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Adolescence in a Changing World: Finnish Adolescents' Climate Change-Related Well-Being, Pro- Environmental Behavior, and Coping Strategies

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ACADEMIC DISSERTATION

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Abstract

The future of planet Earth and humanity is evidently being shaped by climate change and other interrelated ecological crises. However, climate change does not only cause environmental problems; it also affects human well-being. Adolescents are considered a particularly vulnerable group in the face of climate change. While their future will undoubtedly be shaped by current climate policies, they are often not involved in and have little power in the policy-making process. Yet, the expectation is that they will develop more sustainable attitudes and lifestyles than older generations. At the same time, awareness of the urgency of climate change is causing climate change distress. This unique form of distress has a complex relationship with adolescents' pro-environmental behavior, which is influenced by how they cope with climate change. Yet, the existing research on such phenomena throughout adolescence is limited.

Thus, this dissertation builds both an in-depth and a broad picture of climate change distress and its relation to coping strategies, pro-environmental behavior, and general well-being throughout adolescence by approaching the phenomena from both person-centered and variable-centered perspectives, combining cross-sectional and longitudinal data. Based on three original studies, the dissertation answers three key research questions: 1) How does climate change distress manifest itself among Finnish adolescents, and how does it relate to general well-being (Study I, Study II)?; 2) How are climate change distress and pro-environmental behavior associated both contemporaneously (Study I, Study II, Study III) and longitudinally (Study III)?; 3) How do different coping strategies (de-emphasizing/denial, problem-focused and meaning-focused) relate to levels of climate change distress and pro-environmental behavior, and do particular coping strategies moderate the relationship between climate change distress and pro-environmental behavior (Study II & Study III)?

Study I uses cross-sectional data to explore what kind of climate change-related well-being and behavior profiles can be identified among upper secondary school students and how the profiles differ based on general mental well-being. Study II deepens the person-oriented approach by examining profiles of climate change distress and denial among Finnish adolescents, the stability of those profiles within one year and the explanatory similarity of the profiles on general well-being and pro-environmental behavior. Finally, Study III adds to the picture by examining the

interplay between climate change distress and pro-environmental behavior at the within-person level and the relationships with coping strategies both contemporaneously and across one year.

Taken together, the original studies show that climate change distress plays a complex role in adolescents' lives and that adolescents do not react to climate change in homogeneous ways. On the one hand, high levels of climate change distress were often associated with simultaneous active pro-environmental behavior, but on the other hand, high levels of climate change distress were sometimes accompanied by high levels of denial, which was associated with less pro-environmental behavior. While climate change distress and pro-environmental behavior were positively associated at the contemporaneous level in all studies, when the longitudinal associations were examined, the results showed that increases in adolescents' average levels of climate change distress were associated with decreases in pro-environmental behavior one year later. In contrast, increased pro-environmental behavior was associated with higher-than-expected climate change distress one year later. However, meaning-focused coping (i.e., promotion of hope and trust in societal actors) acted as a buffer, since for adolescents with persistently high meaning-focused coping, higher-than-expected climate change distress was associated with an increase in pro-environmental behavior on later occasions. In addition, a bidirectional relationship was found between pro-environmental behavior and problem-focused coping over time, but problem-focused coping was also associated with an increase in an adolescent's personal level of climate change distress the following year. Conversely, denying and de-emphasizing were associated with less pro-environmental behavior but not necessarily always less climate change distress.

In conclusion, the dissertation underscores the importance of addressing climate change distress not only as a psychological burden but also as a complex phenomenon influencing adolescents' ability to meaningfully engage in climate change mitigation and adaptation. Ultimately, the dissertation demonstrates the profound importance of understanding and supporting adolescents' mental well-being and agency in an era of environmental crisis and different ways in which they cope with climate change. In doing so, it provides a foundation for developing policies, interventions, and educational practices that will foster resilience and proactive environmental engagement throughout adolescence, ensuring that young people are better equipped to face the challenges of a rapidly changing world.

Abstrakti

Maapallon ja ihmiskunnan tulevaisuus on vääjäämättä ilmastonmuutoksen ja siihen kytkeytyvien ekologisten kriisien muovaama. Ilmastonmuutos ei kuitenkaan aiheuta vain ympäristöongelmia, vaan sillä on vaikutuksensa myös ihmisten hyvinvointiin. Nuoret nähdään usein erityisen haavoittuvana ryhmänä ilmastonmuutoksesta puhuttaessa, sillä vaikka heidän tulevaisuutensa riippuu nykyisistä ilmastopoliittisista päätöksistä, nuoret eivät usein pääse osallistumaan tai vaikuttamaan päätöksentekoon. Samalla heidän odotetaan omaksuvan kestävämpiä asenteita ja elämäntapoja kuin vanhemmat sukupolvet. Kasvava tietoisuus ilmastonmuutoksen vakavuudesta aiheuttaa negatiivisia tunteita (kuten huolta ja ahdistusta), jotka voivat heijastua myös kognitiivisina vaikeuksina (kuten vaikeus keskittyä). Tätä ilmiötä nimitetään suomeksi usein ilmastoahdistukseksi. Ilmastoahdistuksella on monitahoinen yhteys nuorten ympäristövastuulliseen käyttäytymiseen, johon vaikuttaa myös heidän käyttämänsä ilmastonmuutokseen liittyvät hallintakeinot. Näitä ilmiöitä ja niiden kehitystä nuoruusiässä on kuitenkin toistaiseksi tutkittu hyvin rajallisesti.

Tämä väitöskirja pyrkii rakentamaan laaja-alaisen kuvan suomalaisnuorten ilmastoahdistuksesta ja sen yhteydestä heidän käyttämiinsä hallintakeinoihin, ympäristövastuulliseen toimintaan ja yleiseen hyvinvointiin nuoruusiässä. Väitöskirjassa lähestytään näitä ilmiöitä useista näkökulmista yhdistäen poikkileikkaus- ja pitkittäistutkimusaineistoa. Väitöskirjassa vastataan kolmeen keskeiseen kysymykseen kolmen alkuperäisen osatutkimuksen kautta: 1) Millaisena ilmastoahdistus ilmenee suomalaisten nuorten keskuudessa, ja miten se on yhteydessä yleiseen hyvinvointiin (Osatutkimus I ja II)?; 2) Miten ilmastoahdistus ja ympäristövastuullinen toiminta ovat yhteydessä toisiinsa sekä samanaikaisesti poikkileikkausaineistossa (Osatutkimus I, II ja III) että pitkittäisesti (Osatutkimus III)?; 3) Miten erilaiset hallintakeinot (etäännyttäminen/ kieltäminen, ongelma- ja merkityskeskeiset hallintakeinot) ovat yhteydessä ilmastoahdistukseen ja ympäristövastuulliseen toimintaan, ja voivatko nuorten käyttämät hallintakeinot vaikuttaa ilmastoahdistuksen ja ympäristövastuullisen toiminnan väliseen yhteyteen (Osatutkimus II ja III)?

Osatutkimuksessa I käytetään poikkileikkausaineistoa, jota tutkimalla selvitetään, millaisia ilmastonmuutokseen liittyviä hyvinvoinnin ja toiminnan profiileja voidaan tunnistaa lukiolaisnuorten keskuudessa, ja miten nämä profiilit

eroavat yleisen hyvinvoinnin suhteen. Osatutkimus II syventää henkilösuuntautunutta lähestymistapaa tarkastelemalla suomalaisnuorten ilmastoahdistuksen ja -kieltämisen profiileja, näiden profiilien pysyvyyttä yhden vuoden ajan sekä profiilien eroja yleisen hyvinvoinnin ja ympäristövastuullisen toiminnan suhteen. Lopuksi Osatutkimus III täydentää kokonaiskuvaavaa tutkimalla ilmastoahdistuksen, ympäristövastuullisen toiminnan ja hallintakeinojen välisiä yhteyksiä yksilötasolla sekä ajallisesti samanaikaisesti että pitkittäisesti yhden vuoden aikana. Osatutkimus III keskittyy pääsääntöisesti yksilötasoon eli siinä tutkitaan, miten esimerkiksi muutos yksilön omassa normaalissa ilmastoahdistuksen tasossa on yhteydessä myöhempiin muutoksiin ympäristövastuullisessa toiminnassa tai käytetyissä hallintakeinoissa.

Yhdessä osatutkimusten tulokset osoittavat, että ilmastoahdistuksella oli monitahoinen rooli nuorten elämässä, eivätkä nuoret reagoineet siihen keskenään samoin tavoin. Yhtäältä ilmastoahdistus oli usein positiivisesti yhteydessä aktiiviseen ympäristövastuulliseen toimintaan. Toisaalta joissain tapauksissa korkea ilmastoahdistus saattoi esiintyä yhdessä ilmastokieltämisen kanssa, mikä puolestaan oli yhteydessä vähäisempään ympäristövastuulliseen toimintaan. Pitkittäisesti tarkasteltuna yksilön lisääntynyt ilmastoahdistus oli yhteydessä laskuun ympäristövastuullisessa toiminnassa vuotta myöhemmin. Samalla yksilön ympäristövastuullisen toiminnan lisääntyminen ennusti aiempaa korkeampaa ilmastoahdistusta vuoden kuluttua. Merkityssuuntautuneen hallintakeinon käyttö kuitenkin toimi kilpenä, sillä niillä nuorilla, joilla oli vahva taipumus käyttää merkityssuuntautunutta hallintakeinoja, yksilön lisääntynyt ilmastoahdistus ennustikin myöhempään ympäristövastuullisen toiminnan kasvua. Lisäksi ympäristövastuullisen toiminnan ja ongelmasuuntautuneen hallintakeinon välillä havaittiin kaksisuuntainen positiivinen yhteys. Ongelmasuuntautunut hallintakeino oli yhteydessä kuitenkin myös yksilön kohonneeseen ilmastoahdistukseen seuraavana vuonna. Etäännyttäminen ja kieltäminen puolestaan olivat yhteydessä yksilön ympäristövastuullisen toiminnan vähentymiseen, mutta eivät välttämättä aina vähäisempään ilmastoahdistukseen.

Kaiken kaikkiaan väitöskirjassa korostetaan, että on tärkeää, ettei ilmastoahdistus käsitellä ainoastaan psykologisena taakkana, vaan monitahoisena tekijänä, joka vaikuttaa eri tavoin nuorten kykyyn sitoutua mielekkäästi ilmastomuutokseen sopeutumiseen ja sen hillintään. Väitöskirja osoittaa, miten tärkeää on ymmärtää ja tukea nuorten hyvinvointia, toimijuutta ja heidän käyttämiään hallintakeinoja ympäristökriisien aikakaudella. Näin se tarjoaa perustan sellaisten politiikkatoimien, interventioden ja koulutuskäytäntöjen kehittämiselle, jotka edistävät nuorten resilienssiä ja aktiivista ympäristötoimijuutta ilmastokriisin aikakaudella varmistuen, että he ovat paremmin valmistautuneita kohtaamaan nopeasti muuttuvan maailman haasteet.

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List of original publications

The dissertation is based on the following publications:

- I Veijonaho, S., & Salmela-Aro, K. (2022). Nuoret ja ilmastonmuutos – ilmastonmuutokseen liittyvät lukiolaisnuorten hyvinvointi- ja toimintaprofiilit. *Psykologia*, 57(4). <https://doi.org/10.62443/psykologia.v57i4.110981>
- II Veijonaho, S., Ojala, M., Hietajärvi, L., & Salmela-Aro, K. (2023). Profiles of climate change distress and climate denialism during adolescence: A two-cohort longitudinal study. *International Journal of Behavioral Development*, 1-10. <https://doi.org/10.1177/01650254231205251>
- III Veijonaho, S., Hietajärvi, L., Ojala, M. & Salmela-Aro, K. (2025). From Distress to Action? – A Three-Wave Longitudinal Study of Climate Change Distress, Pro-Environmental Behavior, and Coping Strategies among Finnish Adolescents. *Journal of Environmental Psychology*. <https://doi.org/10.1016/j.jenvp.2025.102676>

The publications are referred to in the text by their Roman numerals.

1 Introduction

In the fall of 2019, a 16-year-old steps up to a podium in front of world leaders at the United Nations' Climate Summit and delivers the now iconic words: *"This is all wrong. I shouldn't be up here. I should be back in school on the other side of the ocean. Yet you all come to us young people for hope. How dare you!"* (YaleGlobal Online, 23.09.2019). The young woman is a Swedish climate activist, Greta Thunberg, who started striking on school days, holding a one-person demonstration on the streets of Stockholm to demand more urgent policymaking in the fight against climate change. This later sparked a nonviolent civil disobedience movement called Extinction Rebellions and a youth-led global demonstration movement called Fridays for Future. The movements, with their *"There is no planet B"* demonstration signs and road blockages, have become the face of the despair and uncertainty young people feel about a future clearly being shaped by changing climate.

The movements have an important message. Climate change, due to its global scale and its deep entanglement with economic, political, and social systems, is a "wicked problem" that is beyond any individual's ability to solve (Head, 2019). In fact, it is something that the whole of humanity cannot fully solve because climate change has already altered our living environment, and at this point it seems highly unlikely that societies can make changes drastic enough to completely stop the increase in average temperatures below 1.5 degrees Celsius, which is considered the critical threshold to avoid the most severe impacts of climate change (Calvin et al., 2023; Thiery et al., 2021). While it may not be possible to avoid all the consequences of climate change, it is still possible to control the severity of those consequences. However, rapid action and major societal transformations will be required to limit the escalation of climate change impacts and secure a livable planet for both present and future generations (Calvin et al., 2023).

Climate change is primarily viewed as an environmental problem, but it is intertwined with many psychological issues as well (Koger et al., 2011). For an individual forced to confront this wicked problem, it can lead to feelings of distress, helplessness, and insecurity, especially among young people, who have less control over the decisions that will affect their future (Hickman et al., 2021; Thiery et al., 2021). While adolescence is likely the period in life when most people learn about climate change and gain a deeper understanding of its seriousness (Clayton &

Crandon, 2024), adolescents are often not involved in the policy-making process and have little power to influence outcomes. The failure to recognize their perspectives on the problem can trigger a strong emotional response in adolescents, who feel betrayed or neglected by those in charge (Thiery et al., 2021). In an international survey conducted among adolescents in ten countries, over half of the Finnish respondents thought that the government is not taking their concerns seriously, not doing enough to avoid a climate catastrophe, and acting in line with climate science (Hickman et al., 2021). In the same survey, 44% of the Finnish respondents reported being extremely or very worried about climate change, which was still lower than the average for all respondents (overall, 59% of all respondents reported being extremely or very worried) (Hickman et al., 2021). In the Finnish Youth Barometer 2023, 58% of respondents said that climate change causes them a great deal or quite a lot of uncertainty and insecurity (Kiilakoski, 2023).

Consequently, the lack of sufficient climate action does not arise from a lack of public concern. National surveys show that Finns' understanding of climate change as constituting a very serious global threat has steadily grown. In 1992, only 34% of Finnish respondents in The Health of the Planet survey considered global warming a very serious threat, while 43% saw it as somewhat serious (Breachin, 2003). More than 30 years later, in the Finnish Climate Barometer 2025 survey, 51% of the respondents strongly agreed and 31% somewhat agreed that climate change poses a serious global threat (Climate Barometer, 2025). Thus, the total number of those who believe that climate change is a threat has remained fairly stable over the years, but the number of those who strongly agree has increased over the years. It is even more pronounced among young people (figure 1). While overall agreement among Finnish youth has slightly declined over the 2000s, the share of those who strongly agree has risen sharply. In 2025, 61% of Finns aged 15–29 strongly agreed that climate change poses one of the most serious global threats to society (figure 1) (Climate Barometer, 2025). Moreover, in the Finnish Youth Barometer 2023 survey, young people even ranked climate change as the greatest global threat—surpassing, for example, concerns about the global economy, weapons of mass destruction, and cybercrime (Kiilakoski, 2023).

While various surveys indicate that most Finns recognize that climate change is a real threat, they are not necessarily ready to take any actions that will help them adapt to or mitigate climate change. In an international survey conducted among Facebook users in 110 countries and territories in 2022, Finnish respondents were most likely to say that they know a great deal or a moderate amount about climate change (92% of respondents), and the majority of them (64% of respondents) reported that they hear about climate change at least once a week (Leiserowitz et al., 2022). However, at the same time Finnish respondents were the least willing to participate in climate activism (9% of respondents) (Leiserowitz et al., 2022). In line with the findings, a study done among adolescents 15–18 years old found that

Finnish respondents were the least willing to participate in building a sustainable world compared to other European adolescents (Rissanen et al., 2024). Thus, in the end, it seems that not all Finnish adolescents are rallying to the barricades, as portrayed in the images of young climate protesters disseminated in the public media. Why is it that acknowledging the fact that climate change is a threat drives action among some people, while for others it does not necessarily translate into action?

To find an answer to the above question, it is important to gain a better understanding of the associations between people's experiences of climate change distress, the ways they cope with it, and their tendency to channel it into climate-friendly action. Although climate change-related well-being and its relationship to behavior have been the subject of a growing number of cross-sectional studies in recent years (see Jarrett et al., 2024; Ramadan et al., 2023), there are still gaps in the research. First, most of the studies focus solely on the adult population, dismissing the importance of understanding how they evolve and develop in adolescence. Second, very few previous longitudinal studies have focused on how the issues are related. Thus, little empirical evidence exists on the longitudinal associations and the direction of influence over time between climate change-related distress, coping, and climate engagement. Lastly, climate change's impacts on Finnish adolescents' well-being remain understudied.

Another often-overlooked view is that adolescents are not a homogeneous group, and they do not react to climate change in the same ways. Ojala (2021) points out that the commonly held twofold view of young people and climate change is overly simple: they are seen either as being highly interested, agentic, and engaged in climate change or as being vulnerable victims. In reality, adolescents are a much more diverse group. Some of them may have a strong interest in climate change and be engaged in related activities, yet they may also be worried and feel that they have no influence at the societal level. Conversely, others may be completely uninterested in climate change, and some may even deny the seriousness of climate change. Therefore, there is a need to understand how adolescents encounter climate change-related distress, how they cope with it, and their tendency to act in a climate-friendly manner, both from a person-oriented perspective and at the within-person level. Taking a person-oriented perspective helps researchers gain an understanding of diverse subgroups of adolescents that share similar patterns with other members of their group, which are unique compared to members of other groups. Focusing on the within-person level, on the other hand, provides insights into changes within individuals. Together, the two approaches move beyond the limitations of more traditional variable-centered approaches, which focus mainly on overall sample averages. By examining both subgroup patterns and within-person fluctuations, it is possible to obtain a more nuanced picture of how

adolescents experience climate change distress, how they cope with it, and how the processes are connected to climate-friendly behavior.

Thus, this dissertation addresses the aforementioned research gaps and broadens current understandings of the phenomena throughout adolescence in the Finnish context. The following introductory sections begin with a discussion of the developmental aspects of adolescence, which are crucial for understanding young people's responses to climate change. The chapter then provides an overview of how climate change impacts adolescents' well-being, introducing such key concepts as climate anxiety, eco-anxiety, climate change distress, and the notion of climate burnout. The chapter then shifts focus to adolescents as pro-environmental actors and explores how pro-environmental behavior intersects with climate change distress, according to previous empirical studies. Finally, the chapter outlines relevant coping strategies, viewing them through the lens of transactional stress and coping theory.

