Special Section: Climate Change

ijbd

International Journal of Behavioral Development
2024, Vol. 48(2) 113–124

DOI: 10.1177/01650254231190919
journals.sagepub.com/home/jbd

Supporting youth emotionally when communicating about climate change: A self-determination theory approach

Jenna Spitzer, Stathis Grapsas, Astrid M. G. Poorthuis and Sander Thomaes

Abstract

Communicating with adolescents about climate change can be challenging if we want to safeguard their emotional well-being. Here, we evaluate the emotional impact of climate change communication that is informed by self-determination theory (SDT). We conducted two experiments with samples of ethnically diverse adolescents from the United States to examine adolescents' emotions when reading needs-aligned, needs-misaligned, and needs-neutral (control) communication about climate change. Adolescents who read needs-aligned communication reported less anxiety compared with adolescents who read needs-misaligned (Study 1) and needs-neutral (Study 2) communication. Unexpectedly, compared with adolescents who read needs-neutral communication, adolescents who read needs-misaligned communication reported more positive emotions (i.e., enjoyment, pride) when learning about climate change (Study 2). Our research provides initial evidence that SDT can inform climate change communication strategies that buffer adolescents from experiencing anxiety.

Keywords

Adolescents, climate change communication, emotions, climate anxiety, basic psychological needs, self-determination theory

Climate change threatens the short- and long-term well-being of young people around the world (Intergovernmental Panel on Climate Change [IPCC], 2022; United Nations Children's Fund, 2021). Educators, policymakers, and parents face a critical task: communicating with youth about climate change to prepare them for an uncertain future. But how can they do so? Learning about climate change and its harmful impacts is an inherently emotional process (Ojala, 2013), and it can have negative consequences for adolescents' emotional well-being (Clayton et al., 2023). Although preventing anxiety is not per se a goal of climate change communication, concern about provoking taxing levels of anxiety can present a barrier to communicating with youth about the topic (Baker et al., 2021; Verlie et al., 2021). Here, we evaluate the potential for self-determination theory (SDT; Ryan & Deci, 2017) to guide efforts to communicate with youth about climate change. In two experiments, we examine how needs-(mis)aligned communication styles affect adolescents' emotional responses to information about climate change. By needs-(mis)aligned communication, we refer to communication that is intended to affirm (or deny) adolescents' basic psychological needs for competence, autonomy, and relatedness.

Climate Change Communication and Adolescents' Emotions

Efforts to communicate with adolescents about climate change range from individual conversations between parents and their children to (inter)national campaigns promoting environmental awareness and behavior (e.g., Ragavan et al., 2021; Simmons, 2022; United Nations Educational, Scientific and Cultural Organization [UNESCO] & United Nations Environment Programme [UNEP], 2016). The urgency of these efforts reflects the reality that climate change will disproportionally affect today's generation of young people (IPCC, 2022; Thiery et al., 2021).

At the same time, communication about climate change is also relevant to adolescents' emotional well-being (Clayton et al., 2023). Recent research in large samples of adolescents from around the world found that most adolescents are worried or anxious about climate change, some of them extremely (Hickman et al., 2021). For example, 75% of adolescents considered the future to be "frightening". Although worry and anxiety can be considered adaptive responses to the realistic threat that climate change presents (Clayton, 2020), such experiences can threaten young people's well-being and mental health (Crandon et al., 2022; Hayes et al., 2018; Wu et al., 2020). Indeed, adolescents who report higher levels of climate anxiety experience lower well-being (Ogunbode et al., 2022). A systematic review found

Utrecht University, The Netherlands

Corresponding author:
Jenna Spitzer, Utrecht University, Heidelberglaan 1, 3584 CS Utrecht, The Netherlands.
Email: j.e.spitzer@uu.nl

consistent associations, especially among youth, between climate anxiety and symptoms of depression, anxiety, stress, insomnia, lower self-reported mental health, and functional impairment (Boluda-Verdu et al., 2022). Even if chronic climate anxiety is particularly harmful, adolescents' in-the-moment emotions are also implicated in their emotional well-being (Reis et al., 2000; Thomaes et al., 2017). Accordingly, socializing agents (e.g., teachers, parents) may be reluctant to address climate change with youth out of concern that such communication will cause painful or overwhelming negative emotion (Baker et al., 2021; Reitsema et al., 2022; Verlie et al., 2021). A better understanding of the direct emotional impact of climate change communication is therefore needed to help socializing agents initiate open and constructive conversations about the topic.

So far, relevant research in the field has focused almost exclusively on adults (e.g., Brosch, 2021; Mah et al., 2020; Moser, 2007; Myers et al., 2012), whereas adolescents are particularly emotionally involved in climate change (Hickman et al., 2021; Hufnagel, 2017; Ojala, 2023). Moreover, adolescents tend to be sensitive to how information about risk (e.g., the dangers that come with substance abuse, dangerous driving) is communicated to them (Abbott et al., 2020; Steinberg, 2015), and this sensitivity may well generalize to communication about the dangers that come with climate change.

Our understanding of how to tend to adolescents' emotions when communicating about climate change remains limited to a few correlational studies. In one investigation of how adolescents perceive their parents' and friends' communication about environmental issues, two general patterns emerged: one "positive," being solution-oriented and supportive, and the other "negative," being doom-and-gloom oriented or dismissive (Ojala & Bengtsson, 2019). Adolescents who experienced more positive communication were more likely to exhibit problem- and meaning-focused coping strategies (e.g., thinking of how one can engage in mitigation efforts, appreciating that people increasingly take climate change seriously) in response to their concerns about climate change. By contrast, adolescents who experienced more negative communication were more likely to de-emphasize the problem as a means of coping. A study on how adolescents perceive their teachers' communication about climate change yielded similar results: when adolescents experienced their teachers as communicating in a more solution-oriented way and respecting their emotional responses to information about climate change, adolescents expressed more constructive hope for the future (Ojala, 2015). On the contrary, when adolescents experienced their teachers as communicating in a gloom-and-doom manner and not taking their emotions seriously, adolescents expressed more hope based in denial (e.g., they felt hope concerning climate change because they failed to see climate change as caused by human behavior). The few studies available thus illustrate how diverse forms of climate change communication have implications for how adolescents respond to and cope with climate change.

In this study, we expand this emerging line of research theoretically and methodologically. Theoretically, we draw upon SDT as a framework for understanding and devising climate change communication for youth. Methodologically, we use an experimental approach to investigate the causal impact of SDT-informed climate change communication on adolescents' emotional states.

An SDT Perspective on Climate Change Communication With Adolescents

SDT offers a meta-theory that accounts for human development and motivation (Ryan & Deci, 2017). We propose that SDT's conceptualization of basic psychological needs offers a useful framework for understanding and tending to adolescents' emotions when communicating about climate change (cf. Pelletier et al., 1998; Wullenkord, 2020).

According to SDT, human beings have basic psychological needs for autonomy, competence, and relatedness. *Autonomy* refers to feeling free to live according to one's own values and interests; *competence* refers to feeling effective in one's pursuits; and *relatedness* refers to feeling connected to significant others. Autonomy, competence, and relatedness are considered basic psychological needs because of their centrality to human functioning and well-being. While these needs are evident across the lifespan, they may be especially pertinent to understanding adolescent development and well-being, given their relevance to adolescents' key developmental tasks (e.g., exploring identity, redefining social roles; Griffin et al., 2017; La Guardia & Ryan, 2002). When adolescents function in contexts that tend to their basic psychological needs, their natural developmental propensities for growth and well-being are also supported (Reis et al., 2000; Rodríguez-Meirinhos et al., 2020). Conversely, when adolescents function in contexts that are misaligned with their basic needs, they are at risk of becoming disengaged and experiencing emotional and psychological ill-being (Balaguer et al., 2012; Chen et al., 2015; Vansteenkiste & Ryan, 2013). For instance, research has shown that the link between parents' caregiving styles and adolescents' emotional well-being is explained by the extent to which parents support adolescents' basic psychological needs (Abidin et al., 2022).

