



OK Boomer: A decade of generational differences in feelings about climate change

Janet K. Swim^{*}, Rosemary Aviste, Michael L. Lengieza, Carlie J. Fasano

The Pennsylvania State University, USA

ARTICLE INFO

Keywords:

Intergenerational justice
Climate change engagement
Discussing climate change
Climate emotions
Climate change impacts

ABSTRACT

The emergence of concern about and evidence of climate change has been argued to create a cultural milieu unique to the Millennial generation (born between 1981 and 1996) and iGeneration (aka iGens or Generation Z born after 1997). The present research tested a) claims of unique angst about climate change among younger versus older generations, b) growing generational discrepancies over time in emotions about climate change, c) generational differences for several emotions about climate change, and d) the implications of these emotions for motivating people to discuss climate change with others, potentially aiding coping with climate change and facilitating action to address climate change. Survey data gathered from 2010 to 2019 of a representative sample of United States residents ($N = 22,468$) document greater increases in worry about climate change and, to a lesser degree, anger and guilt about climate change, within the two youngest generations relative to changes among Generation X, Baby Boomers, and the Silent and Greatest Generations. Although generational differences were small and suggest overstatements of unique effects for younger generations, increases in younger generations' emotions transform into the two youngest generations reporting the strongest emotions in 2019. Over ten years, these differential shifts in emotions explain more substantial increases in the frequency of discussing climate in the youngest generations.

1. Introduction

"OK Boomer" is a meme that swept the internet in 2019, capturing the Millennial generation's and iGeneration's frustrations with the Boomer generation (Lorenz, 2019; Romano, 2019). Ironically, this meme mirrors Boomer's frustrations with older generations in the 1960s, captured by the 1960's phrase, "Don't trust anyone over 30" (Raasch, 2014; Kaines, 2018). As expressed from the younger generation to the older generation, the general sentiment is frustration about how older generations' actions impact and constrain younger generations. Today, a central topic of concern for more youthful generations is climate change, with younger generations being frustrated about older generations' failure to acknowledge and address threats from climate change (Mezzofiore, 2019; Romano, 2019).

At the core of the current intergenerational frustrations is the implication that there is a difference in how younger and older generations feel about climate change. Understanding these feelings is critical for at least two reasons. First, feelings are psychological impacts of climate change connected to individual wellbeing. Most research on

psychological impacts of climate change is based upon the trauma experienced after major events such as wildfires or hurricanes (Manning and Clayton, 2018). Yet, eco-anxiety, specifically climate change anxiety, illustrates that climate change can threaten wellbeing without direct experience with natural disasters (Clayton and Karazsia, 2020; Ojala et al., 2021). These threats to wellbeing are suggested by accounts of angst experienced by younger generations. Research is needed to understand the prevalence of emotional reactions to climate change and to document whether younger generations' emotional wellbeing is being particularly threatened by climate change. Second, emotions can potentially prompt behavioral responses to climate change. One such behavior is discussing climate change with others. Talking with others can help people cope with stress (Taylor, 2006; Fogarty et al., 2015; Biringer et al., 2016) and motivate and support climate action (Swim et al., 2018).

The purpose of the present research is to understand better the breadth and depth of generational differences (aka cohorts) in feelings about climate change by a) testing the possibility of differences between the youngest generations' and several older generations' feelings about

^{*} Corresponding author at: Penn State University, 140 Moore Building, University Park, PA 16801, USA.

E-mail address: jswim@psu.edu (J.K. Swim).

<https://doi.org/10.1016/j.gloenvcha.2022.102479>

Received 22 July 2021; Received in revised form 17 January 2022; Accepted 25 January 2022

Available online 4 February 2022

0959-3780/© 2022 Elsevier Ltd. All rights reserved.

climate change, b) placing intergenerational differences within the context of period effects, c) testing generational differences in a variety of emotions about climate change, and d) linking intergenerational differences in emotions to intergenerational differences in behavioral engagement in the form of discussing climate change with friends and family.

2. Generational effects

The emergence of concern about and evidence of climate change has been argued to create a cultural milieu unique to the Millennial generation (born between 1981 and 1996) and iGeneration (aka iGens or Generation Z, born 1997 or later). For example, in 2010, the YOUNGO (the Youth Constituency to the United Nations Framework Convention on Climate change) declared that climate change would define the generation of youth (Wayback Machine, 2011), which, at that time, would have mostly been Millennials. Particularly salient events illustrate the emergence of climate change as a dominant presence during most of the lives of younger generations. For example, two significant climate-related historical events occurred when the Millennials were between the ages of nine and 25: Hurricane Katrina (2005) and the release of the influential climate change movie, *Inconvenient Truth* (2006). Perhaps particularly relevant for those in the United States, these and other significant events could have shaped Millennials' perspectives because they would not have lived in a world where climate change was not an ever-present part of their existence. Climate change events may similarly define iGens. The oldest iGens were eight when Hurricane Katrina hit Louisiana. Climate change has also become increasingly salient, with repeated record-breaking impacts (USGCRP, 2017). The specific effect on iGens is suggested by youth leaders of recent climate change protests. These leaders include Jamie Margolin, who started "Zero Hour" in Seattle in 2017 and, perhaps most famously, Greta Thunberg, who led school climate strikes in 2018, both of whom gained prominence when they were 15 years old (Marris, 2019). The similarity in the relevance of climate change for Millennials and iGens (Generation Z) led Ross and Rouse (2020) to combine these two groups and call them the MillZ generation.

While accounts of an emerging generational outcry of younger people's concern about climate change suggest generational differences in emotional response to climate change, they do not measure it. For example, when presented with losses from climate change, Gray et al. (2019) found neither generational nor age differences in perceived severity of climate change, suggesting that there would be no generational or age differences in emotional response to climate change. Yet, the lack of effect of age and generation differences may be because of their study design. They may have minimized differences in assessment of climate change impacts by presenting them with the same data about the effects of climate change. Research is needed to validate proposed generational differences and, if present, track changes in emotional responses to climate change. From a practical point, this tracking could contribute to developing trajectories of climate change mental health consequences.

3. Period effects

A period effect is an event during a particular point in time that equally affects all group members. It is critical to document changes over time when considering generational effects to consider the possibility of period effects that may have influenced all generations. For example, the purported rising concern among younger generations might be less distinct than it appears because it is embedded within general increases in climate concern. From 2001 to 2019, there was an upward trend in people in the United States reporting worrying a great deal about climate change from 2001 to 2019, with the most worry reported between 2016 and 2019 (Gallop, 2020). During the latter period, polls also revealed an increasing percentage of people worldwide reporting that

climate change is a very serious problem (Funk et al., 2020). Moreover, from 2009 to 2018, New Zealanders have increased their beliefs about climate change (Milfont et al., 2021). Critically for the consideration of generational differences, the rate of increase in beliefs in New Zealanders did not differ across five birth cohorts – the youngest generation corresponded to Millennials. Additionally, it is not just youth who have been raising alarms. While Greta Thunberg led school strikes, Millions of people of all ages and across the globe participated in climate change strikes (Schiermeier et al., 2019).

In the present research, we examined temporal change and generational differences in emotions and the possibility of differences in temporal change across generations. It is possible that what may be perceived as heightened youth concern about climate change might not be as unique to the younger generations as it appears. If this is the case, there may only be a temporal change in emotions.

4. Emotional engagement

At the core of claimed intergenerational frustrations is the implication that there is a difference in how younger versus older generations feel about climate change. Emotions about climate change can be markers of psychological wellbeing (Doherty and Clayton, 2011; Manning and Clayton, 2018) and motivate climate action (Rees and Bamberg, 2014). Moreover, it can be informative to examine different types of climate change emotions. Accounts of climate change emotions are often limited to reflections emerging anxiety, concern, worry, or, more generally, angst. But one could also study emotions such as hope, anger, and guilt. Different emotions suggest different appraisals of climate change, provide different explanations for why people respond to the threat, and vary in their ability to predict action to address the threat of climate change (e.g., Swim & Bloodhart, 2015). Thus, a fuller understanding of intergenerational climate change emotions would consider different types of emotions.

4.1. Worry

Worry reflects concern about future events or threats (American Psychological Association, 2020b). While not diagnostic of a mental health disorder, worrying about climate change can be a part of climate anxiety – a mental health consequence of climate change (Clayton and Karazsia, 2020). Given the projected increased frequency and extremity of climate change events (USGCRP, 2017), logically, younger generations would be more worried than older generations because they will more likely be alive for more of the worst impacts. Alluding to the particular relevance of worry to younger generations, many popular press articles and opinion pieces focus on climate change anxiety and angst among youth (Bornstein, 2019; Guardian Labs, 2020; Wu, Snell, and Samji, 2020). Consistent with these claims, climate change is a more significant source of stress for iGens than older generations (American Psychological Association, 2018), and polling data indicate that those under 35 are the most worried about climate change (Reinhart, 2018).

4.2. Anger

Noting that others are not responding to climate change can be understood as an ethical violation of unequal distribution of climate change impacts and not fulfilling responsibilities to address the harms (Hayward, 2012). Moral violations can produce anger in the form of moral outrage (Batson, Chao, and Givens, 2009; Thomas and McGarty, 2009). Moral violations against one's in-group can be a particularly strong predictor of anger (aka moral outrage, Batson et al., 2009). Recent youth protests highlight intergenerational injustices (Marris, 2019) – where younger generations will be the most impacted by climate change and the most defenseless against its impacts (Sanson, Hoorn, and Burke, 2019). Thus, younger generations may be most likely to feel anger about climate change.

4.3. Disgust

Though we know no direct research on the topic, research suggests that disgust could emerge when thinking about climate change. Like anger resulting from others' moral violations, those highly involved with the environment report being motivated by their feelings of disgust toward those they perceive as environmentally irresponsible (Jia et al., 2017). Moreover, when liberals and conservatives think about air and water pollution, they report feelings of disgust, support for environmental legislation, and belief in climate change (albeit disgust only mediated the relation between thoughts and pro-environmental attitudes; Wolsko et al., 2016). Thus, like anger, with more discussions about climate change as an intergenerational justice problem (Mezzofiore, 2019; Romano, 2019), the moral issue could create feelings of disgust, especially within younger generations.

