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Longitudinal relations between belief in climate change and environmental efficacy

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THE UNIVERSITY OF
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Abstract

Climate change is one the most important issues we face today as it has catastrophic consequences for our environment, communities, and well-being. Thus, an individual's pro-environmental behaviours are important to mitigate the climate crisis we face today. Research indicates that increased awareness of the climate crisis has led to various climate actions such as the climate strikes in 2019. We test our pre-registered predictions using two waves of an annual national panel study, the New Zealand Attitudes and Values Survey ($N = 13,918$). Cross-lagged results indicate that the climate change is real item and the personal action item showed partial support for a bidirectional association one-year later. These longitudinal findings reveal a novel link between belief in climate change and environmental efficacy, which is crucial for understanding pro-environmentalism among/of individuals in the community.

Keywords: climate change, environmental efficacy, self-efficacy, beliefs, environmentalism, NZAVS, Cross-lagged model

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1 Introduction

1.1 Contextualising the Problem

Climate change threatens our natural environment and society as it continues to impact our ecosystems, land biodiversity and human health. The climate change crisis “calls” on people to take action to decrease the effects of deforestation, oil spills, rising global surface temperatures and forest fires (Intergovernmental Panel on Climate Change [IPCC], 2022). Without mitigation efforts, these consequences pose dire long-term effects such as societal collapse (Bendell, 2018). Fortunately, research shows a steady increase in people’s awareness of anthropogenic climate change (Eichhorn et al., 2020; Milfont et al., 2017, 2021; Shepard et al., 2018) which has led to climate actions, as illustrated by the global climate strikes in 2019 (Laville & Watts, 2019). According to the United Nations (UN), climate change action requires communities and individuals to adopt sustainable pro-environmental behaviours (Pörtner et al., 2022). In saying that, effective climate mitigation strategies rely on perceived self-efficacy as it is an important factor in addressing climate change by promoting individual and collective action (Bostrom et al., 2019). Thus, it is imperative that we understand people’s climate change awareness and perceived self-efficacy to find effective climate change mitigation strategies. To form a better understanding of an individual’s climate change beliefs and perceived self-efficacy we must turn to people’s climate change awareness with regards to climate change.

As people become more aware of climate change and the influence of human-led activities on the decline of the environment, research has examined the relationship between awareness of climate change and efficacy. To illustrate, Milfont (2012) examined the extent to

which awareness of environmental issues influences perceived efficacy using panel data from a national survey of New Zealand adults. The results suggest that an increase in knowledge about environmental issues is associated with higher levels of perceived personal efficacy. Other research findings suggest that climate change beliefs (or awareness of climate issues) and knowledge of climate change are associated with pro-environmental behaviour and engagement (Sibley & Kurz, 2013). In other words, people are more likely to believe that their behaviours or actions can impact the environment in a positive way when they are aware of the consequences of climate change on the environment.

Similarly, a US report on climate change communication surveyed 1,291 American adults about their perceptions of climate change including their global warming beliefs, efficacy beliefs and their personal and social engagement with global warming. The survey revealed that a larger proportion of American adults (55%) believe in the human causation of global warming, and its impacts on the environment (Leiserowitz et al., 2019). Notably, 41% of US adults believe that human behaviours can help mitigate the consequences of climate change (Leiserowitz et al., 2019). Thus, the extent of people's climate change awareness, climate change beliefs and pro-environmental orientations can influence their pro-environmental behaviours. In particular, understanding the relationship between pro-environmental orientations and behaviours are crucial for the implementation of climate change mitigation strategies in our communities.

The present study will contribute to the literature by using a longitudinal national panel survey data to examine the longitudinal relationship between belief in climate change and environmental efficacy, particularly whether they are predictive of each other, and whether the relationship can be moderated by gender. Additionally, the robustness of the relationship between belief in climate change and environmental efficacy will be examined using

socioeconomic status and political orientation as covariates. This study will provide insights into people's pro-environmental orientations and the extent of their perceived personal efficacy. To better understand this relationship, we must delve into prior research in which pro-environmental orientations and behaviours are addressed.

Here, we provide a summary of the information presented in the following chapters. Chapter 2 includes a review of prior research on pro-environmental orientations, climate change beliefs, self-efficacy, and demographic predictors of climate change beliefs such as gender, socioeconomic status, and political orientation and more information on the present study. In Chapter 3 we provide detail regarding our analysis approach namely using a longitudinal national panel survey data to examine the relationship between our variables (belief in climate change and environmental efficacy) and we present our findings in Chapter 4. We discuss our main findings in Chapter 5 and interpret our results. This section also outlines the strengths, limitations, and future research recommendations. Finally, we summarise our findings and conclude our thesis in Chapter 6.

2 Literature Review and Background

The research around the predictors of pro-environmental orientations and behaviours is well supported in the literature (for a review, see Milfont & Schultz, 2018). Therefore, in this section, we will review literature on climate change beliefs (including beliefs about climate change reality and anthropogenic climate change). We will also review studies that look at the socio-psychological predictors of climate change beliefs.

2.1 Climate Change Beliefs and Environmentalism

As awareness of climate change and its consequences continue to increase, research suggests that belief in climate change has also risen over time. Capstick et al. (2015) conducted a systemic review of 57 cross-cultural studies from 1980 to 2010 on public perceptions of climate change using longitudinal methods to identify and examine patterns of change in public opinion. The systematic review found that in developed countries there was an increase in skepticism about climate change from the late 2000s to early 2010s. For example, there was a decline in the proportion of respondents in the United States and Western Europe who viewed climate change as either a ‘somewhat serious’ or ‘very serious’ threat to themselves and their families, accepted climate change is happening, its anthropogenic component, or scientific consensus about its human causes between 2007/2008 and 2010. However, between 2009 and 2013, the importance of climate change has been consistently increasing in developed countries, especially in Europe as 16-20% of respondents consider climate change to be the ‘single most serious problem facing the world.’ The US public’s view on climate change has steadily increased as the proportion of

people stating that ‘human activity is the main cause of climate change’ has risen from 36 to 44% over the same period. Similarly, Milfont et al. (2017) examined the belief in climate change and its anthropogenic cause among the New Zealand public over a six-year period using latent growth curve modelling. The results indicate that people’s belief in the reality of climate change and its anthropogenic causes has been steadily increasing since 2009 and this increase in belief has been greater from 2013 onwards. In addition, Sibley and Kurz (2013) reported that approximately 50% of New Zealanders believed in the reality of climate change and its anthropogenic causation, while one in six remained skeptical or denied the human impacts of climate change (7% did not believe in climate change, and 10% believed in climate change but denied its human causation). These studies suggest that although belief in climate change has increased, there is still a minority of individuals who are climate deniers or skeptical of climate change and its anthropogenic cause (Capstick et al., 2015; Sibley & Kurz, 2013).

As environmental degradation continues to worsen due to human activities, there is growing concern about the impacts of climate change. A national survey in the US analyzed the attitudes of residents towards climate change policy and found that belief in climate change and its anthropogenic causes were positively associated with concern for its impacts and support for policy interventions (Zahran et al., 2006). Other studies have shown that levels of climate change concern can be influenced by an individual’s experience with its impacts and can influence their psychological well-being (Dessai et al., 2004). Building on this, McBride et al. (2021) investigated the link between climate change concern and psychological well-being using a two-wave panel study in New Zealand. The results showed a small residual increase in psychological distress, indicating that concern for the environment may have adverse effects on one’s psychological well-being.