From an SDT perspective, climate change communication that is attuned to adolescents' basic psychological needs could support their proactive responses and emotional well-being in this context (e.g., Kaplan & Madjar, 2015; Williams et al., 1999). Indeed, one study found that parents can facilitate older adolescents' engagement in pro-environmental behavior by communicating pro-environmental expectations in an autonomy-supportive manner (Grønhøj & Thøgersen, 2017). Similarly, another study found that SDT-informed textual materials about recycling and ecology can promote older adolescents' engagement in the topic (Vansteenkiste et al., 2004).

However, research has not yet evaluated the impact of SDT-informed communication on the emotions adolescents experience when learning about climate change. SDT raises the possibility that needs-aligned communication can buffer adolescents from experiencing taxing negative emotions when faced with information about climate change. Indeed, when adolescents' basic psychological needs are supported, they are more capable of responding openly and non-defensively to stressful information and events (i.e., integrative emotion regulation; Roth et al., 2019). Simultaneously, SDT suggests that needs-misaligned communication about climate change may incline adolescents to become distressed or "tuned out" as a means of warding off psychological discomfort (Wullenkord & Reese, 2021). Indeed, when adolescents' basic psychological needs are

unsupported, they are more likely to become overwhelmed (i.e., dysregulated) and avoidant in response to stressful information and events (i.e., suppressive regulation; Brenning et al., 2022). Thus, SDT provides a framework for understanding the emotional consequences of climate change communication, as well as for devising communication that is emotionally supportive.

Overview of Present Research

In two experiments (one pre-registered), we examined the impact of different climate change communication styles (i.e., needs-aligned, needs-misaligned, or needs-neutral communication) on adolescents' emotional states, using validated scales (Harmon-Jones et al., 2016; Raccanello et al., 2022). We focused on the impact of these communication styles on anxiety in particular, given its pervasiveness as an emotional response to climate change (Clayton, 2020; Wu et al., 2020).

In both experiments, participants were high school students from the United States. Adolescence is a critical developmental stage for the present research purposes, as it is a time when youth are at increased risk of emotional distress surrounding climate change (Hickman et al., 2021; Otto et al., 2019; Wu et al., 2020). We conducted our studies through the Character Lab Research Network (n.d.), a consortium of schools across the United States that works collaboratively with scientists to advance research on the well-being of youth. We conducted the experiments in public high schools that predominantly serve adolescents from lower socio-economic and ethnic minority backgrounds (Character Lab, n.d.). As such, our research contributes to efforts to diversify developmental science by including historically under-represented groups in research (Fakkel et al., 2020; Syed et al., 2018).

In Study 1, we evaluated the effects of needs-(mis)aligned messages that were presented directly after information about climate change. In Study 2, pre-registered on OSF (https://osf.io/pxrwz), we evaluated the effects of needs-(mis)aligned messages that were incorporated into information about climate change. Both experiments were part of larger research projects that included additional measures not relevant to this study's purposes. The ethics review board of the faculty of Social and Behavioral Sciences at Utrecht University approved both studies (Study 1: protocol 20-466 and Study 2: protocol 21-390).

Study 1

Study 1 evaluated the impact of needs-(mis)aligned communication on adolescents' emotional responses to information about climate change. We did not pre-register hypotheses, but instead explored whether the needs-aligned communication would provoke less anxiety compared with needs-misaligned and needs-neutral communication, as would be theoretically consistent with SDT (Brenning et al., 2022).

Method

Participants. Participants were 141 American adolescents (M_{age} = 16.43, SD_{age} = 1.00; 51.80% female; 71.60% Hispanic, 15.60% White, 10.60% Black, 2.80% Asian, 1.40% American Indian, 0.70% Pacific Islander), recruited via the Character Lab Research Network. From an initial sample of 199, we excluded 58 participants prior to data analyses for failing an attention check item (i.e., *If you are reading this, select "a lot"; N* = 53) or having incomplete data on the primary outcome variable, anxiety (N = 5). Excluded participants did not differ from those included with respect to age, grade level, ethnicity, or gender ($ps \geqslant .182$). We report findings for the full sample in the Supplemental Material.

Procedure. Study 1 was conducted in January 2021. Participants completed an online experiment during the school day. As a result of COVID-19 restrictions, some schools were operating remotely. Thus, approximately half of the participants (i.e., 56.4%) completed the experiment at home, while others completed the experiment in the school building.

Climate Change Communication. Participants were randomly assigned to a needs-aligned, needs-misaligned, or needs-neutral control condition. In all conditions, participants received information about climate change derived from a real-world, online article outlining "where we are" with respect to climate change (BBC News, 2020). We selected this article because it includes information about climate change that adolescents may typically come across in the media or at school. For instance, it reported on the United Nations' warning that the earth's climate should not become more than 1.5°C hotter than it was in the 1800s; that the 20 warmest years on record were in the past 22 years; and that countries' inaction on climate change could have catastrophic consequences. Although the article contains discouraging information, it is written in a factual, neutral style that does not directly touch upon the three psychological needs. Following this information, participants in the control condition completed the emotions measure. Participants in the needs-aligned and needs-misaligned conditions read an additional message before they completed the emotions measure.

The needs-(mis)aligned messages consisted of three sentences that either affirmed or denied adolescents' autonomy, relatedness, and competence with respect to pro-environmental engagement (e.g., competence [mis]alignment was communicated with these sentences: *Your actions and the decisions of your generation will make a difference to the future of our planet* vs. *Your actions and the decisions of your generation might not make a difference to the future of our planet*; see Supplemental Material for full content). These messages were designed to reflect needs-relevant sentiments that adolescents may realistically encounter in the context of climate change. For example, adolescents may feel pressured to exhibit pro-environmental behavior (restricting their sense of autonomy; Pelletier et al., 2011); alienated from those who identify as environmentalists (restricting their sense of relatedness; Gibson-Wood & Wakefield, 2013; Mock, 2017); or unable to contribute to climate change mitigation (restricting their sense of competence; De Meyer et al., 2020; Loria, 2018). We designed the manipulations to challenge or reinforce these concerns.

Emotional States. We assessed adolescents' emotional states using the Discrete Emotions Questionnaire (DEQ; Harmon-Jones et al., 2016), a validated, well-established measure of state

Table 1. Descriptive Statistics and Correlations Among Study 1 Emotions.

Variable	α	*M* (*SD*)	1	2	3	4	5	6	7
1. Anxiety	.84	3.11 (1.65)	–						
2. Anger	.94	2.85 (1.75)	.75**	–					
3. Disgust	.82	2.02 (1.21)	.68**	.72**	–				
4. Fear	.89	2.22 (1.40)	.76**	.66**	.74**	–			
5. Sadness	.80	2.74 (1.48)	.75**	.72**	.68**	.60**	–		
6. Desire	.86	2.59 (1.47)	.71**	.68**	.66**	.56**	.75**	–	
7. Relaxation	.75	4.16 (1.48)	−.00	.04	.10	−.08	.07	.28**	–
8. Happiness	.91	3.37 (1.76)	.36**	.43**	.38**	.28**	.32**	.54**	.64**

Note. $N = 141$. Emotions were rated on a 7-point Likert-type scale ranging from 1 (*not at all*) to 7 (*completely*).
**$p < .01$.

anxiety and other emotions. The DEQ consists of 32 items (i.e., emotion adjectives), comprising eight emotion subscales: anger, disgust, fear, anxiety, sadness, desire, relaxation, and happiness. Participants reported how they momentarily experienced each of these emotions. For example, the items for the anxiety subscale included "Dread," "Anxiety," "Nervous," and "Worry." Items were rated on a 7-point Likert-type scale ranging from 1 (*not at all*) to 7 (*an extreme amount*). All emotion subscales exhibited good internal consistency (ranging from $\alpha = .75$ to .94; Table 1).

Results

Preliminary Analyses. Table 1 displays descriptive statistics and zero-order correlations among the emotions measured in Study 1. Random assignment to conditions was successful: there were no condition differences in age, grade level, gender, ethnicity, or location ($ps \geqslant .342$). In addition, participants' age, gender, and location were not associated with differences in their reported emotions ($ps \geqslant .057$), with one exception: older participants reported higher levels of relaxation ($r = .17$, $p = .049$). We controlled for age in our relaxation analyses accordingly.