4.4. Guilt

Guilt is felt in response to accepting responsibility for a moral violation, including personal responsibility or in-group's responsibility for climate change (Ferguson and Branscombe, 2010). An increase in Americans, albeit mostly Democrats, who believe that climate change should be a top priority (Asian Society Policy Institute & Data for Progress, 2020) suggests an increasing sense of responsibility to address climate change and correspondingly more guilt. Assertions of intergenerational justice, perhaps made mainly by younger generations blaming older generations (Mezzofiore, 2019; Romano, 2019), might mean that older generations are more likely to accept responsibility for climate change and, hence, also to feel the most guilt.

4.5. Hope

There is emerging literature on the importance of hope on climate change action (Geiger et al., 2019), including research indicating that hope influences coping responses among youth (Ojala, 2012; 2015). Hope could be opposite to worry – worried people may feel less hopeful. Yet, some past research has shown that worry and hope about climate change are positively correlated (Smith and Leiserowitz, 2014). This positive association may be because lay definitions of hope refer to optimism, wishes, wants, and desires (Malle, 2004). As climate change evidence increases, all may have stronger desires for a different future, with younger generations possibly feeling this more strongly because they will be the generation most likely to be alive in that future. Further, Fisher (cited in Marriss, 2019) has described the youth climate movement as providing a feedback loop with action begetting more action. Increasing notable forms of youth engagement could signal that they are experiencing greater hope.

4.6. Interest

Although interest may not be considered an emotion, it suggests a lack of boredom. Boredom is an emotion that can convey something is perceived as too easy, too hard, or lacking meaning (Westgate and Wilson, 2018). Those who report being alarmed and concerned about climate change are particularly likely to display interest in climate change (Swim & Geiger, 2017). Thus, as suggested by the research reviewed above, one might anticipate that those who indicate stronger emotions of climate change over time would also display greater interest in the topic.

5. Discussing climate change

We use interpersonal discussions with friends and family members as a potential marker of coping with climate change via social support and a basis for future climate action. Classically, coping with stress was thought to be either a “fight or flight” response. Yet, an additional way to

cope with stress is to affiliate with others, sometimes termed “tending and befriending” (Taylor, 2006). Discussing climate change with others can provide social support, even if some discussions lead to meaning-focused or problem-focused coping, and other discussions lead to deemphasizing the threat of climate change (Ojala and Bengtsson, 2019). Discussing climate change also has many collectively relevant outcomes, including making an issue publicly salient, teaching climate science, motivating others to speak, and being a precursor to coordinated collective action (Swim et al., 2018). Notable recent climate change activism in youth suggests that they may, as of late, be particularly likely to talk about climate change (Long, 2019; Sabherwal et al., 2021).

Increasing concern about climate change suggests people may result in increasing desire for social support (Taylor, 2006). Tend and befriend is a response to stress, with stress typically associated with anxiety. Although not as frequently studied, other negatively experienced emotions such as anger and guilt can create stress and, as a result, also motivate a desire to seek social support from others (Wang, Wu, and Tian, 2018; Pederson and Faw, 2019).

Emotions might also contribute to a desire for climate change action, with talking with others being a precursor to or a form of climate action. Most popular press articles and opinion pieces have pointed to anxiety or angst to explain a recent surge in youth activism (Bornstein, 2019; Guardian Labs, 2020; Wu, Snell, and Samji, 2020). Further, worry and increasing worry (from age 10 to 19 in the years 2009 to 2018), about climate change is associated with greater political involvement (Sciberras & Fernando, 2021). Yet, other emotions may be as predictive or more predictive than anxiety and angst of discussing climate change when talking with others is a form of or precursor to collective action. Anger has been identified as a central motivator of collective behaviors (van Doorn et al., 2014; van Zomeren, 2013). Given that disgust (like anger) is a moral emotion tied to the lack of others taking on their responsibilities, disgust (like anger) may also be associated with more collective behaviors. Feelings of guilt, including guilt about one's contribution to climate change, may motivate undoing wrong behaviors (Ferguson and Branscombe, 2010). Hope could inspire action because it is similar to agency and efficacy and can facilitate reaching goals (Snyder, 2002; Roseman, 2011; Averill, Catlin and Chon, 2012; Feldman and Hart, 2016). Last, greater interest in climate change suggests greater involvement. With this greater involvement, greater tendencies to discuss climate change with others could emerge.

Changes in emotional engagement with climate change may provide insights into temporal and generational shifts in behavioral engagement with climate change. To the extent that there are generational differences in experiencing different emotions, and these emotions, in turn, predict talking with others as a means of coping with climate change, then generational differences in discussing climate change may be explained by generational differences in emotions about climate change. Moreover, if these generational differences in emotions increase over time, then generational differences in discussing climate change should also increase.

6. Present research

We analyzed ten years of data (from 2010 to 2019) collected from surveys of representative samples in the United States. We predicted that: (1) respondents would report greater intensity of emotions and frequency of discussing climate change over these ten years, (2) the increase in emotions and discussing climate change over time would be more substantial for younger generations, with the exception that the increases in guilt would be more robust for older generations; and (3) changes in emotions would explain temporal and generational changes in discussing climate change over time. The last prediction specifies mediation models. That is, temporal and generational differences, perhaps interactively, were predicted to be associated with emotions, and, subsequently, these emotions were predicted to be associated with

discussing climate change. This pattern would be demonstrated by indirect effects from survey year to frequency of climate change discussion via emotions about climate change.

6.1. Age and generation effects

Because generation and age are confounded, our predictions could have been described as age rather than generation effects. For example, as one gets older, the meaning of the future changes, potentially meaning that the distant future may be of more importance to younger than older people (Lomranz et al., 1986; McBride et al., 2021). Different meanings of the future could suggest linear effects across age. For example, although those under 35 are the most worried about climate change, those between 35 and 54 are more worried than those over 55 (Reinhart, 2018). If generational differences resulted from differences in concern about the future, then one might predict successive generational differences. This prediction differs from generational explanations that draw upon assumptions about Millennials and iGens sharing a unique cultural milieu, leading them to respond to climate change differently than older generations. Moreover, the view that the future is of less importance to older than younger people does not consider the possibility that, as people age, they may express greater concern for future generations (Maxfield et al., 2014), potentially enhancing older generation's concern about climate change.

While acknowledging confounds between generation and age, we focus on generation effects in the paper and present age effects in supplemental materials. First, we decided to focus on generational effects because the impetus for the research followed claims about younger age groups unique responses to climate change, often explicitly attributing such effects to generational effects (Wayback Machine, 2011; Hickman and Riemer, 2016; Long, 2019; Marris, 2019; Ross and Rouse, 2020; Hickman et al., 2021). Second, we treat generation as a categorical variable and test contrasts among the generations. This analysis strategy allows for the possibility of either linear or non-linear age effects being revealed by differences increasing across generations. Third, we present analyses of age effects and tests of generation effects controlling for age in supplemental materials. Fourth, we consider the possibility that age and generation effects may be because they are proxies for other predictors of emotions about climate change and discussing climate change. For example, temporal shifts in age or generational differences emotions and discussing climate change may reflect temporal shifts in age or generation differences in political orientation. Because of multiple possible co-occurring predictor variables, we treat analyses controlling for demographics (e.g., income) and political orientation as exploratory and report then in supplemental materials can account for results.

6.2. Method

We pre-registered our prediction and analyses with Open Science (osf.io/ybd5z). See supplemental materials for deviations from preregistration and exploratory analyses.

6.2.1. Sample

The data for this research was provided by the Yale Program on Climate Change Communication (YPCCC) in partnership with George Mason University's Center for Climate Change Communication. The data were collected online in self-administered surveys completed by US adults (age 18+) recruited using the Ipsos (formerly GfK) Knowledge-Panel®, a representative panel of US adults. While the survey was administered every year from 2009 to 2019, not every emotion was collected every year (see supplemental materials). The sample size was adjusted each year to align with US population changes. Data were weighted based upon sample weights provided by the Center for Climate Change Communication researchers to increase the representativeness of the sample to the US population. The exception was that 370 cases were not weighted for 2014 when participants were recruited to have

similar numbers of Republicans, Democrats, and Independents. These cases were not included in analyses.

We combined data from the “greatest” generation (those born before 1928, $n = 120$) and the Silent Generation ($N = 3019$) and combined iGens ($n = 378$) and Millennials ($n = 4510$) because of the small sample size for the Silent Generation and iGens. Combining iGens and Millennials conceptually fits descriptions of these two groups as living in a similar climate change cultural milieu (Ross and Rouse, 2020). Combining them filled a gap of missing data from 2009 to 2014 for iGens, whose members were not yet 18 years old during these years. Additionally, combining them eliminated iGens being represented by only one age group in the first year they could participate (i.e., 18 years who became eligible to participate in 2016), making generation in 2016 different from other generations that had multiple ages groups every year of the survey.