Demographic variables such as gender play a critical yet complex role in understanding climate change beliefs and pro-environmental orientations. Prior research suggests that climate change beliefs, environmental attitudes and support for environmental policies were not influenced by gender (Van Liere & Dunlap, 1980); instead, the extent of one's belief in climate change depended on the specific type of climate change belief (Arcury et al., 1987). However, research since then has found a gender gap in climate change beliefs and environmental views. McCright et al. (2010) examined climate change knowledge and concern of the general US public using Gallup data from 2001 to 2008. This study found that women tend to have greater scientific knowledge, were more likely to believe in climate change, its anthropogenic causes and be more concerned about the environment compared to their male counterparts. Similarly, Stokes et al. (2015) conducted a global survey and found that in the US, 51% of women see climate change as a very serious problem whereas only 39% of men consider climate change a very serious problem. In addition to this, a study by Milfont et al. (2015) examined the socio-structural and psychological variables that underpin climate change beliefs of New Zealanders using a national probability sample. The findings suggest that with regards to gender, men were overrepresented in the "Climate Skeptics" profile (54.2%) whereas women constituted majority of the other three profiles: Climate Believers (63.4%), Undecided/Neutral (58.4%), and Anthropogenic Climate Skeptics (53.5%). Thus, men are more likely to be skeptical of climate change reality and its human causation compared to women.

The above studies suggest that women are more likely to uphold higher levels of climate change beliefs compared to men; however, to get a better understanding of climate change beliefs we must investigate the literature surrounding other socio-psychological factors that may influence climate change beliefs.

Socio-psychological factors explain the differences in climate change beliefs. Hornsey et al. (2016) conducted a meta-analysis on the predictors of climate change beliefs in which 25 polls and 171 academic studies across 56 nations were examined. The meta-analytical study revealed that political affiliation and political ideology was the largest demographic predictor of climate change beliefs such that conservative individuals are more likely to deny or be skeptical of climate change whereas individuals who align with a liberal political orientation are more likely to believe in the reality of climate change. The association between political orientation and pro-environmental views differ cross-culturally. Ziegler (2017) examined the predictors of climate change beliefs and attitudes across USA, Germany, and China by using an online survey of more than 3400 citizens. The results indicated that the individuals with a conservative political orientation in the US and Germany are significantly less likely to support climate change mitigation policies. Additionally, US and German respondents with a social-green identification as well as Chinese respondents affiliated with the Communist Party exhibited greater willingness to pay the price premium on climate-friendly products. The above research suggests that political orientation is one of the strongest predictors of climate change beliefs and that the strength of the association differs cross-culturally (Hornsey et al., 2018).

In addition to political orientation, socio-economic status is also an important predictor of climate change beliefs. Research indicates that individuals with higher socioeconomic status are more likely to believe in climate change and support mitigation efforts whereas individuals with lower socioeconomic status are less likely to do so (McCright et al., 2010). These differences may be because individuals with higher socio-economic status are likely to be more educated with unlimited access to information resulting in greater awareness and concern for environmental issues (Lübke, 2022). Additionally, those with higher socioeconomic status tend

to have more financial freedom and resources to make environmentally friendly decisions (Lübke, 2022; Ziegler, 2017).

The literature presented above suggests, that overall, there is an increase in awareness of climate change and people's beliefs in climate change. Moreover, individuals who have higher levels of belief in climate change are more likely to be females, aligned with a liberal political orientation and have a higher socio-economic status. Thus, it is likely that these individuals would be more likely to support both of the belief in climate change constructs compared to others. Therefore, to form a better understanding of whether individuals who hold greater levels of climate change beliefs are more likely to engage in pro-environmental behaviours and mitigation strategies, we must review literature which relate to perceived self-efficacy in the environmental domain.

2.2 Efficacy and Environmentalism

Efficacy is explained as the perception an individual has about their capabilities to “organize and execute the courses of action required to produce given attainments” which increases an individual's confidence and agency (Bandura, 1997, p. 3). The literature has identified two main types: self-efficacy and collective efficacy. Self-efficacy focuses on the individual's perception of their capabilities to accomplish the desired outcome, whereas collective efficacy focuses on the groups capabilities to produce the desired outcome (Bandura, 1982; Bandura, 1997). Although, efficacy is related to Bandura's (1997) work, the importance of efficacy is illustrated by its inclusion in other theories Theory of Planned Behaviour (TPB) (Ajzen, 1991). In terms of environmentalism, efficacy (self-efficacy or collective efficacy) plays

a critical role in ensuring that the effectiveness of pro-environmental decisions and initiatives have a significant impact on improving our environmental and human conditions (Hamann & Reese, 2020; Jugert et al., 2016). More specifically, conscious behaviours such as recycling, changing the mode of transportation to an environmentally friendly option, and reducing the waste of natural resources that improve the environmental conditions and mitigate the consequences of climate change (Jensen, 2002; Tian & Liu, 2022). In this section, we will review literature regarding self-efficacy and collective efficacy; however, we primarily focus on self-efficacy in this study.

2.2.1 Self-efficacy

Individual self-efficacy consists of two components: an individual's perception that they a) possess the motivation for an intended behaviour, and b) that their behaviour can have the desired effect (Bandura, 1997; Hines et al., 1987; Tabernero & Hernández, 2011). The latter is also referred to as response efficacy. Self-efficacy is an important predictor of behaviour and changes in behaviour including improving performance, risk-taking behaviours, emotion management or pro-environmental behaviours (Bandura, 1997; Byars-Winston et al., 2017; Klockner, 2013; Olander et al., 2013). Self-efficacy measures are often based on Bandura's conceptualization and includes both components of self-efficacy. For example, one study measured self-efficacy for recycling behaviour with three items: "To what extent do you feel capable of separating all the paper and cardboard generated in your home and taking them to their respective containers?", "To what extent do you feel capable of separating all the glass?", "To what extent do you feel capable of separating all the packaging?" (Tabernero & Hernández, 2011). Another study investigated goal efficacy beliefs and pro-environmental behaviour using

four items which measured each of the four types of goal efficacy beliefs: direct goal self-efficacy ($\alpha = .66$), indirect goal self-efficacy ($\alpha = .78$), direct goal collective efficacy ($\alpha = .70$), and indirect goal collective efficacy ($\alpha = .72$) (Hamann & Reese, 2020), whereas other studies use scales to measure self-efficacy in an environmental domain (Moeller & Stahlmann, 2019; Priya & Thenmozhi, 2021).

Additionally, self-efficacy can be explained as the belief in one's ability to overcome barriers when performing a particular behaviour (for example, pro-environmental behaviour) (Kim et al., 2013). According to the TPB, the proximal predictor of behaviour is the intention to predict the behaviour, while the main predictors of the intention to perform the behaviour are attitudes towards the behaviour, subjective norms, and perceived behavioural control (Ajzen, 1991). Self-efficacy is related to perceived behavioural control in the (TPB) (Ajzen, 1991; Kim et al., 2013) and is considered a domain-specific construct (e.g., self-efficacy regarding pro-environmental behaviours or quality of water ways) (Bandura, 2006; Moeller & Stahlmann, 2019; Sellers et al., 2014) which reinforces an individual's motivation and behavioural intentions (Abraham et al., 2015; Huang, 2016). The combined aspects of self-efficacy are likely to influence pro-environmental behaviours (Doherty & Webler, 2016; Gould et al., 2018; Frick et al., 2004; Wang, 2018).