Primary Analyses. We conducted a series of analyses of covariance (AN[C]OVAs) to explore whether participants' emotions differed between conditions (Figure 1 and Table 2). Participants in the needs-aligned condition did not experience different emotions than their counterparts in the control condition ($ps \geqslant .576$, Bonferroni adjusted). They did, however, report less anxiety than their counterparts in the needs-misaligned condition ($F(2, 138) = 4.66$, $p = .011$, $\eta_p^2 = .06$; pair-wise comparison $p = .008$, Bonferroni adjusted). Similarly, they reported less sadness than their counterparts in the needs-misaligned condition ($F(2, 138) = 3.27$, $p = .041$, $\eta_p^2 = .05$; pair-wise comparison $p = .036$, Bonferroni adjusted).

Discussion

Study 1 provides initial evidence to suggest that needs-(mis) aligned communication can influence the emotions adolescents experience as they learn about climate change. Specifically, we found that adolescents' experiences of anxiety and sadness depend on whether climate change communication tends to—or rather disregards—their basic psychological needs. To conceptually replicate and extend these findings, we conducted Study 2.

Study 2

Building on Study 1, Study 2 evaluated the impact of needs-(mis) aligned messages on a broader range of emotions and in a larger sample of adolescents. In addition, Study 2 tested the effects of needs-(mis)aligned messages that were integrated into the information about climate change (rather than as a follow-up message, as in Study 1). We pre-registered the hypothesis that adolescents in the needs-aligned condition would experience less anxiety compared with adolescents in the control and needs-misaligned conditions, with adolescents in the needs-misaligned condition experiencing the most anxiety.

Method

Participants. Participants were 270 American adolescents ($M_{age} = 16.20$, $SD_{age} = 0.95$; 55.60% female; 57.00% Hispanic, 14.80% White, 12.60% Black, 7.80% Asian, 0.40% American Indian, 0.80% Pacific Islander, 4.10% Other), again recruited via the Character Lab Research Network. Following our pre-registered exclusion criteria, we excluded 201 participants from an initial sample of 471 for failing an attention check item (i.e., *If you are reading this, select "a lot"; N* = 186), or having incomplete data on the primary outcome variable, anxiety ($N = 15$).[1] Excluded participants did not differ from those included with respect to age, grade level, or ethnicity ($ps \geqslant .138$). Excluded participants were, however, more likely to be boys than girls ($t(438.49) = -2.83$, $p = .005$; Cohen's $d = -0.27$). We report findings for the full sample in the Supplemental Material.

Procedure. Study 2 was conducted in October and November 2021. Participants completed the online experiment while at school.

Climate Change Communication. As in Study 1, participants were randomly assigned to a needs-aligned, needs-misaligned, or needs-neutral control condition. Participants in all conditions read the same information about climate change that we presented in Study 1, and they completed the emotions measure

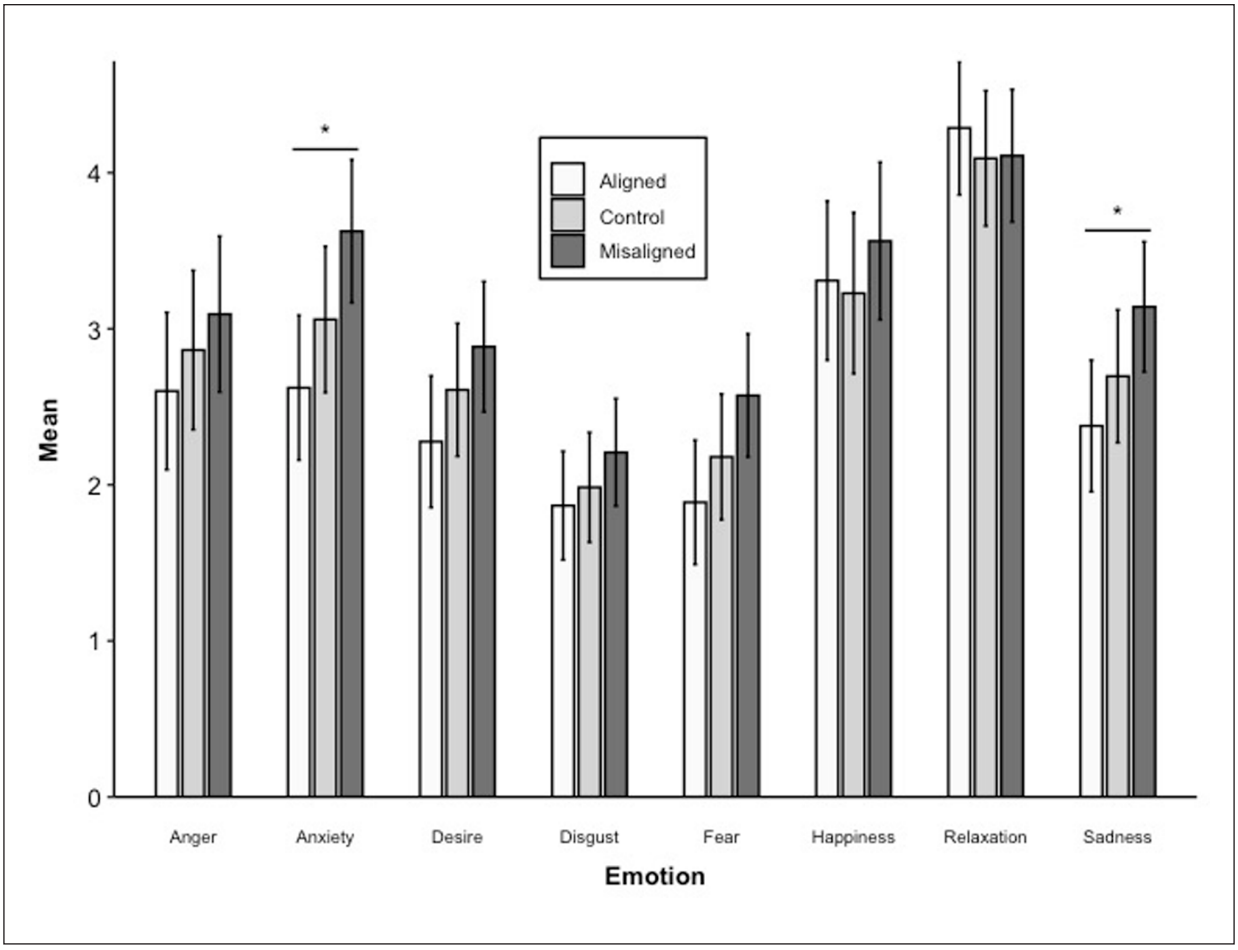

Figure 1. Study 1: Adolescents' Emotions by Condition.
Note. $N = 141$. Emotions were rated on a 7-point Likert-type scale ranging from 1 (*not at all*) to 7 (*completely*). Error bars represent 95% confidence intervals. Asterisk indicates a significant difference between conditions ($^*p < .05$).

Table 2. Study 1: Mean Values, Standard Errors, and Confidence Intervals of Emotions by Condition.

Variable	Condition		
	Control ($N = 46$)	Needs-aligned ($N = 47$)	Needs-misaligned ($N = 48$)
	M (*SE*) 95% CI	*M* (*SE*) 95% CI	*M* (*SE*) 95% CI
Anxiety	3.06 (0.24)^{a,b} [2.59, 3.53]	2.62 (0.23)^{a} [2.16, 3.09]	3.63 (0.23)^{b} [3.17, 4.08]
Anger	2.86 (0.26)^{a} [2.35, 3.37]	2.60 (0.26)^{a} [2.10, 3.11]	3.09 (0.25)^{a} [2.60, 3.59]
Disgust	1.98 (0.18)^{a} [1.63, 2.34]	1.87 (0.18)^{a} [1.52, 2.22]	2.21 (0.17)^{a} [1.86, 2.55]
Fear	2.18 (0.20)^{a} [1.78, 2.58]	1.89 (0.20)^{a} [1.49, 2.29]	2.57 (0.20)^{a} [2.18, 2.97]
Sadness	2.67 (0.22)^{a,b} [2.27, 3.12]	2.38 (0.21)^{a} [1.96, 2.80]	3.14 (0.21)^{b} [2.72, 3.56]
Desire	2.61 (0.22)^{a} [2.18, 3.04]	2.28 (0.21)^{a} [1.86, 2.70]	2.89 (0.21)^{a} [2.47, 3.30]
Relaxation	4.12 (0.22)^{a} [3.66, 4.53]	4.27 (0.22)^{a} [3.86, 4.72]	4.10 (0.21)^{a} [3.69, 4.53]
Happiness	3.23 (0.26)^{a} [2.71, 3.74]	3.31 (0.26)^{a} [2.80, 3.82]	3.56 (0.23)^{a} [3.06, 4.07]

Note. SE: standard error; CI: conference interval. Emotions were rated on a 7-point Likert-type scale ranging from 1 (*not at all*) to 7 (*completely*). Mean values in the same row with the same superscript do not differ significantly from each other. Mean values in the same row with different superscripts differ significantly from each other ($p < .05$, Bonferroni adjusted).