Before weighting, the mean ages for each generation by survey year were as follows: iGens and Millennials, $M = 24$ to 29; Generation X, $M = 39$ to 47; Baby Boomers $M = 54$ to 64; Greatest and Silent generation, $M = 72$ to 80. Standard deviations ranged from 3.62 to 6.06. (See supplemental materials for demographic details.) Across generations and years, respondents consisted of 11,300 men and 11,546 women. Before weighting data, except for 2010, the proportion of men versus women did not statistically differ across generations within each year. In 2010, more men (60%) than women (40%) were classified as Millennials. In other years, the gender discrepancies ranged from a low of 1.8% difference with more men than women in 2011 to 7.60% with more women than men in 2013, $X^2(9) = 25.91$, $p < 0.002$. They earned between “less than \$5,000” to \$250,000. Income increased every year with a mean equal to \$40,000 to 49,000 in 2010 to \$60,000 to \$74,999 in year 2019. There were also generational differences in income. iGens and Millennials and the Greatest and Silent generation were both in the \$40,000 to \$49,000 range, and Generation X and the Baby Boomers were in the \$50,000 to \$59,999 income range. Most had a high school degree or some college, but no college degree. The average education level was “some college, no degree,” and this classification did not change by year or cohort. Politically, most considered themselves “moderate, middle of the road” ($M = 0.14$, $SD = 1.07$ on a -2 very liberal to $+2$ very conservative scale). While always in this range, respondents became more conservative over time (from $M = 0.22$, $SD = 1.04$ in 2010 to $M = 0.09$, $SD = 1.10$ in 2019) and older generations were more conservative than each of the subsequent younger generations (iGens and Millennials, $M = 2.94$, $SD = 1.06$; Silent and greatest generation, $M = 0.29$, $SD = 1.08$).

6.3. Measures

6.3.1. Generation

Generations were derived from birth at the time of the survey and cutoffs defined by Pew Research Center (Dimock, 2019). The cutoffs birth years were as follows: iGens and Millennials: 1981 to 2012; Generation X: 1965 to 1980; Baby Boomers: 1946 to 1964; Silent and Greatest Generation: Before 1928 to 1945

6.3.2. Year

The surveys were taken two times a year. We recoded year so that there was one sample per year because the specific month the surveys were completed differed from year to year. Thus, two waves of surveys collected in one year were represented in the data, but they were coded as the same year. We treated year as a continuous variable because combining waves within a year allowed the data to represent response within a given year and represent a degree of temporal differences across years. This degree of difference is relevant for years where survey data were not collected. For example, data for guilt were not collected from 2014 to 2018. But we wanted to capture the difference between 2013 and 2019 as a six-year time interval rather than two different years.

6.3.3. Climate change emotions

Respondents rated emotions on four-point scales ranging from “not at all” (0) to “very” (3). Worry was indicated by responses to the question, “How worried are you about global warming?” Other emotions were indicated by answers to the question, “How strongly do you feel each of the emotions when you think about the issue of global warming?”: Afraid, Angry, Hopeful, Disgusted, Guilty, and Interested. We report results for worry and not for feeling afraid because worry was assessed in all the survey years (2009 to 2019) and feeling afraid was not available for every year worry, feeling worried and afraid were correlated, $r(22015) = 0.66$, $p < 0.001$, and the results for both were very similar. Hope was assessed in all years except 2012 and 2014. Anger was assessed in all years except 2012, 2014, and 2015. Guilt was assessed in all years except 2012, and 2014 through 2018. Interest was assessed in all years except 2012 and 2014.

6.3.4. Discussion climate change

Discussion about climate change was measured every year by asking respondents, “How often do you discuss global warming with your family and friends?” Possible responses were on a four-point scale ranging from “never” (0) to “often” (3).

6.4. Results

6.4.1. Overview

We regressed worry, anger, disgust, guilt, hope, interest, and discussing climate change onto year, as a continuous variable, and generation, as a dummy coded categorical variable. We followed up significant omnibus effects for generation and generation by year

interactions using estimated marginal means for main effects and the estimated marginal means of linear trends for each generation and their pairwise comparisons for interactions (using R package *emmeans*; Lenth, 2021). Last, we tested mediation and conditional mediation analyses to determine whether emotions help explain year and generation effects on discussing climate change.

6.4.2. Predicting emotions

Interactions for worry, anger, and guilt were all significant (see Fig. 1, Table 1). In the case of worry, even though all generations reported greater worry over time, iGens and Millennials displayed a significantly greater increase in worry over time than older generations. For anger, iGens and Millennials reported a rise in anger over time. This period effect was not significant for older generations. However, despite these generational differences and the significant interaction, the slopes by generation were not significantly different from each other. For guilt, iGens and Millennials reported a greater increase in guilt over time. This period effect was not significant for older generations.

We also tested the effect of generation within the earliest (2010) and latest year of the survey (2019) (see Table 1). In 2010, iGens and Millennials did not differ from most other generations. In 2019, iGens and Millennials reported the most worry, anger, and guilt, and the Silent Generation the least.

There was no interaction between year and generation for disgust, $F(3, 11062) = 2.02$, $p = .11$, $\eta_p^2 = 0.001$, hope, $F(3, 12377) = 0.77$, $p = .51$, $\eta_p^2 < 0.001$, or interest, $F(3, 12390) = 1.16$, $p = .32$, $\eta_p^2 < 0.001$, but there were other effects. There was a main effect of year for disgust, $F(1, 11068) = 5.11$, $p = 0.02$, $\eta_p^2 < 0.001$, such that overtime there was an increase in disgust, $\beta = 0.058$, $SE = 0.01$, $p = 0.002$. Similarly, a main

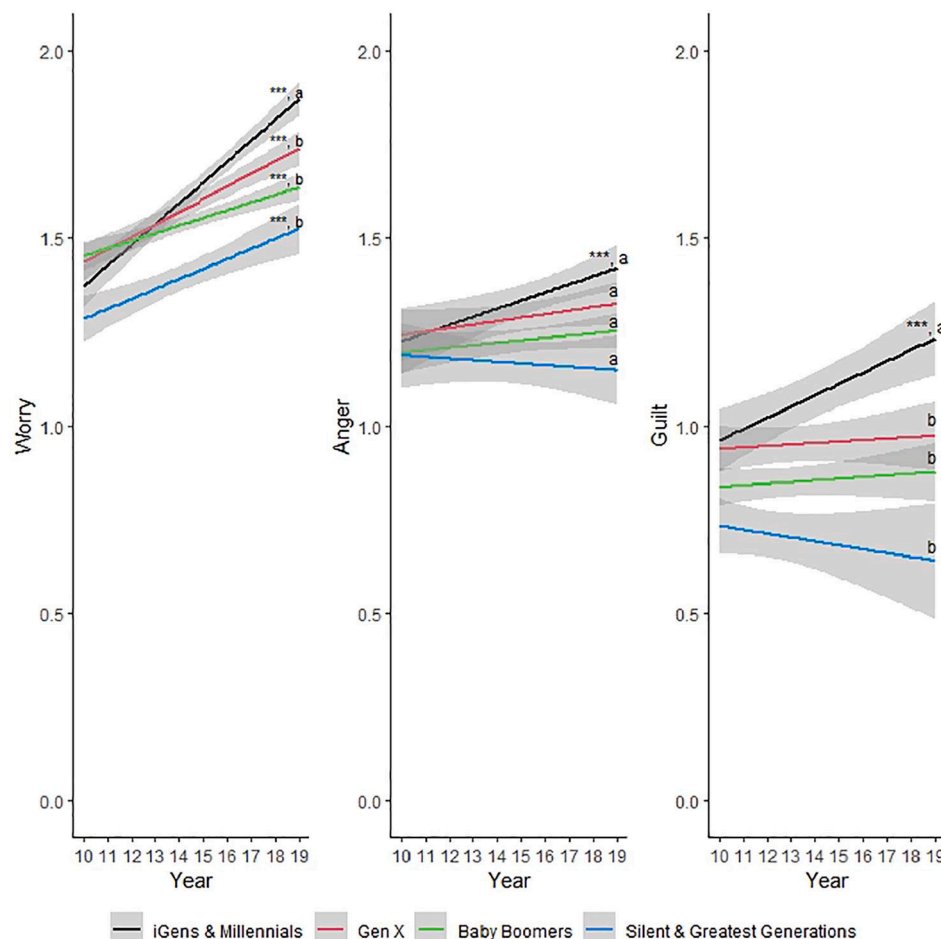


Fig. 1. Effect of year and generation on worry, anger, and guilt. Note: Emotions displayed range from 0 (not at all) to 2 (somewhat worried/moderate anger/guilt) rather than to 3 (very) for clarity in presenting patterns of effects. *** $p < 0.001$; superscripts indicate that slopes between generations differ at $p < 0.05$. Year \times Generation interactions: Worry, $F(3, 22769) = 8.36$, $p = 0.001$, $\eta_p^2 = 0.002$; Anger, $F(3, 11077) = 2.86$, $p = 0.04$, $\eta_p^2 = 0.001$; Guilt, $F(3, 5032) = 2.75$, $p = 0.04$, $\eta_p^2 = 0.002$, Climate Change Discussions, $F(3, 22769) = 4.60$, $p = 0.003$, $\eta_p^2 = 0.001$.