Research has found that self-efficacy beliefs promote discussions about climate change. Geiger et al. (2017) conducted two studies assessing US undergraduate psychology students ($N = 173$) for the first study and American adults ($N = 1066$) for the second study. This study examined whether a knowledge-based intervention related to climate change could increase discussion about climate change by increasing a sense of response efficacy and self-efficacy. The findings suggest that those who received the knowledge-based intervention reported having

higher levels of self-efficacy and response efficacy beliefs which increased engagement in public discussions about climate change. Therefore, this study indicates that components of self-efficacy motivate individuals to engage in pro-environmental behaviour. In other words, interventions that promote self-efficacy can have an influence on pro-environmental behaviours such that people are more likely to take climate actions if they believe that their actions can make a difference.

Indeed, self-efficacy is predictive of pro-environmental behaviours however there are many factors that can impact pro-environmental behaviours. Two meta-analytic studies examined the influences of psycho-social factors on pro-environmental behaviours. The aim of the first meta-analysis by Hines et al. (1987) was to find variables that were strongly associated with pro-environmental behaviours across 128 studies. This meta-analysis found that pro-environmental behaviour was associated with four categories of variables: cognitive variables, psycho-social variables, demographic variables, and experimental interventions which were analysed independently. Cognitive variables (knowledge of the natural environment or environmental issues) had a meta-analytic association of $r = .30$ with pro-environmental behaviours. Psycho-social variables were defined as individual personality characteristics (how people saw themselves and others) and was split into pro-environmental attitudes ($r = .35$), locus of control ($r = .37$), economic orientation ($r = .16$), personal responsibility ($r = .33$), and verbal commitment ($r = .49$), which were moderately to strongly associated with pro-environmental behaviours.

The demographic variables including gender ($r = .08$), age ($r = -.15$), income ($r = .16$), and education ($r = .19$) were weakly to moderately associated with pro-environmental behaviours. Moreover, experimental interventions found that appeals had the strongest influence

on pro-environmental behaviours ($r = .71$), followed by incentives ($r = .69$), information ($r = .47$), and feedback ($r = .28$). According to the proposed model of pro-environmental behaviours (Hines et al., 1987), personality factors (including pro-environmental attitudes, locus of control, and personal responsibility), knowledge (of issues and action strategies), and action skills would influence an individual's intention to act. Therefore, situational factors alongside intention to act would lead to pro-environmental behaviours.

The above study was replicated twenty years later in which responsible environmental behaviours were examined across 46 studies and 57 samples (Bamberg & Möser, 2007). The purpose of the replication was to provide an updated version of the previous meta-analysis and test the model of pro-environmental behaviours proposed by Hines et al. (1987). In this replication, the demographic variables of gender, age, income, and education and the psycho-social variable of economic orientation were not assessed. The cognitive variable of knowledge was re-defined as problem awareness and had a weaker association than the previous meta-analysis ($r = .19$). However, the remaining variables of pro-environmental attitudes ($r = .42$), perceived behavioural control ($r = .30$; re-naming of locus of control), moral norm ($r = .39$; re-naming of personal responsibility), and intention ($r = .52$; re-naming of verbal commitment) were of similar strengths than before. Pro-environmental behaviours were found to be associated with additional variables, these being social norms ($r = .31$), feelings of guilt ($r = .30$), and internal attribution ($r = .24$). Furthermore, the additional variables and the model of pro-environmental behaviours proposed by Hines et al. (1987) were examined and assessed using a meta-analytic structural equation modelling. It was found that, the influence of psycho-social variables on pro-environmental behaviours were mediated by an individual's intention to adopt pro-environmental behaviours. Moreover, the meta-analysis highlights that perceived

behavioural control was a strong predictor of pro-environmental behaviours. In other words, individuals with higher levels of self-efficacy are likely to be motivated to engage in pro-environmental behaviours (Bamberg & Möser, 2007; Hines et al., 1987).

2.2.2 *Collective efficacy*

Collective efficacy has been defined as a “group’s shared belief in its conjoint capabilities to organize and execute the courses of action required to produce given levels of attainments” (Bandura, 1997, p. 477). Similar to Bandura’s conceptualization of self-efficacy, collective efficacy also consists of two components: a groups perception that they a) believe they possess the motivation for an intended behaviour, and b) that as a group their behaviours can have a positive outcome. The latter is also referred to as collective response efficacy. Studies show that collective action is required to overcome the consequences of climate change (Bamberg et al., 2015; Barth et al., 2016) as perceived collective efficacy may motivate individuals to believe that a successful outcome can be achieved together (Barth et al., 2016).

Moreover, research has found that collective pro-environmental actions are needed to effectively combat climate issues. Milfont et al. (2020) examined the role of national identity of New Zealanders on pro-environmental tendencies and environmental norms using a national dataset. The findings suggest that 89% of the respondents placed high importance on having a clean-and-green attitude as part of their national identity. Moreover, the findings also suggest that New Zealand’s environmental national identity also predicts higher levels of belief and concern for climate change as well as individual and collective pro-environmental actions. Therefore, in the environmental context, if people believe that their behaviours can contribute to collective change then they will be encouraged to engage in activities that can have a positive

impact on the environment. However, it is important to note that self-efficacy is a strong predictor of collective efficacy; therefore, collective action still requires individual self-efficacy when mitigating the consequences of climate change (Bandura, 1997; Milfont et al., 2020). Indeed, collective efficacy is important for collective climate actions; however, the focus of our study is self-efficacy. Thus, to get a better understanding of the relationship between self-efficacy and environmentalism we must review studies that explore this relationship cross-culturally.

Prior studies have investigated the relationship between self-efficacy and pro-environmental behaviours cross-culturally (e.g., Homburg & Stolberg, 2006; Huang, 2016; Reese & Junge, 2017). For example, Kim et al. (2013) examined the pro-environmental behaviours of Korean and American undergraduate students. The reported findings suggest that self-efficacy strongly predicted pro-environmental behaviour among American students compared to Korean undergraduate students. Recently, another cross-cultural study examined environmental attitudes, efficacy (self-efficacy and collective efficacy), and pro-environmental behaviours across 11 countries using an international survey ($N = 11,000$) (Miller et al., 2022). It was found that, environmental attitudes were significantly associated with pro-environmental behaviour in each of the 11 countries with the strongest significant association with China (.664) and South Africa (.663) and the weakest association with Kenya (.235). Furthermore, there was a direct and significant relationship between efficacy and pro-environmental behaviour, but this relationship had a small effect size (.004).

Cross-cultural differences in efficacy beliefs and pro-environmental behaviour might be explained by socio-demographic variables such as gender, socio-economic status (SES) and political orientation (Jones & Dunlap, 1992; Raudsepp, 2001; Cottrell, 2003). With regards to

gender, in the environmental context, women tend to adopt more pro-environmental behaviours such as recycling and purchasing organic products (Hunter et al., 2004). Research also suggests that pro-environmental behavioural patterns of women are more strongly associated with perceived self-efficacy, specifically regarding saving energy, to men (Rainisio et al., 2022). The literature offers mixed results about the influence of SES on levels of pro-environmental behaviour as it may depend on specific types of pro-environmental actions (see Pearson et al., 2017 for a review). One study found that people with higher SES reported that they engaged in more pro-environmental behaviours and were stronger advocates for environmental policy (Eom et al., 2018). Another study suggests that individuals with higher SES may not show greater support for climate mitigation strategies; therefore, income negatively predicts intentions for pro-environmental behaviours or actions (O’Conner et al., 2002). As might be expected, political orientation strongly predicts an individual’s pro-environmental behaviours and efficacy (Hine & Giffard, 1991). Individuals with liberal political views, unlike individuals with conservative political views, are more likely to commit to pro-environmental behaviours to mitigate climate issues as they align themselves with moral values of caring for the environment (Feinberg & Willer, 2012; Milfont et al., 2019).