Table 3. Descriptive Statistics and Correlations Among Study 2 Emotions.

Variable	α	*M* (*SD*)	1	2	3	4	5	6	7	8	9
1. Anxiety	.86	3.43 (1.74)	–								
2. Anger	.92	2.59 (1.68)	.61**	–							
3. Shame	.86	2.41 (1.59)	.59**	.71**	–						
4. Hopelessness	.87	2.30 (1.52)	.50**	.62**	.73**	–					
5. Boredom	.82	2.86 (1.80)	.13*	.18**	.24**	.30**	–				
6. Enjoyment	.98	2.74 (1.94)	−.01	−.10	−.14*	−.15*	.19**	–			
7. Pride	.94	2.79 (1.92)	−.04	−.16**	−.20**	−.18**	.20**	.92**	–		
8. Hope	.91	3.36 (1.92)	.04	−.09	−.13*	−.20**	.12	.79**	.80**	–	
9. Relief	.95	2.73 (1.89)	−.01	−.12	−.14*	−.15*	.15*	.89**	.90**	.83**	–
10. Relaxation	.91	3.14 (2.06)	−.14*	−.23**	−.27**	−.25**	.23**	.73**	.78**	.73**	.79**

Note. Emotions were rated on a 7-point Likert-type scale ranging from 1 (*not at all*) to 7 (*completely*). $N = 270$.
*$p < .05$. **$p < .01$.

thereafter. Rather than providing needs-(mis)aligned messages at the end of the information (as in Study 1), Study 2 integrated these messages into the information about climate change. The needs-(mis)aligned messages were the same as in Study 1, apart from slight alterations to suit the new format (see Supplemental Material).

Emotional States. To broaden the spectrum of measured emotions, we assessed emotional states with the Achievement Emotions Adjective List (AEAL) for secondary school students (Raccanello et al., 2022), a validated scale designed specifically for use with adolescents. The AEAL consists of 30 items (i.e., emotion adjectives), divided over 10 emotion subscales: anxiety, anger, shame, hopelessness, boredom, enjoyment, pride, hope, relief, and relaxation. Participants reported how they momentarily experienced these emotions. For example, the items for the anxiety subscale included "Anxious," "Nervous," and "Worried." Items were rated on a 7-point Likert-type scale ranging from 1 (*not at all*) to 7 (*completely*). All subscales exhibited good to excellent internal consistency (ranging from $\alpha = .82$ to .98; see Table 3).

Results

Preliminary Analyses. Table 3 displays descriptive statistics and zero-order correlations among the emotions measured in Study 2. Random assignment to conditions was successful: participants in the three conditions did not differ in terms of age, grade level, gender, or ethnicity ($ps \geqslant .258$). Participants' age was not associated with their reported emotions ($ps \geqslant .455$). Girls tended to report stronger emotions for all measured emotions ($ps \leqslant .051$). Thus, we controlled for gender in all analyses.

Primary Analyses. We used a series of ANCOVAs to test if emotions differed between conditions (Figure 2 and Table 4). Adolescents in the needs-aligned condition did not experience different emotions compared with their counterparts in the needs-misaligned condition ($ps \geqslant .427$, Bonferroni adjusted). However, adolescents in the needs-aligned condition did report less anxiety than those in the control condition ($F(2, 255) = 3.53$, $p = .031$, $\eta_p^2 = .03$; pair-wise comparison $p = .026$, Bonferroni adjusted). Thus, we found partial support for the hypothesis that needs-aligned communication reduces adolescents' anxiety.

Further exploratory analyses revealed that, compared with adolescents in the control condition, adolescents in the needs-misaligned condition experienced more enjoyment ($F(2, 255) = 4.26$, $p = .015$, $\eta_p^2 = .03$; pair-wise comparison $p = .013$, Bonferroni adjusted) and more pride ($F(2, 255) = 5.41$, $p = .005$, $\eta_p^2 = .04$; pair-wise comparison $p = .004$, Bonferroni adjusted) in response to the information about climate change.

Discussion

Study 2 provides further evidence that needs-(mis)aligned communication can affect adolescents' emotions when learning about climate change. In particular, needs-aligned communication appeared to buffer adolescents from experiencing anxiety compared with adolescents who only read information about climate change. Unlike in Study 1, adolescents who read needs-misaligned communication did not experience the most anxiety. Rather, exploratory analyses indicated that these adolescents experienced more positive emotions compared with adolescents who only read information about climate change. We speculate that these positive emotions may reflect adolescents' emotional disengagement or "tuning out" from information about climate change.

General Discussion

The present research suggests that communication styles that are more (or less) attuned to adolescents' basic psychological needs can affect adolescents' emotions as they learn about climate change. Across both studies, adolescents experienced relatively low levels of anxiety when communication was aligned with their basic psychological needs for competence, autonomy, and relatedness. That said, we also found inconsistencies across studies. Needs-aligned communication led to lower anxiety compared with needs-misaligned (but not needs-neutral) communication in Study 1, while it led to lower anxiety compared with needs-neutral (but not needs-misaligned) communication in Study 2. In Study 2, needs-misaligned communication led adolescents to report more enjoyment and pride when learning about climate change compared with the needs-neutral