Table 1

Results of year by generation interactions predicting emotions.

| | Generation differences within year | | Year predicting emotions within generation | | | |
|---------------------|------------------------------------|---------------------------|--|-------|----------|-------|
| | Mean (SE)2010 | Mean (SE)2019 | β | SE | df | F |
| Worry | | | | | | |
| iGens & Millennials | 1.37 ^{ab} (0.02) | 1.87 ^a (0.02) | 0.16 ^a *** | 0.004 | 1, 22769 | 175.3 |
| Gen X | 1.44 ^a (0.02) | 1.74 ^b (0.02) | 0.10 ^b *** | 0.004 | 1, 22769 | 60.62 |
| Boomers | 1.45 ^a (0.02) | 1.64 ^c (0.02) | 0.06 ^b *** | 0.004 | 1, 22769 | 29.16 |
| Silent & Greatest | 1.29 ^{bc} (0.03) | 1.53 ^d (0.04) | 0.08 ^b *** | 0.01 | 1, 22769 | 15.56 |
| Anger | | | | | | |
| iGens & Millennials | 1.23 ^a (0.04) | 1.42 ^a (0.03) | 0.07 ^a *** | 0.01 | 1, 11077 | 13.7 |
| Gen X | 1.24 ^a (0.03) | 1.33 ^{ab} (0.03) | 0.03 ^a | 0.01 | 1, 11077 | 2.61 |
| Boomers | 1.20 ^a (0.03) | 1.25 ^b (0.03) | 0.02 ^a | 0.01 | 1, 11077 | 1.56 |
| Silent & Greatest | 1.19 ^a (0.05) | 1.15 ^b (0.05) | -0.01 ^a | 0.01 | 1, 11077 | 0.24 |
| Guilt | | | | | | |
| iGens & Millennials | 0.96 ^a (0.03) | 1.23 ^a (0.04) | 0.12 ^a *** | 0.01 | 1, 5032 | 23.08 |
| Gen X | 0.94 ^a (0.03) | .97 ^b (0.05) | 0.02 ^b | 0.01 | 1, 5032 | 0.35 |
| Boomers | 0.84 ^b (0.03) | .88 ^{bc} (0.04) | 0.02 ^b | 0.01 | 1, 5032 | 0.54 |
| Silent & Greatest | 0.73 ^b (0.04) | .64 ^c (0.09) | -0.04 ^b | 0.01 | 1, 5032 | 0.79 |
| Discuss Climate | | | | | | |
| iGens & Millennials | .86 ^a (0.02) | 1.10 ^a (0.02) | 0.03 ^a *** | 0.004 | 1, 22769 | 44.8 |
| Gen X | 1.01 ^b (0.02) | 1.10 ^a (0.02) | 0.01 ^b * | 0.004 | 1, 22769 | 5.42 |
| Boomers | 1.09 ^c (0.02) | 1.19 ^b (0.02) | 0.01 ^b ** | 0.004 | 1, 22769 | 9.66 |
| Silent & Greatest | 1.10 ^{bc} (0.03) | 1.15 ^{ab} (0.04) | 0.01 ^b | 0.01 | 1, 22769 | 0.90 |

Note: Subscripts for means indicate means and within each year and outcomes are different from each other at $p < 0.05$. Subscripts for slopes within generation and outcome indicate that the association between year and outcome are different from each other at $p < 0.05$.

effect of year for interest, $F(1, 12396) = 5.15$, $p = 0.02$, $\eta_p^2 < 0.001$, showed increases in interest overtime, $\beta = 0.056$, $SE = 0.01$, $p = 0.002$, but there was no main effect of year for hope, $F(1, 12383) = 1.25$, $p = .26$, $\eta_p^2 < 0.001$. There was no generation effect on disgust, $F(3, 11065) = 0.40$, $p = .75$, $\eta_p^2 < 0.001$, but there were main effects of generation on interest, $F(3, 12393) = 4.21$, $p = 0.01$, $\eta_p^2 = 0.001$, and hope, $F(3, 12380) = 8.26$, $p < 0.001$, $\eta_p^2 = 0.002$. Follow-up tests indicated no differences among the generations for interest, but the pattern of effects was such that the oldest generations was more interested in climate change than younger generations (iGens & Millennials, $M = 1.71$, $SE = 0.02$; Gen X, $M = 1.71$, $SE = 0.02$; Boomers, $M = 1.71$, $SE = 0.02$; Silent and Greatest Generations, $M = 1.74$, $SE = 0.03$). Contrary to predictions which were based upon equating hope with desire (Malle, 2004), generation effects indicated that iGens and Millennials ($M = 1.31$, $SE = 0.02$) were the least hopeful: iGens and Millennials were less hopeful than Boomers ($M = 1.37$, $SE = 0.01$), $p = 0.01$ and the Silent and Greatest Generations ($M = 1.42$, $SE = 0.03$), $p < 0.001$. Also suggestive greater hope in older generations, Gen X ($M = 1.33$, $SE = 0.02$) did not differ from iGens and Millennials, $p = .72$ and Boomers, $p = .23$, but were less hopeful than the Silent and Greatest Generations, $p = 0.01$. Boomers and the Silent and Greatest Generations did not differ from each other, $p = .29$.

6.4.3. Predicting discussing climate change

There were generational differences and temporal changes amid the tendency for all generations to talk rarely about climate change. An interaction between generation and year predicting discussing climate change revealed the associations were significant for all generations except the Silent and Greatest Generations and the greatest increase in discussing climate change among iGens and Millennials. However, despite the most substantial increase, iGens and Millennials were on average the least likely to discuss climate change in 2010 and 2019, albeit converging with Gen X in 2019 (see Fig. 2, Table 1)

6.4.4. Conditional mediation

Conditional mediation tested whether worry, anger, and guilt could explain the different effects of year by generation on discussing climate change (see Fig. 3; Table 2). Because of the pattern of generational

differences noted above, we dummy coded generation to compare iGens and Millennials with the older generations (Gen X, Boomers, Silent, and Greatest Generations). The model was tested using the Lavaan package in R (Rosseel, 2012), where generation moderated both the path from year to each emotion (Path a) and the path from year to discussing climate change (Path c). Replicating effects noted above, results suggest stronger effects of year for iGens and Millennials than other generations all three emotions (Path a). This stronger effect was confirmed by interactions between year and generation for worry, $\beta = 0.21$, $SE = 0.01$, $p < 0.001$, $CI [0.02, 0.04]$, and guilt, $\beta = 0.18$, $SE = 0.01$, $p = 0.01$, $CI [0.01, 0.05]$, but not anger, $\beta = 0.11$, $SE = 0.01$, $p = .10$, $CI [-0.003, 0.03]$. Each emotion was positively associated with discussing climate change (Path b). The indirect effects for all emotions were significant for iGens and Millennials, and the indirect effect was only significant for older generations when worry was the mediator. The index of moderation confirmed that the indirect effect via worry, $\beta = 0.09$, $SE = 0.002$, $p < 0.001$, $CI [0.01, 0.02]$, and guilt, $\beta = 0.04$, $SE = 0.002$, $p = 0.01$, $CI [0.002, 0.01]$, differed between iGens and Millennials versus older generations. Despite the effects for anger following the same pattern, the indirect effect of moderation indicated no difference between the indirect effects for iGens and Millennials versus older generations. The interaction between year and discussing climate change was not significant after accounting for the effects of worry, $\beta = 0.05$, $SE = 0.01$, $p = .27$, $CI [-0.01, 0.02]$, guilt, $\beta = 0.09$, $SE = 0.01$, $p = .17$, $CI [-0.01, 0.03]$, and anger, $\beta = 0.06$, $SE = 0.01$, $p = .35$, $CI [-0.01, 0.02]$ on discussing climate change.

6.4.5. Mediation analyses

Using the Lavaan package in R (Rosseel, 2012), we tested whether disgust and interest mediated the associations between year and discussing climate change, with these two emotions selected based on previous analyses showing associations with year. There was an increase in disgust over time, albeit the effect was marginal significant, $\beta = 0.02$, $SE = 0.004$, $p = 0.05$, 95% $CI [0.00, 0.02]$, and a positive association between disgust and discussing climate change, $\beta = 0.42$, $SE = 0.01$, $p < 0.001$, 95% $CI [0.34, 0.38]$. Additionally, there was a marginally significant indirect effect of year to discussing climate change through disgust, $\beta = 0.01$, $SE = 0.001$, $p = 0.05$, 95% $CI [0.00, 0.01]$. Both the

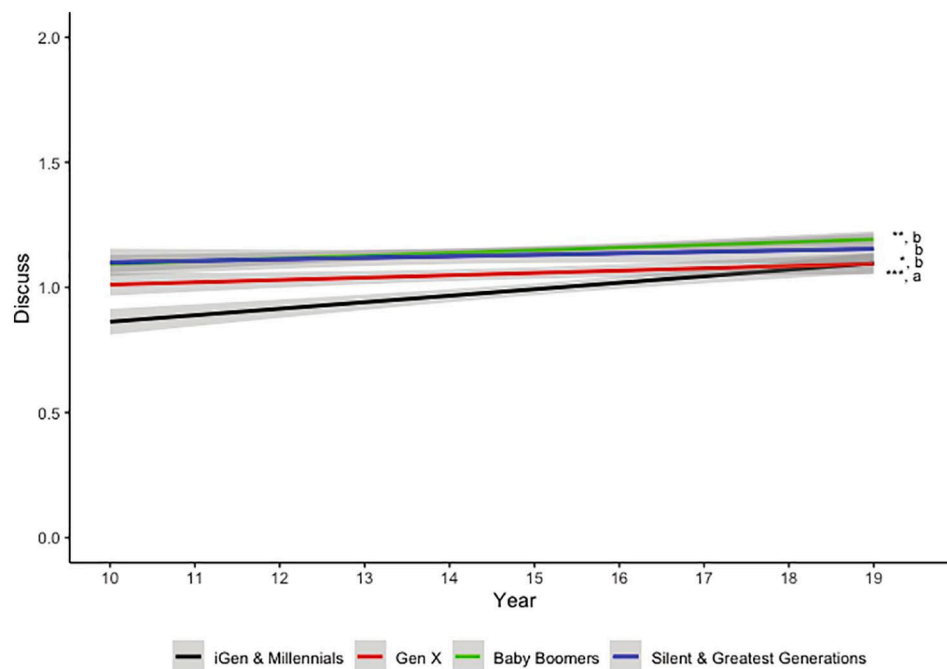


Fig. 2. Effect of year and generation on discussing climate change. Note: Displayed frequency of discussing climate change ranges from 0 (not at all) to 2 (occasionally) rather than to 3 (often) for clarity in presenting patterns of effects. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; superscripts indicate that slopes between generations differ at $p < 0.05$. Year \times Generation interaction: Climate Change Discussions, $F(322769) = 4.60$, $p = 0.003$, $\eta_p^2 = 0.001$.