The literature suggests that similar to climate change beliefs, there are demographic and socio-psychological factors that influence environmental efficacy. Therefore, we can expect that some individuals are more likely to have higher levels of self-efficacy than others. Thus, understanding the relationship between climate change beliefs and environmental efficacy would provide insight into promotion and implementation of mitigation strategies.

2.3 Linking Climate Change Beliefs and Environmental Efficacy

The relationship between climate change beliefs and environmental efficacy is widely supported in the literature as these two concepts are integral in promoting climate action. For instance, a book by Doyle (2011) highlights the importance of climate change, environmentalism, and climate change communication. The author emphasises that climate change awareness and belief has become increasingly important, as the impacts of climate change threaten our environment, societies, economies, mental and physical health. Furthermore, the consequences of climate change can lead to people being displaced from their homes and communities due to extreme weather events, such as floods. Additionally, negative consequences of climate change can exacerbate social inequities, as communities with low socio-economic status tend to be more vulnerable due to lack of access to resources that can help them mitigate the effects of climate change. Thus, the author argues that we must take an inclusive approach to environmentalism to successfully communicate about the social, economic, and political aspects of climate change such as various types of media. Therefore, climate change can be made more meaningful when we understand the relationship humans have with the environment to address the consequences of climate change.

Previous studies, from the literature above, suggest that the two concepts, climate change beliefs and environmental efficacy, are complex and can be influenced by demographic and socio-psychological predictors which help understand individuals' pro-environmental orientations and behaviours. Women and people with higher socio-economic status, as well as individuals who are liberals, tend to uphold higher levels of climate change beliefs and have higher levels of perceived self-efficacy than their counterparts. Therefore, the literature supports climate change beliefs and environmental efficacy indicating that these concepts are interrelated

such that socio-psychological predictors also determine the extent of the relationship between these two concepts.

Additionally, research highlights that perceived self-efficacy has an established link with environmentalism. Arcury et al. (2022) examined self-efficacy for environmental action in vulnerable communities, Latinx youth farmers. In their study, 169 North Carolina Latinx child farm workers completed a 5-point self-efficacy for environmental action scale questionnaire in 2018 or 2019. It was found that most of the participants agreed with the positive statements, indicating that they could take actions that would affect their environment, and disagreed with the negative statement indicating that they could not affect their environment. For example, 63.9% agreed with the statement, “I feel confident in my ability to help protect the planet,” whereas 62.1% disagreed with the statement, “I don’t think I can make any difference in solving environmental problems.” The results indicate that there was a strong sense of self-efficacy in the vulnerable group of Latinx child farmworkers indicating potential for climate actions. This study further proves that in an environmental context, perceived self-efficacy can influence environmental actions.

Along with the literature above, studies have indicated the importance of the association between knowledge, climate concerns and personal efficacy. Milfont (2012) examined the relationship between these three variables using national data from New Zealand over a one-year period. The results indicated that there was a positive association between public knowledge, level of concern and perceived personal efficacy. The findings also highlighted that level of concern mediated the influence of knowledge on an individual’s perceived personal efficacy. Therefore, this means that knowledge of global warming and the consequences of climate change increases the level of concern about the risks of climate change which leads to greater perceived

efficacy. Hence, individuals who have more knowledge about climate change are more likely to have higher levels of perceived personal efficacy and responsibility to mitigate the consequences of climate change.

Furthermore, research examining environmentalism and climate change beliefs indicates that there may be a relationship between perceived self-efficacy and global warming beliefs. Kellstedt et al. (2008) used results of an original survey of a random sample of the American public to examine the role of personal efficacy and information in understanding the public's assessment of global warming and climate change risks. In one section of this study, the authors present a figure to illustrate the causal diagram of beliefs, background, information environment, and efficacy on climate change risk perceptions. Their figure shows that personal efficacy for global warming is an intervening variable between sociodemographic variables, identities, and information as well as concern for global warming. Therefore, their reasoning supports our prediction suggesting that those who uphold greater levels of climate beliefs are more likely to indicate that their individual behaviours can have a positive impact on the environment one-year later, and that greater levels of perceived environmental efficacy may lead to higher levels of climate beliefs one-year later.

The above studies provide important insights into the relationship between climate change beliefs and environmentalism. However, one of the studies above is limited in its generalisability. The study by Arcury et al. (2022) was conducted in the US on youth (aged 10 – 17 years). Thus, we may not find the same relationship in a diverse population. Despite this limitation, the studies presented above highlight the importance of environmentalism as climate change beliefs are increasing over time (Milfont et al., 2017) and higher levels of self-efficacy are predictive of pro-environmental behaviour (Bamberg & Möser, 2007; Milfont, 2012). The

results from the above studies suggest that there is a relationship between climate change beliefs and environmentalism. Therefore, to contribute to this literature, we must examine the relationship between climate change beliefs and environmental efficacy to get a better understanding of individuals pro-environmental behaviours.

2.4 The Present Study

The current study aims to examine the relationship between ‘belief in climate change’ and ‘environmental efficacy’ using a national probability sample from the New Zealand Attitudes and Values Survey (NZAVS). We examine the relationship for support between two different types of climate change beliefs included in the NZAVS (i.e., the belief that climate change is real, the belief that climate change is caused by humans) and two different environmental efficacy measures (i.e., “By taking personal action I believe I can make a positive difference to the environmental problems”, and “I feel I can make a difference to the state of the environment”). These environmental efficacy measures are related to Bandura’s (1997) conceptualisations of self-efficacy and its two components mentioned above. For example, the statement, “By taking personal action I believe I can make a positive difference to the environmental problems” is related to the first component of self-efficacy as it implies that the individual believes that they possess the motivation to take action to address environmental problems. Similarly, the statement, “I feel I can make a difference to the state of the environment” is related to the second component of self-efficacy as it implies that the individual believes that their behaviour can have a desired effect (e.g., “make a difference”) on the state of the environment.

We predict that individuals who uphold greater levels of climate beliefs are more likely to indicate that their individual behaviours can have a positive impact on the environment one year later, and that greater levels of perceived environmental efficacy may lead to higher levels of climate beliefs one year later, and that this association will be greater for females.

To understand the outcome of our predictions, we used cross-lagged panel model to examine the longitudinal relations between belief in climate change and environmental efficacy over a one-year period. We then conducted a moderated cross-lagged model to test if these associations were moderated by gender, such that the predicted relationship between belief in climate change and environmental efficacy will be stronger for females. Finally, we included covariates (political orientation and socioeconomic status) in our third model to examine whether the longitudinal relationship between belief in climate change and environmental efficacy and the moderated effects were robust over time. Political orientation is included as a covariate as conservative individuals tend to be more skeptical about climate change (Hornsey et al., 2016; Lee et al., 2015) and hold lower levels of pro-environmental orientations (Eiser et al., 1990; McCright & Dunlap, 2013). Socioeconomic status is included as a covariate as it is positively associated with awareness of and beliefs in climate change (McCright et al., 2010; Milfont et al., 2015).