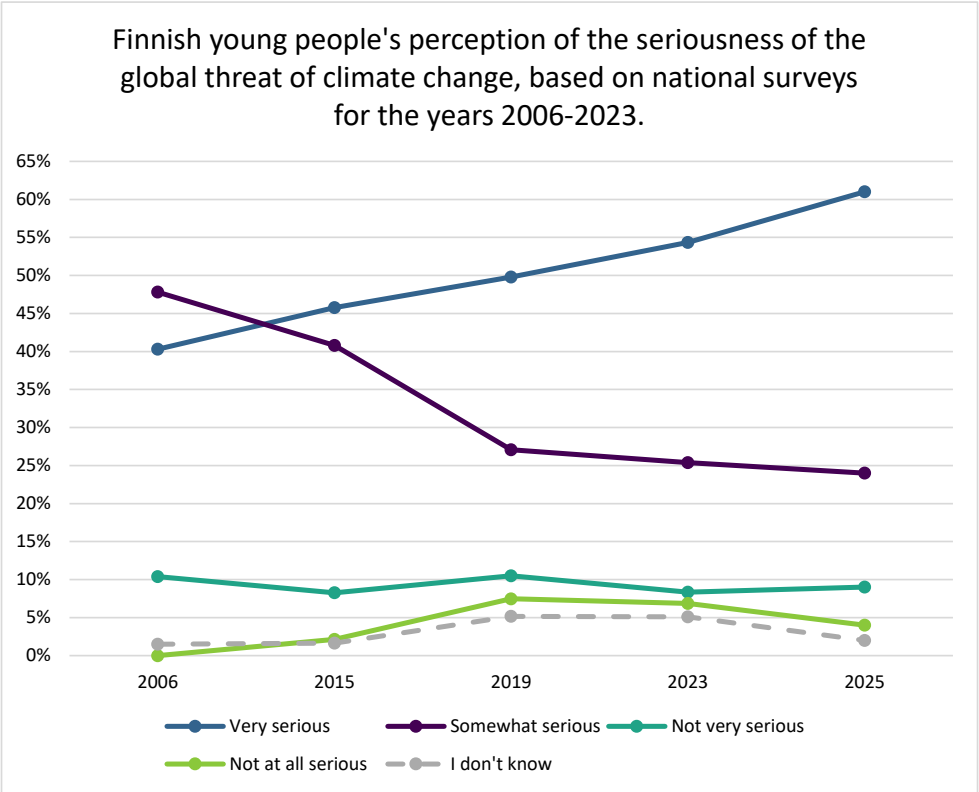


Figure 1 Finnish young people’s perceptions of the seriousness of the global threat of climate change, based on national surveys for the years 2006–2023. The data sources vary, and thus, the questions measuring Finns’ perceptions of the seriousness of the global threat of climate change vary. The 2006 data is from the Climate Change 2006 survey (Ekholm et al., 2006), where participants between 18 and 25 years of age were asked to rate how serious a threat climate change is to humanity based on four options: very serious, somewhat serious, not very serious, not at all serious. The data for 2015, 2019, 2023, and 2025 are from the Finnish Climate Barometer (Climate Barometer, 2023, 2025; Hyry, 2019), where participants between 15 and 29 years of age were asked to rate how much they agree that climate change is a major global threat, with the response options being strongly agree, somewhat agree, somewhat disagree, strongly disagree.

1.1 Growing up in the midst of climate change

According to the APA Dictionary of Psychology (15.11.2023), adolescence is a developmental period that roughly spans the ages between 10 and 20. It is characterized by rapid physical, psychological, and social maturation (Galambos et al., 2003). During this time, adolescents undertake many crucial stage-specific developmental tasks, such as engaging in socially responsible behavior and establishing an identity, personal values, and ethical system (Finkenauer et al., 2002). Early adolescence is particularly characterized by identity exploration and experimentation with multiple different roles, making it a time of instability and growth (Finkenauer et al., 2002). Therefore, adolescents' attitudes and views on societal issues may not be fixed, though they tend to become more set toward adulthood (Russo & Stattin, 2017). Thus, the way in which young people handle developmental tasks during adolescence establishes the basis for long-term patterns of behavior and worldviews.

Given the fluid nature of adolescents' identity, values, and views, adolescence represents a critical window for shaping attitudes toward climate change. As such, the adolescent years may be especially influential in developing resilience and constructive ways to mitigate and adapt to a future that will inevitably be shaped by a changing climate (e.g., Sanson et al., 2022). As adolescents navigate who they are and how they relate to the world amid climate change, the habits formed during adolescence can promote sustainable behavior and engagement well into adulthood (Riemer et al., 2014).

Yet, there is limited research on how climate change distress, pro-environmental behavior, and coping strategies develop and interact with one another during the adolescent years. A longitudinal study of Australian adolescents found that they experienced different patterns of worry about climate change throughout adolescence: While approximately half of the adolescents belonged to groups exhibiting persistently low or high climate change worry, the other half belonged to groups exhibiting decreasing or increasing worry (Sciberras & Fernando, 2022). In addition, pro-environmental behavior generally increases with age, but there appears to be a temporary dip in engagement around the age of 15 (Anderson & Krettenauer, 2021; Olsson & Gericke, 2016). This decline may reflect the cognitive and emotional demands of other developmental tasks that are occupying adolescents' minds at that age. Yet, no longitudinal studies have examined how coping strategies related to climate change evolve during adolescence. Studies on coping with other stress-evoking situations suggest that coping strategies remain stable throughout adolescence, with a gradual increase in problem-focused coping and a decrease in avoidance (which is closely related to de-emphasizing and denial) after early adolescence (Eschenbeck et al., 2018; Vierhaus et al., 2007; Zimmer-Gembeck & Skinner, 2011). Finally, although the small amount of empirical evidence that exists suggests that normative changes in climate

change distress, pro-environmental behaviors, or coping strategies may occur as adolescents grow into adulthood, individual differences will also become evident during different phases of the maturing process (Aldwin, 2010; Galambos et al., 2003). The developmental shifts underscore the need to examine how climate change affects adolescents' mental well-being and behaviors throughout the different stages of adolescence.

1.2 Climate change impacts on the mental well-being of adolescents

Climate change can impact human well-being in both direct and indirect ways (Clayton et al., 2017). First, the direct impacts result from exposure to extreme weather events and changes in one's living environment. The direct impacts can manifest in various forms, including physical health implications (such as increased heat stroke risk due to rising temperatures), psychological health consequences (such as post-traumatic stress disorder following environmental disasters), and community health implications (such as increased social instability and violence in areas where drought conditions hinder agricultural livelihoods) (Clayton et al., 2017). Children and adolescents are more vulnerable than adults to the direct impacts of climate change on well-being, and because they are at sensitive developmental stages in their lives, the direct effects can have lifelong impacts on their physical and mental health (Sanson et al., 2019; Thiery et al., 2021). In addition, climate change can weaken the connection that adolescents develop to place and culture (Clayton & Crandon, 2024), thus disrupting their sense of belonging and contributing to broader societal instability—for example, through increased youth crime and violence (Clayton et al., 2017).

The indirect impacts on well-being, on the other hand, are caused by increasing awareness and knowledge about the effects of climate change and the urgent need to take action (Doherty, 2018; Doherty & Clayton, 2011; Fritze et al., 2008). While the direct impacts are experienced right after exposure to extreme weather events and changes in the living environment, the indirect impacts occur later and are also felt by those who have not personally experienced extreme weather events or radical environmental changes (Doherty & Clayton, 2011), which is predominantly the case with Finnish adolescents. Distress and a variety of unpleasant emotions felt in relation to climate change can be considered indirect effects (Reser et al., 2012), although direct exposure to the environmental impacts of climate change have also been linked to heightened climate change distress (Demski et al., 2017; Ogunbode et al., 2021; J. Reser et al., 2012; Spence et al., 2011). Just like with the direct impacts, young people are also apparently more affected by the indirect impacts on

mental well-being, with younger age being associated with more distress and concern about climate change in studies covering people from late adolescence to old age (Heeren et al., 2022; Patrick et al., 2023; J. P. Reser et al., 2014; Swim et al., 2022; Whitmarsh et al., 2022a).

1.2.1 Climate change-related well-being in the context of this dissertation

There is no consensus among researchers regarding the correct umbrella term for distress, unpleasant emotions, and other indirect impacts of climate change on mental well-being. Although terms such as climate anxiety and eco-anxiety have recently gained widespread popularity, it is important to approach them with a critical lens. Critics of terms like climate anxiety and eco-anxiety and other terms with the word “anxiety” in the name argue that the terms ignore the wide range of emotional responses to climate change by lumping all emotions under the label anxiety, which can have the connotation that such feelings are somehow related to anxiety disorder and other mental health diagnoses (Sanson & Masten, 2024). Therefore, I prefer to use the term “climate change distress” when referring to the indirect effects of climate change on the well-being of Finnish adolescents in this dissertation. According to The American Psychology Association (APA), distress refers to “*the negative stress response, often involving negative affect and physiological reactivity: a type of stress that results from being overwhelmed by demands, losses, or perceived threats*” and to “*a negative emotional state in which the specific quality of the emotion is unspecified or unidentifiable*” (APA Dictionary of Psychology, 19.04.2018). However, whenever specific studies are referenced in this dissertation, the term chosen by the authors is used because the way they define and measure the phenomenon may influence their results.

1.2.2 Climate anxiety, eco-anxiety, and climate change distress

While this dissertation uses the term climate change distress, it is important to situate this choice within the broader spectrum of terms used in the literature. Researchers have introduced various related concepts, such as climate anxiety and eco-anxiety, to capture the indirect psychological impacts of climate change. Although the terms share a certain common ground, they differ in their definitions, scope, and implications. Generally speaking, the terms all share the idea that climate change evokes an affective response in people, which can consist of a range of different unpleasant emotions, such as guilt, worry, and anger. Some researchers

view the distress caused by climate change primarily as an emotional response, distinguishing it from cognitive or functional impairments (Hepp et al., 2023; Kurth & Pihkala, 2022). Others argue that focusing only on emotions may not capture responses that are intense enough to motivate behavior or threaten mental health (Clayton & Crandon, 2024). Scholars in the latter camp point out that emotional reactions may also interact with cognitive processes and manifest, for example, as difficulties in concentrating or feelings of inadequacy (Wardell, 2020). Some, therefore, also include additional dimensions, such as behavioral impairments, ruminative thoughts, and anxiety about one's personal impact on the planet (Clayton & Karazsia, 2020; Hogg et al., 2021).

Of all the terms, climate anxiety and eco-anxiety are arguably the best established. Climate anxiety refers to a constellation of negative emotions, fears about the future, and existential anxiety invoked by increasing knowledge about climate change (Clayton, 2020; Pihkala, 2020). Clayton and Karazia (2020) have developed the Climate Change Anxiety Scale (CCAS) to capture climate anxiety and assess its potential clinical implications. Their two studies, based on U.S. adult samples, indicate that climate anxiety comprises two dimensions. The first dimension captures cognitive-emotional impairments caused by thinking about climate change. The impairments manifest as difficulties with emotional regulation and cognitive tasks, such as concentration. The second dimension captures functional impairments, which manifest as difficulties in performing daily tasks, working, and having fun due to worrying too much about climate change. The results from one longitudinal study conducted among adults in the U.S. suggest that climate anxiety progresses from negative feelings to cognitive-emotional impairments and from cognitive-emotional impairments to functional impairments (Chan et al., 2024).

Second, eco-anxiety is a term closely related to climate anxiety, but while climate anxiety focuses on climate change, eco-anxiety also includes other ecological problems (Pihkala, 2020). According to Hogg's eco-anxiety scale (HEAS), eco-anxiety consists of four dimensions: affective symptoms (i.e., feeling negative emotions related to climate change and ecological crisis), behavioral symptoms (like CCAS's functional impairments), ruminative eco-anxious thoughts (i.e., repetitive thoughts about climate change and ecological problems), and anxiety about one's personal impact on the health of the planet (Hogg et al., 2021). According to cross-sectional analyses done by Hogg and colleagues (2024), the symptomatic aspects of eco-anxiety (affective and behavioral symptoms) are uniquely associated with poorer mental health, while ruminative eco-anxious thoughts and anxiety about one's personal impact are associated with environmental engagement.

Even though some conceptualizations of climate anxiety and eco-anxiety include behavioral impairments, scholars still argue that anxiety most often emerges as a

practical and adaptive response because it motivates people to change their behavior and think about their actions (Pihkala, 2022). Thus, climate anxiety is a natural reaction that signals the approach of a threat and motivates people to prepare appropriately (Clayton, 2020). However, scholars also suggest that when climate or eco-anxiety becomes overwhelming, it can take maladaptive and debilitating forms (Albrecht, 2011; Clayton, 2020; Clayton & Crandon, 2024). In other words, they suggest that moderate levels of eco-anxiety or climate anxiety correspond to the most active engagement with issues related to climate change, while the associations become weaker as eco-anxiety or climate anxiety increases from moderate levels to higher levels. However, this hypothesis remains unconfirmed by empirical studies (for contradicting results, see Becht et al., 2023; Hogg et al., 2024).

Besides the fact that many scholars emphasize the practical and adaptive aspects of climate anxiety and eco-anxiety, at least the CCAS was originally developed to assess potential clinical implications of climate change distress (Clayton & Karazsia, 2020). As a result, some scholars have criticized the terms for focusing too much on impairments, often perceived as a response that requires clinical treatment and is inherently maladaptive (Hepp et al., 2023; Sanson & Masten, 2024). As a result of such critiques, Hepp and colleagues (2023) developed a climate change distress and impairment scale, which distinguishes between distress as an affective response and functional impairments experienced in response to climate change. They emphasize that it is important not to pathologize the negative affective responses to climate change, but they still see the importance of assessing the impairments along with such responses.

Overall, while scholarly debate exists on how best to define climate change-related distress, or what even constitutes it, it is important to acknowledge that no matter what dimensions are included in a measurement scale trying to capture climate change-related distress, the intercorrelations between different dimensions, like emotional and functional impairments, are usually high (Hepp et al., 2023; Hogg et al., 2021; Nezelek & Cypriańska, 2024). Therefore, Hogg and colleagues (2024) caution against dividing and subdividing the different dimensions of climate change-related distress too much, as the dimensions in their study were intrinsically linked both within and across time. For example, it would be tempting to mistakenly think of some dimensions as “determinant” and others as “productive,” and to assume that the “determinant” dimensions should be treated while the “productive” dimensions should be promoted, all while ignoring the fact that the dimensions are strongly interlinked.

1.2.3 Climate burnout

The impact of climate change on well-being can also be examined from the perspective of burnout. According to the contextual demands-resources model, an individual's level of engagement in a situation and their risk of burnout depend on the balance between experienced demands and available resources (Salmela-Aro & Upadyaya, 2014). When demands consistently exceed resources over time, it can lead to a chronic stress response and ultimately to burnout. In the context of climate change, burnout can be understood as a byproduct of climate anxiety becoming chronic (Bird et al., 2024). Supporting this idea, a longitudinal study on different dimensions of climate anxiety among adults found that cognitive-emotional symptoms predicted later behavioral impairments, not the other way around (Chan et al., 2024). Moreover, studies on activists have shown that those experiencing high levels of burnout often distance themselves from the movement in which they were once deeply involved (see Bird et al., 2024). However, high engagement with the cause can also act as a resource and a buffer against burnout (see Salmela-Aro & Upadyaya, 2014). Thus, an individual experiencing burnout symptoms can remain committed to their activities because their high level of engagement enables them to see the meaning in their actions. This phenomenon has been observed in studies conducted with climate activists, who simultaneously report burnout symptoms and a strong degree of engagement, hopelessness, and hope (Nairn, 2019).

Burnout consists of three key dimensions: emotional exhaustion, cynicism (or disengagement, see Bird et al., 2024) directed toward the stressor and feelings of inadequacy (Maslach et al., 2001; Taris et al., 2005). The three dimensions tend to take this particular order (Parker & Salmela-Aro, 2011). First comes a feeling of exhaustion and weariness that does not improve with rest. In the context of climate change, it can mean that individuals become emotionally exhausted when they see little societal progress despite their personal climate actions (Bird et al., 2024). To protect themselves from emotional exhaustion, individuals may begin to distance themselves from the source of the exhaustion and become cynical about it (Parker & Salmela-Aro, 2011). If prolonged, emotional exhaustion may lead to a cynical, negative attitude and disengagement from climate change issues. Finally, cynicism leads to a feeling of inadequacy. The individual starts feeling that the actions they take to mitigate climate change are ineffective and inadequate, and their motivation to act declines as they feel like their actions are never enough (for reference, see Taris et al., 2005). While the three burnout dimensions generally assume the above order, there are exceptions. Research indicates that emotional exhaustion may also lead directly to increased feelings of inadequacy, without cynicism as a mediator (Parker & Salmela-Aro, 2011).

1.2.4 The interplay between climate change distress and general well-being

While researchers primarily view climate change distress as a normal and sometimes adaptive response to the threats posed by a changing climate, it is rarely the only stressor to which an individual is exposed. In fact, stressors rarely occur in isolation, and an individual may be exposed to multiple stressors from their environment and different life domains at the same time, which can have a cumulative effect on their well-being (see Evans et al., 1996; Reser et al., 2012). It is therefore not a coincidence that cross-sectional studies often find that higher levels of climate change distress are associated with general ill-being (Boluda-Verdú et al., 2022; Gago et al., 2024). For example, climate change distress among adults has been associated with lower life satisfaction (Hogg et al., 2024), generalized anxiety disorders (Asgarizadeh et al., 2023; Hogg et al., 2024; Whitmarsh et al., 2022a), more depressive symptoms (Hogg et al., 2024; Prencipe et al., 2023; Stanley et al., 2021), and insomnia (Ogunbode et al., 2021). In addition to the empirical evidence from studies on adults, one study done among Canadian 15–18 year olds found small but significant associations between climate anxiety, general anxiety disorder, and depressive symptoms (Wu et al., 2023). Additionally, neuroscientists have found that the neural correlates of climate anxiety aligned with those observed in anxiety disorder in a clinical study involving university students (Carlson et al., 2024). Yet, they also observed that both climate anxiety itself and the neural correlates of climate anxiety were associated with pro-environmental behavior, suggesting that the neural correlates are associated with the adaptive aspect of climate anxiety rather than the maladaptive aspects (Carlson et al., 2024).

However, previous empirical studies examining the relationship between climate change distress and different measures of general well-being have primarily been conducted among adults. While the relationship among adolescents remains under-studied, the findings among adults do provide a point of reference. It is not surprising that while surveys report that many adolescents are concerned about climate change (Hickman et al., 2021; Kiilakoski, 2023), their general ill-being has also recently received more attention. In a broader picture, the well-being of Finnish adolescents has been of great public concern, with the nationwide School Health Promotion study showing an increasing trend in adolescents' general anxiety and depression symptoms, and a decrease in life satisfaction, especially among girls (Helenius & Kivimäki, 2023). The same trends have also been found in studies on school burnout and engagement (Olivier et al., 2023; Read et al., 2022). To better support adolescents' well-being, it is important to holistically understand the interplay between different stressors in adolescents' lives since stressors are likely to occur simultaneously. Therefore, it is important to look at climate change distress in relation to adolescents' overall well-being.

1.3 Adolescents as pro-environmental actors

All human behaviors have an impact on the natural environment, but some actions have a greater impact than others. Pro-environmental behavior refers to actions undertaken individually to minimize the negative impact of human behavior on the environment. However, no absolute standards exist for determining which actions are pro-environmental because it is a relative term (all actions have an impact on the natural environment, but some pro-environmental behaviors are more effective than others) that is culturally and historically prescribed (what is considered pro-environmental today might be seen as a harmful action in the future) (Schultz & Kaiser, 2012). In line with the idea that pro-environmental behavior is a relative term, Stern (2000) divides pro-environmental behavior into impact-oriented and intention-oriented actions. Impact-oriented actions have either a direct (e.g., removing plastic waste from water) or indirect (e.g., lobbying for higher taxes on fossil fuels) impact on the environment, but the approach makes no assumptions about underlying motivations and does not account for whether a person might engage in pro-environmental behaviour for non-environmental reasons. In contrast, the intention-oriented definition views intentions as independent causes of behavior. As such, intentions can also fail to have a real environmental impact precisely because what people think might be positive for the environment may not always be truly positive in the long run. For example, people often mistake organic for ecological, even though in some cases the production of organic products can have higher environmental costs than non-organic production. Moreover, people's intentions to act pro-environmentally do not always align with their actual behaviors (Carrington et al., 2010; Hu et al., 2025).

In addition to the fact that certain pro-environmental behaviors have greater impacts than others, individuals can play multiple roles as pro-environmental actors. In public discussions about pro-environmental behavior, such behavior is often narrowly interpreted as individual-level consumer actions (e.g., avoiding fast fashion or reducing meat consumption), but in fact it is multidimensional (Whitmarsh et al., 2021). Along with individual-level actions, people can also act pro-environmentally as active members of their communities and of various organizations (e.g., promoting ways to save energy in a neighborhood) or engage in political actions and environmental activism (e.g., participating in a demonstration). Some researchers have even suggested that community-level actions and environmental civic engagement may be more important than individual-level actions (Whitmarsh et al., 2021). Furthermore, other researchers have proposed that a school may be an optimal environment for adolescents to practice low-threshold community-level action and environmental civic engagement by participating in school-level environmental activities (Chawla & Derr, 2012; Hart et al., 2014).

The motives for engaging in pro-environmental behavior involve a mixture of self-interest and concern for other people, the next generation, other species, or entire eco-systems (Bamberg & Möser, 2007). In addition, many behavior models have been applied to the context of climate change to help explain and predict mitigation and adaptation behaviors. The most popular models are general action theories, including the Theory of Planned Behavior (Ajzen, 1991), which posits that perceived behavioral control, attitudes toward a certain behavior, and subjective norms guide an individual's behavior based on their intentions, and the Norm Activation Model (Schwartz, 1975), which emphasizes the key role of personal norms. However, other scholars have criticized the existing behavior models for being too reductive, individualistic, linear, deliberative, and blind to environmental impacts (Whitmarsh et al., 2021).

