that threat eliciting communication can elicit positive or negative consequences for the environment may be important to assist environmental communications to be more effective.



**Interaction with Individual Differences.** Future research could test how outcomes differ depending on whether people's initial perceptions of climate change risk is high or low. The Pilot Study included a small number of participants who denied climate change, which was not surprising as the current proportion of climate change deniers in the population is also low. However, future research would ideally use larger samples to examine how mortality reminders differentially impact climate deniers or individuals with lower perceptions of risk and their responses towards climate change. It may be that, despite some climate change denial, it is possible to increase perceptions of risk when using the same type of appeal on climate change acceptors, as was demonstrated in the Pilot Study. Similarly, De Boer, Botzen, and Terpstra (2016) observed that, despite some climate change denial, it was possible to increase participants' local climate change risk perception and motivation to engage in flood damage prevention.

**TMT.** One gap in the studies in this thesis and the TM literature, is a lack of direct evidence for the TM mediation model. This may be evidence that the mechanism by which MS produces psychological defences to attenuate concerns about death are not a consequence of an increase in death thoughts (Agroskin & Jonas, 2013). Alternatively, it could be that testing the indirect effect itself impacts responses, as evidenced in past research (Greenberg et al., 1994; Hayes & Schimel, 2018). Future TMT research seeking to clearly establish the mechanisms leading to the outcomes under investigation should test the mediation model in separate studies. This would reduce spill over effects from testing concerns about death.

A greater understanding for the framing conditions that need to be met for threat information to promote protection strategies, rather than threat-avoidant, -denial, or -dismissive responses should be investigated. Whilst information that communicates high threat and high efficacy is associated with increased willingness to take action against threat

(Witte & Allen, 2000), it may also have unexpected consequences on other life domains (e.g., material strivings). Thus, the order of presented information is likely important for various outcomes and could be investigated further.

Burke et al.'s (2010) meta-analysis found a medium to strong effect for worldview defence effects after MS. However, due to the changing political climate, could patriotism no longer serve a death-attenuating function for many individuals? Efforts to capture worldview defence may require an understanding of differences in geo-political environments. Furthermore, there has not been much investigation on differences between countries and cultures and its impacts on worldview defence and self-esteem striving responses. Most research has been conducted on US student samples. Because of different cultural scripts, worldview defence may be observed differently for Australian participants, when compared with traditional worldview outcomes observed amongst American college students (e.g., Emiko, 2014).

There is a strong suspicion that in the last few years, climate change denialism has been greatly attenuated, for example due to international movements and declarations. Thus, outright denialism is being supplanted by something akin to “reluctant acceptance” and gradual movement towards actions – e.g., by governments. Cultural worldviews are likely to reflect this recent shift, so the measures become more to do with the *extent* to which people are prepared to make changes, rather than *whether* they will make them. A problem for research is to keep up with these cultural attitudinal changes, which may be an important reason behind differences in findings of studies a few years apart.

## **8.6 Conclusion**

Overall, this research suggested that TMT can allow further understanding and prediction of responses to cover climate change information. Studies described in this thesis applied a TM framework to empirically investigate responses to climate change information,

which is limited as an area of research. Studying mortality concerns may provide a unique understanding of the type of threat that environmental communications may trigger.

Understanding TM responses may thereby provide an opportunity to reduce maladaptive responses to climate change threat information. The experimental work described in this thesis allowed determination of associations between exposure to climate change information and measured responses. The thesis has also advanced TMT investigations demonstrating the lack of sensitivity and existence of floor and ceiling effects of the DWFT, and further by suggesting alternative more sensitive implicit measures to capture unconscious concerns about death (Study 1). TMT research obtaining null findings may experience similar reliability issues when using the DWFT. Further this study highlights gaps in the TMT literature that should be addressed in future research (e.g., TM mediation model, worldview effects).

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