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Does social media use make us more environmentally knowledgeable or more eco-anxious? A multi-country investigation

https://doi.org/10.1515/omgc-2025-0037
Received June 29, 2025; accepted September 1, 2025

Abstract

Purpose: Social media has a great mobilizing power and is considered to be an important vehicle to raise the awareness for the climate crisis across the globe. Despite this undisputed relevance, however, we lack studies exploring the relations between social media use, environmental knowledge, and environmental anxiety, particularly using a non-Western, global approach.
Design/methodology/approach: We conducted a quota-based general population survey in Germany, Belgium, South Africa, Thailand, Chile, Malaysia, South Korea, and India.

Article Note: This article underwent single-blind peer review.

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Findings: Using Structural Equation Modeling with partial measurement invariance across countries, we found that the relationship between social media use and environmental knowledge was remarkably different across countries. However, in all countries, social media use was a significant positive predictor of environmental anxiety, albeit the size of the effect differed across countries. Furthermore, knowledge was found to be a negative predictor of anxiety.
Practical and social implications: By and large, findings suggest that the widespread hopes of social media being a facilitator of learning are ungrounded. Rather, social media seems to make individuals anxious about climate change.
Originality/value: The study tests the role of social media beyond Western countries demonstrating the limited role of social media use for making individuals more knowledgeable.

Keywords: social media use; environmental knowledge; eco-anxiety; climate crisis

Climate change poses an immediate threat to both the planet and humankind. As global warming continues, environmental hazards are increasing (e.g., food- and water insecurities) (IPCC 2023). Without doubt, besides traditional media, social media provide a platform for discussing these issues (Pearce et al. 2019; Rosenthal 2022). In fact, studies suggest that citizens are frequently exposed to information about climate change on social media, offering great potential to foster environmental learning (Veltri and Atanasova 2017). Moreover, the use of social media is typically connected to behavioral outcomes such as participation (Dekoninck and Schmuck 2023), environmental activism (Boulianne and Ohme 2022; Knupfer et al. 2023), or green purchase intentions (Nazish et al. 2024). In short, social media is a key vehicle to inform and engage citizens with respect to environmental topics.

But social media is not only important for such cognitive and behavioral outcomes. Negative emotional reactions have also been described as key outcomes of the environmental crisis. In particular, social media use may foster so-called eco-anxiety (i.e., distress arising from the environmental crisis; Becken et al. 2021) because people are exposed to news about environmental catastrophes or negative consequences of climate change. That is, on social media, stories, memes, and hashtags about the climate crisis have been omnipresent, depicting the climate crisis as "alarming" (e.g., Risbey 2008). Several factors contribute to the complexity of communicating climate change-related issues: the invisibility of causes, distant impacts, and lack of gratification for taking mitigative actions, along with confusion and uncertainty among the public (Sterman 2011). All of this makes anxiety a likely outcome. In fact, studies on traditional media exposure have confirmed associations of exposure to environmental topics and eco-anxiety (e.g., Clayton 2020; Johann et al. 2023).

While environmental knowledge and eco-anxiety are arguably key outcomes in research on environmental communication (Becken et al. 2021), we surprisingly lack research with respect to social media. The available knowledge suggests that traditional media are able to convey knowledge about environmental issues (Gómez-Casillas and Gómez Márquez 2023; Ho et al. 2014; Taddicken 2013). Also in a neighboring research area, there is ample evidence that political social media use relates to knowledge about politics (e.g., Lee and Xenos 2019; Nanz and Matthes 2020). For environmental knowledge, however, we lack such a clear picture. The same argument can be made about eco-anxiety. While it has been theorized that social media has the power to evoke emotional responses (Gunasiri et al. 2022), most research deals with traditional media such as TV, newspapers, or online news at best. Shao and Yu (2023), for instance, found that exposure to news about global warming increased the state of eco-anxiety. Yet studies on social media are scarce, and the few available are based on student or small samples (Gunasiri et al. 2022; Maran and Begotti 2021). This dearth of knowledge is alarming because social media is clearly different from traditional media due to, for instance, its contents, affordances, and audiences (Lee and Xenos 2019).

In this paper, we therefore ask if social media use makes us more knowledgeable, more anxious, or both? We attempt to answer this question by using a quota-based general population cross-sectional survey in eight countries.

1 Social media use and environmental knowledge

Social media platforms like Twitter, Instagram, Facebook, TikTok, or YouTube provide an abundance of information on environmental topics, including, for instance, posts about scientific findings, policy updates, sustainability practices, or climate activism (e.g., Parry et al. 2022; Schäfer 2012). When looking into research on social media and political news more generally, scholars have pointed to a number of reasons why social media can contribute to the learning of information (e.g., Boukes 2019; Nanz and Matthes 2020). First, due to the interactive nature of social media, users have the possibility to discuss and express their views, which allows users to learn from others (Amsalem and Zoizner 2023). Second, social media use connects users from different geographical and socio-economic arenas, providing a diverse platform of information and opinion exchange. This diversity of perspectives makes it likely that users are exposed to new information (Boukes 2019). Along those lines, social media has also been shown to provide opportunities for incidental exposure (i.e., being exposed to information without looking for it), which has been found to foster learning outcomes (Nanz and Matthes 2020).

Third, social media is the key vehicle for climate activism, with influencers and activists raising awareness about the threats associated with climate change. In fact, prominent figures such as Greta Thunberg, social media influencers, but also environmental movements such as Extinction Rebellion have accumulated a legion of followers, who receive, discuss, and further spread environmental messages (Knupfer et al. 2023; Naderer 2023). Related to that, hashtags such as #ClimateChange or #FridaysForFuture have reached, informed, and connected literally millions of users on social media. Although climate skeptics also use social media as a tool, scholars have argued that social media can be used as an educational device to inform people about climate change, making social media an indispensable resource for environmental activism (Schäfer 2012). On top of that, complex topics, such as climate change, are often presented in a simplified manner, making the information accessible and understandable for a very large share of the public (see Schmuck et al. 2022).