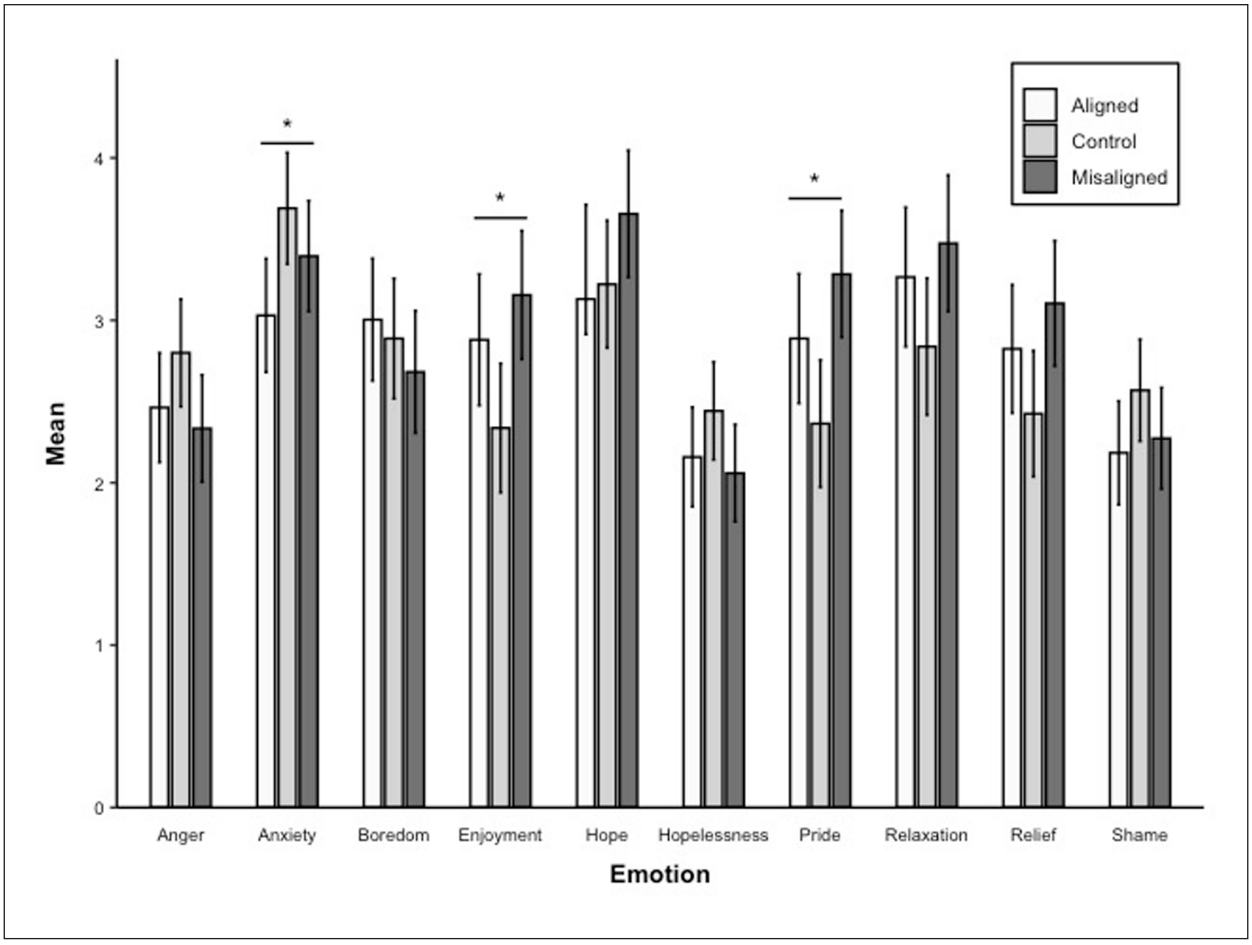

Figure 2. Study 2: Adolescents' Emotions by Condition.
Note. $N = 259$. Emotions were rated on a 7-point Likert-type scale ranging from 1 (*not at all*) to 7 (*completely*). Error bars represent 95% confidence intervals. Asterisk indicates a significant difference between conditions ($^*p < .05$).

communication. Although some results were unexpected, our findings are largely consistent with core tenets of SDT.

Theoretical Implications

That needs-aligned climate change communication appears to buffer adolescents from experiencing anxiety dovetails with evidence that needs-aligned environments can facilitate adolescents' emotionally resilient engagement with stressful information (Brenning et al., 2022; Roth et al., 2019). In addition, it is consistent with evidence that needs-aligned environments can prevent adolescents from experiencing anxiety in the long-term (Yu et al., 2016). Our research thus bolsters evidence that needs-aligned environments can support adolescents' daily emotional well-being, as reflected in momentary experiences of positive and negative affect (Reis et al., 2000; Thomaes et al., 2017). Importantly, it provides first evidence of this effect in the field of climate change communication.

An unexpected finding in Study 2 was that needs-misaligned climate change communication led adolescents to report more positive emotions (i.e., enjoyment and pride). One possible explanation is that needs-misaligned communication led adolescents to engage less deeply with the information about climate change. Although this interpretation is speculative, it would be consistent with previous research: one study found that, when reading information about recycling and ecology, participants who read needs-misaligned materials reported more superficial processing and less deep processing compared with participants who read needs-aligned materials on the same topic (Vansteenkiste et al., 2004). Our interpretation also aligns with evidence that individuals whose basic psychological needs are frustrated in the context of climate change are more likely to engage in self-protective strategies, such as climate change denial (Wullenkord & Reese, 2021). We emphasize, although, that this interpretation is speculative: our study was not designed to test the degree to which adolescents processed or engaged with the information we provided.

Practical Implications

Adolescence is a critical time for understanding the emotional impacts of climate change communication. First, such communication can be especially emotionally impactful in adolescence. Adolescence is a time when the emotional system becomes sensitized, such that adolescents are prone to experiencing negative emotions relatively frequently and intensely (Larson et al., 2002;

Table 4. Study 2: Adjusted Mean Values and Standard Errors of Emotions by Condition.

Variable	Condition		
	Control ($N = 87$)	Needs-aligned ($N = 84$)	Needs-misaligned ($N = 88$)
	M (*SE*) 95% CI	*M* (*SE*) 95% CI	*M* (*SE*) 95% CI
Anxiety	3.69 (0.17)[a] [3.35, 4.03]	3.03 (0.18)[b] [2.68, 3.38]	3.40 (0.17)[a,b] [3.05, 3.74]
Anger	2.80 (0.17)[a] [2.47, 3.13]	2.46 (0.17)[a] [2.13, 2.80]	2.33 (0.17)[a] [2.00, 2.66]
Shame	2.57 (0.16)[a] [2.26, 2.88]	2.18 (0.16)[a] [1.86, 2.50]	2.27 (0.16)[a] [1.96, 2.59]
Hopelessness	2.44 (0.15)[a] [2.14, 2.74]	2.16 (0.16)[a] [1.85, 2.47]	2.06 (0.15)[a] [1.76, 2.36]
Boredom	2.79 (0.19)[a] [2.52, 3.26]	2.98 (0.19)[a] [2.63, 3.38]	2.68 (0.19)[a] [2.31, 3.06]
Enjoyment	2.34 (0.20)[a] [1.94, 2.74]	2.88 (0.21)[a,b] [2.48, 3.29]	3.17 (0.20)[b] [2.76, 3.55]
Pride	2.36 (0.20)[a] [1.97, 2.76]	2.89 (0.20)[a,b] [2.49, 3.29]	3.29 (0.20)[b] [2.90, 3.68]
Hope	3.22 (0.20)[a] [2.83, 3.62]	3.13 (0.20)[a] [2.91, 3.71]	3.66 (0.20)[a] [3.27, 4.05]
Relief	2.43 (0.20)[a] [2.04, 2.81]	2.82 (0.20)[a] [2.43, 3.22]	3.10 (0.20)[a] [2.72, 3.49]
Relaxation	2.84 (0.21)[a] [2.42, 3.26]	3.27 (0.22)[a] [2.84, 3.70]	3.47 (0.21)[a] [3.05, 3.89]

Note. SE: standard error; CI: confidence interval. Emotions were rated on a 7-point Likert-type scale ranging from 1 (*not at all*) to 7 (*completely*). Mean values in the same row with the same superscript do not differ significantly from each other. Mean values in the same row with different superscripts differ significantly from each other ($p < .05$, Bonferroni adjusted).

Moeller et al., 2020). Second, such communication can be especially personally relevant in adolescence. Adolescents are increasingly able to anticipate and reflect on how their future lives will unfold (McCue et al., 2019; Nurmi, 1991). Accordingly, learning about the threats of climate change can be personally meaningful and emotionally salient to them (Hickman et al., 2021; Wu et al., 2020). Third, such communication can be especially formative in adolescence, a period when pro-environmental norms, values, and identities crystallize (Balundė et al., 2020; Otto et al., 2019; Vollebergh et al., 2001). Thus, effective climate change communication that supports adolescents' emotional needs may foster adolescents' climate-related coping and engagement over time (Ojala, 2015; Ojala & Bengtsson, 2019).

The present findings, though preliminary, have potential implications for how to communicate about climate change with youth. They inform socializing agents (e.g., parents and teachers) who wish to raise climate change awareness in youth while limiting negative emotions, and especially anxiety. To communicate in a needs-aligned way, socializing agents could, for example, highlight how adolescents have managed to shift public discourse on climate change (affirming *competence*), by coming together as a unified generation (affirming *relatedness*), and speaking out for changes that challenge the inaction of authorities (affirming *autonomy*). Similarly, when developing public awareness campaigns or other policies targeting youth, organizations and governments could adopt needs-aligned communication styles while broaching this topic. Such initiatives could draw from SDT-based communication guidelines designed for the health sector (e.g., Martela et al., 2021).