Moreover, the models described above often overlook the role of emotions (Kals & Müller, 2012). Consequently, recent empirical studies indicate that both positive and negative immediate (i.e., emotions experienced in the moment) and anticipatory emotions (i.e., emotions arising from experiences) can explain both pro-environmental intentions and behaviors (Du et al., 2023; Odou & Schill, 2020; Russell et al., 2017). Klas and Müller (2012) have illustrated the role of emotions in pro-environmental behavior by dividing them into four categories: 1) emotional burdens and worries caused by fear of environmental threats (similar to climate change distress), 2) emotions arising from pro-environmental behavior (e.g., pleasure as a result of tasting vegan food), 3) affective connection to nature (e.g., feeling relaxed when walking in a forest), and 4) moral emotions (e.g., feeling guilt from not acting as pro-environmentally as others). Some cross-sectional studies have found strong positive associations between pro-environmental behavior and particular negative emotions, such as anger (Stanley et al., 2021), guilt (Mallett, 2012; Shipley & van Riper, 2022), concerns (Lawson et al., 2019), and worry (Wullenkord & Ojala, 2023). However, some specific positive emotions also have a positive association with pro-environmental behavior, such as pride (Onwezen et al., 2014; Shipley & van Riper, 2022). The significance of a particular emotional response seems to depend on the individual's social context and varies across cultures (Caillaud et al., 2019; Onwezen et al., 2014). In addition, the role of different emotions might also depend on an individual's age. For example, Clayton and Crandon (2024) suggest that powerlessness may also be a particularly important emotion that hinders pro-environmental behavior among some younger people, as most of them are not yet in positions of financial, social, or political influence.

1.3.1 The interplay between pro-environmental behavior and climate change distress

As with studies focusing on specific climate change-related emotions, scholars have also found that climate change distress is associated with pro-environmental behavior, but the findings regarding the direction of the relationship are mixed. Several cross-sectional studies have identified a positive association between climate change distress and pro-environmental behavior among adults (Bradley et al., 2014; Heeren et al., 2022, 2023; Hepp et al., 2023; Innocenti et al., 2023; Reser et al., 2014) and among adolescents (Becht et al., 2023; Simon et al., 2022). However, other studies have found negative associations (Qin et al., 2024; Stanley et al., 2021) or even no associations at all (Clayton & Karazsia, 2020). Some researchers have demonstrated that the relationship between climate change distress and pro-environmental behavior depends on what dimensions of climate change distress are included in a particular study (Hogg et al., 2021, 2024) and what type of actions constitute pro-environmental behavior (Prinzing et al., 2024; Whitmarsh et al., 2022b). For instance, researchers have noted that among adults, affective and behavioral symptoms of eco-anxiety are associated strongly with poor mental health, while rumination and personal impact anxiety have a stronger association with pro-environmental behavior (Hogg et al., 2021, 2024). Furthermore, social, active, and effortful pro-environmental behavior (e.g., switching to a sustainable diet or volunteering with an environmental nonprofit organization) have a stronger association with well-being among adults (Prinzing et al., 2024).

While a growing number of cross-sectional studies have shown that climate change distress and pro-environmental behavior are connected (see Jarrett et al., 2024), longitudinal studies on this relationship remain scarce. However, several recent studies have addressed the longitudinal association between climate anxiety and pro-environmental behavior. The first is a study by Pavani and colleagues (2023), in which they found that earlier signs of eco-anxiety had a positive association with later pro-environmental behavior among French adults at the sample level, even after controlling for ecological identity, personality traits, and prior pro-environmental behavior. In a second study, Becht and colleagues (2024) examined the hypothesis that when climate anxiety becomes too excessive, it leads to a paralysis; after studying linear and curvilinear associations between climate anxiety and pro-environmental behavior among Dutch and Colombian adolescents for three years, their findings supported the linear associations, indicating that even high levels of climate anxiety support rather than hinder pro-environmental behavior. The researchers also found that adolescents' environmental efficacy had a moderating effect on the relationship between climate anxiety and public-sphere, pro-environmental behavior (e.g., environmental civic engagement) but had no

effect on individual-level actions. Finally, Hogg and colleagues (2024) also tested the hypothesis of a curvilinear relationship between eco-anxiety and pro-environmental behavior using longitudinal data from Australian adults, but they found that the quadric model accounted for only a small amount of the variance.

As indicated by the study settings of the previous longitudinal studies mentioned above, researchers often assume that climate change distress is a predictor of pro-environmental behavior. Therefore, most have not paid much attention to pro-environmental behavior as a possible predictor. However, some researchers have suggested that the relationship between climate change distress and pro-environmental behavior is actually reciprocal (Whitmarsh et al., 2022b). Their hypothesis is supported by one longitudinal study in particular, which demonstrated small but significant bidirectional effects between climate anxiety and pro-environmental behavior among adults, with pro-environmental behavior predicting later increases in distress (Kühner et al., 2024). The authors argue that it may occur because pro-environmental behavior heightens an individual's awareness of the scale of the problem and the effort required to create change, further contributing to an increase in climate anxiety (Kühner et al., 2024). Furthermore, pro-environmental behavior may also increase distress because adolescents are taking on too much personal responsibility in a very individualized way for a problem that cannot be solved by individual actions alone (Ojala, 2012b, 2013).

1.4 Coping with climate change

The association between climate change distress and pro-environmental behavior is likely influenced, at least in part, by an individual's assessments of their own ability to cope with the perceived threat. Coping is an essential psychological mechanism that is vital for adapting to climate change, building resilience, shifting mindsets, changing behavior, and carrying out other actions needed to respond to the threat of climate change (Reser et al., 2012). The transactional theory of stress and coping by Lazarus and Folkman (1984) views coping as a dynamic and continuous process. First, an environmental stressor triggers a perception of risk (also known as primary appraisal), prompting an individual to position themselves in relation to the stressor and assess its demands. Therefore, the extent to which an environmental stressor is perceived as a threat or risk depends on an individual's subjective assessment. After the initial risk perception, an individual moves on to assess what type of coping strategy to use in response to the stressor. While Lazarus and Folkman focused on conscious coping strategies, later researchers noted that such appraisals of coping are actually part of a complex dynamic involving conscious, semi-conscious, and unconscious coping strategies (Aldwin, 2010). The

outcomes of the coping attempts influence how other stressors are perceived and dealt with in the future. In other words, they influence pre-appraisals of the stressful situation. According to Folkman (2008), if the outcome of coping with a stressor is favorable, it then creates positive emotions that can restore the resources needed to deal with the demands of other stressors and sustain the energy needed to make use of a diverse set of coping strategies. In contrast, unfavorable outcomes are followed by negative emotions and can lead to increased energy “costs” and more negative risk perceptions involving subsequent stressors.

While a large number of the environmental stressors that individuals encounter ebb and flow over time, climate change is a stressor that cannot be solved through individual coping efforts (Reser et al., 2012). Climate change itself is an environmental threat and stressor that is global and ongoing. Therefore, it is too complex and multidimensional to be viewed as a simple stressor, or as Reser et al. (2012, p. 11) put it: *“Climate change also has been a contested and polarizing environmental, political and social issue. ‘Climate change’ is itself a popular explanation and account of multiple events and changes taking place in our contemporary physical and sociopolitical world, and in this latter respect has arguably achieved the status of a globalized metanarrative and encompassing explanatory framework and story of what is happening to our planet.”* Thus, climate change not only creates stress through rising temperatures, but also through factors like the fear of extreme weather events, grief from losses in one’s living environment (e.g., species going extinct or less snowy winters), fear of losing one’s source of income (e.g., due to droughts making farmers’ jobs impossible), societal instability, political frustration, and general uncertainty about a future shaped by climate change (see Clayton et al., 2017; Pihkala, 2022; Thiery et al., 2021). When coping with complex stressors such as climate change, various coping strategies can play a role at different stages: 1) ranging from climate change experiences and increased awareness to perceived risks, 2) ranging from perceived risks to climate change distress, 3) and ranging from climate change distress to taking action (Brandley et al., 2014).

1.4.1 Problem-focused, emotion-focused, and meaning-focused coping strategies

How do adolescents cope with climate change—a problem that is too big for them to fix and too real to ignore? The coping strategies outlined by Lazarus and Folkman (1984) offer a useful framework for understanding the ways in which adolescents

are dealing with climate change-related distress. The coping strategies are broadly divided into problem-focused and emotion-focused coping in the original transactional theory on stress and coping. First, problem-focused coping refers to the strategies that an individual uses to address a problem and try to find ways to deal with it, and thus, problem-focused coping can indirectly alleviate climate change distress (Homburg et al., 2007; Ojala, 2012). Adolescents who rely on problem-focused coping regarding climate change attempt to plan, read about, and talk with others about what they can do to mitigate climate change, and this way of coping is positively associated with pro-environmental behavior (Ojala, 2012a, 2013). However, since climate change, like other societal problems, is not something that individuals can fully control, acting without ever seeing concrete change can lead to an increase in distress (Clarke, 2006; Heyman et al., 2010; Ojala, 2012a).

In turn, emotion-focused coping refers to coping with climate change by regulating uncomfortable emotions evoked by it rather than addressing the issue itself (Ojala, 2012a, 2013). Adolescents who use emotion-focused coping strategies may try to actively reflect on their emotions and seek social support, or they may distance themselves from the stressor and avoid it altogether (Folkman & Lazarus, 1988). Moreover, research on Swedish adolescents has identified de-emphasizing the climate threat as a rather common emotion-focused coping strategy (Ojala, 2012a, 2012b, 2013). Adolescents who de-emphasize climate change often argue that the problem does not personally affect them or their country, or they feel that its consequences are exaggerated and not as important as other problems in their lives, or they may even view it in a positive light (e.g., summers in the Nordic countries will be warmer, which will be a change for the better) (Ojala, 2012b). The tendency to de-emphasize climate change is associated with less pro-environmental behavior and climate change worry (Ojala, 2013; Ojala & Bengtsson, 2019).

In addition to problem-focused and emotion-focused coping, Folkman (2008) later argued that the simple division into problem-focused and emotion-focused strategies fails to account for the co-occurrence of positive emotions in stress-evoking situations. Therefore, she suggested adding a third coping strategy called meaning-focused coping. The role of meaning-focused coping differs from problem-focused and emotion-focused coping in that instead of seeking to mitigate distress, meaning-focused coping is about promoting positive emotions and a sense of meaning to sustain motivation and restore other coping resources. Adolescents who rely on meaning-focused coping are able to maintain their sense of hope and trust that people are taking climate change seriously and can successfully address climate change when working together (Ojala, 2012b, 2013). In this context, meaning-focused coping mainly consists of positive reappraisal, i.e. acknowledging the problem but also being able to switch perspectives and see positive trends, along with having trust in different actors' ability to mitigate the climate crisis (Ojala,

2012b). Since meaning-focused coping helps to restore coping resources, its primary role is to support problem-focused coping in motivating actions rather than directly influencing behavior (Folkman, 2008; Ojala, 2012b; Wullenkord & Ojala, 2023). It can also buffer difficult climate emotions from turning into a general low sense of well-being and pessimism about the future (Ojala, 2012; Wullenkord & Ojala, 2023).

1.4.2 Coping by engaging in climate denial

Previous studies suggest that climate denial falls along a spectrum that ranges from (1) full rejection of the existence of climate change to (2) acknowledging climate change but downplaying the scientific facts (e.g., thinking that climate change exists but is not caused by humans), and finally, (3) accepting the scientific facts but denying the implications of climate change and the necessity for taking action (e.g., thinking that mitigating climate change is not as urgent as some other problems) (Rahmstorf, 2004; Wullenkord, 2022). While climate change denialists themselves may perceive their own approach to the issue as rational, fact-based, and non-emotional, the underlying basis for such an approach is emotional and irrational (Jylhä, 2016). Thus, falling somewhere along the climate denial spectrum does not necessarily mean that an individual is immune to worry and dread about climate change (Haltinner et al., 2021). In fact, a study of adults in the United States found that individuals who deny climate change may still be concerned about specific climate change-related issues (such as pollution, habitat destruction, and species loss) and may even support certain environmental policies (Haltinner et al., 2021). In addition, fear of climate change can lead to apathy, inaction, and the pursuit of alternative, safer narratives, even among people who believe in climate change (Haltinner & Sarathchandra, 2018). Therefore, researchers have suggested that for some, climate denial may serve as an unconstructive and maladaptive strategy to cope with climate change and the negative emotions felt in relation to the threat (Ojala, 2015; Pihkala, 2022). As such, climate denial is an emotion-focused coping strategy similar to de-emphasizing, where people deal with the uncomfortable emotions evoked by climate change by downplaying the root cause of those emotions (Jylhä, 2016). Hence, climate denial may hinder environmental efficacy and active pro-environmental behavior but not necessarily prevent climate change distress.

Little data exists on how widespread climate denial is among Finnish adolescents. However, the 2019 Finnish Climate Barometer survey showed that 23% of people between 15 and 29 years old totally or somewhat disagree that climate change is mainly caused by humans (Climate Barometer, 2019). The same question

was not repeated in newer versions of the Finnish Climate Barometer survey, done four and six years later. However, the results showed that 20% of people between 15 and 29 years old in 2023 and 11% in 2025 totally or somewhat disagreed that the need for climate change mitigation is urgent (Climate Barometer, 2023, 2025). Another survey on emotions related to climate change revealed that 25% of Finns under the age of 30 feel skeptical and doubtful about climate change, while 19% of them are in denial (Hyry, 2021). Yet, more studies on climate denial among Finnish adolescents are needed, especially since adolescence is the time when individuals begin to develop a broader and more sophisticated set of coping strategies, including the establishment of maladaptive strategies, such as denial (Zimmer-Gembeck & Skinner, 2011). Adolescents are more likely to use maladaptive strategies when they perceive a stressor as uncontrollable and too excessive, like climate change (Aldwin, 2010).

2 Aims

The overall aim of the dissertation was to establish an in-depth and comprehensive picture of climate change distress and its relationship with coping strategies, pro-environmental behavior, and general well-being during adolescence. To capture the complex interplay of the phenomena, the dissertation approached them from multiple perspectives—combining variable-centered and person-centered approaches and cross-sectional and longitudinal data. As climate change distress during adolescence is an understudied phenomenon, the first aim was to examine its prevalence among Finnish adolescents and its relationship to general well-being. The second aim was to examine the interplay between climate change distress and pro-environmental behavior, both contemporaneously and across time. The last aim was to investigate how different coping strategies relate to both climate change distress and pro-environmental behavior and whether the coping strategies moderate the association between climate change distress and pro-environmental behavior. All three aims are addressed via the following research questions:

- RQ1: How does climate change distress manifest itself among Finnish adolescents, and how does it relate to general well-being (Study I, Study II)?
- RQ2: How are climate change distress and pro-environmental behavior associated both contemporaneously (Study I, Study II, Study III) and longitudinally (Study III)?
- RQ3: How do different coping strategies (de-emphasizing/denial, problem-focused and meaning-focused) relate to levels of climate change distress and pro-environmental behavior, and do the coping strategies moderate the relationship between climate change distress and pro-environmental behavior (Study II & Study III)?

The dissertation consists of three original studies, which are referred to in the text by their Roman numerals (Studies I–III). Each study is empirical and uses a quantitative approach. Figure 2 gives an overview of the original studies and the research questions that were addressed in each original study. Study I is a person-centered study that explores the profiles of climate change-related well-being and behavior among Finnish upper secondary school students (ages 18–20) and how

the profiles differ based on general well-being (depression symptoms and self-esteem) using cross-sectional survey data collected in 2019. The first and second research questions were addressed in Study I.

Study II also utilizes a person-oriented approach to examine the profiles of climate change distress and denial among Finnish adolescents (ages 11–15) and the stability of those profiles over one year. In addition, Study II investigates how the profile memberships are associated with general mental well-being (life satisfaction, depressive symptoms) and pro-environmental behavior. The dataset used in the study consisted of data from two measurement points collected one year apart from each other, in 2020 and 2021. The first, second, and third research questions were all addressed in Study II.

Finally, Study III investigates the interplay between climate change distress and pro-environmental behavior among Finnish adolescents (ages 11–17) at the within-person level, both contemporaneously and across one year. Additionally, Study III explores how coping strategies may play a role in shaping this relationship. The dataset used in the study was collected annually in three waves between 2021 and 2023. Study III was used to address the second and the third research questions.

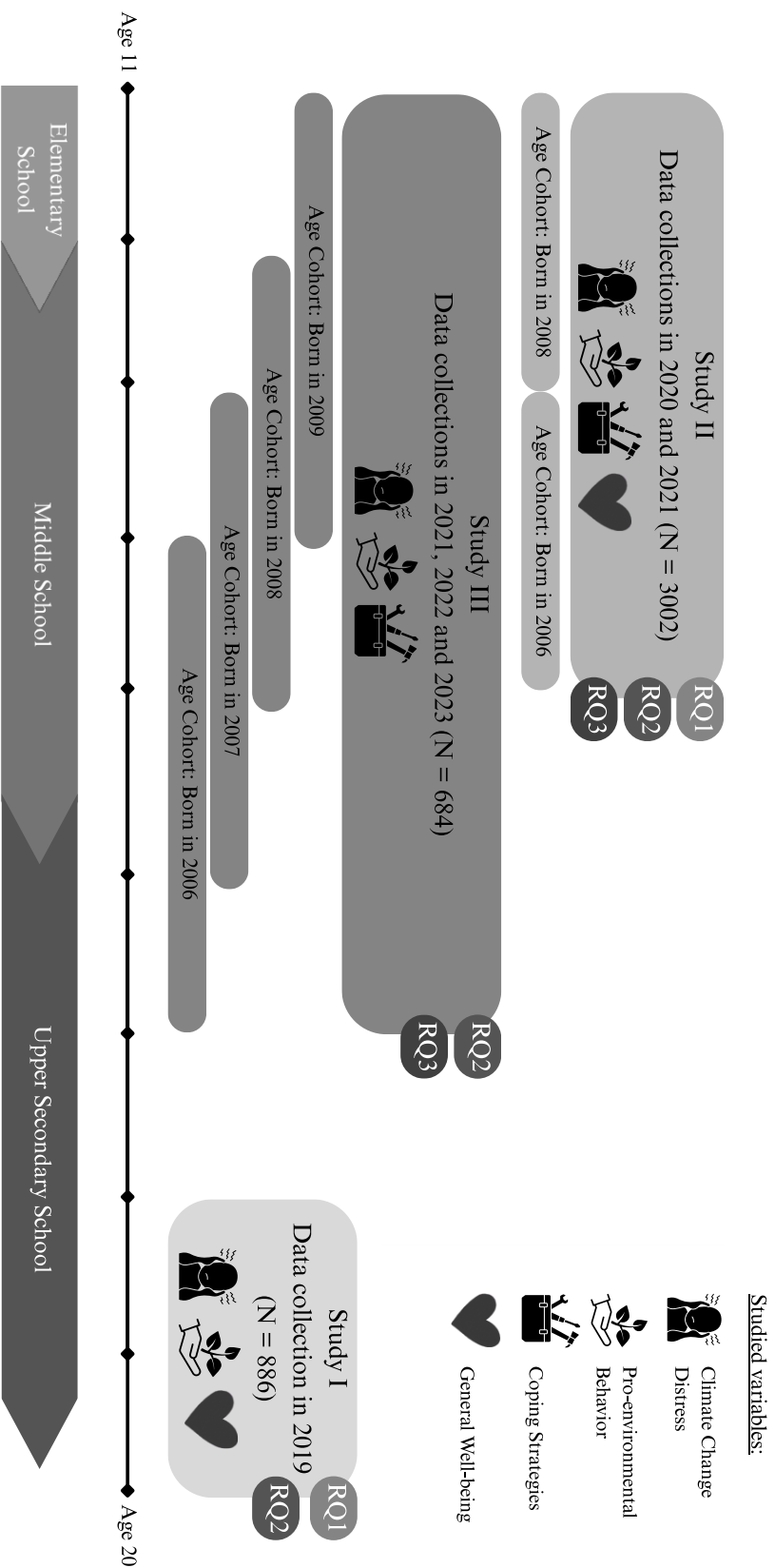


Figure 2 An overview of the original studies and the research questions (RQs) that were addressed in each original study.