Despite these convincing theoretical arguments – and while there is solid knowledge when it comes to traditional media and environmental learning (Schäfer 2012) – only a few studies have actually looked into the relationship between social media use and learning about environmental issues. In content research, Veltri and Atanasova (2017), analyzing tweets about climate change, demonstrated frequent information sharing by users, while Duran-Becerra et al. (2020) found that YouTube has great potential to inform the youth about climate change. Findings by Robelia and colleagues (2011), using survey and focus group data, suggest that social networking sites can foster learning about climate change. In line with that, survey findings by Diehl et al. (2021) suggest that social media use is related to perceived beliefs about anthropogenic climate change.

In sum, while first research indicates that social media use about environmental topics can be a prerequisite for environmental knowledge generation, the measures and findings to date are inconclusive. Studies either did not measure social media use about environmental topics (Diehl et al. 2021; Robelia et al. 2011), or they used content analytical data to infer relationships with learning, rather than measuring them (Duran-Becerra et al. 2020; Veltri and Atanasova 2017). To the best of our knowledge, surprisingly, objective environmental knowledge (i.e., correctly identifying environmental facts) has not been measured in this line of research. Therefore, clear proof for environmental learning in response to social media use is missing.

However, for the reasons explained above, we theorize a positive relationship between social media use and knowledge, defined as a key cognitive outcome. In this study, we focus on passive use. Passive social media use, based on the heterogeneity of social networks, provides citizens with new information about climate change, it also reaches those who are originally not interested in the topic (see Diehl et al. 2021; Robelia et al. 2011; Schäfer 2012; Schmuck et al. 2022). What is more, social media is a key vehicle for environmental activism, which frequently refers to environmental

facts and data. Finally, also incidental exposure – which is passive – can be theorized to foster learning (Amsalem and Zoizner 2023; Nanz and Matthes 2020). On top of that, research in political communication has provided meta-analytic evidence that political social media use is related to political knowledge (Amsalem and Zoizner 2023). It follows:

H1: Environmental social media use is positively associated with environmental knowledge.

2 Social media use and eco-anxiety

Many people worldwide have experienced the negative consequences of the climate crisis firsthand, such as flooding or heatwaves destroying their homes (e.g., IPCC 2023). These traumatizing experiences, or the mediated depiction of it, can lead to eco-anxiety, "experiences of anxiety relating to environmental crises" (Hogg et al. 2021:2; e.g., Hickman 2020), encompassing not only affective symptoms but also rumination related to the climate crisis, behavioral symptoms, and emotions about the personal environmental impact (e.g., Hogg et al. 2021). However, not only people who have experienced the traumatizing negative consequences of the climate crisis firsthand are affected, but also people who were not (yet) directly confronted with environmental catastrophes are increasingly troubled by worries about the future due to climate change (e.g., Clayton 2020; Doherty and Clayton 2011). People worldwide increasingly feel concerned and anxious about the environment (e.g., Hao and Song 2020). Accordingly, people have become aware of the risks of climate change and, consequently, feel increasingly eco-anxious (e.g., Becken et al. 2021; Clayton 2020; Johann et al. 2023).

A key driver of such eco-anxiety is media use. Although media reports about the environment can raise awareness about environmental issues, motivate climate change action, and be a platform to share environmental knowledge (e.g., Knupfer et al. 2023), it can also lead to negative emotions (e.g., Shao and Yu 2023). Several studies have shown an association between environmental media use and aspects related to eco-anxiety (Becken et al. 2021; Clayton 2020; Johann et al. 2023). However, only a few studies specifically focused on social media. For instance, research by Gunasiri et al. (2022) suggests that climate change content on social media can be overwhelming, leading to mental health concerns, such as anxiety related to the environment. Yet the sample in this study was very small (i.e., 14 semi-structured interviews and an online survey with $N = 46$). Likewise, Maran and Begotti (2021), surveying 312 Italian university students, related social media use to climate anxiety. Based on the samples, the evidence from these studies is inconclusive.

Yet on a theoretical level, the argument can be made that social media use may predict eco-anxiety. First, on a content level, social media confronts people with stories, memes, and hashtags about the climate crisis, portraying the climate crisis as "alarming" (e.g., Risbey 2008). Due to social media's inherent logic, stories may involve dramatic imagery, and information spread by social networks may be particularly arousing. Second, the risk amplification framework (e.g., Kasperson et al. 1988) indicates that exposure to environmental social media content can enhance users' perceptions of environmental risks, leading to mental health issues such as eco-anxiety. Third, Terror Management Theory (Greenberg et al. 1986) would suggest that the climate crisis may make us aware of our mortality, which, in turn, evokes anxiety. Thus:

H2: Environmental social media use is positively associated with eco-anxiety.

3 The relationship between environmental knowledge and eco-anxiety

Environmental knowledge may not be independent from eco-anxiety. On the one hand, it can be theorized that knowledge is negatively related to eco-anxiety. In fact, Ágoston et al. (2024) observed a negative association between knowledge and environmental anxiety. The authors argue that knowledge may help to regulate and therefore reduce negative emotions. In other words, environmental knowledge may serve as a "protective factor against the negative consequences of anxiety" (p. 7). Furthermore, the authors theorize that knowledge may be a driver of solution seeking. That means the belief in technological solutions to the climate crisis may foster hope and reduce anxiety. Likewise, environmental knowledge may relate to an awareness of the various actions that can be initiated to combat climate change, helping to cope with negative feelings associated with the climate crisis. This argument is further supported by Zacher and Rudolph (2023), who found that both environmental knowledge and climate-specific knowledge were negatively associated with climate change anxiety. The authors point to various studies from other fields, all suggesting that knowledge can serve as a buffer against uncertainty and, therefore, anxiety (e.g., Wang et al. 2011).