Strengths, Limitations, and Future Research

Our research has several strengths. While large-scale climate education programs and awareness campaigns target adolescents (UNESCO, 2020; UNESCO & UNEP, 2016), the emotional impact of such communication has rarely been studied. The present work enriches understanding of how different forms of climate change communication can emotionally affect adolescents. As such, we address calls for insight into how to design climate change communication that is responsive to adolescents' emotional needs (Baker et al., 2021; Ojala, 2023). Although preliminary, our research demonstrates the potential for SDT to inform and guide climate change communication for youth. Using experimental designs, our research also provides causal evidence, which is important for policy development.

Our research also has limitations. First, the effects we found were small and partially inconsistent between studies. Future research should help better understand the robustness and boundary conditions of our findings. Such research could also test our speculative interpretation that needs-misaligned communication may incline adolescents to emotionally disengage from the reality of climate change. In addition, our samples were comprised of American adolescents from public high schools that predominantly serve youth from lower socio-economic and ethnic minority backgrounds. While these samples strengthen developmental science by representing historically under-represented groups (Fakkel et al., 2020; Syed et al., 2018), future research should test the generalizability of our findings to individuals of other ages, socio-economic groups, and world regions (e.g., regions that are

already more directly subjected to tangible climate impacts). Adding measures of other climate-specific emotions to such research (e.g., apathy, insecurity; Oberauer et al., 2023) could provide an even more fine-grained understanding of adolescents' emotional responses in this context.

Our research focused rather narrowly on adolescents' short-term emotional responses directly after learning about climate change. Future work could evaluate how the impacts of more prolonged experiences of needs-(mis)aligned communication (e.g., implemented throughout environmental education programs) may accumulate over time, with potential downstream consequences for youth's well-being and mental health. Such research could also include pro-environmental engagement outcomes and address whether or how emotional processes drive (or inhibit) adolescents' pro-environmental behavioral dispositions and lifestyles.

We did not examine the psychological mechanism that drives the emotional effects of our needs-(mis)aligned communication. Importantly, our ongoing research suggests that the experimental manipulations do not affect adolescents' self-reported levels of need satisfaction and frustration (see Supplemental Material). One possibility is that our needs-(mis)aligned communication affected adolescents' emotions simply by making them more optimistic (or pessimistic) about the consequences of climate change. However, we found no condition differences in adolescents' experiences of hope or hopelessness (measured in Study 2). Thus, our findings are not consistent with this possibility. Future research is needed to identify the psychological processes that account for why needs-(mis)aligned climate change communication affects adolescents' emotions.

Finally, our research did not examine individual differences that moderate the emotional impacts of needs-(mis)aligned communication. Understanding such individual differences will inform the development of tailored climate change communication (Chapman et al., 2017; Doell et al., 2021). Thus, future research could identify subsets of individuals who are more (and less) responsive to needs-(mis)aligned communication about climate change.

Conclusion

Climate change presents a fundamental threat to the well-being of today's young people, making it a critical topic to address with youth directly (Sanson et al., 2019). However, doing so is challenging for socializing agents who are concerned about exacerbating youth's negative emotions (Baker et al., 2021). Our findings, while preliminary, suggest that SDT provides a valuable framework for developing climate change communication strategies that support adolescents' emotional needs.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation program (grant agreement no. 864137, awarded to Sander Thomaes). This research was supported by Character Lab and facilitated through the Character Lab Research Network, a consortium of schools across the United States working collaboratively with scientists to advance scientific insights that help kids thrive.

ORCID iDs

Jenna Spitzer https://orcid.org/0000-0002-5100-076X
Astrid M. G. Poorthuis https://orcid.org/0000-0002-6541-5288

Supplemental Material

Supplemental material for this article is available online.

Note

1. In the analyses concerning hopelessness, we deviated from our pre-registration in that we chose not to exclude participants with values of >|3| *SD* from the mean. Instead, we winsorized the values of seven participants to 3 *SD* from the mean to avoid further exclusions.

References

Abbott, A., Askelson, N., Scherer, A. M., & Afifi, R. A. (2020). Critical reflections on COVID-19 communication efforts targeting adolescents and young adults. *Journal of Adolescent Health*, *67*(2), 159–160. https://doi.org/10.1016/j.jadohealth.2020.05.013

Abidin, F. A., Yudiana, W., & Fadilah, S. H. (2022). Parenting style and emotional well-being among adolescents: The role of basic psychological needs satisfaction and frustration. *Frontiers in Psychology*, *13*, Article 901646. https://doi.org/10.3389/fpsyg.2022.901646

Baker, C., Clayton, S., & Bragg, E. (2021). Educating for resilience: Parent and teacher perceptions of children's emotional needs in response to climate change. *Environmental Education Research*, *27*(5), 687–705. https://doi.org/10.1080/13504622.2020.1828288

Balaguer, I., González, L., Fabra, P., Castillo, I., Mercé, J., & Duda, J. L. (2012). Coaches' interpersonal style, basic psychological needs and the well-and ill-being of young soccer players: A longitudinal analysis. *Journal of Sports Sciences*, *30*(15), 1619–1629. https://doi.org/10.1080/02640414.2012.731517

Balundė, A., Jovarauskaitė, L., & Poškus, M. S. (2020). Exploring adolescents' waste prevention via value-identity-personal norm and comprehensive action determination models. *Journal of Environmental Psychology*, *72*, Article 101526. https://doi.org/10.1016/j.jenvp.2020.101526

BBC News. (2020, January 14). *Climate change: Where we are in seven charts and what you can do to help*. https://www.bbc.com/news/science-environment-46384067

Boluda-Verdu, I., Senent-Valero, M., Casas-Escolano, M., Matijasevich, A., & Pastor-Valero, M. (2022). Fear for the future: Eco-anxiety and health implications, a systematic review. *Journal of Environmental Psychology*, *84*, Article 101904. https://doi.org/10.1016/j.jenvp.2022.101904

Brenning, K., Soenens, B., Vansteenkiste, M., De Clercq, B., & Antrop, I. (2022). Emotion regulation as a transdiagnostic risk factor for (non)clinical adolescents' internalizing and externalizing psychopathology: Investigating the intervening role of psychological need experiences. *Child Psychiatry and Human Development*, *53*(1), 124–136. https://doi.org/10.1007/s10578-020-01107-0

Brosch, T. (2021). Affect and emotions as drivers of climate change perception and action: A review. *Current Opinion in Behavioral Sciences*, *42*, 15–21. https://doi.org/10.1016/j.cobeha.2021.02.001

Chapman, D. A., Lickel, B., & Markowitz, E. M. (2017). Reassessing emotion in climate change communication. *Nature Climate Change*, *7*(12), 850–852. https://doi.org/10.1038/s41558-017-0021-9

Character Lab Research Network. (n.d.). *Sample size and demographics*. https://clrn.characterlab.org/resources/sample-size-and-demographics#

Chen, B., Vansteenkiste, M., Beyers, W., Boone, L., Deci, E. L., Van der Kaap-Deeder, J., Duriez, B., Lens, W., Matos, L., Mouratidis, A., Ryan, R. M., Sheldon, K. M., Soenens, B., Van Petegem, S., & Verstuyf, J. (2015). Basic psychological need satisfaction, need frustration, and need strength across four cultures. *Motivation and Emotion*, *39*(2), 216–236. https://doi.org/10.1007/s11031-014-9450-1

Clayton, S. (2020). Climate anxiety: Psychological responses to climate change. *Journal of Anxiety Disorders*, *74*, Article 102263. https://doi.org/10.1016/j.janxdis.2020.102263

Clayton, S. D., Pihkala, P., Wray, B., & Marks, E. (2023). Psychological and emotional responses to climate change among young people worldwide: Differences associated with gender, age, and country. *Sustainability*, *15*(4), Article 3540. https://doi.org/10.3390/su15043540

Crandon, T. J., Scott, J. G., Charlson, F. J., & Thomas, H. J. (2022). A social–ecological perspective on climate anxiety in children and adolescents. *Nature Climate Change*, *12*(2), 123–131. https://doi.org/10.1038/s41558-021-01251-y

De Meyer, K., Coren, E., McCaffrey, M., & Slean, C. (2020). Transforming the stories we tell about climate change: From "issue" to "action." *Environmental Research Letters*, *16*(1), Article 015002. https://doi.org.10.1088/1748-9326/abcd5a