3 Materials and methods

3.1 Sampling Procedure and Participants

We utilized data from Time 8 (2016) and Time 9 (2017) of the New Zealand Attitudes and Values Survey (NZAVS), a longitudinal national panel survey that has collected socio-political attitudes of the New Zealand population since 2009 (Sibley, 2022). Participants were randomly selected from the New Zealand electoral roll using a stratified sampling procedure and were posted a copy of the questionnaire, with a second postal follow-up two months later. The participants who provided an email address were emailed and invited to complete the online version of the survey, if they preferred. For participation, entry into a prize draw was offered.

There were 21,936 participants in Time 8 (2016), of which 13,781 participants were from previous waves of the study, with an additional two booster samples taken from the Electoral Roll (without replacement) to increase the sample size and sample diversity ($n = 7,667$). Additionally, there were 488 unmatched participants or unsolicited opt-ins included in the Time 8 sample. There were 17,072 participants in Time 9 (2017), of which 16,931 were retained from a previous wave, and 15,784 were retained from Time 8. Of the sample size in Time 9, 141 participants were unmatched or unsolicited opt-ins. See the NZAVS website for more information on sampling strategies: <http://www.nzvalues.com>.

The University of Auckland Human Participants Ethics Committee reviews the NZAVS every three years. The first phases of the longitudinal study were approved on 09-September-2009 for 3 years (reference number: 2009/336). The most recent ethics approval was approved on 26 May 2021 (reference Number: UAHPEC22576). All participants granted informed written consent. Contact details are removed when the questionnaires are received, and all data were de-identified before analyses were conducted. NZAVS data is hosted at the University of Auckland, and the de-identified data is available to appropriately qualified researchers upon request for the purposes of re-analysis.

The cross-sectional sample, for Time 8 included 13,722 women, 8,171 men, and 41 participants identified as gender diverse, with a mean age of 49.62 years ($SD = 13.93$). In terms of socioeconomic status ($M = 54.30$, $SD = 16.29$) was scored from 10 (low) to 90 (high) using the New Zealand Socioeconomic Index, which assigned a score based on occupation and derived from census data (Fahy et al., 2017). Mean household income was \$108,624 ($M = \$90,000$, $SD = \$97,306$). The cross-sectional sample for Time 9 included, 10,802 women, 6,246 men, and 24 participants identified as gender diverse, with a mean age of 51.33 years ($SD = 13.77$). In terms of socioeconomic status, ($M = 54.88$, $SD = 16.16$) was scored from 10 (low) to 90 (high) using the New Zealand Socioeconomic Index, which assigned a score based on occupation and derived from census data (Fahy et al., 2017). Mean household income was \$113,625 ($SD = 94,464$, median = NZ\$98,000). More information is available in this document (<https://osf.io/qdn4g>).

3.2 Measures

Belief in climate change was assessed using the following items: “Climate change is real”, and “Climate change is caused by humans”. Participants rated these items on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). Environmental efficacy was assessed using the following items: “By taking personal action I believe I can make a positive difference to environmental problems”, and “I feel I can make a difference to the state of the environment” (Milfont et al., 2017; Milfont et al., 2021; Hopwood et al., 2022). Participants rated these items on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). We also included both political orientation and socio-economic status as covariates given their established links with climate change beliefs (Hornsey et al., 2016; Lee et al., 2015) and

pro-environmental orientations (Eiser et al., 1990; Mcright & Dunlap, 2013). Political orientation was measured using an item from the Time 8 and Time 9 assessments. Participants were asked to rate how politically conservative or liberal they were (1 = extremely liberal, to 7 = extremely conservative) (see Jost, 2006). The Socioeconomic status was assessed through the 2013 New Zealand Deprivation Index which accounts for eight socioeconomic deprivation variables and ranks mesh blocks in an ordinal scale (1 = least deprived, to 10 = most deprived) based on New Zealand Census Data (see Atkinson et al., 2014).

3.3 Data Analysis

The main analyses were conducted using Mplus version 8.6 (Muthén & Muthén, 1998-2017). All analyses were pre-registered on the Open Science Framework: <https://osf.io/aextb>. To test our predictions, we conducted a cross-lagged model. Cross-lagged models calculate the longitudinal influences of one variable on another, while controlling for the stability of each construct over time, the associations between variables at the first measurement point, and the residual associations (disturbances) between measurements at the second measurement point. Accordingly, we used two waves of data to estimate a cross-lagged model that examined the stability of each construct over time (i.e., the correlation between each climate change item and environmental efficacy item at Time 1 and Time 2), and the cross-lagged paths between the different constructs (i.e., whether belief in climate change predicts environmental efficacy over time, and vice versa). In the second cross-lagged model we incorporated gender as a moderator. This allowed us to test whether the relationship between belief in climate change and environmental efficacy remained statistically significant after controlling for political orientation

and socioeconomic variables. Additionally, the univariate Wald test of parameter constraints was calculated to assess whether there was a significant difference between the size of a given path compared to another relevant path.

4 Results

4.1 Cross-Lagged Analysis

We conducted a cross-lagged analysis on climate change and environmental efficacy items across Time 8 and Time 9 of the New Zealand Attitudes and Values Study. Both of our models had a perfect fit¹ to the data, $\chi^2(0) = .00, p < .00$; CFI = 1.00; RMSEA = .00, 90% CI [0.00,0.00], SRMR = .00. The model fit statistics for our second model, which included covariates, are discussed in Appendix A.

Figure 1 presents full results from the first cross-lagged model. Examining the individual pathways of the climate change items, both ‘climate change is real’ ($\beta = 0.61, t = 52.74, p < .001, 95\% \text{ CI } [0.61, 0.65]$) and ‘climate change is caused by humans’ ($\beta = 0.65, t = 62.77, p < .001, 95\% \text{ CI } [0.63, 0.66]$) showed reasonable stability over the one-year period. In terms of the individual pathways of the environmental efficacy items, ‘by taking personal action I believe I can make a difference in the environment’ was less stable over the one-year period ($\beta = 0.32, t = 27.11, p < .001, 95\% \text{ CI } [0.30, 0.36]$) compared to ‘I feel I can make a difference to the state of the environment’ ($\beta = 0.40, t = 35.76, p < .001, 95\% \text{ CI } [0.37, 0.41]$), as indicated by the non-

¹ We evaluated model fit using the Comparative Fit Index (CFI), the Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Squared Residual (SRMR) (Hu & Bentler, 1999).

overlapping confidence intervals. Interestingly, the climate belief items are more stable than the environmental efficacy items over the one-year period.

We first report the longitudinal associations from climate change items to environmental efficacy items as depicted in Figure 1. Regarding the cross-lagged pathway, higher levels of agreement with the belief that climate change is real at Time 8 had a positive effect on the ‘personal action’ item at Time 9 ($\beta = 0.08, t = 6.58, p < .001, 95\% \text{ CI } [0.05, 0.09]$). Similarly, higher levels of agreement with the belief that climate change is real at Time 8 had a positive effect on the ‘make a difference’ item at Time 9 ($\beta = 0.07, t = 6.58, p < .001, 95\% \text{ CI } [0.05, 0.09]$).