On the other hand, the reverse relationship can be theorized. Environmental knowledge may increase eco-anxiety, because greater knowledge about environmental issues may also mean that people are more aware of the dangers and negative consequences of climate change. That is, knowledge may lead to a more accurate and therefore more alarming assessment of the detrimental implications of climate

change. In line with this argument, a number of studies have reported a positive relation between environmental knowledge and eco-anxiety. For instance, using survey data from six countries, Shi et al. (2016) observed that higher levels of knowledge about the causes – but not knowledge about the characteristics – of climate change predict concerns. A survey of Mexican students revealed that knowledge about climate change predicts climate anxiety (Ramirez-Lopez et al. 2023). Similarly, a survey conducted among the UK adult population indicated that climate information seeking behavior was the strongest predictor of climate anxiety (Whitmarsh et al. 2022).

How can these conflicting findings be disentangled? As noted by van der Linden (2015), different studies have used different operationalizations of knowledge, such as subjective and objective measures. Subjective measures are biased by third variables. They measure the impression of knowledge, rather than actual knowledge. More importantly, van der Linden (2015) put forth the climate change risk perception model. According to this model, risk perceptions of climate change, which arguably relate to anxiety, can be described as a function of cognitive factors, first and foremost, knowledge about climate change. Knowledge about climate change makes the perception of climate change more vivid. Also, environmental knowledge leads to a better understanding of the consequences of climate change. Since these consequences are most likely negative for humans, anxiety becomes more likely than hope. Based on this, we theorize a positive, rather than negative association between environmental knowledge and eco-anxiety.

H3: Environmental knowledge is positively associated with eco-anxiety.

4 Country differences

Arguably, country context plays a huge role for the associations explored in the present research. While the climate crisis is visible in all countries of the world, there are more severe consequences for some as compared to others. For instance, some countries are facing very severe and life-threatening consequences of climate change, such as extreme heatwaves, droughts, rising sea levels, cyclones, or water scarcity due to inconsistent rainfall. In these countries, eco-anxiety can be understood as a perceptible, real, and immense threat. In other countries, by contrast, climate change remains more abstract and less obtrusive, with threats such as rising temperatures in summer, river floods, or forest dieback. Here, climate change is visible, but it may not immediately and permanently pose a threat to life and security, yet affect agriculture, biodiversity, or well-being. It follows that climate change brings different threats that may be perceptible at different points in time,

with varying consequences for individuals. This general observation underlines the urgent need for cross-country research.

But how can the countries be selected for such research endeavors? The threats associated with climate are so diverse that it is hard to comprehensively map countries along this dimension. Instead, we argue that countries significantly differ with respect to (a) citizens' level of individualism and (b) how the countries respond to climate change, that is, how they perform on environmental issues. Individualism means that citizens prioritize personal goals over collective goals (Allik and Realo 2004). This construct is crucial for environmental topics, because it refers to a mindset that would prioritize personal reward, instead of thinking about the impact of one's actions on others or future generations. It can be theorized that citizens with high individualism are less motivated to analyze and understand the causes and consequences of climate change (Xiang et al. 2019). Likewise, low individualism makes it likely that the future negative consequences of climate change are understood (see Xiang et al. 2019).

When it comes to the performance of countries with respect to environmental issues, scholars have suggested the Environmental Performance Index. As a global ranking system, this index maps countries with respect to ecosystem protection. That is, in some countries, the environmental performance is very strong, which may also relate to how the public is informed and educated about environmental policies. For other countries, environmental performance is less important, which arguably may have consequences for environmental knowledge, and potentially, also eco-anxiety.

Combining these two dimensions, we arrive at countries with high individualism and strong environmental performance (group 1), high individualism and weak environmental performance (group 2), low individualism and strong environmental performance (group 3), and low individualism and weak environmental performance (group 4). However, the current state of evidence, which is largely based on single country studies, does not allow us to formulate hypotheses with respect to these groups. We therefore aim to generally observe if the hypothesized relations can be detected across a wide range of countries, varying in individualism and environmental performance. Based on 39 initially selected country deemed feasible for data collection, we chose eight countries based on the publicly available indices of a country's individualism and environmental performance (EPI 2022: M = 46.484, SD = 13.181; Hofstede Insights 2023: M = 47.444, 24.092): Belgium (EPI: 58.2, Ind: 75) and Germany (EPI:62.4, Ind: 67) (group 1), South Africa (EPI: 37.2, Ind: 65) and India (EPI: 18.9, Ind: 48) (group 2), Chile (EPI: 46.7, Ind: 23) and South Korea (EPI: 46.9, Ind: 18) (group 3), and Malaysia (EPI: 35, Ind: 26) and Thailand (EPI: 38.1, Ind: 20) (group 4). Accordingly, we explore whether the hypothesized relationships can be observed across the countries varying along these two dimensions.

RQ1: How do H1, H2, and H3 differ between the countries?

5 Methods

Between May and July 2023, we conducted a cross-sectional, quota-based survey in eight countries (Belgium, Chile, Germany, India, Malaysia, South Africa, South Korea, and Thailand). Before conducting the study, we sought ethical approval from the Institutional Review Board of the Department of Communication, University of Vienna (Approval ID: 20220723_034). We used the same questionnaire in all eight countries. To guarantee equivalence, we conducted (1) translations of the questionnaires in the respective languages, (2) back translations, and (3) language checks with the help of external native speakers.