3 Methods

3.1 Study context

According to the Intergovernmental Panel on Climate Change (IPCC, 2021), climate change is widely recognized among researchers as one of the most pressing global challenges, with extensive scientific consensus on its anthropogenic causes and consequences. Moreover, Northern Europe is one of the places with the fastest increasing temperature averages (IPCC, 2021). While currently Finland has ambitious aims and strategy plans to achieve carbon neutrality by the year 2035 (Huttunen et al., 2022), the country is still a long way from achieving that goal. Earth Overshoot Day, which marks the day when people have used all the biological resources that the Earth can renew during the entire year, was the 6th of April 2025 in Finland, while the overall Earth Overshoot Day was reached on the 24th of July (Earth Overshoot Day, 2025a, 2025b). Thus, if everyone would live like Finnish people, we would need almost four planets like Earth. Moreover, national surveys show that Finnish younger generations are not necessarily behaving in more environmentally friendly ways than the older generations (Climate barometer, 2023) and that they may be less willing to take action than adolescents in other European countries (Rissanen et al., 2024).

Nevertheless, climate change is widely recognized as an urgent issue that is also changing the living environment in Finland. This fact has also been noted in the development of the Finnish National Core Curriculums for both basic and upper secondary education. The promotion of sustainable ways of living is one of the main cross-curricular themes in the curricula, and it needs to be taken into account in all teaching and school activities (National Core Curriculums for Basic Education, 2014; National Core Curriculum for General Upper Secondary Education, 2019). For example, the National Core Curriculum for Basic Education (2014, pp. 16–17) describes the core value of promoting sustainable ways of living as follows: *“Humans are part of nature and completely dependent on the vitality of ecosystem. Understanding this plays a key role in growth as a human being. Basic education acknowledges the necessity of sustainable development and eco-social knowledge and ability, follows their principles and guides the pupils in adopting*

a sustainable way of living. (...) Eco-social knowledge and ability means that the pupils understand the seriousness of climate change, in particular, and strive for sustainability. (...) In basic education, the pupils examine the conflicting aspects of models of consumption and production in terms of sustainable future and seek and jointly put to practice solutions that improve our way of living over the long term. The pupils are also familiarized with social structures and solutions that impact on the development and guided in exerting influence on them. Basic education broadens the pupils' horizon, allowing them to appreciate their cross-generational global responsibility." In the Finnish education system, however, the national core curriculums serve more as a broad framework used as the basis for more detailed municipal-level curriculums, which in turn are used to write the curriculums for individual schools. In the end, schools and teachers have a great deal of freedom to decide how to implement what is written in the curricula, and therefore the way climate change is taught to young people can vary widely.

3.2 Procedures and participants

	Study I	Study II	Study III
Main aims	1) To study what kind of profiles of climate change related well-being and pro-environmental behavior can be identified; 2) To examine how these profiles differ based on gender, general well-being, family financial situation and school performance.	1) To identify subgroups of adolescents based on their similarities vis-à-vis climate change distress and denialism; 2) To study the constancy or change of these profiles across a 1-year period; 3) To assesses the relations between the profiles and pro-environmental behavior and general well-being.	1) To study how climate change distress, pro-environmental behavior and coping strategies are related for individuals at the contemporaneous level (at the same time point) and across time.
Participants			
N	886	3002	684
Age range (in years)	18-20	11-15	11-17
Gender distribution	65% females, 32% males	47% females, 45% males	54% females, 43% males
Educational context	3rd year of upper secondary school (high school seniors)	From 6th grade in elementary school to 9th grade in middle school	From 6th grade in elementary school to 2nd year in upper secondary school
Year of data collection	2019	2020-2021	2021-2023
Type of data collection	A self-reported online questionnaire	Two annual follow-up self-reported questionnaires	Three annual follow-up self-reported questionnaires
Measures	Climate change related emotional exhaustion and inadequacy, pro-environmental behavior, depression symptoms, self-esteem, family financial situation, grade point average	Climate change distress (cognitive-emotional and behavioral), climate change denial, pro-environmental behavior, depression symptoms, life satisfaction	Climate change distress (cognitive-emotional), pro-environmental behavior, coping strategies (de-emphasizing, problem- and meaning focused coping)
Approach	Cross-sectional, person-oriented	Longitudinal, person-oriented	Longitudinal, within-person
Data analyses	Latent profile analysis	Latent transition analysis	Random intercept cross-lagged panel model

Table 1 Summary of the main aims, participants, measures, approaches, and data analyses methods in the original studies I, II, and III.

3.2.1 Data collection in Study I

The data used in Study I were collected in 2019 as part of the follow-up data collection for a longer Academy of Finland-funded “Bridging the Gaps” research project, in which the participants had been followed up on annually since 2013, but in 2019 climate change-related measures were added to the questionnaire for the first time. Participants were invited to respond to the questionnaire via text messages with a link to an online questionnaire in Finnish. Participation was voluntary and, as the participants were over 18 years of age, only their consent was sought. The online questionnaire began with an introduction to the research themes, after which participants were asked to give their consent before proceeding to the question section. They were able to fill in the questionnaire on their mobile phones. If necessary, they were also able to take a break from answering and pick up where they had left off whenever it was convenient for them. Participants were motivated to complete the questionnaire by receiving ten-euro gift cards.

3.2.2 Data collection in Study II

Study II was based on data collected using self-reported online questionnaires in the fall of 2020 and 2021. The data were collected as part of the “Growing Mind” research project, funded by the Strategic Research Council of Finland. The project was organized in close cooperation with the City of Helsinki. The participants’ guardians were informed about the data collection, and only those students whose guardians gave active consent were allowed to participate. The participants’ own consent to use their answers for the research was requested at the beginning of the questionnaire. Participants completed the questionnaire during their class time, supervised by their teachers, after watching an instructional video made by the researchers. The questionnaire was offered to them in Finnish, Swedish, or English, depending on the language they used at school. The participants did not receive any compensation, as it was against the policy of the City of Helsinki. However, to better engage the schools, each has received individual feedback reports every year based on their students’ data.

3.2.3 Data collection in Study III

The data collection for Study III was provided by 14 schools in two neighboring cities in western Finland as part of a larger “ySKILLS” research project funded by the European Council’s Horizon 2020. The data were collected using online follow-up questionnaires, a process repeated every spring during the years 2021–2023. Participants completed the self-report questionnaires during school hours and were monitored by their teachers. Again, participation was voluntary, and participants

were asked for their informed consent at the beginning of the questionnaire. Guardians were also informed of the data collection, but active consent was only sought from guardians of adolescents under 16 years of age. The participants received no compensation.

3.2.4 Participants

At the time of the data collection period for Study I, the participants were 18–20 years old and in their third year at 37 different upper secondary schools in the Helsinki metropolitan area. In the Finnish school system, this means that most of them were taking the final matriculation exams and about to graduate that same spring. In total, 886 participants were included in the analysis.

In Study II, all students born between 2006 and 2008 in the recruited schools participated in the study. Participants in the younger cohort were 11–12 years old at the time of the first wave of data collection, in 2020, and 12–13 years old at the time of the second wave of data collection, in 2021. The older cohort was 13–14 years old in 2020 and 14–15 years old in 2021. In 2020, 55 schools in Helsinki participated in the study, but since the younger participants transitioned from primary to middle school between data collection periods, only 31 middle schools participated in 2021. In total, 3,002 participants were included in the analysis, 1,239 of whom participated at both measurement points.

In Study III, all students born between 2006 and 2009 in 14 recruited schools participated in the study. Participants in the youngest cohort were 11–12 years old at the time of the first data collection and the oldest were 14–15 years old. Only participants who replied at least twice across the three measurement points were included in the analysis. Thus, 684 participants were included in the study.

3.2.5 Measures

To answer the main research questions addressed in this dissertation, a diverse set of self-reported measures were utilized in the original studies (see table 1). Some of the measurements used in this dissertation were selected based on previous studies and validated scales. However, since some of the studied phenomena, such as climate change distress, are relatively new research fields, no existing scales proved suitable for use with Finnish adolescents at the time of the data collection for the original studies. Therefore, some of the scales were developed for the purposes of the present study, drawing upon existing literature, empirical research, and interviews with the target group. See appendix 1 for the Cronbach's alpha scores, means, and standard deviations of each study variable.

3.2.5.1 Measures of climate change-related well-being

Climate change-related emotional exhaustion and feelings of inadequacy

In Study I, emotional exhaustion and feelings of inadequacy related to climate change were assessed using an adapted version of the School Burnout Inventory (SBI), developed by Salmela-Aro and Näätänen (2005) (see Salmela-Aro, Kiuru, Leskinen, & Nurmi, 2009), as no suitable validated scales existed for measuring adolescents' climate change-related well-being when planning the data collection process in 2018. Thus, statements in the SBI, which originally focuses on school-related burnout, were modified to address environmental crises. The original inventory assesses school burnout through three dimensions: 1) emotional exhaustion, defined as a high level of fatigue that does not go away by sleeping, 2) cynicism toward studying, and 3) feelings of inadequacy related to schoolwork. In this adaptation, climate change-related emotional exhaustion was measured using the exhaustion dimension (three statements: e.g., *"I often sleep poorly because of the environmental crisis and worries related to it"*), while climate change-related inadequacy was measured using the inadequacy dimension (three statements: e.g., *"I often have feelings of inadequacy because of the environmental crisis"*). Responses were rated on a six-point scale (1 = strongly disagree to 6 = strongly agree).

Climate change distress

For Study II and Study III, the measurement tool for assessing adolescents' climate change-related well-being was developed further and a scale measuring climate change distress was created. With the new scale, climate change distress was assessed using eight items adapted from Clayton and Karazsia's (2020) Climate change Anxiety Scale and measures of climate change-related emotional exhaustion and feelings of inadequacy from Study I. This adaptation was done to create a scale specifically suitable for Finnish adolescents. To confirm the scale's relevance for this age group, five adolescents aged 11–15 were interviewed in depth to refine the items. Ultimately, five items were included to capture cognitive-emotional aspects of climate change distress (e.g., *"Thinking about climate change makes it difficult for me to concentrate"*), while three items focused on behavioral impacts (e.g., *"My concerns about climate change interfere with my ability to complete school assignments"*) (see all items in appendix 2). Participants rated each item on a 6-

point scale, ranging from 1 (“not true at all”) to 6 (“completely true”). All eight items were included in Study II, but only the five items measuring cognitive-emotional indicators of climate change distress were included in Study III.

3.2.5.2 Measures of pro-environmental behavior

Pro-environmental behavior was measured with a different set of items in all the original studies. In Study I, pro-environmental behavior was measured using four items. Two of the items measured consumer habits (e.g., *“I boycott a product or company for environmental reasons”*). One item measured overall change in habits (*“I changed my habits because of climate change (e.g., change in diet or resetting the heating at home)”*) and the last item measured societal action (*“I have taken concrete actions (e.g., become involved in environmental protection activities or participated in a riot) due to concern about climate change”*). The participants were instructed to evaluate how often they had acted in relation to the items during the past two years. Participants rated each item on a 5-point scale, ranging from 1 (“never”) to 5 (“very often”).

In Study II, pro-environmental behavior was measured using a 7-item scale adapted from a longer version developed by De Leeuw and colleagues (2015). Since the 7-item scale version was designed to also be suitable for adolescents as young as 11 years of age, all the items measured low-effort individualistic acts, such as *“I turn off the light when I leave my room”*. Participants were asked to evaluate how often they behaved in line with the items on a scale ranging from 1 (“never”) to 5 (“always”).

In Study III, pro-environmental behavior was measured using four items adapted from Ojala (2012a), two of which measured individual actions, such as *“I cycle or walk instead of driving or being driven in a car,”* while the other two measured social actions, such as *“I try to influence my friends in how to act in a climate-friendly way.”* The participants were instructed to evaluate how often they take such actions for reasons related to climate change on a scale ranging from 1 (“never”) to 5 (“almost always”).

3.2.5.3 Measures of coping strategies

Climate change-related coping strategies

In study III, coping strategies were measured using a scale originally developed and validated for Swedish adolescents (Ojala, 2012a, 2013). For the study, a professional translator translated the scale into Finnish, and five adolescents aged 11–15 were interviewed to ensure that the items were clear and easy for the target group to understand. The scale measured three distinct coping strategies: problem-focused coping (three items), meaning-focused coping (five items), and de-emphasizing (six items). Problem-focused coping included items like *“I search for information about what I can do as an individual to help,”* while de-emphasizing included items like *“I think that the climate change problem does not concern people living in my country”* and meaning-focused coping included items like *“I have faith in humans and humanity; we can fix most problems.”* Participants were instructed to rate how well each item reflected their thoughts and actions in relation to the idea of “climate change,” using a scale that ranged from 1 to 5 (where 1 meant “not at all true” and 5 meant “completely true”).

Climate change denial

In Study II, climate change denial was measured using a scale adapted from a study conducted with Swedish adolescents (Ojala, 2015), which was translated into Finnish by a professional translator. The scale consisted of three items designed to assess three distinct dimensions of climate change denial (Rahmstorf, 2004). The first item, *“I doubt that global warming exists,”* measured the extent to which respondents doubted the existence of climate change. The second item, *“I doubt that climate change is as big a problem as some researchers claim,”* measured the extent to which respondents downplayed the scientific facts surrounding climate change. The third item, *“I doubt that climate change is caused by human emissions,”* measured the extent to which respondents denied the implications of climate change. Participants were instructed to indicate the extent to which they agreed with the statements on a scale ranging from 1 to 5 (with 1 representing “totally disagree” and 5 indicating “totally agree”).

3.2.5.4 Measures of general well-being

General well-being was measured in Study I and Study II. In both studies, it was assessed by measuring both negative and positive indicators of well-being with two distinct scales. Study I measured depression symptoms and self-esteem, while Study II combined depression symptoms with life satisfaction. All the measurements were based on the scales described below, which were previously validated in the Finnish context.

Depression Symptoms

Depression symptoms were measured in Study I and Study II as a negative indicator of general well-being. In both studies, depression symptoms were measured using The Depressive Symptoms Scale (DEPS-10), developed by Salokangas and colleagues (1995). The participants were instructed to rate ten items (e.g., “*I have had feelings of worthlessness*”) based on how well the statements described their depression symptoms over the past month. The participants rated the items on a scale ranging from 1 to 4 (with 1 indicating “not at all” and 4 indicating “very much”).

Self-esteem

Self-esteem was used to specify positive indicators of general well-being in Study I. It was measured using a five-item version of the Self-Esteem Scale, developed by Rosenberg (1965). The participants were instructed to rate the items based on how well the statement described their sense of self (e.g., “*I feel that I have a number of good qualities*”) on a scale ranging from 1 to 7 (with 1 indicating “totally disagree” and 7 indicating “totally agree”).

Life satisfaction

In Study II, life satisfaction was used as a positive indicator of general well-being. It was measured using a Finnish translation (e.g., Salmela-Aro & Wiese, 2006; Vasalampi et al., 2009) of the Satisfaction with Life Scale (Diener et al., 1985; Pavot et al., 1991). The participants rated their life situation via three items, such as “*I am satisfied with my life,*” on a scale ranging from 1 to 7 (with 1 indicating “completely disagree” and 7 indicating “completely agree”).

3.2.6 Ethical considerations

All the original studies that are part of this dissertation were carefully planned following the ethical research practices of the Finnish National Board on Research Integrity (TENK). All the studies also received statements of approval from the Ethical Review Board in Humanities and Social and Behavioral Sciences at the University of Helsinki prior to the data collection process. Furthermore, participation was always voluntary in all the studies, and all participants were asked for their consent to use the data for research purposes. In addition, all guardians of minor participants were given information about the studies. Yet, active parental consent was only required for participants under the age of 16, according to the TENK guidelines at the time. However, guardians of underage adolescents over 16 years of age were informed that they had the right to refuse to allow their children to participate, if they so desired. All participants were clearly informed about their rights during and after the data collection process, and each of the participants was informed that they had the right to withdraw from the study at any time without consequences.

3.3 Overview of data analysis process

To form a comprehensive understanding of adolescents' climate change distress, pro-environmental behavior, and coping strategies, the dissertation employs both variable-centered and person-centered approaches. The variable-centered approach provides insight into the associations between phenomena on a population level, whereas the person-centered approach reveals the existence of groups of adolescents who share a particular set of attributes while differing from other groups (Laursen & Hoff, 2006). Together, the two approaches complement each other and create a more holistic understanding of the overall trends and unique patterns that exist within subgroups throughout adolescence.

The following subsections provide an overview and explanation of the key analytical methods used in the original studies. See table 1 for an overview of the statistical data analysis methods used in each original study. The original publications and their supplements contain more detailed descriptions of the data analysis process. The main part of the data analysis in all original studies was done using R studio and R (versions 3.6.3, 4.2.1., & 4.3.2) (The R Core Team, 2020–2023). In addition, some aspects of the data analysis were performed using IBM Statistical Package for Social Sciences (SPSS) in Study I and Mplus 8.6 (Muthén & Muthén, 1998–2017) in Study II.

3.3.1 Missing values and attritions

Missing data analysis was conducted prior to the main analysis in each original study. The missing value patterns were examined based on the overall percentages of missing data in each item and by conducting the Missing Completely at Random Test (MCAR). In each of the original studies, the test indicated that the missing data did not occur in a completely random manner, which can be explained by the way in which the data was collected. Often in longer self-reported surveys of this type, with a variety of different questions on different themes, some of the adolescents stop replying either because they become tired of answering the questions or because they lose their ability to concentrate. Therefore, the percentage of missing data increased towards the end of the surveys in all the original studies. To handle the missing data, the robust maximum likelihood estimator (MLR), together with the full information maximum likelihood estimation (FIML), was used whenever possible. The application of FIML made it possible to utilize all the observed data to estimate models without the need for imputation (Graham, 2009).

In addition, the effects of attrition were assessed in Studies II and III since both studies contained longitudinal data and not all participants took part in every data collection wave. In Study II, the retention rate between the first data collection phase in 2020 and the second phase in 2021 was 57.3%. This low retention rate can be partly explained by the fact that the dataset was collected during the years of the ongoing COVID-19 pandemic, during which time participants completed the survey in class while present at school. Participants could not complete the survey if they were unable to attend school on the scheduled day. In addition, since the data collection process originally began in 2019 and parental consent was requested annually, an additional 780 participants joined the second data collection wave. Those participants either joined for the first time after receiving parental consent or were original participants from 2019 who had dropped out in 2020 but rejoined in 2021, thus creating a non-monotonous pattern of missing data. All the participants were kept for analysis using FIML.

In Study III, only participants who responded at least twice during the three data collection waves were included in the analysis. However, some of the participants did not continue to the end of the surveys or only responded with the additional response options “I don't know” or “I prefer not to say.” Exploration of the pattern underlying those responses revealed that participants more often provided “I prefer not to say” responses ($M = 10.09\%$, $SD = 0.16$, median = 2.74%) than “I don't know” responses ($M = 4.49\%$, $SD = 0.12$, median = 0%), with both options being evenly distributed across the separate items. Those response options were coded as missing information. As a result, some participants' responses included a large amount of missing information. Therefore, to control for data quality, all participants with more than 75% missing responses were removed. In the final

sample, the retention rate from time 1 to time 2 was 91.1%, while the rate from time 2 to time 3 was 80.8% and the rate from time 1 to time 3 was 76.2%.

3.3.2 Internal measurement consistencies and structural validation

The internal measurement consistencies were studied before conducting the main analysis for each of the original studies. In all three studies, the reliability of the measurement scales was studied with Cronbach's alpha scores (appendix 1). In addition, the structural validity and measurement invariance of the measurement scales across age cohorts (Study II) and time (Studies II and III) were tested by fitting three confirmatory factor models (CFA) to the data: the first model was an unconstrained baseline model; the second model had factor loadings for the groups (in multigroup study settings) or measurement points (in longitudinal study settings), constrained to be equal (metric invariance); and the third model had both factor loadings and intercepts, constrained to be equal (scalar invariance). The most restricted well-fitting models were used for further analysis to better account for the measurement errors (e.g., Kam et al., 2016; Morin & Marsh, 2015). The most well-fitting models were determined by examining the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), and the Root Mean Square Error (RMSEA). A model was considered to have a good fit if the CFI and TLI values were over .90 (Bentler, 1990; Fabrigar et al., 1999) and RMSEA was less than .06 (Steiger, 1990). When comparing the baseline models and the constrained models, two models were viewed as equivalent and invariance assumed if the decrease in the CFI was not more than .01 and the increase in RMSEA was less than .015 for a more parsimonious model (Cheung & Rensvold, 2002). In addition, chi-square difference tests were conducted, but they were not used as the primary criterion to determine model equivalence because the chi-square statistic is sensitive to sample size and even small violations of the normality assumption (Chen, 2007). The invariance tests were computed either with Lavaan-package in R (Rosseel, 2012) (Study II and Study III) or with Mplus (Study II).

