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A 'greenhouse affect'? Exploring young Australians' emotional responses to climate change

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Abstract
Recent studies reveal that young people are experiencing a range of emotions relating to climate change, including anxiety, anger and a sense of powerlessness. Young people have also voiced distrust in governments for failing to adequately address climate change, which they see as a critical threat to their future. However, there is limited research considering the interplay between young people's emotions about climate change and the broader social context in which they live; social-ecological theory can assist in identifying important systemic factors influencing emotional responses to climate change. In this qualitative research project, I drew upon a social-ecological theoretical framework to explore the affective dimensions of climate change as experienced by young Australians aged 18–24 ($N=14$). A primary, overarching finding was of climate change as a multidimensional emotional challenge for young people, with four sub-themes that describe key experiences through which it manifests: a fragmented climate education; disillusionment with politics, but hope for change; reckoning with uncertain futures; and grappling with agency. The findings contribute to the growing literature on climate-related emotions, highlighting experiences of interrelated emotions that resist being reduced to one label (e.g., 'eco-anxiety'). Accordingly, I discuss a 'greenhouse affect' to convey the affective quandary provoked by climate change, expanding upon established anxiety-centred concepts. I also discuss implications for educating young Australians about climate change, and how this might improve their sense of agency to meaningfully contribute to climate solutions.

Keywords Climate change · Emotion · Anxiety · Affect · Young people · Education

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1 Introduction

Climate change poses ever-growing risks across social, environmental and economic systems, as well as to physical and mental health of individuals (IPCC, 2022). The impacts of climate change are beginning to be felt around the globe, but the myriad ways in which people's lives will be affected are yet to fully unfold. Contemplating this situation can be deeply unsettling, and in recent years, scholarly attention has turned to associated questions of how people are responding to the climate crisis in an emotional, affective sense. While there are a variety of contrasting theories of affect and emotion residing in different academic disciplines, we can broadly conceive of emotions and feelings as 'affective responses to external stimuli or the imagination' (Reyes et al. 2021; p.1). Diverse disciplinary perspectives, including from social psychology and human geography, have been applied to understanding the affective dimensions of climate change (see Ojala et al. 2021; and Reyes et al. 2021; for examples). Broadly, the literatures indicate that people are experiencing significant levels of distress due to climate change and society's failure to adequately address it. Climate distress, which commonly comprises feelings of worry, grief, anger and despair, is considered a rational response to a serious threat (Verplanken and Roy 2013; Hickman et al. 2021; Lawrance et al. 2022a). Understanding these affective dimensions of climate change is critical given that emotions can influence people in multiple ways – for example, regarding support for climate policy (Wang et al. 2018), undertaking pro-environmental behaviours (Ogunbode et al. 2022), and participating in climate action (Stanley et al. 2021).

Research in the social psychology discipline has begun to shift focus from examining direct psychological impacts caused by extreme weather events, to the indirect impacts related to knowledge of climate change as a broad phenomenon (Pihkala 2020). In this literature, emotional responses to climate change are commonly defined in ways that centre on individual experiences of anxiety. This has led to the introduction of new terms and standardised measures to describe and assess such experiences, including instruments to evaluate 'eco-anxiety' (Hogg et al. 2021) and 'climate anxiety' (Clayton and Karazsia 2020). The use of said instruments in empirical studies is primarily intended to develop an understanding of the nature and prevalence of distressing climate emotions. Despite the efforts to define and measure such experiences, Coffey et al. (2021) found that there is a suite of terms describing similar experiences - such as 'eco-anger', 'climate grief', and the place-based concept of 'solastalgia' (Albrecht 2005) - and some of these are used interchangeably in the literature. The lack of clarity around many of these terms has led to the proposal of an initial taxonomy to help elucidate the array of climate-related emotions (Pihkala 2022). Definitional challenges aside, terms such as eco-anxiety and climate anxiety appear to have resonated outside of academia; they are being increasingly reported in media outlets to describe people's climate distress (e.g., Gregory 2021; Sarner 2022), suggesting a broader societal relevance.

Human geographers and political ecologists have also examined the role of emotions and affect towards environmental issues, and sought to place them into social context (Pile 2010). Literature in this field emphasises the relational aspects between people and nature, as well as interrogating issues of power, politics and conflict (Sultana 2015). In this literature, emotions are conceptualised as both subjective and social experiences; they can also present generative opportunities for shaping social and political action against environmental harm (Head, 2016). Indeed, Nightingale et al. (2022) highlight the need to understand

these experiences of climate in order to effect transformative change, positioning it as a critical component in grappling with an uncertain, climate-altered future.