5.1 Sample

We excluded participants from our final sample who 1) were speeders (< 1/3 of the median of total duration time; n = 276), or 2) have failed three out of three attention checks (e.g., "I know how to count to 10"; Dunn et al. 2018; n = 40). The total sample consisted of N = 4364 social media users aged between 18 and 65 years (Belgium: n = 536, Chile: n = 525, Germany: n = 531, India: n = 529, Malaysia: n = 594, South Africa: n = 514, South Korea: n = 530, and Thailand: n = 605). The sample was recruited with the help of a professional polling company based on age (Belgium: M = 42.02, SD = 13.23; Chile: M = 39.32, SD = 12.92; Germany: M = 43.06, SD = 13.29; India: M = 36.31, SD = 13.23; Malaysia: M = 39.18, SD = 12.41; South Africa: M = 35.80, SD = 12.52; South Korea: M = 39.20, SD = 12.99; Thailand: M = 39.07, SD = 12.37) and gender (Belgium: 49.8 % female; Chile: 51.6 % female; Germany: 50.8 % female; India: 49.1 % female; Malaysia: 50.8 % female; South Africa: 51.4 % female; South Korea: 49.2 % female; Thailand: 56.7 % female) quotas, as well as soft quotas for educational backgrounds (Belgium: 20.3 % low, 41.6 % intermediate, 38.1 % high; Chile: 24.6 % low, 52.6 % intermediate, 22.9 % high; Germany: 14.7 % low, 66.3 % intermediate, 19 % high; India: 60.5 % low, 24 % intermediate, 15.5 % high; Malaysia: 24.7 % low, 54.5 % intermediate, 20.7 % high; South Africa: 42 % low, 41.4 % intermediate, 16.5 % high; South Korea: 14.7 % low, 38.7 % intermediate, 46.6 % high; Thailand: 51.6 % low, 30.4 % intermediate, 18 % high).

5.2 Measures

To measure passive *environmental social media use*, we used three items inspired by Gerson and colleagues (2017) on a 7-point Likert scale ranging from 1 – "Never" to 7 – "Very often". In an introduction, we defined environmental topics as, for instance, aspects of climate change, sustainability, environmental protection, environmental

consequences of our lifestyle, and climate policy. We asked participants how often they were exposed to environmental topics on social media in the last few weeks. We used the following three items: "I looked at posts about environmental topics on social media", "I read posts about environmental topics on social media", "I observed posts about environmental topics on social media" (Belgium: M = 4.09, SD = 1.59, Ω = 0.92; Chile: M = 4.81, SD = 1.48, Ω = 0.91; Germany: M = 3.97, SD = 1.85, Ω = 0.92; India: M = 4.98, SD = 1.49, Ω = 0.89; Malaysia: M = 4.81, SD = 1.53, Ω = 0.91; South Africa: M = 4.59, SD = 1.69, Ω = 0.89; South Korea: M = 4.24, SD = 1.67, Ω = 0.93; Thailand: M = 4.61, SD = 1.45, Ω = 0.86).

We gauged *environmental knowledge* with single-choice test questions about general environmental knowledge, based on DeChano (2008). To form an index, we summarized the correct answers (Belgium: M = 1.89, SD = 1.44; Chile: M = 2.42, SD = 1.22; Germany: M = 2.63, SD = 1.51; India: M = 2.24, SD = 1.37; Malaysia: M = 2.11, SD = 1.28; South Africa: M = 2.03, SD = 1.31; South Korea: M = 2.44, SD = 1.32; Thailand: M = 1.86, SD = 1.41).

For *eco-anxiety*, we used eleven items from Hogg and colleagues (2021). We asked participants how often they have been bothered by the following problems when thinking about climate change and other global environmental conditions over the last few weeks. We used the following items on a 7-point Likert scale ranging from 1 – "Not at all" to 7 – "Nearly every day": "Feeling nervous, anxious or on edge", "Not being able to stop or control worrying", "Worrying too much", "Feeling afraid", "Unable to stop thinking about future climate change and other global environmental problems", "Unable to stop thinking about past events related to climate change", "Unable to stop thinking about losses to the environment", "Difficulty sleeping", "Difficulty enjoying social situations with family and friends", "Feeling anxious about your personal responsibility to help address environmental problems", "Feeling anxious that your personal behaviors will do little to help fix the problem" (Belgium: M = 3.65, SD = 1.56, Ω = 0.97; Chile: M = 3.61, SD = 1.43, Ω = 0.94; Germany: M = 3.25, SD = 1.49, Ω = 0.95; India: M = 4.47, SD = 1.20, Ω = 0.91; Malaysia: M = 3.97, SD = 1.38, Ω = 0.95; South Africa: M = 3.73, SD = 1.53, Ω = 0.94; South Korea: M = 3.69, SD = 1.27, Ω = 0.94; Thailand: M = 3.91, SD = 1.31, Ω = 0.94).

We used the following three items derived from Schuhwerk and Lefkoff-Hagius (1995) to measure *environmental concern* on a 7-point Likert scale ranging from 1 – "Do not agree at all" to 7 – "Completely agree": "I am willing to make great sacrifices to protect the environment", "I care a lot about the environment", "The state of the environment greatly affects my quality of life" (Belgium: M = 4.57, SD = 1.28, Ω = 0.79; Chile: M = 5.18, SD = 1.33, Ω = 0.81; Germany: M = 4.41, SD = 1.52, Ω = 0.85; India: M = 5.21, SD = 1.28, Ω = 0.82; Malaysia: M = 5.08, SD = 1.24, Ω = 0.83; South Africa: M = 5.41, SD = 1.34, Ω = 0.79; South Korea: M = 4.63, SD = 1.19, Ω = 0.77; Thailand: M = 4.76, SD = 1.32, Ω = 0.81).

We measured *income* with the following item derived by Donnelly and Pop-Eleches (2016) on a scale ranging from 1 – "Very low" to 10 – "Very high": "How would you rate your income compared to the majority of people in COUNTRY?" (Belgium: M = 5.84, SD = 2.17; Chile: M = 4.59, SD = 2.11; Germany: M = 5.12, SD = 2.38; India: M = 5.00, SD = 2.19; Malaysia: M = 5.23, SD = 2.16; South Africa: M = 4.44, SD = 2.54; South Korea: M = 5.05, SD = 2.18; Thailand: M = 4.94, SD = 2.31). Lastly, we gauged *political orientation* with the following item inspired by Kroh (2007) on a scale from 1 – "Left" to 10 – "Right": "Many people use the terms "left" and "right" for labeling political attitudes. If you think about your own political views, where would you place those views on the scale?" (Belgium: M = 6.24, SD = 2.30; Chile: M = 5.69, SD = 2.50; Germany: M = 5.71, SD = 1.96; India: M = 7.05, SD = 2.40; Malaysia: M = 6.44, SD = 2.11; South Africa: M = 5.94, SD = 2.57; South Korea: M = 5.99, SD = 1.92; Thailand: M = 6.19, SD = 2.07).