Doell, K. C., Conte, B., & Brosch, T. (2021). Interindividual differences in environmentally relevant positive trait affect impacts sustainable behavior in everyday life. *Scientific Reports*, *11*(1), 1–11. https://doi.org/10.1038/s41598-021-99438-y

Fakkel, M., Peeters, M., Lugtig, P., Zondervan-Zwijnenburg, M., Blok, E., White, T., van der Meulen, M., Kevenaar, S. T., Willemsen, G., Bartels, M., Boomsma, D. I., Schmengler, H., Branje, S., & Vollebergh, W. (2020). Testing sampling bias in estimates of adolescent social competence and behavioral control. *Developmental Cognitive Neuroscience*, *46*, Article 100872. https://doi.org/10.1016/j.dcn.2020.100872

Gibson-Wood, H., & Wakefield, S. (2013). "Participation," white privilege and environmental justice: Understanding environmentalism among Hispanics in Toronto. *Antipode*, *45*(3), 641–662. https://doi.org/10.1111/j.1467-8330.2012.01019.x

Grønhøj, A., & Thøgersen, J. (2017). Why young people do things for the environment: The role of parenting for adolescents' motivation to engage in pro-environmental behaviour. *Journal of Environmental Psychology*, *54*, 11–19. http://doi.org/10.1016/j.jenvp.2017.09.005

Griffin, L. K., Adams, N., & Little, T. D. (2017). Self determination theory, identity development, and adolescence. In M. L. Wehmeyer, K. A. Shogren, T. D. Little, & S. J. Lopez (Eds.), *Development of self-determination through the life-course* (pp. 189–196). Springer Science + Business Media. https://doi.org/10.1007/978-94-024-1042-614

Harmon-Jones, C., Bastian, B., & Harmon-Jones, E. (2016). The discrete emotions questionnaire: A new tool for measuring state self-reported emotions. *PLOS ONE*, *11*(8), Article e0159915. https://doi.org/10.1371/journal.pone.0159915

Hayes, K., Blashki, G., Wiseman, J., Burke, S., & Reifels, L. (2018). Climate change and mental health: Risks, impacts and priority actions. *International Journal of Mental Health Systems*, *12*(1), 1–12. https://doi.org/10.1186/s13033-018-0210-6

Hickman, C., Marks, E., Pihkala, P., Clayton, S., Lewandowski, R. E., Mayall, E. E., Wray, B., Mellor, C., & van Susteren, L. (2021). Climate anxiety in children and young people and their beliefs about government responses to climate change: A global survey. *The Lancet: Planetary Health*, *5*(12), e863–e873. https://doi.org/10.1016/S2542-5196(21)00278-3

Hufnagel, E. (2017). Attending to emotional expressions about climate change: A framework for teaching and learning. In D. P. Shepardson, A. Roychoudhury, & A. S. Hirsch (Eds.), *Teaching and learning about climate change* (pp. 43–55). Routledge. https://doi.org/10.4324/9781315629841-4

Intergovernmental Panel on Climate Change. (2022). Summary for policymakers. In H.-O. Pörtner, D. C. Roberts, M. Tignor, E. S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, & B. Rama (Eds.), *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 3–33). Cambridge University Press.

Kaplan, H., & Madjar, N. (2015). Autonomous motivation and pro-environmental behaviours among Bedouin students in Israel: A self-determination theory perspective. *Australian Journal of Environmental Education*, *31*(2), 223–247. https://doi.org/10.1017/aee.2015.33

La Guardia, J., & Ryan, R. (2002). What adolescents need. In T. Urdan & F. Pajares (Eds.), *Academic motivation of adolescents* (pp. 193–218). Information Age Publishing.

Larson, R. W., Moneta, G., Richards, M. H., & Wilson, S. (2002). Continuity, stability, and change in daily emotional experience across adolescence. *Child Development*, *73*(4), 1151–1165. https://doi.org/10.1111/1467-8624.00464

Loria, K. (2018, August 30). Scientists calculated a "point of no return" for dealing with climate change—And time is running out. *Business Insider*. https://www.businessinsider.nl/global-warming-point-of-no-return-temperature-2018-8?international=true&r=US

Mah, A. Y., Chapman, D. A., Markowitz, E. M., & Lickel, B. (2020). Coping with climate change: Three insights for research, intervention, and communication to promote adaptive coping to climate change. *Journal of Anxiety Disorders*, *75*, Article 102282. https://doi.org/10.1016/j.janxdis.2020.102282

Martela, F., Hankonen, N., Ryan, R. M., & Vansteenkiste, M. (2021). Motivating voluntary compliance to behavioural restrictions: Self-determination theory–based checklist of principles for COVID-19 and other emergency communications. *European Review of Social Psychology*, *32*, 305–347. https://doi.org/10.1080/10463283.2020.1857082

McCue, R., McCormack, T., McElnay, J., Alto, A., & Feeney, A. (2019). The future and me: Imagining the future and the future self in adolescent decision making. *Cognitive Development*, *50*, 142–156. https://doi.org/10.1016/j.cogdev.2019.04.001

Mock, B. (2017, February 27). The green movement is talking about racism? It's about time. *Outside*. https://www.outsideonline.com/2142326/environmentalism-must-confront-its-social-justice-sins

Moeller, J., Brackett, M. A., Ivcevic, Z., & White, A. E. (2020). High school students' feelings: Discoveries from a large national survey and an experience sampling study. *Learning and Instruction*, *66*, Article 101301. https://doi.org/10.1016/j.learninstruc.2019.101301

Moser, S. C. (2007). More bad news: The risk of neglecting emotional responses to climate change information. In S. C. Moser & L. Dilling (Eds.), *Creating a climate for change: Communicating climate change and facilitating social change* (pp. 64–80). Cambridge University Press. https://doi.org/10.1017/CBO9780511535871.006

Myers, T. A., Nisbet, M. C., Maibach, E. W., & Leiserowitz, A. A. (2012). A public health frame arouses hopeful emotions about climate change. *Climatic Change*, *113*(3), 1105–1112. https://doi.org/10.1007/s10584-012-0513-6

Nurmi, J. E. (1991). How do adolescents see their future? A review of the development of future orientation and planning. *Developmental Review*, *11*(1), 1–59. https://doi.org/10.1016/0273-2297(91)90002-6

Oberauer, K., Schickl, M., Zint, M., Liebhaber, N., Deisenrieder, V., Kubisch, S., . . . Keller, L. (2023). The impact of teenagers' emotions on their complexity thinking competence related to climate change and its consequences on their future: Looking at complex interconnections and implications in climate change education. *Sustainability Science*, *18*, 907–931. https://doi.org/10.1007/s11625-022-01222-y

Ogunbode, C. A., Doran, R., Hanss, D., Ojala, M., Salmela-Aro, K., van den Broek, K. L., . . . Karasu, M. (2022). Climate anxiety, wellbeing and pro-environmental action: Correlates of negative emotional responses to climate change in 32 countries. *Journal of Environmental Psychology*, *84*, Article 101887. https://doi.org/10.1016/j.jenvp.2022.101887

Ojala, M. (2013). Emotional awareness: On the importance of including emotional aspects in education for sustainable development (ESD). *Journal of Education for Sustainable Development*, *7*(2), 167–182. https://doi.org/10.1177/0973408214526488

Ojala, M. (2015). Hope in the face of climate change: Associations with environmental engagement and student perceptions of teachers' emotion communication style and future orientation. *The Journal of Environmental Education*, *46*(3), 133–148. https://doi.org/10.1080/00958964.2015.1021662

Ojala, M. (2023). Climate-change education and critical emotional awareness (CEA): Implications for teacher education. *Educational Philosophy and Theory*, *55*, 1109–1120. https://doi.org/10.1080/00131857.2022.2081150

Ojala, M., & Bengtsson, H. (2019). Young people's coping strategies concerning climate change: Relations to perceived communication with parents and friends and proenvironmental behavior. *Environment and Behavior*, *51*(8), 907–935. https://doi.org/10.1177/0013916518763894