These bodies of work from diverse disciplinary perspectives can be broadly understood as dealing with the ways that people feel about environmental problems such as climate change. For young people coming of age in a time of climate-altered futures, these issues are particularly acute: not only are they disproportionately burdened by the impacts of greenhouse gases emitted even before they were born, but they will also bear much responsibility for enacting society's climate mitigation and adaptation agenda in coming decades. This daunting prospect is exacerbated for young people who feel they currently lack political power and agency to effect change, and who are disheartened with societal and governmental responses to date. Thus, how young people think and feel about climate change may have important ramifications for how society adapts to an altered environment in coming decades. The following section considers the significance of climate distress for young people, and important contextual factors in its development as the conceptual grounding for the qualitative exploration of young people's climate emotions.

1.1 Climate distress in young people

Young people are particularly vulnerable to the psychological impacts of climate change (Clayton et al. 2017), and are also reporting higher levels of climate anxiety than older people (Heeren et al. 2022). The relationship between individually experienced emotions and the real-world context in which they manifest is particularly compounded in young adulthood, a significant developmental phase in which individuals continue to develop worldviews and relate to the challenges of the larger world (see Corner et al., 2015, for discussion). According to Ecological Systems Theory (Bronfenbrenner, 1979) a person's development is profoundly influenced by the individual's social environment. The theory proposes a nested set of 'systems' that affect young people's social, emotional and cognitive development to varying degrees. Crandon et al. (2022) utilised this theory to create a social-ecological framework describing systemic factors influencing development of climate anxiety in young people. The authors describe the factors at play, which begin with the immediate 'micro' system (family, peers) and move through more distal influences: 'meso' (community, school, local environment); 'exo' (media, government); and 'macro' systems (culture). In other words, if we accept that a person's emotional and cognitive responses to climate change are not arrived at spontaneously, but are influenced by family relationships, education, media, and government policies, then exploring these factors may provide insight into how climate distress develops.

A recent review (Ma et al. 2022) found limited research examining how systemic factors may influence development of climate distress in young people. Examples of published studies include work by Jones and Davison (2021), in which the authors investigated the emotional significance of climate education experiences among participants aged 18–24 in Tasmania, Australia. Here, the authors identified three major themes connecting experiences of education, emotion and climate change: 'stripped of power'; 'stranded by the generational gap'; and 'daunted by the future'. Another important study (Hickman et al. 2021) was the first to demonstrate that young people's climate distress was greater when coupled with perceptions of deficient governmental climate responses, which led to feelings of betrayal.

Findings such as these underscore the need to apprehend emotions not merely as individualised experiences, but as reflections of the world in which they exist.

Given the implications for young people's mental health from sustained climate distress, there are urgent calls for further research to improve the state of knowledge on these matters (Wu et al. 2020; Hickman et al. 2021). The present paper contributes to furthering the current understanding in several ways. Firstly, the study responds to an identified need to improve our understanding of distressing climate-related emotions in young people (Lawrance et al. 2022b). Secondly, it responds to calls for these emotional experiences to be placed into social context, so that contributing factors may be better understood (Crandon et al. 2022). Thirdly, it utilises a qualitative approach to generate nuanced insights into the experiences of young people - an approach identified as largely absent in current research (Ma et al. 2022). Understanding these matters is critical to supporting young people whose futures are disproportionately burdened by climate change.

2 Research design, methodology and methods

In this study, I ask the question: 'In the context of societal efforts to address climate change, what are the implications of young Australians' emotional responses to climate change for how they perceive the future?' The question is explored through several key themes, including:

– How societal influences might shape participants' understanding of climate change.
– Participants' emotional experiences related to that understanding.
– Levels of trust in the Australian government to act on climate change.
– Perceived agency to influence the climate response, through voting or by other means.

An objective of this study was to ascertain whether and how these themes are connected in the experience of young Australians; and further, to develop a nuanced account of how emotional responses to climate change are interwoven with the lived experiences of young people, and particularly their expectations for their future.

Given the exploratory nature of the research question above, I employed an interpretivist methodology which focuses on understanding participants' lived experiences within their social contexts, and the subjective meaning that they make from these experiences (Creswell 2007; Usher and Jackson 2014). An important contextual factor at the time of the study was the 2022 Australian Federal election[1], which helped to increase the salience of questions related to government and politics. I recruited participants aged 18–24, in line with the World Health Organisation's definition of 'young people' (WHO, 2022), using a social media platform to advertise the study[2]. Twitter and Facebook were used to share informa-

[1] The federal election on 21 May 2022 saw the former opposition Australian Labor Party (centrist/centre-left) gain government from the incumbent Coalition (centre-right/right) of Liberal and National parties.