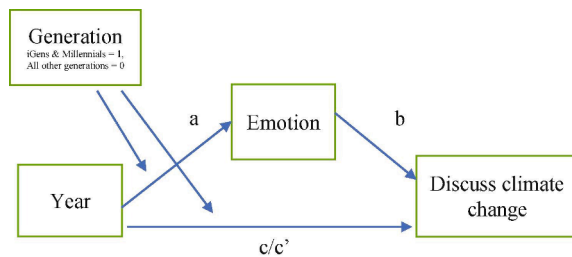


Fig. 3. Conditional mediation model.

total, $\beta = 0.04$, $SE = 0.003$, $p = 0.001$, 95% $CI [0.00, 0.02]$, and direct effects, $\beta = 0.03$, $SE = 0.003$, $p = 0.01$, 95% $CI [0.00, 0.01]$, from year to discussing climate change were significant. In contrast to what was noted above for interest that had included contrasts for generation within the analyses, there was no significant association between year and interest, $\beta = 0.02$, $SE = 0.004$, $p = 0.09$, 95% $CI [-0.00, 0.01]$ and hence, meditation was not supported.

Also using Lavaan package in R (Rosseel, 2012), we tested whether

interest and hope mediated the association between generation and discussing climate change, with these two emotions selected based on previous analyses showing associations with generation. As was done with the conditional mediation, generation was dummy coded to test the contrast between iGens and Millennials and all other generations. Consistent with the lack of support in follow-up tests comparing generation predicting interest noted above, this contrast was not associated with interest, $\beta = -0.02$, $SE = 0.03$, $p = .40$, 95% $CI [-0.07, 0.03]$ in the mediation models. Hence, the mediation model was not supported. In contrast and consistent with what was reported above, iGens and Millennials were least hopeful about climate change, $\beta = -0.03$, $SE = 0.02$, $p = 0.02$, 95% $CI [-0.10, -0.01]$ and hope was subsequently positively associated with discussing climate change, $\beta = 0.21$, $SE = 0.01$, $p < 0.001$, 95% $CI [0.19, 0.23]$. Further, the indirect effect of generation to discussing climate change through hope was significant, $\beta = -0.01$, $SE = 0.01$, $p = 0.02$, 95% $CI [-0.02, -0.002]$. Both the total, $\beta = -0.03$, $SE = 0.02$, $p = 0.004$, 95% $CI [-0.12, -0.02]$, and direct effects, $\beta = -0.03$, $SE = 0.02$, $p = 0.02$, 95% $CI [-0.09, -0.01]$, from generation to discussing climate change were significant.

Table 2
Conditional mediation for year by generation effects.

| Mediator | Path a (SE) | Path b (SE) | Total Path c (SE) | Direct Path c' (SE) | Indirect a \times b (SE) |
|---------------------|-----------------|----------------|----------------------|------------------------|-------------------------------|
| Worry | | | | | |
| iGens & Millennials | 0.17*** (0.01) | 0.43*** (0.01) | 0.09*** (0.01) | 0.02 (0.01) | 0.07*** (0.002) |
| Older Gens | 0.08*** (0.003) | 0.43*** (0.01) | 0.12*** (0.003) | -0.01 (0.003) | 0.04*** (0.001) |
| Anger | | | | | |
| iGens & Millennials | 0.07** (0.01) | 0.44*** (0.01) | 0.08** (0.01) | 0.04 (0.01) | 0.03** (0.003) |
| OlderGens | 0.02 (0.004) | 0.44*** (0.01) | 0.03* (0.004) | 0.02 (0.003) | 0.01 (0.002) |
| Guilt | | | | | |
| iGens & Millennials | 0.12*** (0.01) | 0.24*** (0.02) | 0.12** (0.01) | 0.08* (0.01) | 0.03** (0.002) |
| OlderGens | 0.02 (0.01) | 0.24*** (0.02) | 0.03 (0.01) | 0.02 (0.004) | 0.004 (0.001) |

Note: *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

7. Discussion

Amidst increasing public concern about climate change (Goldberg et al., 2020), our results are consistent with claims of increases in negative emotions in reference to climate change, most robustly worry, being particularly evident in younger generations. Correlations between emotions and frequency of discussing climate change are consistent with people seeking social support when feeling distressed (Taylor, 2006) and emotions motivating and climate change action (Rees and Bamberg, 2014). Conditional mediation analyses confirmed that generational differences in increased discussions could be accounted for by emotions, as illustrated by the combination of the association between generation and emotions and the subsequent association between emotions and discussing climate change (i.e., the indirect effects). Yet, while validating claims and confirming predictions, the strength of emotions and associations with emotions do not match the strength of assertions about the extent of emotional stress from climate change, stress motivating climate action, and these characteristics being a defining characteristic of younger generations.

7.1. Generational differences in climate change emotions

The most robust support for predicted interactions between generation and year was found for worry about climate change. Yet, the patterns of effects were the same for guilt and anger. Younger generations' worry, anger, and guilt about climate change increased from 2010 to 2019. In contrast, older generations had smaller increases in worry and no temporal changes in guilt and anger. We predicted that older generations would feel more guilt over time, perhaps because they have had longer to contribute to climate change or accept the publicized blame from younger to older generations. However, the results suggest that younger generations may accept personal contributions to climate change and not simply blame others, perhaps because they, like older generations, rarely take action to address climate change (Funk, 2021). They may have felt more guilty because they felt more worry but were simultaneously not taking personal action.

There is ambiguity as to generational differences in increases in anger. Like worry and guilt, the interaction between generation and year was significant for anger. Additionally, like results for guilt, the association between year and anger was significant for younger and not older generations. Yet, the association between year and anger for each generation did not differ from each other. It appears that the association within the younger generation between year and anger was weaker than the associations between year and worry and between year and guilt. This weaker association means that the distinction among younger and older generations is less evident for anger than worry and guilt.

It is potentially telling that by 2019, average worry was more substantial than average guilt and anger. Guilt and anger are considered moral emotions (Thomas and McGarty, 2009; Sheikh and Janoff-Bulman, 2010). Although some youth may think about climate change as a justice issue, a moral framing might not be as salient as the risk from climate change.

In contrast to predictions, younger generations reported less hope than older generations. This pattern could signal an overarching tendency to feel worse about climate change for all emotions. Yet, unlike worry, anger, and guilt, we did not find interactions between year and generation on hope. The lack of similarity may be because hope has multiple meanings (Gasper, Spencer, and Middlewood, 2019). Hope may have signaled optimism or efficacy rather than signaling desire as we anticipated based upon lay use of the term (Malle, 2004).

Results only partially supported predictions for disgust and interest. While disgust was stronger for younger generations, follow-up tests did not support distinctions among generations, and there was no effect for year on disgust. Perhaps, as suggested by the discussion of anger above, the moral framing of climate change may not be as salient to the public as other frames. Also, while interest increased over time, interest did not

differ by generation. Perhaps, interest was a more cognitive than affective measure and did not capture the emotions, particularly the angst, felt by younger generations.

7.2. Generational differences in discussing climate change

All generations infrequently discussed climate change and increases in discussion over time were small, albeit strongest for the youngest generations more than other generations. Moreover, in the last year of the survey, 2019, the youngest generations were less likely to discuss climate change than Boomers and as likely to discuss climate change as the remaining generations. The incongruity between greater worry but equal or less talking may be explained by the proposal that extrinsic values and endorsing individualism have risen more among younger than older generations (Twenge, Campbell and Freeman, 2012; Campbell et al., 2015). This proposal suggests younger generations endorse a "Me-Generation" orientation as reflected by increased self-focus (e.g., narcissism, materialism), less civic engagement, and other trends. Greater self-focus could account for stronger emotions about the effects of climate change, which will more assuredly impact their generation than older generations, while simultaneously accounting for less talking with others about climate change.

A second possible explanation for the incongruence between greater worry about climate change and but not greater talking about climate change by 2019 among the youngest generations relative to older generations is that the measure of frequency of talking may not have fully captured discussions about climate change: younger generations have decreased in-person peer interactions from 2000 to 2017 but have increased interactions via social media (Twenge, Spitzberg and Campbell, 2019). Younger generations may have been more likely than older generations to turn to social media with friends as a way of garnering social support (Quinn, 2019). The greater tendency for younger generations to use social media to engage with climate change could also be a source of their greater concern about climate change (Funk, 2021).

Even with these two explanations, it is notable that we predicted and found a greater increase in discussing climate change among younger than older generations. The consequence was that the mean frequency of discussion across generations converged in 2019. Moreover, the more considerable increase in discussing climate change for younger than older generations parallel the increase in worry, guilt, and possibly anger over time.

We anticipated that generation differences in emotions about climate change over time would explain changes in discussions about climate change over time. Although we cannot determine the motives for or the specific content of conversations about climate change, the stress implied by feeling worried, and perhaps also anger and guilt, suggests younger generations increasingly sought support as a means of coping with their increase in negative emotions. Although anger and guilt can signal stress (Wang, Wu, and Tian, 2018; Pederson and Faw, 2019), the connection between worry and wellbeing is more evident. Instead of contributing to climate change's negative mental health impacts, anger and guilt may be more critical for motivating collective action or reparative behavior, especially if these emotions reflect group-based emotions (van Zomeren et al., 2004; Ferguson and Branscombe, 2010; Rees and Bamberg, 2014; Bamberg, Rees and Seebauer, 2015). Thus, the more substantial indirect effect from generation to talking via worry than via anger and guilt with climate change suggests their conversations were more motivated by stress reduction, perhaps through meaning-making or emotion-focused coping, than a desire to take action (Ojala, 2012). However, the latter could emerge if the stress reduction comes in the form of problem-solving (Ojala, 2012).