3.3.3 Latent profile and transition analysis

To study whether adolescents have distinct ways of reacting to climate change, Study I and Study II employed a person-oriented approach. Study I aimed to identify distinct subgroups based on climate change-related well-being and pro-environmental behavior, while Study II aimed to identify distinct subgroups based

on climate change distress and denial among adolescents. Latent profile analysis (LPA) was used to meet the aims and reveal sets of subgroups that best describe the distribution of the data, which remains hidden if only average means on a population level are examined (Oberski, 2016). LPA enables the examination of relationships between individuals and the formation of profiles based on observed similarities, with the predicted means of the formed groups providing a unique profile for each group (Oberski, 2016). With LPA, the goal is to find the smallest number of profiles that have a response profile that is similar within the profile group and different from other profiles (Muthén & Muthén, 2000). Unlike confirmatory methods, LPA calculates the probability rates for each participant to belong to any given profile in the model. Thus, the profile solutions are based on the most likely profile memberships.

In Study II, LPA was further complemented by latent transition analysis (LTA), as the second aim of the study was to examine the degree of stability of profile membership over time. With LTA, latent profile variables are estimated separately at different time points, and the relationship between the variables is estimated via logistic regression to determine if profile memberships change or remain the same over time (Collins & Lanza, 2009). Before performing LTA in Study II, the measurement invariance of the LPA solutions over time was tested. Once the longitudinal measurement invariance was verified, the LPA solutions from both time points were integrated into a single longitudinal LPA model in order to proceed with LTA. Finally, the LTA model estimating transitions was converted, based on the final model, with equal means, following the guidelines for simplified three-step estimation (Asparouhov & Muthén, 2021).

Estimation and model selection

In Studies I and II, the best number of profiles was determined based on several indicators. First, the best fitting models were evaluated based on several goodness-of-fit criteria, including, for example, the Akaike Information Criterion (AIC), the Consistent Akaike Information Criterion (CAIC), the Bayesian Information Criterion (BIC), and the Sample-Size-Adjusted Bayesian Information Criterion (SABIC). Lower goodness-of-fit criteria values indicate better fitting models. However, since the criteria are heavily influenced by sample size (Marsh et al., 2009), they may keep on suggesting the addition of profiles without reaching a minimum when the sample size is sufficiently large. Therefore, the information criteria were also presented graphically with “elbow plots,” where the point after the slope flattens helps determine the best profile solution (Morin et al., 2011). Next, the plots were used to visualize a few selected profile solutions with the best model fits, according to the goodness-of-fit criteria, to examine the qualitative differences between the profiles with those solutions. The final number of profiles was determined in relation to theory, previous research, and the qualitative

interpretation of the profiles (Marsh et al., 2004). Finally, the entropy values were studied to ensure that the selected profile solutions had strong classification accuracy, which was determined if the value was over .80 (Tein et al., 2013).

Multiple-group analysis of similarity

Since Study II included two age cohorts (the younger group was 11–12 years old and the older group was 13–14 years old at the time of the first wave of data collection), it was important to ensure that profile solutions for the two age groups could be integrated into the same LPA model. Given that adolescence is a period of rapid maturation (Galambos et al., 2003), the optimal profile solutions for the two age groups had the potential to differ from each other. Therefore, the similarity of the profile solutions was verified using a multiple-group analysis of similarity. Following the guidance of Morin and colleagues (2016), the analyses were performed separately at both time points in four steps. First, configural similarity (i.e., number of profiles) was assessed. Then, structural similarity (i.e., within-profile means) was examined. Next, dispersion similarity (i.e., within-profile variability) was assessed, followed by distributional similarity (i.e., profile sizes). It was determined that the profile solutions for the age cohorts passed the similarity analyses after first concluding that at least two out of three information criteria (CAIC, BIC, and SABIC) decreased on a step-by-step basis.

Profile differences, covariates, and distal outcomes of the profiles

After determining the optimal number of profiles, the explanatory (Studies I and II) and deterministic similarities (Study II) between the profiles were studied to better understand the characteristics of different subgroups of adolescents. In Study I, after settling on the model with the best number of profiles, the information on the most likely memberships was saved and variance analyses with ANOVA were performed to discover how the identified profiles differed based on gender, general well-being, family financial situation, and school performance. In Study II, the LTA model made it possible to add covariates and outcomes to determine the associations between the profiles and the covariates (deterministic similarity) and their distal outcomes (explanatory similarity) at both time points (Morin et al., 2016). This was done by using the manual Bose–Chaudhuri–Hocquenghem (BCH) method, which accounts for classification uncertainty (i.e. entropy < 1) (Nylund-Gibson et al., 2019). In Study II, age cohort was used as a covariate and pro-environmental behavior, depression symptoms, and life satisfaction as distal outcome variables.

3.3.4 Random-intercept cross-lagged panel model

In Study III, the aim was to study how climate change distress, pro-environmental behavior, and coping strategies are related for individuals at the contemporaneous level (at the same time point) and across time. Thus, instead of focusing on the relationships between the study variables based on sample averages (at the between-person level), the interest was in assessing the relationships based on changes in the adolescents' personal means (at the within-person level). Focusing on the within-person level can provide a more nuanced understanding of the trajectories of individuals who exhibit, for example, either higher-than-expected or lower-than-expected climate change distress and pro-environmental behaviors in relation to their personal mean.

To study the within-person level, the Random Intercept Cross-Lagged Panel Model (RI-CLPM) was utilized. The RI-CLPM model controls for trait-like and time-invariant stability through the inclusion of random intercepts that partial out between-person variance (Hamaker et al., 2015). Contemporaneous associations and cross-lagged paths at the within-person level represent, for example, what happens to an adolescent's expected level of climate change distress when they are behaving pro-environmentally above or below their expected mean. In contrast, the traditional Cross-lagged Panel Model (CLPM) conflates the between-person and within-person processes, which may lead to the wrong conclusions regarding the cross-lagged paths (Hamaker et al., 2015).

However, the RI-CLPM model requires enough variance within variables to decompose them into between-person and within-person levels. Accordingly, prior to constructing the models, the individual variation from the sample means was evaluated using intraclass correlation coefficients (ICCs) at the person level, and the stability of individual responses was investigated graphically. If the changes in a variable were overly stable over time, or if they lacked individual variation from the sample means, then the random intercept of that variable is considered redundant and can be set at zero to retain it as a non-decomposed variable, like in a traditional CLPM. This means that instead of representing individual fluctuations around a personal mean over time, the non-decomposed variable represents individual fluctuations around the sample means over time (while the other variable in the model can remain decomposed) (Mulder & Hamaker, 2021). In the case of Study III, the coping strategies showed a lack of relevant variance, making the between-person and within-person decomposition overly complex. As a result, coping strategies were retained as non-decomposed variables, while climate change distress and pro-environmental behavior were decomposed to the stable between-level and within-person level fluctuations around it each year.

In total, seven different RI-CLPM models were estimated to study contemporaneous and longitudinal associations between 1) climate change distress and pro-environmental behavior and 2) climate change distress and pro-

environmental behavior separately with each of the three coping strategies. In addition, three multigroup RI-CLPM models (one for each coping strategy) were estimated to discover whether adolescents who rely more on a specific coping strategy differ in terms of the within-person association between climate change distress and pro-environmental behavior over time. All the models were built in three steps. First, the models are estimated without any constraints to evaluate how well they reproduce the data. Then for the next step, the tenability of the parameter constraints regarding model parsimony as well as stationarity are tested by constraining the longitudinal structural relations so that they are equal across all measurement points. Finally, the covariates of the measurement components are also constrained within the same time point, which is done to constrain the dynamic errors. As with Study I and Study II, the best fitting models were determined by using several goodness-of-fit criteria (AIC, CAIC, BIC, and SABIC).

4 Overview of the main findings of the original studies

This chapter presents the key findings from the original studies, structured around the three research questions (for a study-by-study summary, see figure 9). First, RQ1 is addressed by focusing on the key findings from Study I and Study II. The second section explores RQ2 based on findings from Studies I, II, and III. Finally, RQ3 is addressed by exploring the key findings from Study II and Study III. Each section begins with an overview of the key findings, followed by a more detailed, separate description of the results from each original study.

4.1 RQ1: How does climate change distress manifests itself among Finnish adolescents, and how does it relate to general well-being?

To address the first research question, Studies I and II examined how Finnish adolescents experience climate change distress and how those experiences are linked to their overall well-being. Taken together, the studies identified distinct subgroups of Finnish adolescents who experience climate change distress in different ways. In both studies, most adolescents reported low levels of emotional exhaustion, feelings of inadequacy, or distress related to climate change. However, both studies also identified subgroups of adolescents with heightened climate change distress. The longitudinal results further suggest that the responses are not fixed but can change over time, highlighting the ongoing and dynamic nature of adolescents' interactions with climate change. Across both studies, greater climate change distress was associated with poorer general well-being. The following subchapters provide a more detailed description of the findings, presented on a study-by-study basis.

4.1.1 Findings from Study I

Study I showed that Finnish adolescents (18–20 years old) respond to climate change in different ways, identifying three different profiles consisting of different patterns of climate change-related emotional exhaustion, feelings of inadequacy, and pro-environmental behavior (figure 3). The largest group (44% of the participants) comprised young people detached from climate change, who appeared to be disconnected from the effects of climate change since they reported low levels of climate change-related emotional exhaustion and feelings of inadequacy and low engagement in pro-environmental behaviors. The second largest group (42% of participants) consisted of climate anxious adolescents, who experienced elevated levels of climate change-related inadequacy but did not experience high levels of emotional exhaustion. They were also somewhat actively engaged in pro-environmental behavior. The smallest group (14% of participants) consisted of young people overburdened by climate change. The group reported both high levels of climate change-related exhaustion and feelings of inadequacy as well as active engagement in pro-environmental behavior.

A comparison of the general well-being of the three groups (table 2) revealed that the overburdened group exhibited a higher frequency of depressive symptoms and weaker self-esteem than the detached and climate-anxious groups, which did not differ from each other. The observed differences in depression symptoms and self-esteem were of medium effect size, according to partial eta squared scores. Therefore, it could be concluded that those who experienced greater levels of emotional exhaustion and feelings of inadequacy related to climate change also exhibited weaker general well-being. These findings were also evident in the correlations between the variables. Climate change-related emotional exhaustion demonstrated a weak negative association with self-esteem ($r = -.25, p < .001$) and a positive association with depression symptoms ($r = .32, p < .001$). Additionally, climate change-related inadequacy demonstrated a weak negative correlation with self-esteem ($r = -.27, p < .001$) and a positive correlation with depression symptoms ($r = .28, p < .001$).

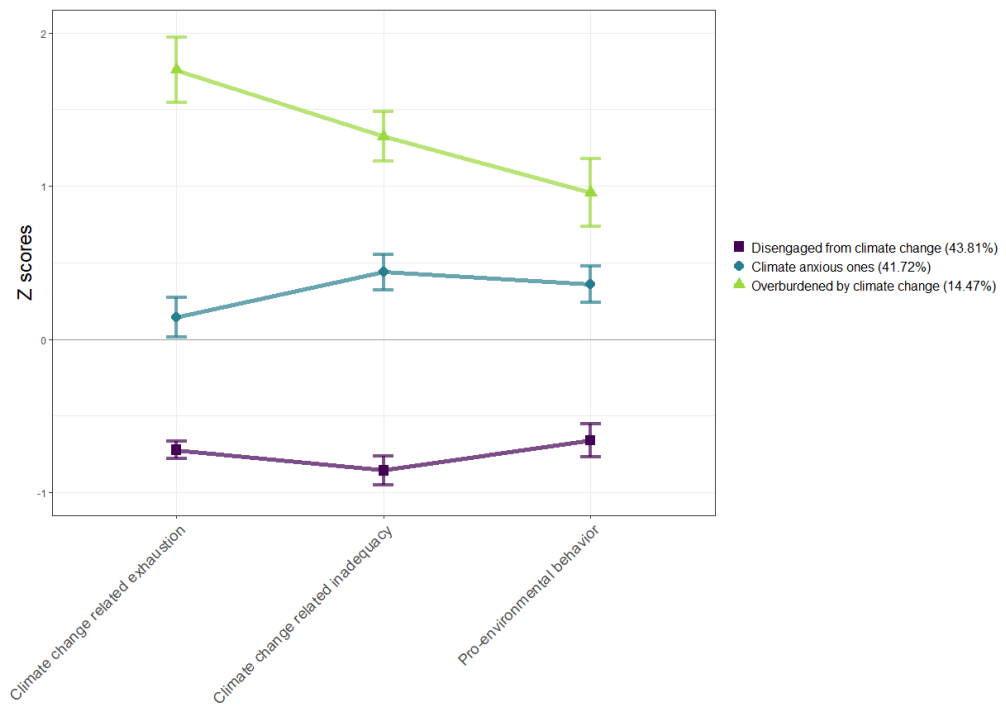


Figure 3 Study I: Profiles Of climate change-related well-being and behavior with z-score standardized means ($M = 0$, $SD = 1$).

Table 2 Study I: Profile differences in self-esteem and depression symptoms

Variable	Scale	Disconnected from climate change		Climate anxious		Overburdened by climate change		F	Partial η^2
		M	SD	M	SD	M	SD		
Self-esteem	1–7	4.62 _a	1.32	4.37 _a	1.3	3.57	1.16	F(2, 581) = 21.24***	0.07
Depression symptoms	1–4	1.80 _a	0.7	1.96 _a	0.57	2.56	0.76	F(2, 581) = 35.50***	0.11

*** $p < .001$

a = There were nonsignificant differences between the groups with the same subscript ($p > .05$).

M = Mean and *SD* = Standard deviation.

4.1.2 Findings from Study II

The results from Study II provided further evidence supporting the findings from Study I. Study II also revealed that Finnish adolescents (11–15 years old) respond to climate change in diverse ways, identifying four distinct profiles based on climate change distress and denialism (figure 4). As in Study I, the largest profile in Study II comprised adolescents with low levels of both climate change distress and denial (comprising 49–51% of participants). The group was referred to as the *normative-carefree* group. Additionally, a second group (comprising 17–20% of participants) exhibited low levels of climate change distress but elevated climate denial scores. Consequently, the group was referred to as the *denialists* group. Furthermore, two discrete profiles were identified, characterized by elevated climate change distress scores. The first of the two groups was designated the *emotionally involved* group (21–23% of participants) due to their high scores on items measuring cognitive-emotional aspects of climate change distress, coupled with a lower incidence of behavioral impairments and low levels of climate denial. As in Study I, the last group was designated the *overburdened* group (9–10% of participants). However, unlike in Study I, while adolescents in this group exhibited elevated scores on both

the cognitive-emotional aspects and behavioral impairments of climate change distress, they also reported elevated climate denial.

In addition, the stability of the four profiles across one year was studied. The results suggest that adolescents' climate change distress is ongoing and developing all the time, rather than being more or less permanent, as the estimated transition patterns showed that the profiles were unstable within a one-year span (figure 5). The most stable group was the *normative-carefree* group, with 49% of the members remaining in the group over time. Among those who transitioned from this group, most moved to the *emotionally involved* group (22%) or the *denialists* (20%), while only a small proportion moved to the *overburdened* group (10%). Members of the *denialists* group were more likely to shift groups, with 54% transitioning to the *normative-carefree* group and only 33% remaining in the *denialists* group over time. Only a small percentage of them moved to the *overburdened* (9%) or *emotionally involved* (3%) groups. For those in the *emotionally involved* group, a majority transitioned to the *normative-carefree* group (51%), while 41% remained in the *emotionally involved* group. Very few moved to the *denialists* (1%) or *overburdened* (7%) groups. Lastly, 22% of the members of the *overburdened* group remained in the same group over time. Most of them, however, transitioned to the *normative-carefree* group (61%), while a small number shifted to the *denialists* (8%) or *emotionally involved* (9%) groups. However, the model where the transition patterns of two age cohorts were estimated freely across time fitted the data the best, indicating that the transition patterns of the age cohorts differed from each other. When the separate transition patterns of the age cohorts were compared, the most notable difference between the groups was that the *denialists* group was more stable among those in the younger cohort (stability of 41%) than those in the older cohort (stability of 26%).

Finally, the explanatory similarity between the four profiles in terms of general well-being was examined separately for each time point. At the first time point, the means for the younger and older cohorts differed so much that they were reposted separately. Overall, the older age cohort reported more depression symptoms and less life satisfaction at the first time point. However, no significant differences were evident between the age cohorts at the second time point, and so the means were reported together. The group comparison showed that adolescents in the *overburdened* group experienced depression symptoms the most at both time points. However, there were no differences between the *overburdened* and *emotionally involved* groups among adolescents in the older age cohort at the first time point. Contrarily, those in the *normative-carefree* and *denialists* groups had the highest life satisfaction at both time points. Thus, those adolescents who reported experiencing high levels of climate change distress and denial at the same time also had the weakest general wellbeing.

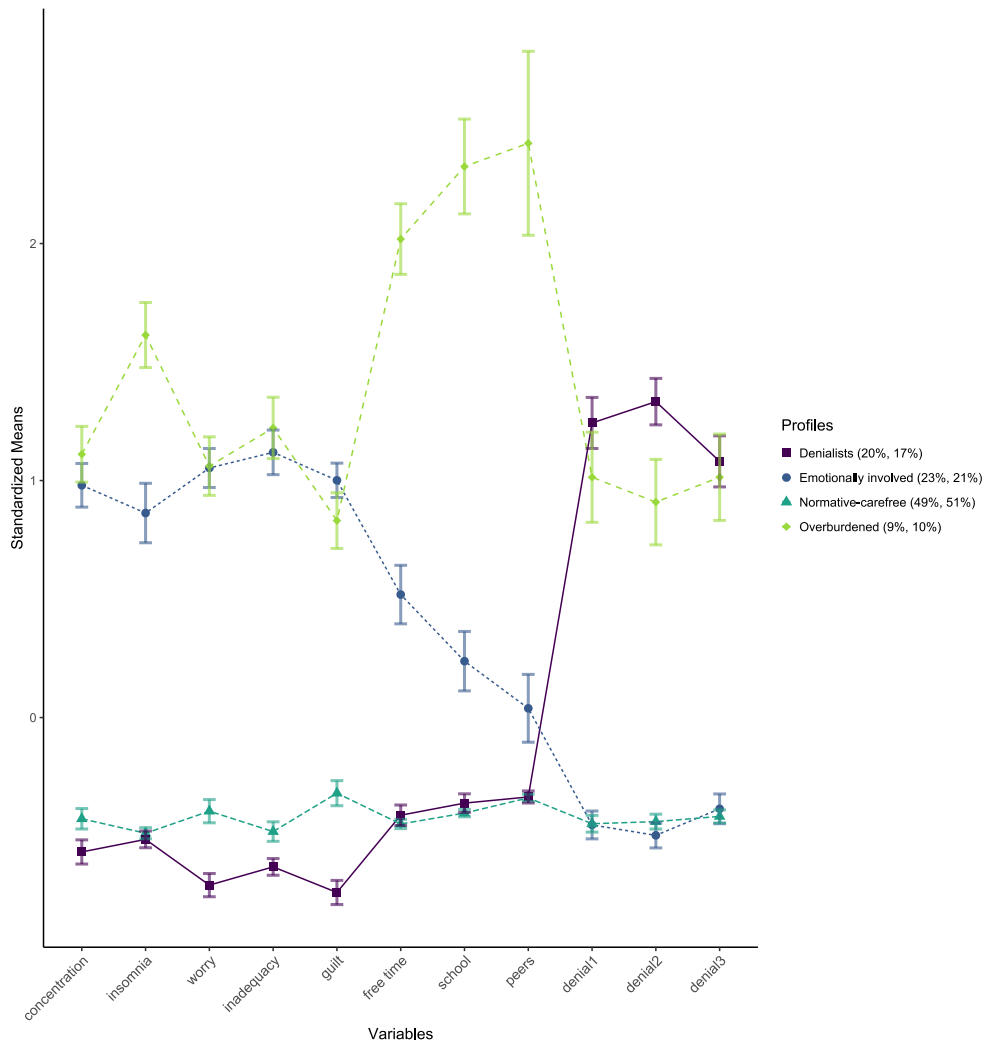


Figure 4 Study II: Profiles of climate change distress and denialism with z-score standardized means. *Note:* the bars indicate 95% confidence intervals; total N of observations = 3002; concentration = thinking about climate change makes it difficult for me to concentrate; insomnia = thinking about climate change makes it difficult for me to sleep; worry = I brood over matters related to climate change a lot; inadequacy = I have feelings of inadequacy because of climate change; guilt = I feel guilty if I'm not acting to combat climate change; free time = My concerns about climate change make it hard for me to have fun with my family or friends; school = My concerns about climate change interfere with my ability to get school assignments done; peers = My friends say I think about climate change too much; denial1 = I doubt that global warming is actually occurring; denial2 = I doubt that the climate change problem is as serious as some scientists claim; denial3 = I doubt that climate change is caused by human emissions.