[2] Initially I sought to recruit participants aged 18–20, so that they would be 'first time voters' in the 2022 federal election). Despite extensive recruitment efforts including delivering presentations at vocational colleges, and distributing recruitment leaflets with QR codes linking to study information, ultimately recruitment of this initially targeted sample was unsuccessful. This may have been due to the very small number of students present in person, given the shift to online learning prompted by COVID. This led to the expansion of the age range to 18–24, and the use of social media and snowballing for recruitment.

tion and recruitment links through the online networks of colleagues. Initial recruitment was supported by snowballing and attracted participants from multiple jurisdictions for a remote interview: Australian Capital Territory (n = 5), New South Wales (n = 3), Queensland (n = 1), South Australia (n = 2) and Victoria (n = 3). As gender was not, a priori, a salient conceptual theme for the research, I did not require participants to disclose their gender identification. The final participant group (n = 14) was arrived at through an iterative process of evaluating the data collected for richness, depth, and ability to identify clear themes (e.g., Gunasiri et al. 2022). Participants were given a $20 online gift voucher as an expression of appreciation for their time.

Rather than using firm pre-determined questions, I used semi-structured interviews to encourage a more free-flowing interaction that allowed for follow-up questions (Yin 2015). An interview protocol (Table 1) was developed and reviewed by two academic colleagues, and used to guide the conversations. My questions were asked in a manner that allowed participants to identify significant factors for themselves (e.g., broad educational influences); these were then followed up with more specific questions (e.g., specific school experiences). Interviews ranged in length from 24 min to 65 min and were conducted over Zoom to facilitate participation from different Australian jurisdictions. Participant responses were audio recorded and transcribed, and supplemented by notes recording significant affective cues that could be lost during transcription (for example, using a sarcastic tone of voice).

I analysed the interview data by listening to each interview in full before commencing coding of transcripts using NVivo12. Following Helm et al. (2021), I devised various deductive codes based on the project's objectives (e.g., 'emotional responses') and added

Table 1 Areas of research focus and key questions

Research Focus	Indicative Interview Questions
• Influences on knowledge/awareness	• How have you come to your understanding of climate change? • *Follow-up: Were there other influences that affected how you view climate change?*
• Emotional response	• How often do you think about climate change? How does it make you feel? • *Follow-up: Can you describe what sorts of feelings they are, or what they focus on?* • How do these feelings affect your view about the future?
• Perspectives on government and trust	• Who is most responsible for acting on climate change, and what should they do? • *Follow-up: Do you feel the government has a role to play?* • How much trust do you have in the Australian government to act on climate change? Why?
• Perspectives on voting and agency	• How important an issue is climate change to your vote? Why/why not? • How does being able to vote make you feel about your power to influence issues that are important to you? • What other ways do you see to meaningfully influence the climate change issue?

inductive codes as I identified these themes in the transcripts (e.g., 'ways to cope'). My aim was to generate inductive insights linking emotional experiences of climate change in the context of different systemic influences, and reveal any patterns, similarities or differences in experiences between participants. I was also interested in participants' engagement with complexity and contradictions in their responses, and later reviewed coded content in all nodes to challenge, verify, extend and complement the insights I had developed thus far. Through this process, I was able to engage with the content theme-by-theme, after having done so participant-by-participant. While taking this perspective, I re-evaluated the themes that I felt best represented the breadth and depth of perspectives shared by participants. This resulted in five top-level themes (explored below in Findings) that cut across and incorporated a range of codes.

3 Findings

The interviews yielded five key themes regarding the emotional dimensions of climate change as expressed by a group of young Australians, most of whom had completed – or were currently enrolled in – tertiary education. A primary, overarching theme was of climate change as an emotional challenge for young people, with four sub-themes describing key experiences through which it manifests: a fragmented climate education; disillusionment with politics, but hope for change; reckoning with uncertain futures; and grappling with agency. Each is discussed in turn in the following sections, with illustrative quotes.

3.1 Climate change as an emotional challenge

Perhaps the most important overarching finding is that climate change poses complex challenges for these young Australians in an affective sense. Climate change presents a series of dilemmas, tensions and contradictions that young people must work through, provoking emotional responses that are interwoven in many aspects of their lives.

Rather than reporting one specific emotion, participants articulated multiple co-existing emotions related to climate change. In answer to the question, 'how does your understanding of climate change make you feel?', the most common responses were worry, hopelessness, sadness, and frustration. Participants also commonly expressed anger, overwhelm, depression and guilt. At times, several of these emotions fused together in an intense and profound way:

> *We're pretty much a plague on Earth, human beings, you know. We've sort of been destroying it from the start and it's showing us signs that we're destroying it and we're not listening.*
> *(Young person, age 20).*

Feelings of worry took different forms, relating to specific issues, such as climate-induced species extinctions, but also manifesting as a generalised undercurrent of uneasiness about the future, for example:

I guess… I just sort of accept that bad things are gonna happen.
(Young person, age 24).

At the same time, there was a clear sense that these young people do not want to give in to the negativity, and actively seek ways to cope with their emotions. Coping mechanisms included processing climate distress verbally with friends; taking practical pro-environmental actions, such as a beach clean-up; and periodically disengaging from news about climate change. Several participants expressed negativity alongside a determined optimism:

I feel a little bit grim about the outlook, but I think… you can't drop all the tools and give up, […] you need an optimistic positive approach, you have to believe there is a way.
(Young person, age 23).