5.3 Statistical analysis

We conducted a Structural Equation Model (SEM) for each country with latent variables using AMOS (e.g., Arbuckle and Wothke 1999). To establish the model fit, we used the CFI, TLI, RMSEA, and chi-square to degrees of freedom ratio ($\chi 2$/df; Byrne 2001). For the dataset, please see OSF: https://osf.io/u7a3x/?view_only=949fbefa3d614a1c8d8fd574e92dc697.

6 Results

6.1 Measurement invariance

We examined a metric measurement invariance of all latent variables by constraining all factor loadings to be equal across countries. When comparing the constrained model to the unconstrained model, there was a significant difference in model fit ($p < 0.01$). Full metric invariance could thus not be established. However, when releasing the constraint for three out of the eleven items for eco-anxiety, there was no decrease in model fit as compared to the unconstrained model ($p = 0.148$). Thus, partial metric invariance over time was established.

6.2 Structural equation model

The model is shown in Figure 1. The Model fit was acceptable: CFI = 0.95; TLI = 0.94; $\chi 2$/df = 2.59, $p < 0.001$; RMSEA = 0.02, 90 % CI [0.02; 0.02]. Please see Table 1 and Table 2 for

an overview of the results. Regarding our H1, results showed that environmental social media use was significantly related to environmental knowledge in four countries. While in Belgium (b = −0.33, SE = 0.05, p < 0.001), Germany (b = −0.20, SE = 0.05, p < 0.001), and South Africa (b = −0.17, SE = 0.05, p < 0.001), environmental social media use was negatively associated with environmental knowledge, in Malaysia (b = 0.11, SE = 0.04, p = 0.003), it was positively related to environmental knowledge. However, for Chile (b = 0.01, SE = 0.05, p = 0.817), India (b = 0.05, SE = 0.06, p = 0.942), South Korea (b = −0.02, SE = 0.06, p = 0.748), and Thailand (b = 0.02, SE = 0.05, p = 0.650), we found no such statistically significant relationship. Thus, our H1 was supported in only one out of eight countries.

Concerning our H2, results indicated a significant association between environmental social media use and eco-anxiety in all countries. In Belgium (b = 0.39, SE = 0.04, p < 0.001), Chile (b = 0.28, SE = 0.05, p < 0.001), Germany (b = 0.31, SE = 0.05, p < 0.001), India (b = 0.16, SE = 0.05, p = 0.001), Malaysia (b = 0.18, SE = 0.04, p < 0.001), South Africa (b = 0.33, SE = 0.06, p < 0.001), South Korea (b = 0.27, SE = 0.05, p < 0.001), and Thailand (b = 0.10, SE = 0.05, p = 0.025), results showed that environmental social media use is positively related to eco-anxiety, in line with H2.

We found no support for H3. In Belgium (b = −0.18, SE = 0.03, p < 0.001), Germany (b = −0.12, SE = 0.04, p = 0.003), Malaysia (b = −0.16, SE = 0.04, p < 0.001), and South Korea (b = −0.08, SE = 0.04, p < 0.05), environmental knowledge was negatively associated with eco-anxiety. In Chile (b = −0.06, SE = 0.05, p = 0.242) and Thailand (b = −0.09, SE = 0.05, p = 0.197), we observed no such relationship, although the coefficient pointed into the same direction. In South Africa (b = −0.09, SE = 0.05, p = 0.056) as well as India (b = −0.06, SE = 0.03, p = 0.087), we found a tendency for a significant negative relationship.

6.3 Multi-group analysis

Regarding our RQ1, we found country differences between Belgium, Germany, and South Africa (negative associations) and Malaysia (positive association) with regard to the relationship between environmental social media use and environmental knowledge. In contrast, results in Chile, India, South Korea, and Thailand showed no significant relationships. We formally tested these differences with multi-group structural equation modeling: There was a significant worse model fit when constraining the path to be equal across countries, meaning that the association between social media use and knowledge was significantly different across countries (p < 0.001). Thus, H1 was not supported.

With respect to the relationship between environmental social media use and eco-anxiety, we observed a positive association across all countries. Still, multi-group

structural equation modeling revealed that the size of this significant positive relation was not equal across countries ($p < 0.001$), meaning that some showed stronger significant relations as compared to others (see Table 2). Thus, H2 was supported.

Regarding the relationship between environmental knowledge and eco-anxiety, there was a negative sign of the relationship for all countries, significant for some. Multi-group structural equation modeling reveals that countries did not significantly differ in the size of the effect ($p = 0.11$). This means, the effect coefficients do not differ, some coefficients are significant in some countries, while insignificant in others. Overall, we can clearly conclude that environmental knowledge and eco-anxiety are negatively related. This finding stands in contrast to H3.