7.3. Limitations and future research

One might assert that worry is not particularly strong, and the temporal increases are small, so worry might not signal harm from

climate change. Accepting this conclusion suggests that press attention to youth activism may be targeting a small portion of the population, not representative of the entire youth population. Small effects also mean that it could take a large sample, as we had here, to detect effects across all the population. Future research may want to differentiate among subgroups and moderators of generation effects. Examining profiles of worry among young Australians from 2009 to 2018, suggest that about half of these youth's climate change worry did not change as they aged, while just under a quarter either increased or decreased in worry (Sciberras & Fernando, 2021). Averaged together suggests little change over time for these youth. Yet, it would be informative to compare these within person changes with older generations, examine reasons for different patterns of change, and, examine correlates of change over time, as Sciberras and Fernando (2021) did. Further, drawing from social identity theory, Ross and Rouse (2020) demonstrate that the perceived importance of climate change increases the stronger iGens and Millennials identify with these generation groups. Thus, the generational effects found here might be more substantial among those with stronger generational identities or as they become more strongly identified with these groups. Also considering identity, Wallis and Loy (2021) demonstrate that having friends participate in the movement could explain youth participation in climate change protests. Extending this finding to the current research topic, generational differences in perceptions of friends' emotions might drive youth emotional response. The extent to which youth and their friends identify with climate activists may be critical.

Future research should attend to the health consequences of different amounts and types of negative emotions. Research indicates that even low levels of negative emotions can have negative repercussions, perhaps contributing to insomnia or cognitive impairments (Marques, 2013). Related to worry about climate change, recent research indicates a small but statistically significant association between concern about climate change and diminished clinical forms of psychological well-being a year after concern was measured (McBride et al., 2021). Also, worry about climate change adds to worry about other topics. National surveys indicate that from at least 2018 to 2020, there has been increasing stress in the US population, with the greatest stress being among iGens and climate change is one of their reported stressors (American Psychological Association, 2018, 2020a). Yet, Sciberras and Fernando (2021) research suggest that increasing in worry as one ages is not related to reported depressive symptoms while those whose worry persisted across time reported more depression symptoms than those with more moderate worry.

Even with mean worry not being intense, it is potentially telling that we find that respondents reported less hope than worry. Moreover, increased worry in all groups and not change in hope suggests that views of climate change in the future are becoming relatively more negative than positive. But the generational differences suggest this gap is growing more so for younger than older generations. These views are concerning because worry can contribute to the detrimental impacts of climate change on psychological wellbeing (Clayton and Karazsia, 2020; Ojala et al., 2021) and the possibility of diminished well-being over time (McBride et al., 2021). Thus, while, on average, respondents were not strongly worried, there was an increase in worry over the decade, and they were more worried than hopeful.

Small effects could be a result of methodological reasons. Small effect sizes could have resulted from the single item measures we used. Future research would benefit from more nuanced assessments of emotions which might strengthen the ability to detect relations between generations and emotions and provide a more nuanced understanding of findings. Research could specify the target of anger (e.g., anger due to inaction or, in contrast, too much attention to climate change), define hope (e.g., optimism or desire) (Gasper, Spencer, and Middlewood, 2019), and differentiate between personal and collective guilt (Ferguson and Branscombe, 2010). Future research could also take a more nuanced examination of the behavioral consequences of changes in emotions. It

would also be informative to know whether the content of conversations change over time or across generations. Content of conversations could assess whether emotion, problem, or meaning-based coping were supported (Ojala and Bengtsson, 2019). The greater increase in emotions in younger generations could help drive particular forms of civic engagement found among younger generations, such as volunteerism (Twenge, Campbell, and Freeman, 2012).

It may also be enlightening to know whether the increase in climate discussions was among friends versus various family members and to include discussions via social media. If they are seeking social support, younger generations may believe older generations do not understand their feelings, and given generational differences in emotion, they may not receive confirmation for their feelings when talking with their parents. However, suppose that social media provides less effective social support than in-person discussions. The advantages of discussions with peers may diminish if younger generations' discussions are primarily on social media. The content of intergenerational conversations could also be informative, with for example, with older generations learning from younger generations with the conversations potentially powerful when they are within families (Smyer, 2018; UNICEF, 2021).

Future research with more data over time could also potentially provide additional insights into generational effects. First, small effect sizes could result from combining data from iGens and Millennials. For example, the direction of effects was such that if iGens were more likely than Millennials to report stronger emotions and talk more about climate change (see supplemental materials). Second, we were unable to disentangle generation and age effects. With more years of data, future research might be able to separate findings for these two generations and disentangle confounds between generation and age effects. However, when we controlled for age (see supplemental materials), the only reduced effect was the association between generation and hope. This reduction in strength of association suggests that age effects are a viable alternative explanation for the effects of generation on hope about climate change but not other emotions.

We cannot rule out third variables for associations between generation and year on emotions. Our exploratory analyses controlling for demographics (see Supplemental Materials) suggest that younger generations being more politically liberal than older generations might account for the significant association between year and anger for younger than older generations. Yet controlling for political orientation and other demographics (e.g., education) did not alter other effects. We also cannot document generational differences are because younger generations' lives are more defined by climate change than older generations. For example, climate change may be one of many stressors perhaps particularly threatening to younger generations, such as school shootings and one of the most alarming historical examples of political polarization in the United States.

We cannot rule out reverse causation for the correlation between emotions and discussing climate change. Research on emotions suggests that emotions motivate actions (Ferguson and Branscombe, 2010; Van Doorn, Heerdink and Van Kleef, 2012; van Zomeren, 2013; Geiger et al., 2019). Yet research also suggests that discussions could accentuate emotions (Isenberg, 1986; van Zomeren et al., 2004). Thus, emotions and discussing climate change are likely mutually supportive, and bi-directional pathways are worth exploring.

Our results are limited to U.S. country respondents before the pandemic, economic crises, and other defining historical incidents in 2020. Country context may impact generational differences in emotions about climate change (Geiger, McLaughlin, and Velez, 2021). Polls indicate that concern about climate change has continued to increase in the US and several other countries through events of 2020 (Fagan and Huang, 2020). This increase could create greater spread or convergence across generations. Future research should track emotional responses to climate change, potentially adding psychological impacts to research projecting climate change impacts on humans under different climate change scenarios (Ebi, 2014). Data like that reported in the present

paper could be baseline data for comparisons in later years and comparisons across countries.

8. Conclusion

Amidst increasing public concern about climate change, differential generational shifts in emotions and discussions are emerging. Our results are consistent with and potentially validate claims that increases in negative emotions are especially evident in younger generations, albeit the strength of these negative emotions may not match the claims. These emotional impacts are concerning because they can contribute to the detrimental impacts of climate change on psychological wellbeing (Clayton and Karazsia, 2020; McBride et al., 2021). An increase in potentially problematic emotions is demonstrated most robustly for the emotion of worry for all generations and greater increases in worry for younger than older generations. It is potentially telling that worry is stronger than hope, suggesting more negative than positive visions of the future. The pattern of effects for worry, guilt, and potentially anger are similar, with increases in all three of these negative emotions occurring over time, most prominently within the youngest generations.

We suggest that increases in worry, guilt, and anger increase a desire to affiliate with others to cope with climate change. This explanation is consistent with greater increases in discussing climate change among younger generations than older generations, and worry, guilt, and anger mediating the relation between year and discussions with others for younger generations. Our results are also consistent with the media assertions that anxiety and angst drive current behavioral engagement about climate change among iGens and Millennials and reflect a rise in such engagement, albeit the outcomes we studied were talking with others and not these forms of collective action. Yet, increasing frequency of discussing climate change in younger generations did not lead them to be most likely to discuss it in 2019—the last year of the survey. These temporal changes could be because they are communicating via social media. We suggest that social connections are more indicative of coping with the stress of climate change than behavioral engagement in climate action: Mediation analyses indicated that worry was a better explanation for the effects of generation on talking about climate change than anger and guilt. Other research suggests that guilt and anger may predict collective action (van Zomeren et al., 2004; Ferguson and Branscombe, 2010; Rees and Bamberg, 2014; Bamberg, Rees and Seebauer, 2015). Thus, seeking others for discussions may be better accounted for by a desire to cope with worry about climate change than planning collective action, although the latter could develop from coping with worry about climate change.

CRedit authorship contribution statement

Janet K. Swim: Conceptualization, Writing – original draft, Writing – review & editing, Supervision, Project administration. **Rosemary Aviste:** Formal analysis, Data curation, Writing – original draft, Writing – review & editing. **Michael Lengieza:** Supervision, Formal analysis. **Charlie J. Fasano:** Conceptualization, Formal analysis.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We would like to thank the following people for their assistance with the data analyzed in this paper: Edward Maibach, George Mason University Center for Climate Change Communication, Mathew Ballew, Chapman University, and Seth Rosenthal and Anthony Leiserowitz both from Yale Program on Climate Change Communication.