The need to process negative emotions about climate change while maintaining hope that society will pull together to avert the crisis constitutes an emotional dilemma. This dilemma is one of a series facing this study's participants in relation to climate change: contradictions are encountered in many aspects of their lives, from educational experiences to engaging with politics. The following sections describe how the emotional challenge of climate change is woven into the different life experiences of these young Australians.

3.2 A fragmented climate education

Learning has long been acknowledged as a process comprising both reason and emotion (see Jones and Davison 2021; for discussion). For most of these participants, learning about climate change occurred chiefly through traditional and social media, with limited contributions from formal schooling. Despite all having completed over a decade of formal schooling, most participants identified media as the primary way they learned about climate change. Several mentioned that media informed their understanding of Australia's climate policy positions, particularly the tumultuous period known as the 'climate wars', which played out during the last decade (see Crowley 2013; 2017; 2021) - years in which young people were first engaging with climate issues.

In terms of formal schooling, most participants regarded their education on climate change as inadequate. Specifically, they reported that climate change was covered in a fragmented manner across primary and high school years, or that it was largely absent from their education. Given the implications of climate change for society, some participants were perplexed at this disjointed approach:

I don't think it was touched on much because we weren't assessed on it […] that's kind of strange when you consider how big of an issue that it actually is.
(Young person, age 20).

Where lessons did cover climate change, several participants recalled that these largely focused on the mechanics of atmospheric warming and its consequences, with little discussion of how society could address the problem or options for adaptation, which instigated feelings of helplessness. Further, several participants reported feeling saddened or depressed

following these lessons, but lacked avenues for expressing or processing those feelings once the lesson was finished. The following quote captures one participant's experience of learning about climate change and its emotional impact:

> *{As the teacher} 'this is what climate change is, the polar bears will die and islands are drowning. We need to stop emissions'… but then you understand like, emissions aren't going to stop and you're like, OK, so we're doomed…[…] I think leaving people in that place is probably an issue.*
> *(Young person, age 20).*

The common perception of an inadequate education about a critical topic led these young people to acquire information from other sources. Participants reported supplementing their understanding of climate change via social media channels, which they acknowledged as sometimes confronting, and potentially misleading, sources of information:

> *I'm so passionate about the environment and climate change but I don't know everything, and I want to be able to know what more can I do, instead of just… going through this loophole of social media and getting fed this false information.*
> *(Young person, age 21).*

In the absence of a comprehensive climate curriculum (see Whitehouse and Larri 2019), the ubiquity of social media provides an accessible proxy for this generation seeking to understand the issues. Several participants also provided recommendations for improving climate education in Australia, and identified a need to address the general emotional impact of learning about climate change regardless of source:

> *I think also being taught […] about how to disengage from these kinds of issues is really important to teach the next generation of people […] Otherwise you just get depressed and can't function.*
> *(Young person, age 20).*

The paradox described here, of recognising an issue as critical for society but scarcely learning about it at school, provoked feelings of confusion and disempowerment – a situation that some participants believe needs to be acknowledged and addressed in the Australian education system.

3.3 Disillusionment with politics, but hope for change

Participants' responses largely conveyed feelings of frustration and distrust in Australian governments on the matter of climate change. Previous Australian Federal governments were broadly perceived as having performed poorly on the issue in both international and domestic contexts. Several young people referenced key events, such as the repeal of the carbon price under the Abbott government[3], as reasons for their lack of trust in governments to act in their interest; some cited a sense of repeated broken promises on climate action as grounds for their distrust. Based on this appraisal, many participants conveyed misgivings

[3] Tony Abbott led the Liberal-National Coalition government in Australia between 2013 and 2015.

that governments would now begin to take the required actions to prioritise climate change action:

> *The government… have all this money to build all these stadiums and things we don't really need, when we could be using that to like, help endangered species that are getting affected by climate change and reducing our emissions […] it's frustrating.*
> *(Young person, age 20).*

This posed yet another dilemma. Most participants believed that governments have primary responsibility for addressing climate change due to the ability to act at scale, but had little confidence they would do so. Thus, these young people feel unable to trust the very institution they see as having the most responsibility and potential for positive impact, which leads to frustration.

Several participants additionally raised an appreciation of the complex trade-offs that politicians had to contend with in order to make decisions about energy transitions and the economy. There was a resounding view that governments must lead on these issues by either incentivising or regulating the private sector, who are not otherwise motivated to do anything other than seek profit in a capitalist system:

> *Ultimately if governments don't lead the market, then in a capitalist [system], the market will seek profit as the end goal, the end goal is not social justice.*
> *(Young person, age 23).*

The recognition of the complicated trade-offs inherent to climate action demonstrates the participants' willingness to engage with the challenges in this space, refuting potential criticism that their emotions stem from being naïve (see Barrett 2018). Yet this willingness, and desire for governments to lead on climate action, is undermined by the deficiencies the participants see in the political system. Indeed, this study has surfaced feelings of disillusionment and distrust in the political system, even among those who were newly eligible to vote.