Higher agreement with the ‘make a difference’ item at Time 8 was not significantly associated with the belief that climate change is real at Time 9 ($\beta = 0.01, t = 0.81, p = .418, 95\% \text{ CI } [-0.01, 0.02]$), but higher levels of agreement with the ‘personal action’ item at Time 8 had a positive effect on the belief that climate change is real at Time 9 ($\beta = 0.03, t = 3.95, p < .001, 95\% \text{ CI } [0.02, 0.05]$). Interestingly, the longitudinal effect of the ‘personal action’ item on the belief that climate change is real was stronger than the reverse longitudinal effect of belief that climate change is real on the ‘personal action’ item ($\chi^2(1) = 9.46, p = 0.002$).

Moreover, higher levels of agreement with the belief in anthropogenic climate change at Time 8 had a positive effect on the ‘personal action’ item at Time 9 ($\beta = 0.06, t = 5.35, p < .001, 95\% \text{ CI } [0.04, 0.08]$). However, higher agreement with the ‘personal action’ item at Time 8 was not significantly associated with belief in anthropogenic climate change at Time 9 ($\beta = 0.01, t = 1.17, p = .243, 95\% \text{ CI } [-0.01, 0.02]$). Higher levels of agreement with the belief in anthropogenic climate change at Time 8 had a positive effect on the ‘make a difference’ item at Time 9 ($\beta = 0.06, t = 5.35, p < .001, 95\% \text{ CI } [0.03, 0.06]$). Finally, higher agreement with the

‘make a difference’ item at Time 9 was not significantly associated with the belief in anthropogenic climate change at Time 8 ($\beta = 0.01$, $t = 0.81$, $p = .418$, 95% CI [-0.01, 0.02]).

Our moderation model showed no evidence that gender modulated the relationship between climate change beliefs and environmental efficacy. Thus, no evidence to support our prediction that the associations between the variables are greater for females.

Overall, individuals who uphold greater levels of belief that climate change is real and anthropogenic climate change at Time 8 are more likely to have greater levels of perceived environmental efficacy such that of the ‘personal action’ item and the ‘make a difference’ item at Time 9. Likewise, higher agreement for the ‘personal action’ item at Time 8 was associated with higher levels of belief that climate change is real at Time 9. Therefore, our results show partial support for our prediction that belief in climate change and environmental efficacy have a bidirectional, longitudinal associations. However, the relationship between belief in climate change and perceived environmental efficacy differed based on the specific type of climate change and environmental efficacy items. We observe a bidirectional association for the belief that climate change is real with the ‘personal action’ item. However, the lagged effects differed in size as in the longitudinal effect of the ‘personal action’ item on the belief that climate change is real was stronger than the alternative longitudinal effect. These paths remained the same in additional models covarying for political orientation and socioeconomic status. Full results from covariate testing are available in Appendix A.

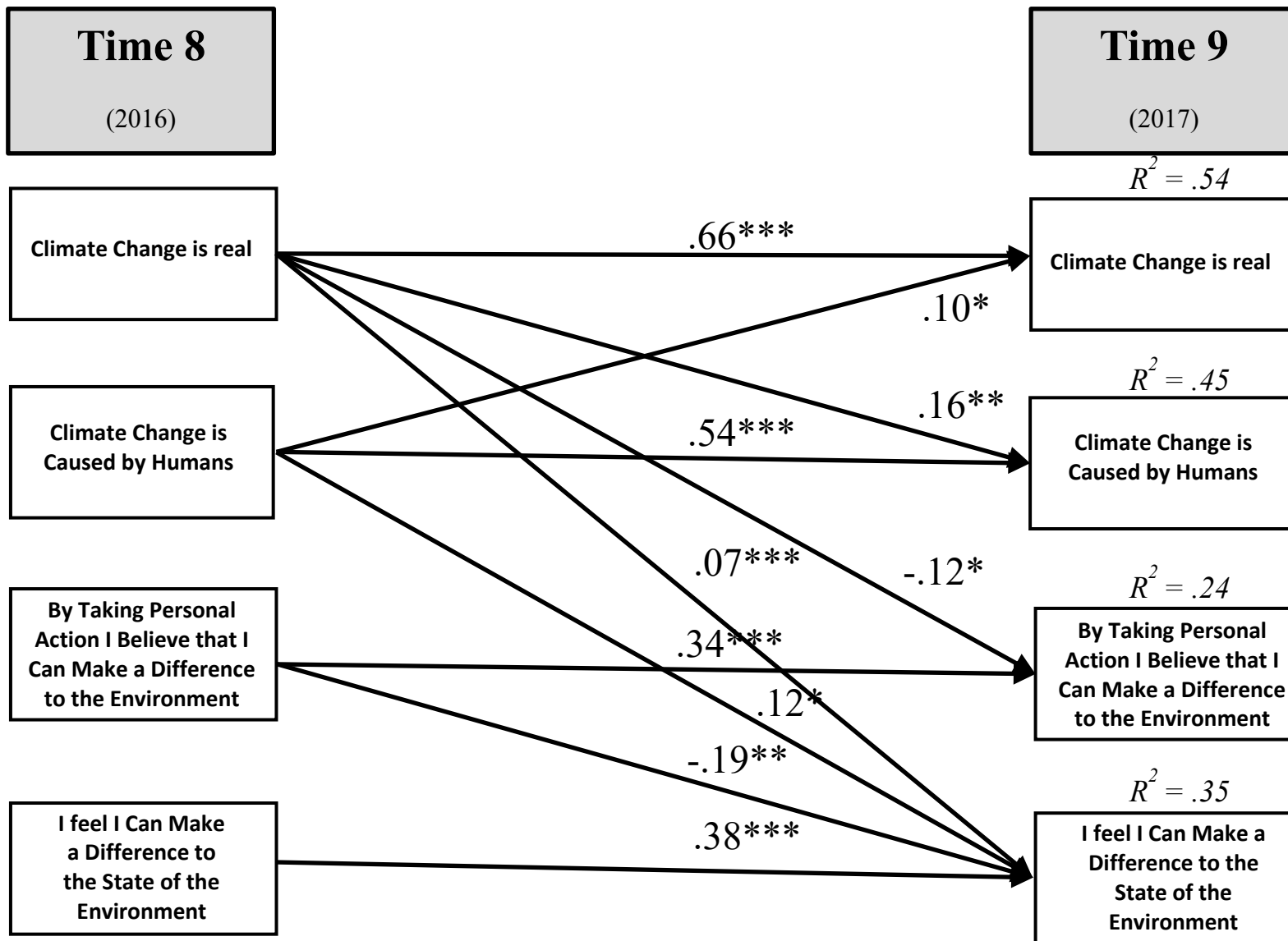


Fig. 1. Autoregressive cross-lagged panel path model. *Note.* The concurrent associations between constructs at Time 8 and the disturbances (or residual associations) between measures at Time 9 and reports standardised coefficients **p < .001.

5 Discussion

The impact of climate change on human societies is multi-faceted, including social and economic impacts as well as environmental degradation (IPCC, 2022). As climate change awareness grows, so does the recognition of the urgency of the situation and the need for global climate action. In response, the IPCC emphasizes that governments, businesses, communities, and individuals must engage in environmentally friendly behaviours to address the consequences of climate change. To better understand the role of self-efficacy in climate change mitigation efforts, we used data from a national probability survey to examine the longitudinal relationship between belief in climate change and environmental efficacy. We measured climate change beliefs and efficacy using two climate change items and two efficacy items from the New Zealand Attitudes and Values Study ($N = 13,487$). In this section, we discuss our key findings and the implications of our research for better understanding the importance of efficacy in implementing climate change mitigation strategies.