Otto, S., Evans, G. W., Moon, M. J., & Kaiser, F. G. (2019). The development of children's environmental attitude and behavior. *Global Environmental Change*, *58*, Article 101947. https://doi.org/10.1016/j.gloenvcha.2019.101947

Pelletier, L. G., Baxter, D., & Huta, V. (2011). Personal autonomy and environmental sustainability. In V. I. Chirkov, R. M. Ryan, & K. M. Sheldon (Eds.), *Human autonomy in cross-cultural context: Perspectives on the psychology of agency, freedom, and well-being* (pp. 257–277). Springer Science + Business Media. https://doi.org/10.1007/978-90-481-9667-8_12

Pelletier, L. G., Tuson, K. M., Green-Demers, I., Noels, K., & Beaton, A. M. (1998). Why are you doing things for the environment? The motivation toward the environment scale (MTES) 1. *Journal of Applied Social Psychology*, *28*(5), 437–468. https://doi.org/10.1111/j.1559-1816.1998.tb01714.x

Raccanello, D., Brondino, M., Crescentini, A., Castelli, L., & Calvo, S. (2022). A brief measure for school-related achievement emotions: The Achievement Emotions Adjective List (AEAL) for secondary students. *European Journal of Developmental Psychology*, *19*(3), 458–476. https://doi.org/10.1080/17405629.2021.1898940

Ragavan, M. I., Marcil, L. E., Philipsborn, R., & Garg, A. (2021). Parents' perspectives about discussing climate change during well-child visits. *The Journal of Climate Change and Health*, *4*, Article 100048. https://doi.org/10.1016/j.joclim.2021.100048

Reis, H. T., Sheldon, K. M., Gable, S. L., Roscoe, J., & Ryan, R. M. (2000). Daily well-being: The role of autonomy, competence, and relatedness. *Personality and Social Psychology Bulletin*, *26*(4), 419–435. https://doi.org/10.1177/0146167200266002

Reitsema, A. M., Jeronimus, B. F., van Dijk, M., & de Jonge, P. (2022). Emotion dynamics in children and adolescents: A meta-analytic and descriptive review. *Emotion*, *22*(2), 374–396. https://doi.org/10.1037/emo0000970

Rodríguez-Meirinhos, A., Antolín-Suárez, L., Brenning, K., Vansteenkiste, M., & Oliva, A. (2020). A bright and a dark path to adolescents' functioning: The role of need satisfaction and need frustration across gender, age, and socioeconomic status. *Journal of Happiness Studies*, *21*(1), 95–116. https://doi.org/10.1007/s10902-018-00072-9

Roth, G., Vansteenkiste, M., & Ryan, R. M. (2019). Integrative emotion regulation: Process and development from a self-determination theory perspective. *Development and Psychopathology*, *31*(3), 945–956. https://doi.org/10.1017/S0954579419000403

Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. The Guilford Press. https://doi.org/10.1521/978.14625/28806

Sanson, A. V., Van Hoorn, J., & Burke, S. E. (2019). Responding to the impacts of the climate crisis on children and youth. *Child Development Perspectives*, *13*(4), 201–207. https://doi.org/10.1111/cdep.12342

Simmons, D. (2022, August 12). How to talk with kids about climate change. *Yale Climate Connections*. https://yaleclimateconnections.org/2020/08/how-to-talk-with-kids-about-climate-change/

Steinberg, L. (2015). How to improve the health of American adolescents. *Perspectives on Psychological Science*, *10*(6), 711–715. https://doi.org/10.1177/1745691615598510

Syed, M., Santos, C., Yoo, H. C., & Juang, L. P. (2018). Invisibility of racial/ethnic minorities in developmental science: Implications for research and institutional practices. *American Psychologist*, *73*(6), 812–826. https://doi.org/10.1037/amp0000294

Thiery, W., Lange, S., Rogelj, J., Schleussner, C. F., Gudmundsson, L., Seneviratne, S. I., Andrijevic, M., Frieler, K., Emanuel, K., Geiger, T., Bresch, D. N., Zhao, F., Willner, S. N., Büchner, M., Volkholz, J., Bauer, N., Chang, J., Ciais, P., Dury, M., . . . Wada, Y. (2021). Intergenerational inequities in exposure to climate extremes. *Science*, *374*(6564), 158–160. https://doi.org/10.1126/science.abi7339

Thomaes, S., Sedikides, C., van den Bos, N., Hutteman, R., & Reijntjes, A. (2017). Happy to be "me?" Authenticity, psychological need satisfaction, and subjective well-being in adolescence. *Child Development*, *88*(4), 1045–1056. https://doi.org/10.1111/cdev.12867

United Nations Children's Fund. (2021). *The climate crisis is a child rights crisis: Introducing the Children's Climate Risk Index*. https://www.unicef.org/reports/climate-crisis-child-rights-crisis

United Nations Educational, Scientific and Cultural Organization. (2020, October 4). *Climate change education*. https://www.

unesco.org/en/education/sustainable-development/climate-change?TSPD_101_R0=080713870fab2000bf780b310a1a70ceb3f9443e842fc880a072a974c8155542823d26725e806eea08cdc420a7143000ad585e98bed06680c8bb1c5468e8fd34d9e1fcbdde964ff8d56b6a6cbd2785162e8f1429e4524a0e7a55b5daf75c5ce1

United Nations Educational, Scientific and Cultural Organization & United Nations Environment Programme. (2016). *YouthXchange: Green skills and lifestyles guidebook*. https://wedocs.unep.org/bitstream/handle/20.500.11822/8641/-YouthXchange_guidebook_series_Green_skills_and_lifestyles-2016youthXchange_green_skills.pdf.pdf?sequence=2&isAllowed=y

Vansteenkiste, M., & Ryan, R. M. (2013). On psychological growth and vulnerability: Basic psychological need satisfaction and need frustration as a unifying principle. *Journal of Psychotherapy Integration*, *23*(3), 263–280. https://doi.org/10.1037/a0032359

Vansteenkiste, M., Simons, J., Lens, W., Sheldon, K. M., & Deci, E. L. (2004). Motivating learning, performance, and persistence: The synergistic effects of intrinsic goal contents and autonomy-supportive contexts. *Journal of Personality and Social Psychology*, *87*(2), 246–260. https://doi.org/10.1037/0022-3514.87.2.246

Verlie, B., Clark, E., Jarrett, T., & Supriyono, E. (2021). Educators' experiences and strategies for responding to ecological distress. *Australian Journal of Environmental Education*, *37*(2), 132–146. https://doi.org/10.1017/aee.2020.34

Vollebergh, W. A., Iedema, J., & Raaijmakers, Q. A. (2001). Intergenerational transmission and the formation of cultural orientations in adolescence and young adulthood. *Journal of Marriage and Family*, *63*(4), 1185–1198. https://doi.org/10.1111/j.1741-3737.2001.01185.x

Williams, G. C., Cox, E. M., Kouides, R., & Deci, E. L. (1999). Presenting the facts about smoking to adolescents: Effects of an autonomy-supportive style. *Archives of Pediatrics & Adolescent Medicine*, *153*(9), 959–964. https://doi.org/10.1001/archpedi.153.9.959

Wu, J., Snell, G., & Samji, H. (2020). Climate anxiety in young people: A call to action. *The Lancet. Planetary Health*, *4*(10), e435–e436. https://doi.org/10.1016/S2542-5196(20)30223-0

Wullenkord, M. (2020). Climate change through the lens of Self-Determination Theory: How considering basic psychological needs may bring environmental psychology forward. *Zeitschrift Umweltpsychologie*, *24*(2), 110–129.

Wullenkord, M. C., & Reese, G. (2021). Avoidance, rationalization, and denial: Defensive self-protection in the face of climate change negatively predicts pro-environmental behavior. *Journal of Environmental Psychology*, *77*, Article 101683. https://doi.org/10.1016/j.jenvp.2021.101683

Yu, C., Li, X., Wang, S., & Zhang, W. (2016). Teacher autonomy support reduces adolescent anxiety and depression: An 18-month longitudinal study. *Journal of Adolescence*, *49*, 115–123. https://doi.org/10.1016/j.adolescence.2016.03.001