At the same time, however, most participants expressed a cautious optimism as a result of the change of government following the 2022 election:

> *We have a few more Independent politicians in Parliament now […] so I think that is a positive… I feel more hopeful, but the trust is still low due to the previous government when nothing happened.*
> *(Young person, age 24).*

Similar statements conveyed a guarded hope that the Albanese-led Labor government elected in 2022, with support of the Greens and Independents, would overcome the legacy of the climate wars and devise a more progressive national climate policy for Australia. This provides further demonstration of the tensions these young people need to manage regarding climate change: how to reconcile competing feelings of distrust and hope in government action.

3.4 Reckoning with uncertainty

When asked about how their understanding of climate change made them feel about the future, participants overwhelmingly expressed deep uncertainty relating to many issues. Numerous issues were raised, including concern regarding anticipated climate impacts to people living in small island nations, and empathy for the injustice that presents; sadness for the expected extinction of other species; and a strong feeling of doubt that humanity will collectively be able to do what's needed to avert the climate crisis. The uncertainty toward the future in the context of climate change was pervasive, and in some cases was perceived as obstructing young people's intended life paths:

> *It makes it really hard to imagine a future and especially with my partner, you know, we can like, plan all of these things and think about our lives together, but again there's that like… 'climate pending, climate pending, climate pending'.*
> *(Young person, age 24).*

In terms of the personal, some participants questioned their career aspirations due to growing understanding of their chosen field's contribution to climate change. Yet more arresting was the finding that several participants actively questioned whether they would have children of their own given the threats posed by climate change. This finding had two dimensions: concern about the carbon footprint that another human would represent; and worry about the state of the planet that the next generation would inherit. This demonstrates an acute awareness of the long-term nature of climate change that will affect not only the participants' lives, but the lives of future generations. It also constitutes another dilemma facing these young people attempting to plan their lives in the context of climate change, as expressed here:

> *It doesn't feel right, to have kids. But I want kids and then it sucks to even have to think about, like, sacrificing having a family, because we're worried about climate change.*
> *(Young person, age 20).*

That climate change is compelling some young people to re-evaluate an intention to have children is an important finding, speaking to the depth of their concerns for the future. Once again, there is a dilemma posed between the desire to have a family, and a regret that this feels irresponsible in the context of climate change:

> *For a while I didn't want to have kids because it's cruel to bring kids into the world that we know is going to burn, essentially, but […] I think you have to hold on to some sort of hope that there will be a turnaround.*
> *(Young person, age 20).*

The emotional challenge is once more illustrated here, with the profound uncertainty about the future existing together with a need to maintain a hopeful outlook.

3.5 Grappling with agency

Participants reported complicated emotions regarding their ability to meaningfully influence climate change. Two opposing ideas emerged: that everyone can and should take individual action to combat climate change; and that individual action is futile if more systemic change is not enacted. This constitutes yet another dilemma for these young people grappling with the issue of climate change. One participant found this especially vexing when considering that large-scale societal shutdowns in 2020 yielded little impact upon global greenhouse gas emissions (Le Quéré et al. 2020):

> *Like, how many people stayed home in 2020 and weren't driving their cars […] it didn't make that much of a dent… […] it only proves it's not really the average population that needs fixing.*
> *(Young person, age 20).*

The majority of participants discussed the conundrum of individual versus systemic action at length. Many detailed the individual choices they had made to reduce their carbon footprints, such as becoming vegan, while expressing frustration that powerful entities were not taking commensurate measures that could create larger impact. In addition, several participants pushed back on the idea of devolving responsibility to individuals at all, when many of the actions required are those at the heart of Australia's economic system:

> *It's not an individual responsibility to combat climate change. If you make it an individual responsibility you abdicate responsibility from corporations and government.*
> *(Young person, age 23).*

However, most participants expressed feeling some sense of agency through the process of voting in the 2022 Federal election. The participants' disillusionment with politics, discussed earlier, did not translate into distrust or apathy for the entire democratic process; indeed, casting a vote in the election was broadly perceived as empowering, particularly for the nine participants who were first-time voters:

> *[Voting] made me feel like I could actually have a say, you know, it's not just a spectator sport watching politicians decide what's going to happen to Australia… it felt like I made a difference.*
> *(Young person, age 19).*

Several participants reported that the ability to formally voice their views improved their sense of agency, especially given that climate change was in many cases their 'number one' voting issue. Outside of the electoral system, participants raised various forms of action as contributing to a sense of agency. For some, this included being involved in collective movements, such as organised protests and strikes. For others reluctant to engage in formal protests, collective activities included supporting groups lobbying government for climate action, and encouraging others in their networks to boycott companies with environmentally-damaging practices, or to patronise more environmentally responsible companies. Despite some doubts around the efficacy of individual choices, several participants

also mentioned implementing pro-environmental behaviours such as veganism in their own lives, and modelling these choices to others as a way of promoting sustainable social norms. The various ways in which these young people sought to contribute to climate action demonstrate both the importance of the issue to their lives, and the emotional commitments they make to live a life that is aligned with their values.