References

- American Psychological Association (2018) *Stress in America™ Generation Z, The American Psychological Association*. Available at: <https://www.apa.org/news/press/releases/stress/2018/stress-gen-z.pdf>.
- American Psychological Association (2020a) *Stress in America™ 2020: A National Mental Health Crisis, The American Psychological Association*. Available at: <https://www.apa.org/news/press/releases/stress/2020/report-october>.
- American Psychological Association (2020b) *worry – APA Dictionary of Psychology*. Available at: <https://dictionary.apa.org/worry> (Accessed: 11 February 2021).
- Asian Society Policy Institute & Data for Progress (2020) *Understanding American Voter Attitudes Toward U.S.-China Climate Cooperation, Asia Society*. Available at: <https://asiasociety.org/policy-institute/understanding-american-voter-attitudes-toward-u-s-china-climate-cooperation> (Accessed: 19 February 2021).
- Averill, J.R., Catlin, G., Chon, K.K., 2012. *Rules of Hope*. Springer Science & Business Media.
- Bamberg, S., Rees, J., Seebauer, S., 2015. Collective climate action: Determinants of participation intention in community-based pro-environmental initiatives. *J. Environ. Psychol.* 43, 155–165. <https://doi.org/10.1016/j.jenvp.2015.06.006>.
- Batson, C.D., Chao, M.C., Givens, J.M., 2009. Pursuing moral outrage: anger at torture. *J. Exp. Soc. Psychol.* 45 (1), 155–160. <https://doi.org/10.1016/j.jesp.2008.07.017>.
- Biringer, E., et al., 2016. Coping with mental health issues: subjective experiences of self-help and helpful contextual factors at the start of mental health treatment. *J. Mental Health* 25 (1), 23–27. <https://doi.org/10.3109/09638237.2015.1078883>.
- Bornstein, S. (2019) 'A planet full of ifs': Young people express climate angst, AP NEWS. Available at: <https://apnews.com/article/2d7ccb5d1b3242b9923deb2ca197a56b> (Accessed: 29 January 2021).
- Campbell, W.K., et al., 2015. Generational differences are real and useful. *Ind. Organ. Psychol.* 8 (3), 324–331. <https://doi.org/10.1017/iop.2015.43>.
- Clayton, S., Karazsia, B.T., 2020. Development and validation of a measure of climate change anxiety. *J. Environ. Psychol.* 69 <https://doi.org/10.1016/j.jenvp.2020.101434>.
- Dimock, M. (2019) 'Defining generations: Where Millennials end and Generation Z begins', *Pew Research Center*. Available at: <https://www.pewresearch.org/fact-tank/2019/01/17/where-millennials-end-and-generation-z-begins/> (Accessed: 29 January 2021).
- Doherty, T.J., Clayton, S., 2011. The psychological impacts of global climate change. *Am. Psychol.* 66 (4), 265–276. <https://doi.org/10.1037/a0023141>.
- Ebi, K.L., 2014. Health in the new scenarios for climate change research. *Int. J. Environ. Res. Public Health* 11 (1), 30–46. <https://doi.org/10.3390/ijerph110100030>.
- Fagan, M., Huang, C. (2020) 'Many globally are as concerned about climate change as about the spread of infectious diseases', *Pew Research Center*. Available at: <https://www.pewresearch.org/fact-tank/2020/10/16/many-globally-are-as-concerned-about-climate-change-as-about-the-spread-of-infectious-diseases/> (Accessed: 4 April 2021).
- Feldman, L., Hart, P.S., 2016. Using political efficacy messages to increase climate activism: the mediating role of emotions. *Sci. Commun.* 38 (1), 99–127, 10/gft2m6.
- Ferguson, M.A., Branscombe, N.R., 2010. Collective guilt mediates the effect of beliefs about global warming on willingness to engage in mitigation behavior. *J. Environ. Psychol.* 30 (2), 135–142. <https://doi.org/10.1016/j.jenvp.2009.11.010>.
- Fogarty, A.S., et al., 2015. Men's use of positive strategies for preventing and managing depression: a qualitative investigation. *J. Affect. Disord.* 188, 179–187. <https://doi.org/10.1016/j.jad.2015.08.070>.
- Funk, C. et al. (2020) 'Concern over climate and the environment predominates among these publics', *Pew Research Center Science & Society*, 29 September. Available at: <https://www.pewresearch.org/science/2020/09/29/concern-over-climate-and-the-environment-predominates-among-these-publics/> (Accessed: 9 February 2021).
- Funk, C. (2021) 'Key findings: How Americans' attitudes about climate change differ by generation, party and other factors', *Pew Research Center*. Available at: <https://www.pewresearch.org/fact-tank/2021/05/26/key-findings-how-americans-attitudes-about-climate-change-differ-by-generation-party-and-other-factors/> (Accessed: 2 November 2021).
- Gallup (2020) *Environment*, Gallup.com. Available at: <https://news.gallup.com/poll/1615/Environment.aspx> (Accessed: 14 December 2020).
- Gasper, K., Spencer, L.A., Middlewood, B.L., 2019. Differentiating hope from optimism by examining self-reported appraisals and linguistic content. *J. Positive Psychol.* [Preprint]. <https://doi.org/10.1080/17439760.2019.1590623>.
- Geiger, N., et al., 2019. Untangling the components of hope: Increasing pathways (not agency) explains the success of an intervention that increases educators' climate change discussions. *J. Environ. Psychol.* 66, 101366 <https://doi.org/10.1016/j.jenvp.2019.101366>.
- Geiger, N., McLaughlin, B., Velez, J., 2021. Not all boomers: temporal orientation explains inter- and intra-cultural variability in the link between age and climate engagement. *Clim. Change* 166 (1), 12. <https://doi.org/10.1007/s10584-021-03116-x>.
- Goldberg, M. et al. (2020) 'For the first time, the Alarmed are now the largest of Global Warming's Six Americas', *Yale Program on Climate Change Communication*. Available at: <https://climatecommunication.yale.edu/publications/for-the-first-time-the-alarmed-are-now-the-largest-of-global-warmings-six-americas/> (Accessed: 11 February 2021).
- Gray, S.G., et al., 2019. 'Will Millennials save the world? The effect of age and generational differences on environmental concern. *J. Environ. Manage.* 242, 394–402. <https://doi.org/10.1016/j.jenvman.2019.04.071>.
- Guardian Labs (2020) 'How youth activism is moving the needle on climate action', *The Guardian*, 23 September. Available at: <https://www.theguardian.com/climate-aca>