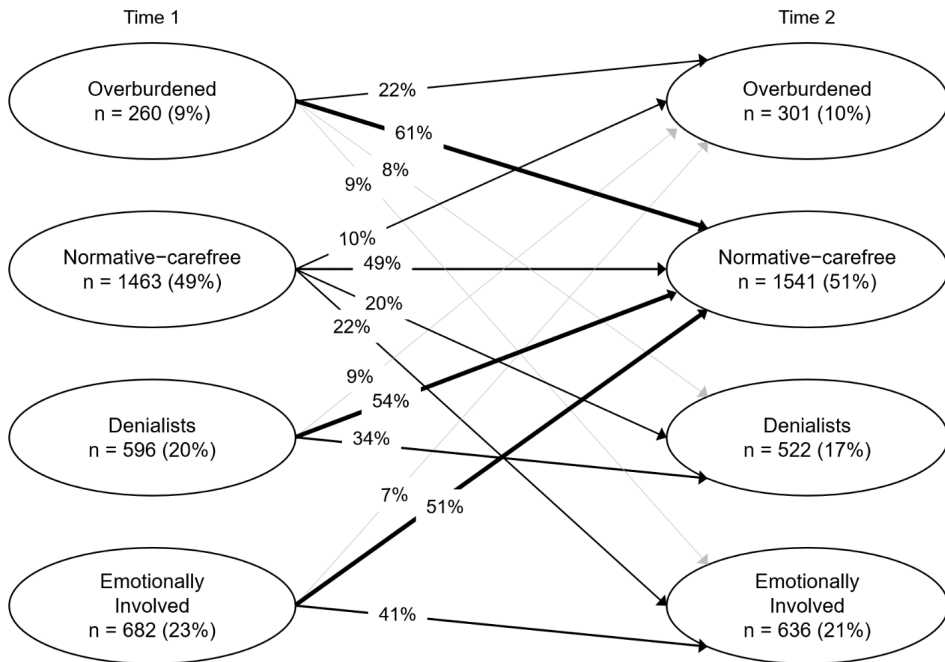


Figure 5 Study II: Percentages Of estimated transitions from time point 1 to time point 2 (transitions with less than 5% Of participants are excluded from the figure)

4.2 RQ2: How are climate change distress and pro-environmental behavior associated both contemporaneously and longitudinally?

To address the second research question, the studies examined the relationship between adolescents' climate change distress and their pro-environmental behavior at the same point in time (Studies I, II, and III) and over time (Study III). Across all the original studies, climate change distress and pro-environmental behavior were found to be closely intertwined. Generally, adolescents who experienced greater climate change distress were more likely to simultaneously engage in pro-environmental behavior. While the link was evident at the contemporaneous level, longitudinal findings at the within-person level revealed a more complex picture: higher-than-expected climate change distress at one time point was associated with reduced pro-environmental behavior later, and vice versa. Interestingly, greater pro-environmental behavior was associated with increased climate change distress one year later. These findings are presented in more detail, on a study-by-study basis, in the following subchapters.

4.2.1 Findings from Study I

The results from Study I suggest that climate change-related well-being and pro-environmental behavior are intertwined at the contemporaneous level. Of the three identified profiles (figure 3), the group consisting of overburdened adolescents exhibited the most active pro-environmental behavior while also experiencing more climate change-related exhaustion and feelings of inadequacy than the other two groups. At the other end, those in the detached from climate change group had the lowest level of engagement in pro-environmental behavior and the lowest levels of climate change-related exhaustion and feelings of inadequacy (figure 3). The same finding was noted in the strong positive associations between pro-environmental behavior and climate change-related emotional exhaustion ($r = .48, p < .001$) and feelings of inadequacy ($r = .56, p < .001$) at the variable level. Thus, the results suggest that those adolescents who are distressed about climate change are simultaneously more likely to act in pro-environmental ways.

4.2.2 Findings from Study II

Study II supported the view that climate change distress and pro-environmental behavior are intertwined phenomena. When the four groups identified in Study II were compared based on their explanatory similarities in pro-environmental

behavior, adolescents in the *emotionally involved* group reported pro-environmental behavior significantly more than those in the other groups (with the exception being that no significant differences were detected between the *normative-carefree* and *emotionally involved* groups amongst the younger age cohort at the first time point). Adolescents in the *emotionally involved* group reported experiencing climate change distress on a cognitive-emotional level but no behavioral impairments caused by the distress. At the other end of the climate change distress scale, the adolescents in the *denialists* group had the lowest engagement in pro-environmental behavior (with the exception that the *denialists* and the *overburdened* groups exhibited no significant differences within the younger age cohort at the first time point).

4.2.3 Findings from Study III

Study III supported the idea that those adolescents who are experiencing elevated levels of climate change distress are simultaneously engaging in more active pro-environmental behavior when studied at the contemporaneous level (across the same time point). The results at the within-person level showed that if an adolescent was experiencing climate change distress above their usual average, they also reported engaging in pro-environmental behavior more than expected at the same time (figure 6). This finding also proved true when assessed from the reverse angle: if an adolescent was experiencing climate change distress below their usual average, then they also engaged in pro-environmental behavior less than expected.

However, when the relationship between climate change distress and pro-environmental behavior was studied over time, it became evident that the phenomenon is more complex and nuanced. As illustrated in figure 7, the longitudinal associations revealed that higher-than-expected climate change distress was associated with a decline in the expected level of pro-environmental behavior one year later. Conversely, when adolescents reported lower-than-expected climate change distress on one occasion, they demonstrated a higher level of pro-environmental behavior than expected one year later. Furthermore, the findings indicated that pro-environmental behavior can also exert an influence on distress. The longitudinal associations with pro-environmental behavior as the predictor demonstrated the opposite pattern. When adolescents engaged in pro-environmental behavior to a greater extent than usual on one occasion, they experienced higher-than-expected climate change distress one year later. Conversely, when an adolescent engaged in less pro-environmental behavior than usual, they experienced lower-than-expected levels of climate change distress one year later.

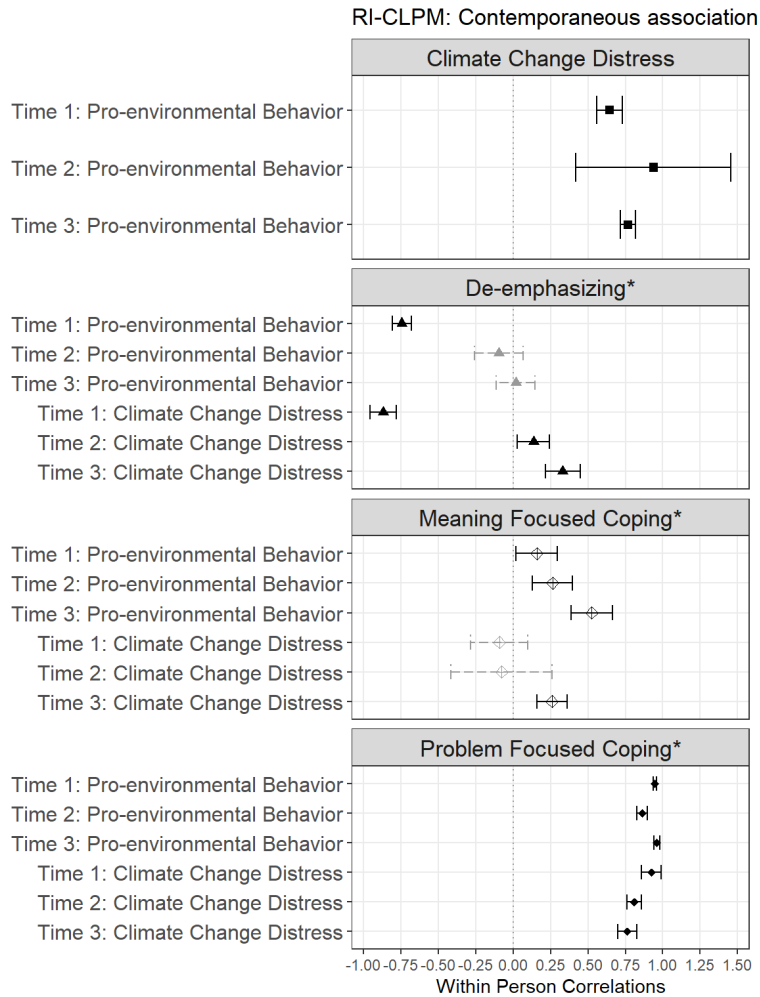


Figure 6 Study III: Illustrated within-person correlations at all three time points: the symbols mark the values of the regression coefficients and the lines around them mark the 95% confidence intervals (CI); when the CI line crosses point zero, the correlations are not statistically significant and are marked in the figure with a lighter color and dashed line, while statistically significant correlations are marked with solid CI lines and a darker color: * = the variance of the variable is not decomposed, so the variable represents differences from the sample mean instead of within-person fluctuations.

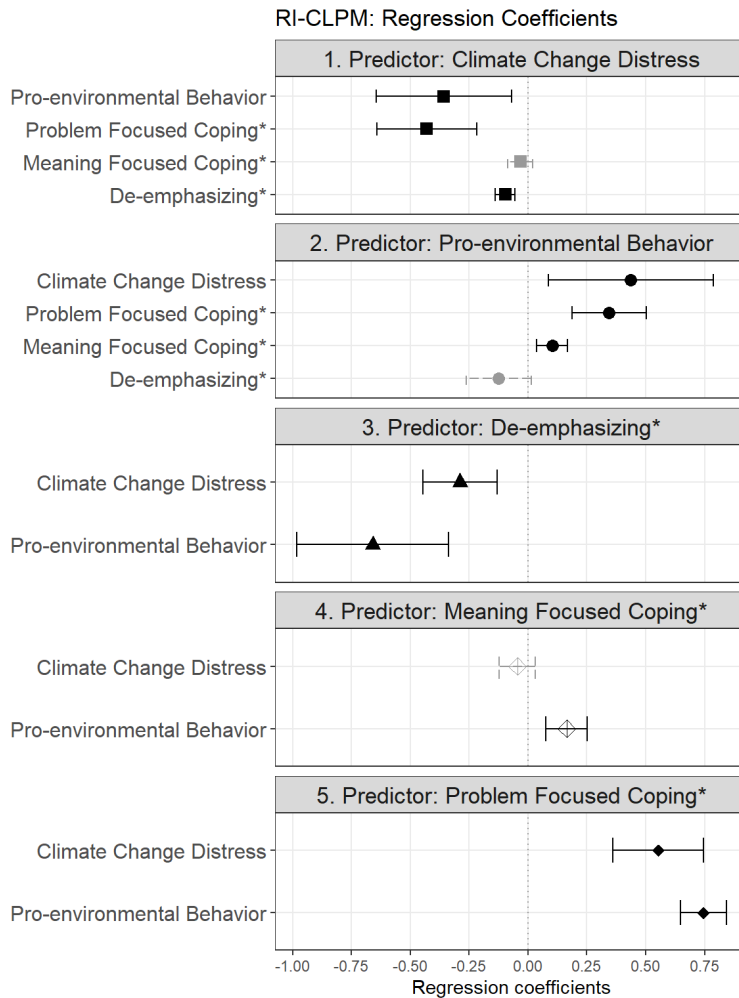


Figure 7 Study III: Illustrated regression coefficients of the longitudinal associations at the within-person level based on models with constrained longitudinal relationships: the symbols mark the values of the regression coefficients and the lines around them mark the 95% confidence intervals (CI); when the CI line crosses point zero, the longitudinal associations are statistically nonsignificant and are marked in the figure with a lighter color and dashed line, while statistically significant longitudinal associations are marked with solid CI lines and a darker color: * = the variance of the variable is not decomposed, so the variable represents differences from the sample mean instead of within-person fluctuations.

4.3 RQ3: How do different coping strategies (de-emphasizing/denial, problem-focused and meaning-focused) relate to levels of climate change distress and pro-environmental behavior, and do particular coping strategies moderate the relationship between climate change distress and pro-environmental behavior?

Studies II and III addressed the third research question by exploring different coping strategies in relation to adolescents' levels of climate change distress and pro-environmental behavior. Together, the findings from the studies highlight the complex and sometimes contradictory ways in which Finnish adolescents cope with climate change. For a notable minority, denialism emerged as a maladaptive strategy. Some adolescents even exhibited an unusual combination of high levels of climate change distress and denial, which was linked to disengagement from pro-environmental behaviors and lower general well-being. Problem-focused coping demonstrated a reciprocal relationship with pro-environmental behavior over time, but it was also associated with increased climate change distress over time. Meaning-focused coping played an important role in shaping the association between climate change distress and pro-environmental behavior over time. Among adolescents who exhibited high levels of meaning-focused coping, higher-than-expected climate change distress was linked to increased pro-environmental behavior, while increases in pro-environmental behavior were not significantly associated with climate change distress. The following subchapters provide a more detailed description of the findings related to specific coping strategies.

4.3.1 Findings from Study II

4.3.1.1 Regarding Denialism

Study II examined the diverse patterns of climate change distress and denial among adolescents. The results showed that about one-fifth of the participants belonged to the *denialists* group at both time points (figure 4). The group was characterized by low levels of climate change distress and elevated levels of climate denial, and group

membership was associated with low engagement in pro-environmental behaviors. It is noteworthy that membership in the *denialists* group was more stable within the younger age cohort (ages 11–12 at the first time point), with a stability rate of 41%, compared to the older age cohort (ages 13–14 at the first time point) with a stability rate of 26%. After one year, most adolescents in the *denialists* group (55% of the members at the first time point) transitioned to the *normative-carefree* group, which was the other group characterized by low levels of climate change distress but also low levels of denial.

Another group that had elevated levels of climate change denial was the group referred to as the *overburdened* group. Although this group was the smallest of the identified profiles, comprising only about one-tenth of the participants, adolescents in it exhibited an unusual combination of elevated levels of distress and climate change denial. Thus, this group showed that high levels of climate change distress and climate denialism can also co-exist among adolescents. The group was associated with more pro-environmental behavior than the *denialists*, with the exception being that the *denialists* and the *overburdened* groups exhibited no significant differences within the younger age cohort at the first time point. However, adolescents in both groups engaged less in pro-environmental behavior than those in the group of *emotionally involved* group, with elevated scores in cognitive-emotional aspects of climate change distress but low climate denial scores.

4.3.2 Findings from Study III

4.3.2.1 Regarding de-emphasizing

Just as climate denial in Study II manifested in two distinct profiles, accompanied by both low and high levels of climate change distress, de-emphasizing also exhibited inconsistent contemporaneous associations with climate change distress at different measurement points in Study III. Higher-than-expected climate change distress was associated with less reliance on de-emphasizing in the first year, while the same association was positive but minor in the following years (figure 6). Examination of the longitudinal associations revealed small negative regression coefficients (figure 7). Adolescents exhibiting higher-than-expected climate change distress levels at one point were likely to engage in de-emphasizing less often a year later, while those with lower-than-expected distress levels tended to rely more on de-emphasizing the following year. Similarly, adolescents who relied heavily on de-emphasizing at one time point were more likely to report lower-than-expected levels of climate change distress a year later.

In addition, de-emphasizing did not have consistent contemporaneous or longitudinal associations with pro-environmental behavior. Higher-than-expected

pro-environmental behavior was associated with less de-emphasizing at the first measurement point, but no significant contemporaneous associations were found at the later time points (figure 6). In the bivariate models examining the relationship between pro-environmental behavior and de-emphasizing, the model with constrained longitudinal structural relationships (figure 7) did not show a significant longitudinal link between pro-environmental behavior and de-emphasizing. However, the unconstrained model, which fits the data better, revealed a small but significant positive association between time 1 and time 2 ($B = .14$, $SE = .05$, $p < .01$) and a small negative association between time 2 and time 3 ($B = -.17$, $SE = .04$, $p < .001$). In addition, the constrained model suggested that de-emphasizing had a negative impact on pro-environmental behavior (figure 6), but the unconstrained model identified this link only between time 2 and time 3 ($B = -.40$, $SE = .05$, $p < .001$) and no significant link between time 1 and time 2 ($B = -.05$, $SE = .14$, $p > .05$).

4.3.2.2 Regarding problem-focused coping

Similar to the results from Study III regarding the links between pro-environmental behavior and climate change distress, problem-focused coping exhibited a strong positive contemporaneous association with climate change distress (figure 6). Hence, higher-than-expected climate change distress was associated with more active problem-focused coping at the same time. Likewise, the longitudinal associations revealed the same reciprocal influences as they did for pro-environmental behavior and climate change distress: climate change distress was negatively related to problem-focused coping over time, while problem-focused coping had a positive link to climate change distress (figure 7). Specifically, adolescents who reported higher-than-expected climate change distress at one time point were likely to engage in problem-focused coping less a year later, and the reverse was also true. On the other hand, when adolescents relied more heavily on problem-focused coping, they reported higher-than-expected levels of climate change distress the following year.

In addition, within-person fluctuations in pro-environmental behavior were strongly and positively associated with problem-focused coping at the contemporaneous level (figure 6). Thus, adolescents engaging in pro-environmental behavior more than their usual norm were simultaneously utilizing problem-focused coping above the sample average. Over time, pro-environmental behavior and problem-focused coping also had mutually reinforcing longitudinal effects (figure 7). Adolescents who reported high levels of problem-focused coping at one time point were more likely to engage in pro-environmental behavior above their expected level a year later. Conversely, adolescents with low levels of problem-

focused coping at one time point were more likely to exhibit lower-than-expected pro-environmental behavior a year later. Similarly, those who engaged in more pro-environmental behavior than their usual norm were more likely to report higher problem-focused coping levels the following year, while those engaging in less pro-environmental behavior than expected were more likely to report lower levels of problem-focused coping over time. Thus, the results showed a bidirectional relationship between problem-focused coping and pro-environmental behavior over time.

4.3.2.3 Regarding meaning-focused coping

In Study III, which examined the cross-lagged paths between meaning-focused coping and climate change distress as well as between meaning-focused coping and pro-environmental behavior, the results were inconsistent across the measurement points. The model assessing the links between climate change distress and meaning-focused coping identified only one significant, albeit minor, positive contemporaneous association between climate change distress and meaning-focused coping at time 3 (figure 6). The model assessing the constrained longitudinal structural relationships, shown in figure 7, did not identify significant longitudinal associations between climate change distress and meaning-focused coping. However, the unconstrained model, which provided a better fit, found a significant negative association between climate change distress at time 1 and meaning-focused coping at time 2 ($B = -.30$, $SE = .10$, $p < .01$). It also revealed a smaller negative link between meaning-focused coping at time 2 and climate change distress at time 3 ($B = -.14$, $SE = .06$, $p < .05$).

In addition, meaning-focused coping showed positive contemporaneous associations with pro-environmental behavior. Thus, when participants reported high levels of meaning-focused coping, they also tended to engage in pro-environmental behavior more often than usual at the same time. However, the results regarding the longitudinal associations were inconsistent across the different time points. The model assessing constrained longitudinal structural relationships (figure 7) estimated small positive reinforcing associations over time. However, the unconstrained model, which provided a better fit, did not find significant associations across all time points. In the unconstrained model, within-person variation in pro-environmental behavior at time 1 was not significantly associated with meaning-focused coping at time 2 ($B = -.06$, $SE = .06$, $p > .05$). However, between time 2 and time 3 the association became significantly positive ($B = .24$, $SE = .07$, $p < .001$). Conversely, meaning-focused coping at time 1 was positively linked to within-person fluctuations in pro-environmental behavior at

time 2 ($B = .20$, $SE = .05$, $p < .001$), but this relationship proved nonsignificant between time 2 and time 3 ($B = -.003$, $SE = .05$, $p > .05$).

However, a multigroup model used to detect any differences in the associations between climate change distress and pro-environmental behavior when participants engaged in a high level of meaning-focused coping was also estimated in Study III. The results showed qualitative differences between the high meaning-focused coping group and the groups with low to moderate levels of meaning-focused coping (figure 8). For the group with high meaning-focused coping, higher-than-expected levels of climate change distress were linked to an increase in pro-environmental behavior one year later. In contrast, for those with moderate to low levels of meaning-focused coping, the same association was negative. The effect of pro-environmental behavior on climate change distress over one year differed as well. For participants with a high level of meaning-focused coping, the relationship was nonsignificant, whereas for others it was positive. This finding indicates that engaging in pro-environmental behavior more than usual did not result in higher-than-expected climate change distress a year later for those who relied greatly on meaning-focused coping. Thus, meaning-focused coping acted as a protective factor, preventing pro-environmental actions from increasing distress in individuals who used this coping strategy extensively.