3.6 Summary of findings

The findings describe a complicated emotional challenge for these young people trying to navigate a future in the context of climate change. For many participants, a fragmented climate education in earlier years left them feeling ill-equipped to handle the implications of climate change as young adults. Their understanding of climate change triggered conflicting emotions, such as hope in the new Federal government alongside a distrust of politics. An overarching sense of worry about the impacts of climate change produced deep unease about the future, resulting in profound uncertainty about personal life choices. Finally, the participants voiced a desire to meaningfully contribute to climate action, but questioned whether individual actions would make a difference in the context of entrenched social and economic systems. This complex emotional landscape, experienced at the individual level, was deeply connected to the social and environmental context confronting these young people in the era of climate change.

4 Discussion

The purpose of this study was to explore young Australians' emotional responses to climate change, while attending to the broader social context in which these emotions develop and manifest. Informed by the social-ecological model advanced by Crandon et al. (2022), the study investigated the ways in which young people came to understand climate change and the emotional responses evoked. It also examined young people's perspectives on societal responses to climate change, including consideration of their own agency. This study contributes in several ways to existing literature, which are discussed in the following sections.

4.1 A 'greenhouse affect'

The findings reported here support published studies situated in social psychology regarding challenging climate-related emotions (e.g., Swim et al. 2022), as well as interdisciplinary studies noting the intertwined nature of such emotions (e.g., Marczak et al. 2023) and connections to the societal context in which they are experienced (see Kalwak and Weihgold 2022; for overview). The findings expand upon themes in other Australian studies examining young people's emotional responses to climate change - in particular, feelings of worry and uncertainty about the future (Verlie 2019; Jones and Davison 2021; Gunasiri et al. 2022). The present study furthers understanding of these experiences by revealing the emotional dilemmas that these young people needed to negotiate when envisaging a future under climate change; tensions which were deeply relational, influenced by and manifested in daily life experiences.

Taken together with recent efforts to advance conceptual frameworks of climate emotions (e.g., Pihkala 2022; Voşki et al. 2023), these findings suggest we are witnessing an unfolding phenomenon - a state of affective quandary occasioned by the climate crisis. Contemplating the realities of climate change includes contending with the ways in which we are both implicated and impacted by the prevailing social-ecological system; this provokes an array of interlinked emotions that resist neat delineation. The state of affective quandary elicited by confronting a future altered by anthropogenic greenhouse gas emissions can be understood as a 'greenhouse affect'. Accommodating emotional plurality, the 'greenhouse affect' does not assign dominance to any particular emotional construct, such as anxiety. Rather, the 'greenhouse affect' reflects the tensions inherent to experiencing diverse and at times competing climate emotions – for example, anxiety and hope. Given that climate anxiety and hope can co-exist and prove difficult to disentangle (e.g, Sangervo et al. 2022), the 'greenhouse affect' provides a means of describing the complex emotional realities of climate change. The phenomenon is arguably being experienced at a societal level, comprising a shared experience across nations (as demonstrated in Hickman et al. 2021). Further research to understand the 'greenhouse affect' would be welcomed, particularly studies examining the interconnectedness of emotional responses to climate change situated in different social contexts.

This study also demonstrates the value of using social-ecological frameworks to examine affective dimensions of climate change. Rather than interrogating one specific facet of the social-ecological system – such as the influence of media or government policy – this study sought to allow participants to identify significant influences in how they perceive the issue of climate change. Applying a social-ecological systems perspective has revealed the complex interplay between the individual and the societal context. As posited by Crandon et al. (2022), there appears to be bidirectionality between external influences and internal emotional experiences: these young people exhibited affective responses to the situation they were confronted with, and these in turn informed how they engaged with the world. Figure 1 depicts some key relational elements comprising the 'greenhouse affect' as described by this study's participants.