- demy/2020/sep/23/youth-activism-climate-crisis-action (Accessed: 29 January 2021).
- Hayward, T., 2012. Climate change and ethics. *Nat. Clim. Change* 2 (12), 843–848. <https://doi.org/10.1038/nclimate1615>.
- Hickman, C., et al., 2021. A global survey of climate anxiety in children and young people and their beliefs about government responses to climate change. *Lancet Planetary Health* [Preprint].
- Hickman, G., Riemer, M., 2016. A theory of engagement for fostering collective action in youth leading environmental change. *Ecopsychology* 8 (3), 167–173. <https://doi.org/10.1089/eco.2016.0024>.
- Isenberg, D.J., 1986. Group polarization: a critical review and meta-analysis. *J. Pers. Soc. Psychol.: Interpersonal Relat. Group Processes* 50 (6), 1141–1151. <https://doi.org/10.1037/0022-3514.50.6.1141>.
- Jia, F., et al., 2017. 'Are environmental issues moral issues? Moral identity in relation to protecting the natural world. *J. Environ. Psychol.* 52, 104–113. <https://doi.org/10.1016/j.jenvp.2017.06.004>.
- Kaines, M. (2018) *Baby Boomers, Critics of Millennials, Once Advised: 'Ignore Anyone Over 30'*. Medium. Available at: <https://medium.com/@MKaines/baby-boomers-critics-of-millennials-once-said-ignore-anyone-over-30-9b2f694b8dec> (Accessed: 11 February 2021).
- Lenth, R.V. (2021) *Estimated Marginal Means, aka Least-Squares Means [R package emmeans version 1.6.0]*. Comprehensive R Archive Network (CRAN). Available at: <https://CRAN.R-project.org/package=emmeans> (Accessed: 29 May 2021).
- Lomranz, J., et al., 1986. The meaning of time-related concepts across the life-span: an Israeli sample. *Int. J. Aging Human Dev.* 21 (2), 87–107. <https://doi.org/10.2190/UJPR-3394-KY51-UJTL>.
- Long, C. (2019) *The 'Greta Effect' On Student Activism and Climate Change* NEA. Available at: <https://www.nea.org/advocating-for-change/new-from-nea/greta-effect-student-activism-and-climate-change> (Accessed: 1 February 2021).
- Lorenz, T. (2019) "'OK Boomer' Marks the End of Friendly Generational Relations", *The New York Times*, 29 October. Available at: <https://www.nytimes.com/2019/10/29/style/ok-boomer.html> (Accessed: 11 February 2021).
- Malle, B.F. (2004) *How the mind explains behavior: Folk explanations, meaning, and social interaction*. Cambridge, MA, US: MIT Press. Available at: <https://search.proquest.com/psycinfo/docview/620655579/A78FFA5368E94EDCPQ/3> (Accessed: 5 September 2019).
- Manning, C., Clayton, S., 2018. Threats to mental health and wellbeing associated with climate change. In: *Psychology and Climate Change: Human Perceptions, Impacts, and Responses*. Elsevier Academic Press, San Diego, CA, USA, pp. 217–244. <https://doi.org/10.1016/B978-0-12-813130-5.00009-6>.
- Marques, L., 2013. Almost Anxious: Is My (or My Loved One's) Worry or Distress a Problem? (The Almost Effect), Illustrated edition. Hazelden Publishing.
- Marris, E., 2019. Why young climate activists have captured the world's attention. *Nature* 573 (7775), 471–472. <https://doi.org/10.1038/d41586-019-02696-0>.
- Maxfield, M., et al., 2014. Increases in generative concern among older adults following reminders of mortality. *Int. J. Aging Human Dev.* 79 (1), 1–21. <https://doi.org/10.2190/AG.79.1.a>.
- McBride, S.E., et al., 2021. Longitudinal relations between climate change concern and psychological wellbeing. *J. Environ. Psychol.* 78, 101713 <https://doi.org/10.1016/j.jenvp.2021.101713>.
- Mezzofiore, G. (2019) *A 25-year-old politician got heckled during a climate crisis speech. Her deadpan retort: 'OK, boomer'*, CNN Digital. Available at: <https://www.cnn.com/2019/11/06/asia/new-zealand-ok-boomer-trnd/index.html> (Accessed: 11 February 2021).
- Milfont, T.L., et al., 2021. Ten-year panel data confirm generation gap but climate beliefs increase at similar rates across ages. *Nat. Commun.* 12 (1), 4038. <https://doi.org/10.1038/s41467-021-24245-y>.
- Ojala, M., 2012. How do children cope with global climate change? Coping strategies, engagement, and well-being. *J. Environ. Psychol.* 32 (3), 225–233. <https://doi.org/10.1016/j.jenvp.2012.02.004>.
- 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. *J. Environ. Educ.* 46 (3), 133–148. <https://doi.org/10.1080/00958964.2015.1021662>.
- Ojala, M., et al., 2021. Anxiety, worry, and grief in a time of environmental and climate crisis: a narrative review. *Annu. Rev. Environ. Resour.* 46 (1), 35–58. <https://doi.org/10.1146/annurev-environ-012220-022716>.
- Ojala, M., Bengtsson, H., 2019. Young people's coping strategies concerning climate change: relations to perceived communication with parents and friends and proenvironmental behavior. *Environ. Behav.* 51 (8), 907–935. <https://doi.org/10.1177/0013916518763894>.
- Pederson, J.R., Faw, M.H., 2019. Communal coping following relational transgressions: perspectives of third-party personal network members. *Commun. Rep.* 32 (3), 112–124. <https://doi.org/10.1080/08934215.2019.1608281>.
- Quinn, S. (2019) 'Positive aspects of social media', in Attridge-Smith, A. and Fullwood, C. (eds) *The Oxford handbook of cyberpsychology*. Oxford University Press (New York, NY, US), pp. 413–431, Chapter xxv, 752 Pages. Available at: <https://www.proquest.com/psycinfo/docview/2494385599/abstract/7D9F284787064E7BPQ/5> (Accessed: 1 July 2021).
- Raasch, Ch. (2014) *Never trust anyone over 30? A second thought | Gateway to DC | stltoday.com*. Available at: https://www.stltoday.com/news/local/govt-and-politics/gateway-to-dc/never-trust-anyone-over-30-a-second-thought/article_c975d85c-58ce-56ca-b4ec-f4fe5828acc1.html (Accessed: 11 February 2021).
- Rees, J.H., Bamberg, S., 2014. Climate protection needs societal change: determinants of intention to participate in collective climate action. *Eur. J. Soc. Psychol.* 44 (5), 466–473. <https://doi.org/10.1002/ejsp.2032>.
- Reinhart, R.J. (2018) *Global Warming Age Gap: Younger Americans Most Worried*, Gallup.com. Available at: <https://news.gallup.com/poll/234314/global-warming-age-gap-younger-americans-worried.aspx> (Accessed: 9 February 2021).
- Romano, A. (2019) 'OK boomer' isn't just about the past. It's about our apocalyptic future., Vox. Available at: <https://www.vox.com/2019/11/19/20963757/what-is-ok-boomer-meme-about-meaning-gen-z-millennials> (Accessed: 11 February 2021).
- Roseman, I.J., 2011. Emotional behaviors, motivational goals, emotion strategies: multiple levels of organization integrate variable and consistent responses. *Emot. Rev. ew* 3 (4), 434–443, 10/dztjgb.
- Ross, A.D., Rouse, S.M., 2020. (Young) generations as social identities: the role of Latino*Millennial/generation Z in shaping attitudes about climate change. *Polit. Behav.* [Preprint]. <https://doi.org/10.1007/s11109-020-09649-8>.
- Rossee, Y., 2012. Lavaan: an R package for structural equation modeling. *J. Stat. Softw.* 48 (2), 1–36.
- Sabherwal, A., et al., 2021. The Greta Thunberg effect: familiarity with Greta Thunberg predicts intentions to engage in climate activism in the United States. *J. Appl. Soc. Psychol.* <https://doi.org/10.1111/jasp.12737>.
- Sanson, A.V., Hoorn, J.V., Burke, S.E.L., 2019. Responding to the impacts of the climate crisis on children and youth. *Child Dev. Perspect.* 13 (4), 201–207. <https://doi.org/10.1111/cdep.12342>.
- Schiermeier, Q., et al., 2019. Scientists worldwide join strikes for climate change. *Nature* 573 (7775), 472–473. <https://doi.org/10.1038/d41586-019-02791-2>.
- Sciberras, E., Fernando, J.W. (2021) 'Climate change-related worry among Australian adolescents: an eight-year longitudinal study', *Child Adolescent Mental Health*, n/a(n/a). doi:10.1111/camh.12521.
- Sheikh, S., Janoff-Bulman, R. (2010) 'The "shoulds" and "should nots" of moral emotions: A self-regulatory perspective on shame and guilt.', *Personality and Social Psychology Bulletin*, 36(2). Available at: <http://search.proquest.com.ezaccess.libraries.psu.edu/docview/213992009/137C310CB4464685389/3?accountid=13158> (Accessed: 6 July 2012).
- Smith, N., Leiserowitz, A., 2014. The role of emotion in global warming policy support and opposition. *Risk Anal.* 34 (5), 937–948. <https://doi.org/10.1111/risa.12140>.
- Smyer, M. (2018) *Fighting climate change must be an intergenerational conversation*. Available at: <https://www.usatoday.com/story/opinion/voices/2018/12/20/climate-change-talk-report-students-column/2350167002/> (Accessed: 13 January 2022).
- Snyder, C.R., 2002. Hope theory: rainbows in the mind. *Psychol. Inq.* 13 (4), 249–275. <https://doi.org/10.1207/S15327965PLI1304.01>.
- Swim, J.K. et al. (2018) 'Social Construction of Scientifically Grounded Climate Change Discussions', in Clayton, S. and Manning, C. (eds) *Psychology and climate change: From denial and depression to adaptation and resilience*. Academic Press (San Diego, CA, US), pp. 65–93. Available at: <https://doi.org/10.1016/B978-0-12-813130-5.00004-7>.
- Swim, J.K., Bloodhart, B., 2015. Portraying the perils to polar bears: the role of empathic and objective perspective-taking toward animals in climate change communication. *Environ. Commun.* 9 (4), 446–468. <https://doi.org/10.1080/17524032.2014.987304>.
- Swim, J.K., Geiger, N., 2017. From alarmed to dismissive of climate change: a single item assessment of individual differences in concern and issue involvement. *Environ. Commun.* 11 (4), 568–586. <https://doi.org/10.1080/17524032.2017.1308409>.
- Taylor, S.E., 2006. Tend and befriend: biobehavioral bases of affiliation under stress. *Curr. Direct. Psychol. Sci.* 15 (6), 273–277. <https://doi.org/10.1111/j.1467-8721.2006.00451.x>.
- Thomas, E.F., McGarty, C.A., 2009. The role of efficacy and moral outrage norms in creating the potential for international development activism through group-based interaction. *Br. J. Soc. Psychol.* 48 (1), 115–134 <http://dx.doi.org.ezaccess.libraries.psu.edu/10.1348/014466608X313774>.
- Twenge, J.M., Campbell, W.K., Freeman, E.C., 2012. Generational differences in young adults' life goals, concern for others, and civic orientation, 1966–2009. *J. Pers. Soc. Psychol.* 102 (5), 1045–1062. <https://doi.org/10.1037/a0027408>.
- Twenge, J.M., Spitzberg, B.H., Campbell, W.K., 2019. Less in-person social interaction with peers among U.S. adolescents in the 21st century and links to loneliness. *J. Soc. Personal Relationships* 36 (6), 1892–1913. <https://doi.org/10.1177/0265407519836170>.
- UNICEF (2021) *Tackling climate change: an intergenerational conversation*, Unicef UK. Available at: <https://www.unicef.org.uk/mary-robinson-intergenerational-conversation-climate-change/> (Accessed: 13 January 2022).
- USGCRP (2017) *Climate Science Special Report: Fourth National Climate Assessment, Volume I*. Washington DC, USA: U.S. Global Change Research Program, pp. 1–470. Available at: <https://science.2017.globalchange.gov/> (Accessed: 11 February 2021).
- Van Doorn, E.A., Heerdink, M.W., Van Kleef, G.A., 2012. Emotion and the construal of social situations: inferences of cooperation versus competition from expressions of anger, happiness, and disappointment. *Cogn. Emot.* 26 (3), 442–461. <https://doi.org/10.1080/02699931.2011.648174>.
- Wallis, H., Loy, L.S., 2021. What drives pro-environmental activism of young people? A survey study on the Fridays for future movement. *J. Environ. Psychol.* 74 <https://doi.org/10.1016/j.jenvp.2021.101581>.
- Wang, W., Wu, X., Tian, Y., 2018. Mediating roles of gratitude and social support in the relation between survivor guilt and posttraumatic stress disorder, posttraumatic growth among adolescents after the Ya'an earthquake. *Front. Psychol.* 9, 2131. <https://doi.org/10.3389/fpsyg.2018.02131>.
- Wayback Machine (2011). Available at: https://web.archive.org/web/20110717114138/http://sustainus.org/docs/2010/YOUNGO-Youth@COP15_Report_2009_HiRes.pdf (Accessed: 29 January 2021).
- Westgate, E.C., Wilson, T.D., 2018. 'Boring thoughts and bored minds: The MAC model of boredom and cognitive engagement. *PsychNET* 125 (5), 689–713. <https://doi.org/10.1037/rev0000097>.

- Wolsko, C., Ariceaga, H., Seiden, J., 2016. Red, white, and blue enough to be green: effects of moral framing on climate change attitudes and conservation behaviors. *J. Exp. Soc. Psychol.* 65, 7–19. <https://doi.org/10.1016/j.jesp.2016.02.005>.
- Wu, J., Snell, G., Samji, H., 2020. Climate anxiety in young people: a call to action. *Lancet Planetary Health* 4 (10), e435–e436. [https://doi.org/10.1016/S2542-5196\(20\)30223-0](https://doi.org/10.1016/S2542-5196(20)30223-0).
- Van Doorn, Janne, Zeelenberg, Marcel, Breugelmans, Seger M., 2014. Anger and prosocial behavior. *Emotion Review* 6 (3), 261–268.
- van Zomeren, M., et al., 2004. Put your money where your mouth is! Explaining collective action tendencies through group-based anger and group efficacy. *J. Pers. Soc. Psychol.* 87 (5), 649–664. <https://doi.org/10.1037/0022-3514.87.5.649>.
- van Zomeren, M., 2013. Four core social-psychological motivations to undertake collective action. *Soc. Pers. Psychol. Compass* 7 (6), 378–388. <https://doi.org/10.1111/spc3.12031>.