6.4 Controls

Results showed that female gender (dummy-coded) was negatively associated with environmental knowledge in Belgium ($b = -0.30$, SE = 0.12, $p = 0.014$), Chile ($b = -0.30$, SE = 0.11, $p = 0.005$), Germany ($b = -0.31$, SE = 0.13, $p = 0.017$), South Africa ($b = -0.26$, SE = 0.11, $p = 0.021$), and South Korea ($b = -0.41$, SE = 0.12, $p < 0.001$). Moreover, while age was positively related to environmental knowledge in Belgium ($b = 0.01$, SE = 0.01, $p = 0.025$), Chile ($b = 0.01$, SE = 0.00, $p = 0.011$), Germany ($b = 0.02$, SE = 0.01, $p = 0.005$), India ($b = 0.01$, SE = 0.01, $p = 0.037$), and Thailand ($b = 0.04$, SE = 0.00, $p < 0.001$), we found a negative association in South Korea ($b = -0.02$, SE = 0.01, $p = 0.001$). Low education (dummy coded) was negatively related to environmental knowledge in Belgium ($b = -0.53$, SE = 0.16, $p < 0.001$), Chile ($b = -0.27$, SE = 0.13, $p = 0.038$), Germany ($b = -0.60$, SE = 0.18, $p < 0.001$), and South Africa ($b = -0.43$, SE = 0.13, $p < 0.001$). Further, high education (dummy coded) was positively related to environmental knowledge in Malaysia ($b = 0.57$, SE = 0.13, $p < 0.001$) and South Korea ($b = 0.29$, SE = 0.13, $p = 0.027$). Moreover, results showed a negative association between political orientation and environmental knowledge in India ($b = -0.09$, SE = 0.03, $p < 0.001$) and Thailand ($b = -0.08$, SE = 0.03, $p = 0.004$) and between income and environmental knowledge in Malaysia ($b = -0.14$, SE = 0.03, $p < 0.001$) and South Korea ($b = -0.11$, SE = 0.03, $p < 0.001$). Finally, we found a positive relationship between environmental concern and environmental knowledge in Belgium ($b = 0.32$, SE = 0.07, $p < 0.001$), Germany ($b = 0.23$, SE = 0.06, $p < 0.001$), India ($b = 0.19$, SE = 0.09, $p = 0.024$), and South Korea ($b = 0.22$, SE = 0.10, $p = 0.030$). Lastly, results indicated that female gender was positively associated with eco-anxiety in Germany ($b = 0.24$, SE = 0.12, $p = 0.039$) and South Africa ($b = 0.38$, SE = 0.12, $p = 0.002$). Additionally, we found that age was negatively related to eco-anxiety in Belgium ($b = -0.01$, SE = 0.00, $p = 0.030$), Chile ($b = -0.01$, SE = 0.01, $p = 0.034$), Germany ($b = -0.01$, SE = 0.01, $p = 0.005$), and Malaysia ($b = -0.01$, SE = 0.00, $p = 0.001$). Moreover, low education was positively related to eco-anxiety in Germany

(b = 0.42, SE = 0.16, p = 0.011) and India (b = 0.24, SE = 0.12, p = 0.038). High education was negatively related to eco-anxiety in Germany (b = –0.60, SE = 0.17, p < 0.001) and India (b = –0.59, SE = 0.15, p < 0.001). Moreover, while political orientation was negatively related to eco-anxiety in Germany (b = –0.08, SE = 0.03, p = 0.010), in India (b = 0.05, SE = 0.02, p = 0.021), Malaysia (b = 0.09, SE = 0.03, p = 0.001), South Korea (b = 0.06, SE = 0.03, p = 0.028), and Thailand (b = 0.07, SE = 0.03, p = 0.005), we found a positive relationship. Regarding income, results showed a negative association with eco-anxiety in Germany (b = –0.13, SE = 0.03, p < 0.001) and South Africa (b = –0.08, SE = 0.03, p = 0.004). Finally, environmental concern and eco-anxiety were positively related in all countries (Belgium: b = 0.60, SE = 0.06, p < 0.001; Chile: b = 0.46, SE = 0.07, p < 0.001, Germany: b = 0.34, SE = 0.06, p < 0.001, India: b = 0.44, SE = 0.07, p < 0.001, Malaysia: b = 0.50, SE = 0.07, p < 0.001, South Africa: b = 0.41, SE = 0.08, p < 0.001, South Korea: b = 0.41, SE = 0.09, p < 0.001, Thailand: b = 0.50, SE = 0.07, p < 0.001).

7 Discussion

Our findings clearly suggest a limited potential of social media use for learning about environmental issues. Against expectations, a positive association could only be observed for Malaysia. For most of the countries, however, social media use was even negatively related to environmental knowledge. In interpreting these findings, one could, of course, point to the measurement of environmental knowledge. We measured environmental knowledge as objective knowledge, the task was to correctly identify the main drivers of climate change, the reasons behind it as well as humankind's impact on climate change. Obviously, on social media, such environmental facts play a minor role. Perhaps, with knowledge items referring to the role of climate change in people's day-to day life (i.e., changes in weather), the results could have been different. Yet environmental knowledge as conceptualized in the present study is pretty basic, picking up basic facts such as the burning of fossil fuels, greenhouse gases, humans' use of water, or the environmental effect of overpopulation. It is key to understand these indicators and drivers of climate change. In short, such knowledge is a necessary condition for meaningful environmental engagement and thus, sustainable action.

We offer three major explanations for our findings. First, one could argue that social media content may not provide the substance and depth to learn about environmental facts. Oftentimes, the focus is on content that is easy to process, entertaining, or emotionalizing (Schmuck et al. 2022). By contrast, environmental facts are complex and abstract, they may require background knowledge or in-depth explanation. This is oftentimes not provided on social media. This argument is in line with the so-called "shallowing hypothesis", holding that social media makes

individuals less likely to engage in reflective thinking (Annisette and Lafreniere 2016). Second, and also zooming in on the negative relation between social media and environmental knowledge observed in some countries, social media has a distractive potential, too (Matthes 2022). That is, those who are exposed to environmental information on social media are also likely to be exposed to all other kinds of entertaining content. For instance, an influencer may talk about sustainability issues, but also about music or the latest (sustainable) fashion trends at the same time (Dekoninck and Schmuck 2023). In such an environment, users can be overloaded with information, therefore suppressing rather than fostering learning. Third and finally, it is well known that the algorithms behind social media prioritize content that is likely to generate shares, likes, and comments. In other words, the key mechanism may be engagement, rather than education and learning. Overall, these approaches also help explain why the model accounts for less variance in knowledge than in eco-anxiety.

In contrast to environmental knowledge, we observed a strong and consistent positive relation with eco-anxiety. On social media, visuals play a key role, and stories, memes, and hashtags often employ emotionalizing, alarming, and dramatic imagery (Risbey 2008). The algorithms may favor negative information, which may create a feeling of permanent crisis. The finding can also be explained by Terror Management Theory (Greenberg et al. 1986), which holds that the climate crisis increases mortality salience, which fosters eco-anxiety.