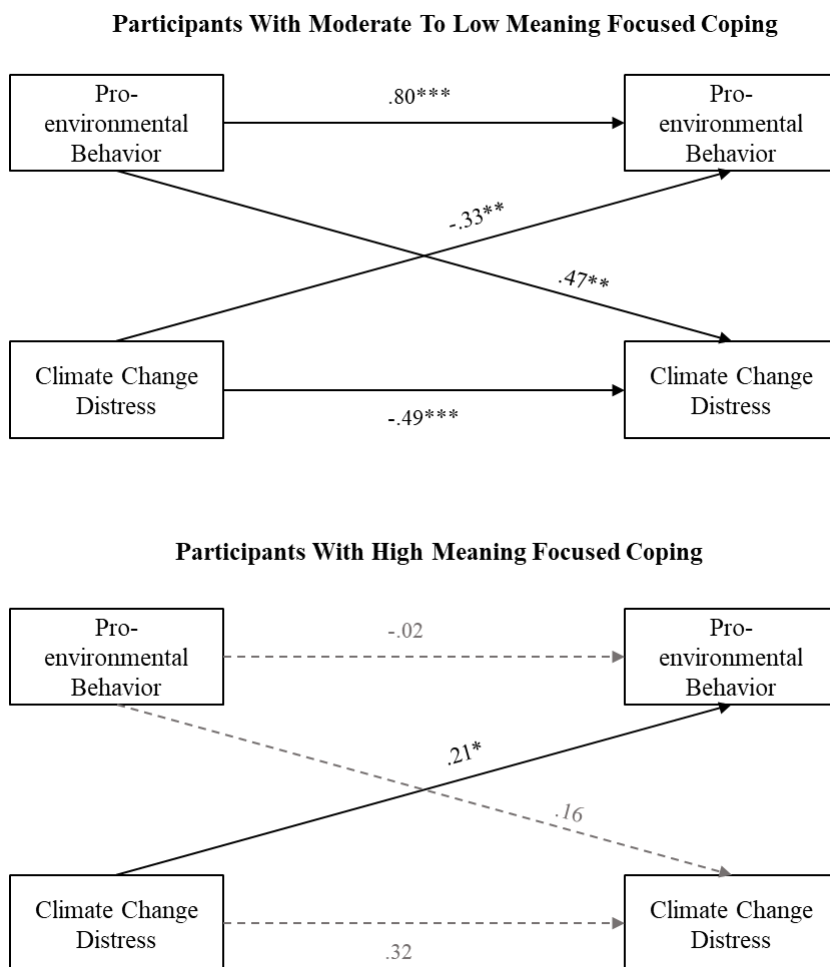


Figure 8 Study III: The regression coefficients and lay-over effects of climate change distress and pro-environmental behavior over one year at the within-person level, with high meaning-focused coping as a grouping variable; the regression coefficients are marked numerically in the figure: when the regression coefficients are not statistically significant, they are marked in the figure with a lighter color and dashed line, while statistically significant correlations are marked with solid lines and a darker color: * $p < .05$, ** $p < .01$, *** $p < .001$.

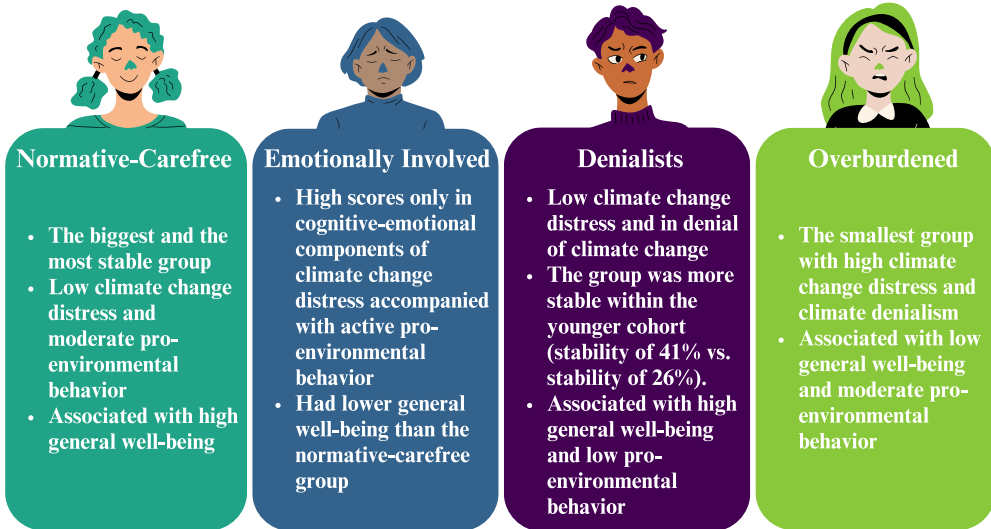
5 Discussion

The results of the original studies paint a comprehensive picture of climate change distress and its connection to different coping strategies, pro-environmental behavior, and general well-being among Finnish adolescents. The discussion chapter explores the findings (for a summary, see figure 9) in relation to the research questions, previous studies, and theoretical frameworks presented in the introduction. The chapter begins by discussing the multiple faces of climate change-related well-being and distress. Then, the chapter focuses on the nuanced relationship between climate distress and pro-environmental behavior. The third section highlights the role of coping strategies, emphasizing the importance of meaning-focused coping. The fourth section of the chapter offers a critical reflection on methodological considerations, followed by a discussion of the educational implications of the findings. The chapter ends with concluding remarks that summarize the dissertation's key insights. It argues that adolescents' climate change distress should be addressed not only as a psychological burden, but also as a complex and dynamic phenomenon that, in some forms, can be considered a natural reaction to a threat. When supported with adaptive coping strategies, it can fuel meaningful pro-environmental action.

STUDY I

- Three distinct profiles were identified:
 - Disengaged from Climate Change (44%): Did not report climate change-related emotional exhaustion or feelings of inadequacy, nor did they engage in pro-environmental behavior.
 - Climate-Anxious (42%): Reported feelings of inadequacy regarding climate change, engaged in moderate pro-environmental behavior, and exhibited little emotional exhaustion.
 - Overburdened by Climate Change (14%): Experienced the highest levels of climate change-related emotional exhaustion and feelings of inadequacy, and participated most actively in pro-environmental behavior.
- The overburdened group had the lowest self-esteem and reported the highest levels of depressive symptoms.

STUDY II



STUDY III

- Higher-than-expected pro-environmental behavior was associated with an increase in the expected level of climate change distress one year later.
- On the contrary, higher-than-expected climate change distress was associated with a decrease in expected level of pro-environmental behavior over time.
- A positive bidirectional relationship was found between pro-environmental behavior and problem-focused coping over time.
- For adolescents using high levels of meaning-focused coping, higher-than-expected climate change distress was linked to increased pro-environmental behavior, while the impact of behavior on distress was non-significant.

Figure 9 Summary of the key findings in Studies I–III.

5.1 The many faces of climate change-related well-being and distress

Images of passionate young climate activists holding protest signs dominate the news headlines about climate change. While media narratives seem to emphasize a rise in climate change distress among young people (for a discussion, see Pihkala, 2020), somewhat contradictory findings emerged from the original studies of this dissertation: While several respondents expressed a sense of climate change distress, the majority reported low levels of emotional exhaustion, feelings of inadequacy, or distress related to climate change. Thus, it can be posited that for many Finnish adolescents, climate change may not yet be significantly impacting their psychological well-being. Exposure to the environmental impacts of climate change is associated with greater climate change distress (Demski et al., 2017; Ogunbode et al., 2021; Reser et al., 2012; Spence et al., 2011), but Finnish adolescents generally do not encounter the severe impacts of climate change in their daily living environment that often. Therefore, the reality of climate change may not cause them so much personal distress. Another important aspect to consider is that the original studies included in this dissertation measured climate change distress among adolescents through both affective and cognitive responses to climate change. Previous empirical studies indicate that while a wide range of different affective responses to climate change are often reported, the affects do not necessarily translate into cognitive difficulties (Clayton & Crandon, 2024; Hepp et al., 2023). Moreover, the argument can be made that it is good that most Finnish adolescents are not experiencing climate change distress since it should not be their responsibility to carry the burden of climate change; rather, communal actions are required (for a discussion, see Hickman et al., 2021; Whitmarsh et al., 2021).

However, it could also be argued that experiences of climate change distress are an expected response for adolescents when confronting uncertainty about their future (Clayton, 2020). Moreover, certain factors related to climate change distress have proven more adaptive and practical than others (Chan et al., 2024; Clayton & Crandon, 2024; Hogg et al., 2024), a finding supported by the *emotionally involved* group in Study II. The adolescents in that group reported elevated levels of emotional-cognitive distress but a low frequency of behavioral impairments. In a way, they represented adaptive elements of distress, as belonging to the group was associated with higher pro-environmental behavior at both time points and their general wellbeing was somewhat better compared with the other identified group with elevated levels of climate change distress. This finding raises the question of whether certain elements of climate change distress are beneficial to the development of pro-environmental efficacy and mindsets, while others are

detrimental to them. Perhaps, if climate change distress remains at the cognitive-emotional level, it can be considered primarily as an adaptive response, but when it reaches behavioral impairments levels, then it takes more debilitating forms. This view is in line with previous research indicating that climate anxiety progresses from cognitive-emotional impairments to behavioral impairments, but not the other way around (Chan et al., 2024). Researchers, though, have also cautioned against dividing and subdividing the different dimensions of climate change-related distress overly much since the dimensions are usually strongly intercorrelated both within and across time (Hogg et al., 2024), which was also true in the original studies of this dissertation.

The other group exhibiting elevated levels of climate change distress in Study II demonstrated that it can also sometimes be accompanied by maladaptive aspects, such as denial. Indeed, this group, called the *overburdened* group, reported both elevated levels of climate change distress and denial. This finding shows that climate change distress and denial are not always at polar ends of the spectrum, cancelling each other out, but that they can co-exist among Finnish adolescents, which is in line with the results from earlier studies conducted among adults showing that some people can still feel distress about climate change even though they deny its existence (Haltinner et al., 2021). Thus, some people may attempt to deal with the overwhelming distress evoked by climate change by downplaying its root cause (Jylhä, 2016). This idea is similar to the role of cynicism in burnout: To protect oneself from emotional exhaustion, adolescents may begin to downplay climate change and become cynical about it (Parker & Salmela-aro, 2011). Another indication that climate change distress among adolescents was more debilitating and unconstructive for those in the *overburdened* group than in the *emotionally involved* group was that the former reported not only elevated emotional-cognitive distress levels but also behavioral impairments. They also exhibited a higher frequency of depression symptoms and lower life satisfaction and reported engaging in pro-environmental behavior only rarely.

In addition to concluding that climate change distress manifests itself in different patterns among Finnish adolescents, the original studies also demonstrated that their experiences of climate change distress were not stable over the course of a year. Study II showed that adolescents moved between the identified profiles over time. What is particularly noteworthy was the finding that a significant number of adolescents in the high climate change distress profiles transitioned to low climate change distress profiles over time, and vice versa. Moreover, Study III found that when an adolescent was experiencing increased climate change distress on one occasion, they often reported lower-than-expected climate change distress one year later. Thus, rather than thinking that climate change distress is just a personal trait of some adolescents, the climate change distress of all participants was ongoing and evolving and developing all the time. Also, a previous person-

oriented study found that Australian adolescents experienced various patterns of climate change-related worry throughout adolescence: roughly half of the adolescents they studied belonged to groups exhibiting persistently low or high levels of concern, while the other half belonged to groups exhibiting decreasing or increasing levels of concern (Sciberras & Fernando, 2022). However, the results from Study II suggest that age differences may have played a role, as the transition patterns of the older and younger age cohort were distinct. More studies are needed covering longer time spans in adolescents to discover whether such differences emerge at different developmental stages or whether the differences are rather between generations.

While the climate change distress of Finnish adolescents manifested in different forms that were not necessarily stable over time, a consistent association between climate change distress and general well-being emerged: Higher levels of climate change-related distress, emotional exhaustion, and feelings of inadequacy were linked to poorer general well-being. Aligning with previous findings from a study done among Canadian adolescents (Wu et al., 2023), Finnish adolescents who reported climate change impacts on their mental well-being also reported more depression symptoms, lower life satisfaction, and lower self-esteem. The findings were also consistent with previous cross-sectional studies done among adults (Boluda-Verdú et al., 2022; Gago et al., 2024). Thus, while distress can be considered a normal and at times adaptive response to the threats posed by climate change, the findings highlight that climate change distress does not occur in isolation but is interconnected with broader aspects of psychological well-being. Adolescents may simultaneously be navigating their way through other stressors, such as academic pressures or peer and family conflicts, leading to cumulative effects on their well-being (see Evans et al., 1996; Reser et al., 2012). However, research to date has not adequately examined the possible causal mechanisms or common factors underlying both climate change-related distress and other forms of psychological distress. Further longitudinal studies are needed to clarify whether climate change distress acts as a distinct contributor to adolescent well-being, or if it is a manifestation of broader vulnerabilities.

5.2 The complex relationship between climate change distress and pro-environmental behavior

The results of the original studies revealed a nuanced relationship between climate change distress and pro-environmental behavior among Finnish adolescents. Consistent with most previous cross-sectional studies (Bradley et al., 2014; Heeren et al., 2022, 2023; Hepp et al., 2023; Innocenti et al., 2023; Reser et al., 2014), climate change distress was positively correlated with pro-environmental behavior in all the original studies when studied at the contemporaneous level. Thus, Finnish adolescents who reported elevated climate change distress levels were also actively behaving pro-environmentally. In turn, Finnish adolescents who reported low levels of climate change distress also exhibited little pro-environmental behavior. One could interpret the findings in such a way that climate change distress promotes rather than hinders behavioral change. This proposition supports the perspective that climate change distress functions as an adaptive response—alerting individuals to a threat and motivating them to prepare accordingly (Clayton, 2020). Traditional models of pro-environmental behavior often downplay the role of emotions (Klas & Müller, 2012). However, the findings presented here highlight that emotional responses like climate change distress are closely linked to pro-environmental behavior and should be more fully integrated into such models.

While climate change distress and pro-environmental behavior were strongly positively correlated at the contemporaneous level, the longitudinal relationship examined in Study III proved more complex. The results showed that higher-than-expected climate change distress was associated with a decrease in the expected level of pro-environmental behavior one year later. Conversely, adolescents with lower-than-expected climate change distress engaged in pro-environmental behavior more than expected one year later. These longitudinal findings challenge the assumption that climate change distress always motivates people to engage in pro-environmental behavior. With respect to such findings, some scholars have suggested that moderate levels of climate change distress correspond to the most active engagement with issues related to climate change, while the associations become weaker as distress increases from moderate levels (Albrecht, 2011; Clayton, 2020; Clayton & Crandon, 2024), but this hypothesis of a curvilinear relationship has received limited empirical support (e.g., Becht et al., 2023; Hogg et al., 2024). However, the hypothesis and the empirical studies testing it focus on fluctuations in climate change distress and pro-environmental behavior at the sample level (on the group level). The findings from Study III suggest a need to shift the focus from group-level patterns alone by also accounting for changes within individuals. By paying attention to the within-person level, researchers can explore what happens

when adolescents' climate change distress increases or decreases from their own personal mean. If climate change distress increases from its normal level, then the simultaneous increase in demands may exceed their resources to regulate the distress and to channel it into action (Lazarus & Folkman, 1984). Thus, the overwhelming nature of the increase may weaken adolescents' motivation to engage in pro-environmental behaviors, while a drop in normal levels of distress may free up emotional and cognitive resources, thereby facilitating more proactive behaviors.

Just as scholars who devote too much of their attention to explaining and predicting pro-environmental behavior often dismiss the role of emotional responses, those scholars focusing primarily on climate change distress often assume that it explains pro-environmental behavior, and not the other way around (e.g., Becht et al., 2023; Hogg et al., 2024; Pavani et al., 2023). However, the findings from Study III showed that pro-environmental behavior can also influence distress levels. The findings are consistent with those from an earlier longitudinal study conducted among adults (Kühner et al., 2024). When adolescents behaved pro-environmentally more than usual on one occasion, they experienced higher-than-expected levels of climate change distress one year later. Hence, taking action appears to lead to more distress, which may be because pro-environmental behavior increases people's awareness of the severity of climate change, leading to an increase in climate change distress (Kühner et al., 2024). In addition, pro-environmental behavior is a highly individualized way of trying to deal with a problem that can only be solved at a collective level, and so perhaps it is not enough to diminish feelings of climate change distress (see Clarke, 2006; Heyman et al., 2010). Qualitative studies have shown that young people who engage in pro-environmental behavior experience many conflicts, for instance with friends and family, and that the conflicts are related to difficult emotions, such as frustration and guilt (Ojala, 2022). Although it is good that adolescents are engaging with climate action, they may need adult support so that such engagement does not increase their level of climate change distress (Sanson et al., 2018). Promoting adaptive coping strategies that sustain an adolescent's motivation to act without increasing their distress level could also be important (see Ojala, 2022).

5.3 Combining problem-focused coping with meaning-focused coping: The key to nurturing future active climate actors

In relation to the transactional theory of stress and coping by Lazarus and Folkman (1984), this dissertation emphasizes that adolescents' coping strategies are intertwined with their experiences of climate change distress and their engagement in pro-environmental actions. Adapting their framework, figure 10 illustrates the dynamic and continuous process between climate change distress, coping, and pro-environmental behavior based on the results of the original studies. The process begins with becoming aware of climate change and its urgency, which triggers a risk perception in an individual. If risk perception results in an assessment of the situation as a real threat, it is followed by an emotional response that accumulates, ultimately manifesting as climate change distress (Bradley et al., 2014). Following this progression, the individual moves on to assess what type of coping strategies to use to respond to the distress (Reser et al., 2012). As seen in Study II and Study III, de-emphasizing and denial as emotionally focused coping strategies do not promote pro-environmental behavior, and they might even hinder action. The strategies can create a feedback loop, reducing perceived risk and climate change distress but inhibiting engagement in addressing climate change. While de-emphasizing and denial are associated with lower levels of climate change distress for most adolescents, the coping strategies may still fail to hinder distress for some (the overburdened group in Study II).

In contrast, Study III found that problem-focused coping promoted pro-environmental behavior. This finding is consistent with previous cross-sectional research (Ojala, 2012a; Ojala & Bengtsson, 2019; Wullenkord & Ojala, 2023). The association is often interpreted as implying that problem-focused coping leads to pro-environmental behavior (e.g., Ojala, 2013; Reser et al., 2012). Yet, Study III adds nuance to the previous interpretation by demonstrating that the relationship was bidirectional. Thus, acting more pro-environmentally can also promote tendencies to use problem-focused coping strategies in later stress-evoking situations. However, problem-focused coping or pro-environmental behavior alone may not be enough to hinder climate change distress; instead, they may lead to an increase in distress, based on the findings presented in Study III. This paradox is understandable when viewed through the lens of the original theory: Problem-focused coping is considered an adaptive way of regulating emotions in controllable situations, making it possible for a person to modify the distressing event, but this type of coping mechanism is more problematic in uncontrollable situations (Lazarus, 1999). For stressors like societal problems, problem-focused coping, if used alone, can lead to an increase in distress (Clarke, 2006; Heyman et al., 2010).

This finding underscores the importance of meaning-focused coping, which, according to Folkman (2008), functions differently than emotion- or problem-focused strategies. The purpose of meaning-focused coping is not to hinder climate change distress but rather to promote positive emotions and a sense of meaning in combination with the distress. This response was noted in Study III, which did not find consistent direct longitudinal nor contemporaneous associations between climate change distress and meaning-focused coping. However, it did show that meaning-focused coping may moderate the longitudinal association between pro-environmental behavior and climate change distress. For adolescents with persistent high levels of meaning-focused coping, higher-than-expected pro-environmental behavior did not result in an increase in later climate change distress, as it did with adolescents ranging from low to moderate meaning-focused coping levels. This finding is critical, as some researchers suggest that acting pro-environmentally may increase people's awareness of how much needs to be done to tackle climate change, leading to an increase in climate change distress (Kühner et al., 2024). However, if adolescents are able to find broader meanings in their actions and trust in the process, it may buffer them from pro-environmental behavior leading to increased distress (see Ojala, 2012b, 2012a). Rather than directly eliminating climate change distress, it gives adolescents more resources to deal with the distress and supports them in sustaining more constructive coping strategies, and thereby also reducing a reliance on maladaptive coping (such as denial, withdrawal, or substance abuse) (Folkman, 2008). This finding was also evident in Study III: For those adolescents with high levels of meaning-focused coping, higher than expected climate change distress was associated with an increase in later pro-environmental behavior.