4.2 Educational implications

My research highlighted the importance of the ways in which these young people learned about climate change for how they responded to the issue emotionally. The findings of this

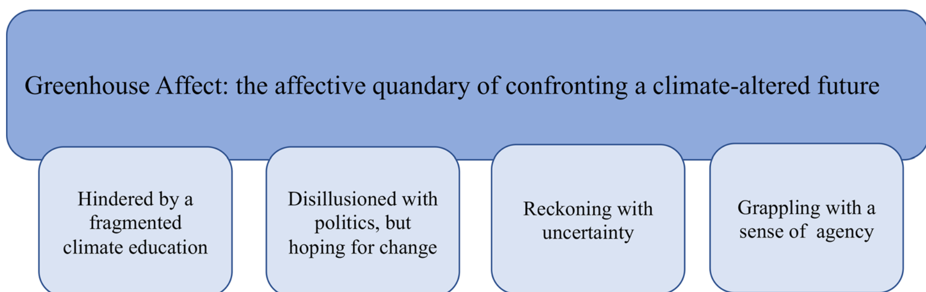

Fig. 1 This model depicts key experiential elements inherent to the 'greenhouse affect' described by young people in the present study

study add to existing Australian literature critiquing the adequacy of school-based climate education (e.g., Jones and Davison 2021). The Australian Curriculum was introduced with the rationale of 'setting out the knowledge, understanding and skills needed for life and work in the 21st century' (ACARA, 2012, p.5). It sets the expectations regarding what students are taught in primary and secondary schooling, which is delivered through State and Territory education systems. Most participants in this study – reflecting on their educations in five of the eight Australian jurisdictions – assessed their climate education as inadequate for facing a future under climate change. This assessment appears to support other critiques (e.g., Whitehouse and Larri 2019; Beasy et al. 2023) that found climate change to be largely absent in the Australian curriculum, and that individual teachers are left to decide whether and how to cover the issue in the classroom. While the Australian Curriculum has recently increased the number of references to climate change (ACARA, 2022), the majority of those references reside in secondary science and technology areas, which puts at a disadvantage those students studying the arts and humanities. Further, they do not appear at all in the primary school curriculum, despite primary school students demonstrating deep engagement with the topic through participating in youth-led climate strikes (Zhou 2019). This appears to undermine the Australian Curriculum's stated rationale of equipping young people for the 21st century.

The mismatch between rhetoric and action regarding Australian climate education is borne out by the responses of participants in this study, some of whom reported emotional disturbance in their limited learning experiences about climate change. Attending to the affective dimensions of climate change in educational settings should be a priority, as it can help students to better endure challenging emotions, as well as work to generate new ideas for climate adaptation (Verlie 2019). Wamsler and Bristow (2022) advocate for policy support to improve environmental education in a way that balances knowledge acquisition with cultivation of 'inner human qualities/capacities that underpin individual and societal flourishing and sustainability' (p.18). Further, enhancing learning and engagement in climate action may help to counter feelings of hopelessness (Ojala 2015). Delivering an improved climate education in Australia will thus require incorporating climate change across year levels and subject areas, and affording students a space to process their new knowledge cognitively and affectively. This presents considerable challenges for educational policy and practice, but is urgently required for preparing young Australians whose lives will be significantly impacted by climate change.

4.3 Navigating the future

The deep uncertainty regarding the future under climate change, alongside efforts to resist negativity, are reflective of the tensions described by the 'greenhouse affect'. Studies are only just beginning to examine whether young people's negative assessments of the future materially influence their life decisions, such as whether or not to have children. For example, the Australian Conservation Foundation (ACF) found that one-third of women under 30 were reconsidering having children due to concern about climate change (ACF, 2019). In Denmark, Bodin and Bjorkland (2022) conducted focus groups discussing reproductive decisions and intentions using the words 'in relation to world conditions', and found that the issue of climate change was raised almost exclusively as the 'burning topic across age groups' (p.3). Two more studies examined reproductive intentions with direct reference

to climate change concern. In the first empirical study of this topic, Schneider-Mayerson and Leong (2020) showed that all participants (climate-concerned Americans aged 27–45, $n=607$) were factoring climate change into reproductive decisions to some degree. In the same vein in the USA and New Zealand ($n=24$), Helm et al. (2021) found that the uncertainty of climate-altered futures introduced feelings of guilt around having children. This guilt related to the potential planetary conditions that future children would be exposed to, and to the potential impact that future children would have on the planet – both themes which were raised in the present study. Such responses indicate the emotional toll that climate change may exert upon people, and how that affects perceptions about life decisions under a climate-altered future.

4.4 Implications for climate action

Another important intersection highlighted in my research is that the 'greenhouse affect' is interwoven with engagement with climate change, politics and avenues for climate action. A key element is the distrust and disillusionment that many participants expressed about governments and politics. These sentiments have been reported elsewhere; for example, Cameron and McAllister (2020) found that a mere 17% of Australians aged 18–24 agreed with the statement, 'People in government can be trusted'. Participants in my study commonly identified politicians as having a unique responsibility to lead action on climate change, but they struggled to trust governments to do so. At the same time, there was a strong sense of limited agency to exert influence on climate change outside of election cycles.