5.1 Longitudinal Associations Between Climate Change Beliefs and Efficacy

We employed a cross-lagged panel model to investigate the longitudinal associations between climate change beliefs and efficacy. We predicted that individuals with stronger climate change beliefs would be more likely to report positive impacts on the environment through their individual behaviours one-year later, and that greater perceived environmental efficacy would lead to higher levels of climate beliefs one year later. The results yielded a few key findings. First, we found that only the ‘personal action’ item at Time 8 was bidirectionally associated with higher levels of belief that climate change is real at Time 9.

Thus, these results provide partial support for our initial prediction that belief in climate change and environmental efficacy have a bidirectional, longitudinal association. Instead, we found that the relationship between belief in climate change and perceived environmental efficacy differed based on the specific type of climate change and efficacy items being measured. We observe a full bidirectional association for the belief that climate change is real with the ‘personal action’ item. The lagged effects of this association differed in size as the longitudinal effect of the personal action item on the belief that climate change is real was stronger than the alternative longitudinal effect. However, we found no evidence that gender moderated the relationship between climate change beliefs and environmental efficacy. Thus, no evidence to support our prediction that the associations between the variables are greater for females. Additionally, we found that the climate belief items were more stable than the environmental efficacy items over the one-year period. These findings held when accounting for political orientation and socio-economic status as covariates.

Prior research indicates that individuals who uphold climate change beliefs are more likely to engage in pro-environmental behaviours (Milfont, 2012; Laville & Watts, 2019). The bidirectional association we found between climate change is real at Time 8 and the ‘personal action’ item at Time 9 means that individuals who believe in the reality of climate change are more likely to believe that their actions can make a positive difference to their environment. This association may therefore demonstrate that individuals who believe in the reality of climate change may also experience a sense of responsibility to take personal action to mitigate the effects of climate change (Brody et al., 2012; Wang, 2018). Namely, a New Zealand study conducted by Sibley and Kurz (2013) found that climate change beliefs specifically, belief in the reality of climate change was better linked to pro-environmental behaviour than belief in the anthropogenic causes. Conversely, an individual’s perception that engaging in pro-environmental actions to reduce the impacts of climate change may

strengthen the belief that climate change is real, as this may reinforce the concept that one's actions can have a positive impact when mitigating the consequences of climate change (Doherty & Webler, 2016; Frick et al., 2004; Geiger et al., 2017; Wang, 2018). Therefore, our results combined with previous research indicates that an individual's perceived self-efficacy may increase their understanding regarding the reality of climate change and increase pro-environmental behaviours.

Another possible explanation for the finding that the 'personal action' item was only associated with one climate change item, is that individuals with higher levels of belief that climate change is real may be more motivated to engage in pro-environmental behaviour (Bandura, 1997; Milfont et al., 2017). Research has examined the extent to which awareness of the consequences plays a role on perceived efficacy, with studies showing individuals with increased knowledge about environmental issues are more likely to believe in the reality of climate change (Capstick et al., 2015; Sibley & Kurz, 2013), and therefore have higher levels of perceived self-efficacy (Milfont, 2012). Prior research has highlighted the importance self-efficacy through perceived behavioural control in influencing behaviour (Ajzen, 1991). Thus, individuals who have higher levels of belief that climate change is real and also have a strong sense of perceived behavioural control are more likely to perceive that they possess the motivation to take action against environmental issues and engage in pro-environmental behaviours (Bamberg & Möser, 2007; Milfont, 2012; Geiger et al., 2017). Therefore, effective promotion of pro-environmental behaviours must implement interventions that increase an individual's sense of perceived behavioural control (Geiger et al., 2017). Thus, climate mitigation strategies should consider individuals beliefs in climate change in conjunction with perceived behavioural control to encourage pro-environmental.

There is an increased awareness of climate change over time (Capstick et al., 2015). Our results yielded an interesting finding; the climate change belief items were more stable

than the environmental efficacy items over the one-year period. An explanation for this could be that climate change beliefs are increasing over time. A study conducted in New Zealand found that there has been a steady increase in belief in the reality of climate change and its anthropogenic cause since 2009 (Milfont et al., 2017). Thus, as awareness of climate change and its consequences increases over time, an individual's confidence in their climate change beliefs may increase as well and become ingrained over time. In contrast, the environmental efficacy items are more likely to be impacted by other factors, such as changes in social norms, resource availability or access to information (Bamberg & Möser, 2007; Hines et al., 1987). Therefore, it is possible that these external factors may influence perceived self-efficacy, in the environmental context, compared to the beliefs in climate change resulting in the differences in efficacy measures over time. It should be noted that further research is needed to understand the underlying mechanisms that may be driving the differences in stability of the belief in climate change items and environmental efficacy items over time.

Researchers have suggested that, with respect to gender in the environmental context, females tend to have greater scientific knowledge, are more likely to engage in pro-environmental actions, or hold pro-environmental beliefs in comparison to men (McCright, 2010; Brough et al., 2016); perhaps explained by the differences in self-efficacy such that women tend to have higher levels of perceived self-efficacy than men (Hunter et al., 2004; Rainisio et al., 2022). Thus, it is unclear why our moderation model revealed that gender did not moderate the relationship between climate change beliefs and environmental efficacy. Therefore, no evidence was found to indicate that the positive associations between the two variables were greater for females. One possible explanation for this could be that men and women may feel equally responsible and motivated to take action to address climate change. Another explanation could be that men and women may have had similar levels of exposure

to information and education about change, resulting in similar levels of beliefs about climate change and perceived self-efficacy in the environmental context.

Overall, the results of our cross-lagged analysis provide novel evidence of a partial bidirectional relationship between belief in climate change and environmental efficacy. Our findings contribute to research examining how climate change beliefs predict self-efficacy in an environmental context by showing that belief in the reality of climate change is associated with both types of efficacy beliefs.

5.2 Implications of Our Research

This research contributes to the literature by showing that our belief in climate change item, such as belief in the human causation of climate change, did not have a bidirectional association with either of the environmental efficacy measures. On the other hand, we also contribute to the literature by showing that the relationship between our belief in climate change item, climate change is real, has a bidirectional association with the environmental efficacy ‘personal action’ item. Thus, believing in the reality of climate change increases an individual’s perception that they possess the motivation to make a positive difference to the environment. This finding is similar to Arcury et al. (2022), who examined self-efficacy for environmental action among Latinx youth farm workers and found that there was a strong sense of self-efficacy for environmental action among the Latinx youth farmers. Although, Arcury et al. (2022) did not examine climate beliefs in their study, their finding that self-efficacy was likely to be predictive of pro-environmental actions indicates that individuals with higher levels of perceived self-efficacy are more likely to engage in mitigation behaviours. In the New Zealand context, Milfont (2012) found that individuals with higher levels of knowledge of climate change were more likely to have higher levels of perceived

efficacy. Milfont et al. (2020) found that belief in climate change and its anthropogenic causes are increasing over time. Therefore, the bidirectional relationship between belief in climate change item, climate change is real, and the environmental efficacy 'personal action' item may be indicative of the extent to which upholds climate beliefs over time. Therefore, our finding that belief in human causation of climate change did not have a bidirectional association with any environmental efficacy items may reflect that individuals may believe in climate change but not its human causation (Sibley & Kurz, 2013).