Study III found that the adolescents' strategies for coping with climate change remained stable over three years of data collection. Thus, unlike studies focusing on other stress-evoking situations (Eschenbeck et al., 2018; Vierhaus et al., 2007; Zimmer-Gembeck & Skinner, 2011), Study III did not discover an increase in problem-focused coping strategies or a decline in de-emphasizing. However, Study II showed that the *denialists* group (low climate change distress and elevated climate denial) was more stable among younger adolescents. From a developmental perspective, it makes sense that denial and de-emphasizing may be more prevalent in early adolescence, while problem-focused and meaning-focused coping strategies may become more prevalent as adolescents' cognitive abilities and complex thinking skills develop (see Ojala, 2012b). As adolescents grow, they become better at attending to and reflecting on their emotions. Thus, they also begin to incorporate more sophisticated coping strategies into their repertoire (Zimmer-Gembeck & Skinner, 2011). However, it is also plausible that some adolescents develop a rather limited set of climate change-related coping strategies in general. In a study done with Swedish adolescents, the researchers identified a

group of adolescents who reported employing hardly any climate change-related coping strategies while also reporting high degrees of pessimism and hopelessness concerning climate change (Rikner Martinsson & Ojala, 2024). Therefore, adults and educators can play an important role in helping adolescents develop strategies to cope with climate change. Adolescence is also a time when many maladaptive coping strategies may develop, such as using external regulators of distress (like drugs) and engaging in social withdrawal (Aldwin, 2010). There is an increased risk that adolescents will turn to those types of maladaptive coping strategies in situations that seemingly fall outside their control, such as climate change (Aldwin, 2010). This finding highlights the importance of helping adolescents adopt a robust set of adaptive coping strategies while preventing them from adopting maladaptive ones.

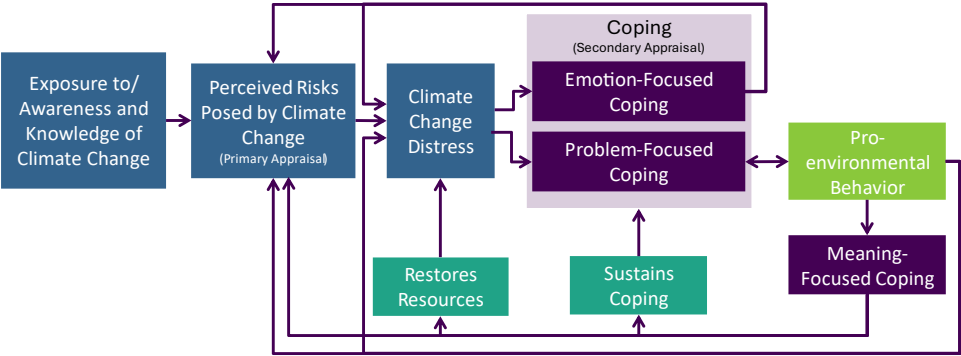


Figure 10 Illustration of the role of coping strategies in the relationship between climate change distress and pro-environmental behavior, adapted from the transactional theory on stress and coping.

5.4 Methodological reflections

This dissertation advances current understandings of adolescents' climate change-related well-being and the nuanced relationship between climate change distress and pro-environmental behavior and the role of coping strategies across different stages of adolescence. When this dissertation project began and the data collection process was being planned, research on climate-change-related psychological well-being was in its infancy. Although the field has since developed rapidly (e.g., Jarrett

et al., 2024; Ramadan et al., 2023), many research gaps remain. This dissertation addresses some of the gaps in the following four ways: 1) by demonstrating the need for more person-centered research, as adolescents react to climate change in different ways (Study I & Study II); 2) by moving beyond cross-sectional study settings to show that adolescents' experiences of climate change distress are not fixed and that the longitudinal relationship between climate change distress and pro-environmental behavior is complex (Study II & Study III); 3) by demonstrating the need to broaden the perspective from examining group-level changes to examining within-person level changes (Study III); and 4) by highlighting the need for conducting more studies among adolescents and throughout adolescence that explore the importance of age as a moderating factor (Study II).

In addition to the four empirical contributions, the dissertation aligns with open science practices. Honoring the principles of open science is particularly important with respect to research on climate change and mental well-being, where transparency, reproducibility, and accessibility can advance scientific progress and build public trust. Openly sharing research materials enables others to verify, replicate, and build upon existing findings, which are essential practices for developing cumulative knowledge and minimizing errors or biases. To promote transparency and support open science, all original articles have been published in open access form. The syntaxes and outputs of Studies II and III have been made publicly available via the Open Science Framework (OSF). Furthermore, Study III was pre-registered on the OSF before the data was accessed.

However, this dissertation also had some limitations that should be considered in future studies. First, some of the measurement tools need to be considered more carefully. As illustrated in the introduction, there is no consensus among researchers on how best to measure climate change distress, or even what constitutes it. Some researchers see it as a purely emotional response, while others see it as including cognitive and behavioral impairments (Clayton & Karazsia, 2020; Kurth & Pihkala, 2022). At the time of the data collection planning phase for Study I, no validated scales for measuring adolescents' climate change-related psychological well-being existed. Therefore, the measures for climate change-related emotional exhaustion and feelings of inadequacy were adopted from the School Burnout Inventory (Salmela-Aro & Näätänen, 2005) since it had been developed for use with adolescents. Later, the climate change distress scale was developed for Study II and Study III. It was based on the scale used in Study I and further developed by adapting elements from the CCAS (Clayton & Karazsia, 2020), which was originally developed for use with adults. In the process of developing the climate change distress scale, in-depth interviews were conducted with adolescents of different ages to ensure its relevance for the target group. Moreover, the reliability and structural validity of the scales were studied using Cronbach's alpha scores and confirmatory factor analysis prior to the main analysis in all original

studies. Since collecting the data for the original studies, many potential scales have been developed and validated to capture how climate change awareness is manifested in psychological well-being (e.g., Hepp et al., 2023; Hogg et al., 2021). Due to the many ways to measure climate change-related distress today, researchers must always be critical when comparing the results of previous studies with the findings of this dissertation.

Second, the original studies measured pro-environmental behavior using limited sets of items. Moreover, since the data collection process for Study II and Study III began when the youngest participants were 11 years old, the measurements used in Study II and Study III focused on actions that can be considered examples of low-impact behavior (e.g., recycling) because those were the type of actions that were relevant for younger adolescents as well. However, it would be important to study a broader range of different acts and include measurements of high-impact and community-level acts (e.g., switching to a sustainable diet or volunteering with an environmental nonprofit organization) since the associations between climate change distress and different types of pro-environmental behavior may differ (e.g., Becht et al., 2023; Prinzing et al., 2024).

Third, there is a need to further develop the way in which coping strategies are measured. In this dissertation, emotion-focused coping strategies were studied via the dimensions of de-emphasizing and denial. While both are important constructs, they may not capture the full spectrum of emotion-focused strategies employed by adolescents. For example, social support seeking or rumination may be important emotion-focused coping strategies that adolescents use to regulate their climate change distress, but, like de-emphasizing and denial, such strategies may not necessarily hinder pro-environmental behavior (for a discussion of social support, see Nieminen et al., 2025; on rumination, see Hogg et al., 2024). The results from this dissertation suggest that the process of moving between climate change distress, various coping strategies, and pro-environmental behavior is dynamic and continuous. Moreover, climate change itself is a multifaceted stressor that not only causes environmental problems but is also intertwined with economic, political, and social systems (Reser et al., 2012). Therefore, there is a need for more research on how adolescents use different coping strategies to deal with different climate change-related stressors (e.g., direct exposure to climate change, political frustration, or learning about climate change). Understanding these situational coping dynamics would provide critical insights for improving climate education, particularly in finding fruitful moments to foster constructive coping strategies among adolescents. This type of research could benefit from momentary assessment methods (e.g., ecological momentary assessment) that capture how coping unfolds in real time and across different contexts.

One advantage of this dissertation is that it sheds light on the longitudinal relationships between climate change distress, pro-environmental behavior, and

coping. However, scholars should not interpret the results as indicating causal relationships between them precisely because causal relationships in the social and human sciences are complex (Janson, 1981). For instance, the RI-CLPM model (employed in Study III) has been criticized for biasing the reciprocal effects of cross-lagged paths, as it does not account for unobserved time-varying confounders (Lüdtke & Robitzsch, 2021). In Study III, some time-varying confounders were controlled for by using factor scores estimated based on a longitudinal CFA-model with all five study variables.

However, the longer the time gap between the measurement points, the more significant the unobserved time-varying confounders (Lüdtke & Robitzsch, 2021). In both longitudinal studies (Study II and Study III), datasets were collected annually. A year is a significant amount of time in the life of adolescents, who are in a developmental stage characterized by rapid maturation (Galambos et al., 2003). Moreover, as the results show, adolescents' levels of climate change distress can fluctuate greatly within one year. This finding raises many questions: Do changes in levels of climate change distress vary according to months, weeks, or even days? Will the levels of climate change distress become more stable when adolescents reach adulthood? What kinds of situations or physical places trigger feelings of distress? Thus, more longitudinal research is needed with shorter time intervals between measurement points, as well as research capturing the transition from adolescence to early adulthood. To better understand the situational fluctuation and spatial nature of adolescents' climate change distress, research methods like geographically explicit ecological momentary assessments could prove beneficial (Kirchner & Shiffman, 2016). Employing such research methodologies would enhance current understandings of individual differences in different situations.

Finally, it is important to acknowledge the positionality of the researcher within the study. As the author is a native Finn conducting research on the well-being of Finnish adolescents in relation to climate change, it is important to acknowledge Finland's status as a WEIRD (Western, Educated, Industrialized, Rich, and Democratic) country. The actions of WEIRD countries have had a great impact on climate change, while they are not the ones suffering the most from the severe consequences of climate change (see Coffey et al., 2021). Therefore, the results of this research cannot be extrapolated and applied to adolescents worldwide, as cultural contexts may vary considerably. Thus, while the findings from the studies of Finnish adolescents are valuable, they must be interpreted within the specific cultural and societal context of Finland.

5.5 Practical implications for educators

One of the main reasons for adopting a person-centered approach in this dissertation was the recognition that adolescents respond to climate change in diverse and often contrasting ways. While some may be extremely distressed about climate change, others may be disengaged or even deny the existence of climate change (Ojala, 2021). Study I and Study II demonstrated that adolescents are not a homogeneous group, and they react to climate change in different ways. Thus, educators should also recognize that climate change distress manifests differently among adolescents, and therefore, they may need different types of approaches and tools when discussing climate change in the classroom. Some adolescents might benefit from more information-led teaching (facts about climate change and how to practice pro-environmental behavior), while others may need a safe space in which to share their climate change-related emotions. Importantly, it is crucial to not to pathologize adolescents' climate change distress, as it is primarily a natural reaction to a threat (Clayton & Crandon, 2024), and adolescents have every right to feel all types of emotions toward it (Sanson et al., 2018). However, climate change distress may sometimes take debilitating forms, as seen in the group of *overburdened* adolescents in Study II.

Yet rather than focusing on treating adolescents' climate change-related ill-being, it could be more efficient to pay attention to the development of constructive coping strategies (see Ojala, 2012b). One constructive approach might be to find ways to help adolescents face their difficult emotions rather than encouraging them to suppress them by, for example, focusing on other problems, as is the case with those who cope by de-emphasizing their emotions (Ojala, 2022; Sanson et al., 2022). Moreover, adolescents who deny climate change but still experience high levels of climate change distress may be particularly in need of support in developing healthy and constructive ways to cope with climate change, especially since those adolescents also reported lower levels of overall well-being in Study II. The adults in adolescents' lives play a large role in whether they develop constructive coping strategies, as adolescents' social environment influences their appraisals of distressing situations and their choice of coping strategies (Aldwin, 2010). For example, adolescents who feel that adults take their negative emotions about societal issues seriously tend to employ more constructive coping strategies (Ojala & Bengtsson, 2019).

What about the question of how to encourage adolescents to engage more in pro-environmental behavior? Study III showed that encouraging and teaching adolescents to behave pro-environmentally may promote their tendency to rely on problem-focused coping. This result, in turn, could lead them to engage even more in pro-environmental behavior. The finding is crucial because pro-environmental habits formed during adolescence often carry over into adulthood (Prentice et al., 2024; Riemer et al., 2014). School is an optimal environment for adolescents to practice pro-environmental behaviors under the guidance of teachers. Schools, as a

type of micro-community, offer opportunities for students to engage in low-threshold environmental actions, such as participating in student union initiatives or school-wide sustainability efforts (Chawla & Derr, 2012; Hart et al., 2014). These collective efforts can enhance students' self-efficacy and self-perceived competence—key factors in long-term intentions to take environmental action (see Barnett et al., 2011; Crichton et al., 2024; Torsdottir et al., 2024).

However, while promoting problem-focused coping may serve as a concrete way for adolescents to face their emotions and turn them into a motivating force, it may not be enough to sustain motivation to act in the long run, as Study III found a negative cycle between problem-focused coping and climate change distress over time. Thus, it is important to promote meaning-focused coping along with problem-focused coping, as it can serve as a buffer against negative emotions while motivating adolescents to take action (Ojala, 2012b). Meaning-focused coping in the context of climate change entails sustaining a sense of hope and trust in the community (Ojala, 2012b, 2013). To help adolescents sustain a sense of meaning and hope, teachers need to provide them with concrete examples. For example, teachers could invite different actors into the classroom who, despite facing difficulties, are working to combat climate change (Ojala, 2012a). Furthermore, Ojala (2012a) has suggested that to foster key elements of meaning-focused coping, teachers could help young people to practice complex thinking and perspective-taking skills—competencies that Finnish adolescents also recognize as vital for addressing climate change (Taurinen et al., 2024). Promoting complex thinking and perspective-taking skills may be good not only for adolescents' meaning-focused coping, but also for the adaptive combination of meaning-focused and problem-focused coping, which sustains the motivation to act without increasing distress. One concrete method for nurturing this type of integration is through utopia scenario-building in the classroom (Hall, 2015). In this exercise, students imagine different hopeful futures and the paths to achieve them. Research suggests that adolescents who can see how climate change concerns both current and future generations and who engage in future scenario thinking are more likely to use both problem-focused and meaning-focused coping (Syropoulos et al., 2024; see also Richter et al., 2023).

5.6 Concluding remarks

This dissertation offers insights into the psychological dimensions of climate change among Finnish adolescents, revealing that their experiences of climate change distress, coping strategies, and pro-environmental behaviors are complex, fluctuating, and interconnected. Furthermore, the dissertation emphasizes that

adolescents' climate change distress is neither pathological nor static, but rather a natural and dynamic response to the threat of climate change. Depending on how it is managed, this distress can hinder or empower them to take action. Hence, the dissertation calls for a shift from reactive to proactive approaches: from treating adolescents' climate change distress as a problem to recognizing it as a signal that, when constructively navigated, can lead to meaningful and empowered actions.

Moreover, a central contribution of this dissertation is the recognition that experiencing intense climate change distress and being an active climate actor are not necessarily opposing positions. Sometimes, climate change distress—especially when accompanied by a combination of meaning-focused and problem-focused coping—can be a catalyst for constructive and sustained pro-environmental behavior. However, adolescents may also respond to climate change distress by using maladaptive coping strategies, such as denial and de-emphasizing. These maladaptive coping strategies hinder pro-environmental behavior but are not always enough to stifle distress or promote overall well-being.

The overall mental well-being of adolescents has been a major public concern in recent years, along with adolescents' increased worries regarding climate change. While there is a need to be concerned about such trends, perhaps it would also be important to shift attention from adolescents' ill-being a bit more toward the tools they use to cope with different stressors. Parents, educators, and other adult figures may potentially play a crucial role in what kinds of coping strategies adolescents develop. In the current era of environmental crisis, it is more important than ever to acknowledge and support adolescents—not only in terms of their well-being but also in terms of their capacity for agency. Young people do not need to be passive, powerless victims of the impacts of climate change; they can be active interpreters and potential drivers of collective change if adults just enable and empower them to do so. Providing adolescents with the tools to cope, reflect, and act within supportive educational and societal structures is essential for fostering both individual well-being and collective climate resilience. However, the findings also showed that adolescents do not react to climate change in homogeneous ways. Therefore, there is most likely no tool that fits all adolescents. Different groups of adolescents may benefit from different types of tools to help them handle climate change and the uncertainties it causes.

Finally, while the research on climate change distress, coping, and pro-environmental behavior is rapidly increasing, there are still a lack of longitudinal studies especially on adolescents. This dissertation demonstrates that an over-reliance on cross-sectional studies may distort understandings of the links between climate change distress, coping, and pro-environmental behavior. The longitudinal findings of this dissertation further emphasize the importance of taking a developmental perspective: adolescents' levels of distress and behavioral responses to climate change vary over time, suggesting the need for longitudinal, age-

sensitive, and person-centered approaches in both further research and interventions.

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Appendices

Appendix 1. Cronbach's Alpha Scores, Means, and Standard Deviations of All Study Variables

Table s1. Cronbach's Alpha Scores, Means and Standard Deviations of All Study Variables

Variable	Study I		Study II				Study III						Scale Range
	α	Mean (SD)	α		Mean (SD)		α			Mean (SD)			
			T1	T2	T1	T2	T1	T2	T3	T1	T2	T3	
Climate Change Distress													
Emotional Exhaustion	.76	2.18 (1.09)											1-6
Inadequacy	.78	3.06 (1.33)											1-6
Cognitive-Emotional			.90	.91	2.37 (1.25)	2.36 (1.27)	.89	.90	.91	2.28 (1.09)	2.14 (1.10)	2.09 (1.11)	1-6
Behavioral Impairments			.87	.90	1.54 (.96)	1.57 (1.03)							1-6
Pro-environmental Behavior	.80	2.69 (1.07)	.73	.74	3.66 (.72)	3.64 (.72)	.72	.68	.73	2.57 (.88)	2.46 (.84)	2.45 (.87)	1-5
Coping Strategies													
Climate Denial			.85	.87	1.72 (.94)	1.64 (.93)							1-5
Problem-focused Coping							.79	.78	.81	2.42 (.87)	2.28 (.90)	2.21 (.91)	1-5
De-emphasizing							.73	.75	.73	2.04 (.72)	2.14 (.81)	2.14 (.87)	1-5
Meaning-focused Coping							.73	.82	.86	3.12 (.70)	3.19 (.71)	3.28 (.70)	1-5
General Well-being													
Depression Symptoms	.87	1.20 (.76)	.93	.93	1.71 (.72)	1.79 (.74)							1-4
Self-esteem	.83	4.37 (1.33)											1-7
Life Satisfaction			.87	.87	4.94 (1.50)	4.75 (1.47)							1-7

Note. α = Cronbach's Alpha; SD = Standard Deviation; T1 = Time 1; T2 = Time 2; T3 = Time 3

Appendix 2. Climate Change Distress Measurement Scale (Study II and Study III)

In English:

Instruction: Now think about climate change and matters related to it. How true are the following statements for you?

1. Thinking about climate change makes it difficult for me to concentrate.
2. Thinking about climate change makes it difficult for me to sleep.
3. I brood over matters related to climate change a lot.
4. I have feelings of inadequacy because of climate change.
5. I feel guilty if I'm not acting against climate change.
6. My concerns about climate change make it hard for me to have fun with my family or friends.
7. My concerns about climate change interfere with my ability to get school assignments done.
8. My friends say I think about climate change too much.

Scale: 1 (Not at all true) – 6 (Completely true)

In Finnish:

Ohjeistus: Mieti seuraavia ilmastonmuutokseen liittyviä väittämiä. Kuinka hyvin ne pitävät paikkansa sinun kohdallasi?

1. Ilmastonmuutoksen ajatteleminen vaikeuttaa keskittymistäni.
2. Ilmastonmuutoksen ajatteleminen vaikeuttaa nukkumistani.
3. Murehdin paljon ympäristöasioita.
4. Minulla on usein ilmastonmuutokseen liittyviä riittämättömyyden tunteita.
5. Tunnen syyllisyyttä, jos en toimi ilmastonmuutoksen eteen.
6. Huoleni ilmastonmuutoksesta tekee hauskanpidon perheen tai ystävien kanssa vaikeaksi minulle.
7. Huoleni ilmastonmuutoksesta haittaa kykyäni saada kouluun liittyvät tehtävät tehtyä.
8. Ystäväni sanovat, että ajattelen ilmastonmuutosta liikaa.

Asteikko: 1 (Täysin eri mieltä) – 6 (Täysin samaa mieltä)

Items 1–5: Cognitive-Emotional

Items 6–8: Behavioral impairments (only in Study II)