Fostering a sense of agency through climate action – in particular, through collective activities - has been suggested as offering young people protection from the psychological impacts of climate change (Sanson et al. 2019). In their study of political agency in a climate policy context, Wamsler et al. (2022) use the definition of political agency as 'citizens' capacity and actions to exert political influence to support transformation' (p.2). The authors argue that in order to foster political agency, policy processes and practices must integrate external, structural factors with individuals' emotions and perceptions, which are important influences on engagement. Bright and Eames (2022) write that young people have typically been marginalized in politics due to political discourse being determined by adults, and that this marginalisation – combined with working through challenging emotions about climate change - was a key motivator for youth-led climate protest movements. The authors found that successfully working through climate distress to ultimately take strike action increased participants' sense of political agency. Taking part in collective actions thus offers a means of political agency that is especially valuable for those under the age of 18, as well as an opportunity to process and channel difficult emotions about climate change. Indeed, as Nightingale et al. (2022) highlight, it was the outrage of young people that first sparked the youth-led international climate protest movement, demonstrating the connection between emotions and climate action.

Yet climate strikes are only one mode of collective action that may afford a space for the affective dimensions of climate change. Several participants in my study voiced a willingness to take part in other collective activities, such as community-based forums to generate ideas for tackling climate change at the local level, though they did not necessarily know whether these forums existed or how to access them. This reveals a latent potential to meaningfully engage young people on a subject that is critical to their future, and in ways that

may build a sense of agency, beyond the electoral process or strike action. Thus, I argue that political discourse and processes need to make space for the affective dimensions of climate change in order to foster empowerment of young people. Further, a climate politics that regards young people as legitimate actors in shaping their own climate-altered future is necessary if society is to realise truly transformative climate policy.

5 Limitations and future directions

There are several limitations to this study which could be addressed in further research. Firstly, the purposive sampling and method of recruitment used here precludes generalization, and means that the participants likely represent a group of young people that are highly engaged on issues of climate change and politics. Future studies could seek to broaden the participant pool to establish whether these findings are consistent, or differ, among different cohorts of young people. For example, there would be value in examining the emotional experiences of climate change among specific groups of young people - such as early school leavers, First Nations Australians, and those from culturally diverse backgrounds – as well as intersectional experiences. Secondly, the timing of the study close to the Federal election was intended to increase the salience of questions regarding government and politics. It is possible, however, that this timing may have also promoted more 'cautiously hopeful' responses than if the study were conducted at a different time, perhaps later in the new government's tenure. Thirdly, conducting the interviews over Zoom caused occasional technological glitches that interrupted the flow of the conversation; further, talking online may cause discomfort for some, which may have caused participants to share less than they would have during an in-person dialogue. Fourthly, examining reflections about education several years after leaving school may provide a different perspective than examining the experiences of current students; there is therefore opportunity to investigate this with current school students to assess whether they also express similar sentiment.

Aside from addressing limitations, there are many benefits to further research in this space. This study has provided five key findings that were interconnected in the lives of these young people, any one of which offers opportunity for deeper interrogation. For example: how do different educational approaches influence emotional responses to climate change in students? Does young people's sense of disillusionment with governments on climate change predispose them to distrust governments on other matters, outside of climate change? What are the longer-term implications of these affective states on young people's life decisions, or for mental wellbeing? Further research might also explore the utility of the 'greenhouse affect' as an overarching concept to describe the tensions inherent to experiencing multiple, interrelated climate emotions.

6 Conclusion

In this study, I qualitatively explored young Australians' emotional responses to climate change and the societal influences significant in these experiences. I found that there are multiple intersections between participants and the broader social-ecological system that present a series of dilemmas that they must negotiate in daily life, and in contemplating

their future. The ensuing range of emotions includes, but is not limited to, experiences of anxiety, a predominant characterisation in current research. The 'greenhouse affect' provides an overarching encapsulation of the complex affective challenge of living in an era of climate-altered futures, and confronting the associated dilemmas present in the broader social-ecological system.

My findings contribute to and strengthen those from existing literature, highlighting links between how young people learn and feel about climate change, and how this informs their broader perspectives about climate agency and politics. In particular, this study underscores the need to overcome fragmented approaches to climate education in Australian schools by embedding it across year levels and subjects, to better prepare young people to face the future challenges of climate change. This endeavour should be strengthened by facilitating an environment in which teachers and students can work through the affective demands inherent to this learning process. The study is also significant in its timing, examining these issues immediately following a Federal election, and revealing participants' cautious hope for meaningful policy change under the newly elected Australian government. Finally, this study highlights the opportunity to engage young people in a climate politics that recognises them not only as agents of social change, but critical actors in the transformative efforts demanded of us as a society.

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Data availability The datasets generated during and/or analysed during the current study are not publicly available due to ethical obligations to protect the anonymity of participants.

Declarations

Ethical approval This research was granted approval from the Australian National University Human Research Ethics Committee – Protocol 2022/107.

Consent Informed voluntary consent was obtained from each participant in this study as per the abovementioned Ethics Protocol requirements.

Competing interests The author has no relevant financial or non-financial interests to disclose.

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