Our research also has important practical implications for promoting and implementing mitigation strategies. Research suggests that 89% of the New Zealanders placed high importance on having a clean-and-green attitude as part of their national identity (Milfont et al., 2020). Furthermore, New Zealand's environmental national identity also predicts higher levels of belief and concern for climate change as well as individual and collective pro-environmental actions (Milfont et al., 2020). Therefore, mitigation strategies must appeal to the public's belief in a clean-and-green attitude to increase levels of participation and engagement in pro-environmental behaviours. Our cross-lagged results offer insights regarding which climate beliefs and environmental efficacy items should be targeted to promote mitigation strategies. Our results show that the individuals who have higher levels of belief that climate change is real are more likely to believe that their personal actions can make a positive difference in the environment and that this relationship is bidirectional. Therefore, incorporating these two areas when promoting mitigation strategies would be beneficial and more effective in engaging individuals to address environmental issues.

5.3 Strengths, Limitations and Future Research Recommendations

Notwithstanding these novel findings, we must consider further strengths as well as limitations of our study. A strength of our study is that it is a longitudinal panel study which allowed us to collect data from the same individuals over a longer period such that, for our study, we were able to analyse the stability of the variables (“belief in climate change” and “environmental efficacy”) as well as their associations over time (Ruspini, 2003). In other words, we were able to identify the effect (positive or negative) of one variable at a point in time on another variable at a point in time. Another advantage of using a longitudinal panel study is that it can help improve the accuracy and reliability of the variables by controlling for individual differences. For example, in our study, the relationship between belief in climate change and environmental efficacy was moderated by gender so we included political orientation and socio-economic status as covariates to test whether the relationship between belief in climate change and environmental efficacy was statistically significant (Ruspini, 2003). Thus, longitudinal panel studies are useful as it allows the researcher to study a variable and changes of the variable over time.

The environmental efficacy measures used in our study are related to Bandura’s (1997) conceptualisations of self-efficacy and its two components such that the ‘personal action’ item is related to the first component of self-efficacy which implies that the individual believes they possess the motivation to take action to address environmental problems. Similarly, the ‘make a difference’ item is related to the second component of self-efficacy which implies that the individual believes that their behaviour can have a desired effect (e.g., “make a difference”) on the state of the environment. However, the environmental efficacy items used in our study may not fully explain the complexity of the self-efficacy construct as described by Bandura (1997). According to Bandura (1997), self-efficacy can be explained as a belief

that is specific to a certain task or behaviour. Hence, it is possible that the environmental efficacy items used in our study may not be specific enough to encapsulate the range of environmentally friendly behaviours an individual might engage in to make a positive difference to the environment. In addition to this, it is important to note that there are other factors, besides self-efficacy, that influence pro-environmental behaviours. These factors include social norms, personal values, and situational factors (Bamberg & Möser, 2007; Hines et al., 1987). Hence, it is important to consider these factors when interpreting the results of this study. Despite these limitations, the two environmental efficacy items provide insight into an individual's perception of their ability to make a positive impact to the environment. Therefore, future research might include a more comprehensive understanding of self-efficacy and the various factors that influence pro-environmental behaviour. Furthermore, understanding the specific pro-environmental behaviours, that individuals feel confident in performing, may be beneficial in promoting climate change mitigation strategies.

Another limitation is that our measures of climate change and environmental efficacy was restricted to the individual items included in the NZAVS. Our findings indicated that the relationship between belief in climate change and environmental efficacy differed depending on the item being measured. Future research may consider examining other climate related measures such as climate concern. Therefore, the relationship between the climate concern and environmental efficacy may be expected to be different. However, it is important to note that climate beliefs, climate concern and anxiety are related. Research suggests that belief in climate change and its anthropogenic causes were positively associated with concern for the consequences of climate change and support for policy interventions (Zahran et al., 2006). Similarly, other studies highlight that climate change concern can impact an individual's psychological wellbeing thus concern for the environment may cause son psychological distress (Dessai et al., 2004, Lorenzi et al., 2005; McBride et al., 2021). Considering that our

findings suggest that belief in climate change is real shows a bidirectional association with environmental efficacy then, most likely, the association between climate concern and environmental efficacy may be similar.

Furthermore, previous research on climate change beliefs and perceived self-efficacy in the environmental context has utilized US and European samples. The addition of a New Zealand sample to the literature would be beneficial as New Zealand is an island nation so is particularly vulnerable to the effects of climate change such as, floods and rising sea levels. Therefore, the extent to which New Zealanders uphold climate beliefs and engage in pro-environmental behaviours may differ compared to the US or European samples. Therefore, one limitation of our study is that our sample mainly reflects a Western view of climate change as majority of the participants at both time waves identified as Europeans (at Time 8 approximately 19,478 people identified as European and at Time 9 approximately 15,606 people identified as European). Thus, our sample does not accurately represent the Non-Western populations which are most affected by the consequences of climate change (Johnson et al., 2019). Therefore, to get a non-Western perspective on climate change, future research could include indigenous populations and adjust the climate-related measure used to represent the indigenous views on climate change.

6 Conclusions

To conclude, the present research examines the relationship between climate change beliefs and environmental efficacy. We use longitudinal panel data and variable centered analysis to understand the relationships. Our findings show support for a partial bidirectional association between the belief in climate items and environmental efficacy item. Instead, we a longitudinal bidirectional association between the reality of climate change and efficacy item

and that this association was not moderated by gender. Theoretically our findings contribute to the climate change beliefs and efficacy literature by showing that these concepts are partially, positively predictive of each other, in that some efficacy items are associated with climate change beliefs than others. Practically, our findings provide evidence that with regards to environmentalism, the New Zealand public would be more likely to engage in climate mitigation strategies.

7 References

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7.1 Appendix A

For our second cross-lagged analysis, we included 2 covariates in the model: political orientation and socioeconomic status. Based on the same criteria reported in the main document, this cross lagged model with covariates had a perfect fit to the data, $\chi^2(0) = .00$, $p < .00$; CFI = 1.00; RMSEA = .00, 90% CI [0.00,0.00], SRMR = .00. As mentioned earlier, adding covariates to the model is not expected to decrease the model fit statistics.

All pathways between the variables remained the same as in the model without the covariates. belief that climate change is real and belief in the anthropogenic climate change showed reasonable stability over the one-year period (β 's > 0.60 , $p < .001$). In terms of the individual pathways of the 'personal action' item and the 'make a difference' item were less stable over the one-year period (β 's > 0.31 , $p < .001$). As found in the model without the covariates, the cross-lagged relationship between climate change and environmental efficacy was influenced by the specific items being measured. A bidirectional association was observed for the belief that climate change is real item with the 'personal action' item.

Political Orientation

Political orientation negatively predicted the belief that climate change is real ($\beta = -0.07$, $t = -10.70$, $p < .001$, 95% CI[-0.07, -0.05]), negatively predicted the belief in anthropogenic climate change ($\beta = 0.06$, $t = -10.33$, $p < .001$, 95% CI[-0.08, -0.06]) but political orientation was not significantly related to any of the environmental efficacy variables.

Socio-economic Status

Socioeconomic status negatively predicted the 'make a difference' item ($\beta = -0.03$, $t = -4.22$, $p < .001$, 95% CI[-0.01, 0.00]); however, was not significantly related to any other environmental efficacy or climate change variable.