Interestingly, we could not confirm our prediction that environmental knowledge is positively related to eco-anxiety. Our argument was that environmental knowledge makes us aware about the dangers and negative consequences of climate change, thus fostering eco-anxiety. By contrast, we consistently observed a negative relationship across countries. As noted by Ágoston et al. (2024), knowledge may help us to regulate and suppress our eco-anxiety. Also, knowledge may be the key to finding solutions to the dramatic climate change. In other words, knowledge about the effects of greenhouse gases, humans' use of water, or the environmental consequences of overpopulation also implies an understanding of how the issue can be fixed. Tis may dampen rather than fuel anxiety.

Given the diverse set of countries in our study, the findings were remarkably consistent. To reiterate, social media use does not positively predict environmental knowledge, with the exception of Malaysia. Perhaps the dependence on industries that relate to environmental issues, such as the production of palm oil, makes Malaysia stand out. However, more research specifically on Malay social media content is needed to corroborate this claim. What is more, social media use was a significant driver of eco-anxiety. Finally, environmental knowledge and eco-anxiety, by and large, were negatively related. Although the relationship was not statistically significant in some countries, the countries did not differ significantly in the size of

the effect. In other words, differences in statistical significance (i.e., significant in one country, and not significant in another) does by no means indicate a significant difference between countries. The more powerful analysis is a multigroup analysis, which clearly showed a consistent and highly significant positive relationship (which did not significantly differ between countries).

7.1 Limitations

Several limitations must be considered. First, the cross-sectional nature of this study does not allow us to draw causal conclusions. Future research needs to provide further evidence on this matter using experimental and longitudinal designs. Second, our insights are based on self-reported data which are subject to a number or biases. Third, we measured general environmental social media use. Therefore, we have no insights into the specific environmental content to which participants are exposed to on social media. Also, the information depth and emotionality of the content needs to be taken into account. In this study, we only captured passive social media use. Future research should also explore the learning outcomes with respect to active uses, such as posting, sharing, or commenting. Fourth, the inclusion of additional variables, such as individual difference variables or firsthand experiences with environmental catastrophes may lend deeper insights. Finally, our comparative findings are limited to data from eight countries only. Although our countries varied greatly along the important dimensions of individualism and environmental performance, eight countries do not allow multi-level analyses specifically testing the role of macro-factors as well as the interaction of macro-factors and individual-level variables. Still, our data are by far superior to the stream of single country studies, particularly well-studied Western countries.

7.2 Conclusions

Social media is an indispensable resource for sustainability-related information and an important driver of environmental action, protest, and mobilization. Yet the results of our study, across various countries, suggest that social media use may not help to increase our environmental knowledge. What social media does, by contrast, is making us more anxious about environmental issues. In short, social media seems to emotionalize its users, rather than to inform. How can we reconcile these findings with our ideal of a public that is well educated about environmental facts? Read positively, the results of the present study do not imply that individuals do generally not learn about environmental facts. There may be other paths to learning, as for

instance, with traditional media use or educational programs. Also, not all environmentally conscious actions may necessitate a deeper understanding about the drivers of climate change, but just a basic acknowledgement that there is a pressing issue. The primary role of social media may thus not lie in educating the public, but rather in awareness building and mobilization. That is, the emotionalizing effect of social media can be an important factor, too. If environmental social media use is related to eco-anxiety, and eco-anxiety is a key driver of environmental action, the social media use can be a small but very an important part in the puzzle to combat climate change.

Author contributions: Jörg Matthes: Conceptualization; Formal analysis; Investigation; Methodology; Resources; Supervision; Validation; Visualization; Roles/Writing – original draft; Writing – review & editing. Ariadne Neureiter: Conceptualization; Data curation; Investigation; Methodology; Project administration; Supervision; Validation; Visualization; Roles/Writing – original draft; Writing – review & editing. Thomas Kirchmair: Data curation; Methodology; Project administration; Writing – review & editing. Mokhtarrudin Bin Ahmad: Methodology; Project administration; Writing – review & editing. Alice Binder: Conceptualization; Data curation; Investigation; Methodology; Project administration; Supervision. Christina Brandstetter: Roles/Writing – original draft; Writing – review & editing. Ploypin Chuenterawong: Methodology; Project administration; Writing – review & editing. Jeong-woo Jang: Methodology; Project administration; Writing – review & editing.
Competing interests: The authors declare that there are no known conflicts of interest associated with this publication.
Research funding: None.
Data availability: The data generated and analyzed are available under OSF https://osf.io/u7a3x/?view_only=949fbefa3d614a1c8d8fd574e92dc697.
Ethical Approval and Informed Consent: This study was conducted in accordance with ethical standards and received approval by institutional Review Board of the Department of Communication, University of Vienna. Informed consent was obtained from all participants involved in the study.
Declaration of generative AI in scientific writing: Generative AI has not been used.

Appendix

See Tables 1 and 2 and Figure 1

Table 1: Results for Environmental Knowledge.

	Belgium B(SE)	Chile B(SE)	Germany B(SE)	India B(SE)	Malaysia B(SE)	South Africa B(SE)	South Korea B(SE)	Thailand B(SE)
Social media use	**−0.332 (0.050)*****	0.010 (0.045)	**−0.198 (0.050)*****	0.005 (0.064)	**0.113 (0.038)****	**−0.174 (0.050)*****	−0.018 (0.055)	0.021 (0.047)
Female[a]	**−0.296 (0.121)***	**−0.298 (0.105)****	**−0.314 (0.131)***	−0.014 (0.126)	−0.164 (0.101)	**−0.261 (0.113)***	**−0.411 (0.116)*****	0.263 (0.112)
Age	**0.011 (0.005)***	**0.011 (0.004)***	**0.015 (0.005)****	**0.011 (0.005)***	0.007 (0.004)	0.005 (0.005)	**−0.015 (0.005)****	**0.043 (0.004)*****
Low education[b]	**−0.532 (0.158)*****	**−0.270 (0.130)***	**−0.595 (0.179)*****	0.034 (0.151)	0.011 (0.130)	**−0.427 (0.127)*****	−0.165 (0.191)	0.007 (0.129)
High education[b]	0.122 (0.137)	−0.068 (0.135)	−0.038 (0.189)	0.269 (0.198)	**0.571 (0.134)*****	0.182 (0.170)	**0.287 (0.130)***	0.183 (0.156)
Political orientation	−0.053 (0.028)	−0.034 (0.021)	−0.043 (0.034)	**−0.090 (0.027)*****	0.004 (0.026)	−0.007 (0.024)	0.018 (0.032)	**−0.078 (0.027)****
Income	0.027 (0.032)	0.042 (0.027)	−0.022 (0.060)	0.028 (0.023)	**−0.136 (0.025)*****	0.020 (0.026)	**−0.112 (0.029)*****	0.026 (0.026)
Environmental concern	**0.323 (0.073)*****	−0.003 (0.063)	**0.233 (0.060)*****	**0.191 (0.085)***	0.109 (0.068)	0.123 (0.073)	**0.220 (0.101)***	0.119 (0.068)
Explained variance	*0.170*	*0.053*	*0.129*	*0.056*	*0.102*	*0.075*	*0.074*	*0.195*

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$. [a]Reference category: Male; [b]Reference category: Intermediate education. Bold values indicate statistical significance.

Table 2: Results for Eco-Anxiety.

	Belgium B(SE)	Chile B(SE)	Germany B(SE)	India B(SE)	Malaysia B(SE)	South Africa B(SE)	South Korea B(SE)	Thailand B(SE)
Social media use	**0.388 (0.042)*** **	**0.280 (0.052)*** **	**0.306 (0.047)*** **	**0.161 (0.050)** **	**0.184 (0.039)*** **	**0.325 (0.056)*** **	**0.269 (0.048)*** **	**0.101 (0.045)** *
Environmental knowledge	**−0.179 (0.034)*** **	−0.057 (0.049)	**−0.117 (0.039)** **	−0.057 (0.033)	**−0.160 (0.041)*** **	−0.092 (0.048)	**−0.081 (0.037)** *	−0.051 (0.039)
Female[a]	−0.169 (0.092)	−0.168 (0.119)	**0.244 (0.118)** *	0.057 (0.096)	−0.014 (0.100)	**0.383 (0.123)** **	−0.078 (0.101)	−0.003 (0.108)
Age	**−0.008 (0.004)** *	**−0.010 (0.005)** *	**−0.012 (0.005)** *	−0.004 (0.004)	**−0.014 (0.004)** **	−0.006 (0.005)	0.004 (0.004)	−0.005 (0.005)
Moderate education[b]	−0.029 (0.120)	0.177 (0.146)	**0.415 (0.162)** *	**0.239 (0.116)** *	0.121 (0.129)	0.270 (0.139)	0.176 (0.163)	0.168 (0.124)
High education[b]	−0.113 (0.103)	−0.189 (0.152)	**−0.597 (0.170)*** **	**−0.588 (0.154)*** **	−0.019 (0.134)	−0.081 (0.028)	0.043 (0.111)	0.018 (0.150)
Political orientation	0.031 (0.021)	−0.020 (0.024)	**−0.078 (0.031)** *	**0.047 (0.021)** *	**0.085 (0.026)** **	−0.001 (0.025)	**0.060 (0.027)** **	**0.074 (0.026)** **
Income	−0.010 (0.024)	−0.050 (0.030)	**−0.131 (0.028)*** **	0.000 (0.018)	0.015 (0.025)	**−0.081 (0.028)** **	−0.027 (0.025)	0.024 (0.025)
Environmental concern	**0.599 (0.063)*** **	**0.456 (0.074)*** **	**0.338 (0.057)*** **	**0.442 (0.070)*** **	**0.497 (0.072)*** **	**0.409 (0.083)*** **	**0.414 (0.090)*** **	**0.496 (0.071)*** **
Explained variance	*0.675*	*0.319*	*0.350*	*0.349*	*0.365*	*0.302*	*0.402*	*0.273*

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$. [a]Reference category: Male; [b]Reference category: Intermediate education.

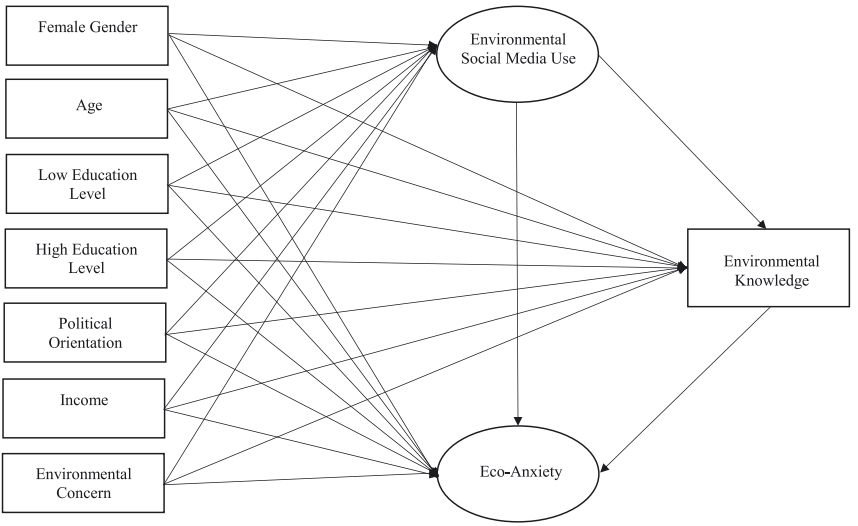

Figure 1: Conceptual multi-country structural equation model. Note. Measurement errors, correlations, and country not shown.

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