Citation: Kang, W. Residence and Education Moderate the Longitudinal Association between Environmental Concern (EC) and Proenvironmental Behavior. Sustainability 2022, 14, 14716. https://doi.org/10.3390/su142214716

Abstract: The association between environmental concern (EC) and proenvironmental behavior is well-established in the literature. However, previous studies are limited to cross-sectional designs, small sample sizes, and limited populations (e.g., college students). Thus, longitudinal studies on large sample sizes are needed to understand the complex associations between EC and proenvironmental behavior, which can provide insights into how EC is related to changes in proenvironmental behavior over time. In addition, education and residence are closely related to both environmental attitudes and behavior. The current study investigated how education and residence moderate the longitudinal association between the EC and proenvironmental behavior of 17,658 participants (42.86% male and 57.14% female) with a mean age of 53.05 ± 16.40 years old from Understanding Society: the UK Household Longitudinal Study (UKHLS). Factor analysis and hierarchical regression were used to analyze the data. The current study, for the first time in the literature, found that education and residence significantly moderate the longitudinal association between EC and proenvironmental behavior. Thus, it is important to consider people’s educational level and residence when trying to improve EC, which can then lead to effective proenvironmental behavior.

Keywords: residence; education; environmental concern; proenvironmental behavior; longitudinal

1. Introduction

Environmental changes lead to severe and irreversible changes, such as global warming, which affect ecosystems and humanity, which makes them some of the most important challenges of the 21st century. As a significant proportion of these environmental changes trace back to individual actions, rapid and drastic changes in people’s habits, such as buying recycled paper products, are demanded [1]. Thus, understanding the association between environmental concern (EC, i.e., concern for the severity of various environmental issues) and proenvironmental behavior (i.e., behaviors that are beneficial to the environment) is of great importance.

Previous studies have conceptualized EC in several ways that are not mutually exclusive [2]. Some EC concepts refer to the fact that people do not care about the environment for themselves, but environmental degradation can affect the health and well-being of people or other species around the world [3]. EC can also be seen as reflecting more fundamental factors such as religious beliefs and post-materialist principles [3]. Finally, EC can be conceptualized as concern for the severity of various environmental issues, the impact of human activities on these issues, and the support for solving these issues [4], which is the most widely used concept to represent EC in the literature. The current research focuses on the third construct of EC, which is the concern for the severity of various environmental issues.

The following part of this section further introduces the relationship between EC and proenvironmental behavior and then discusses how education and residence may moderate the associations between EC and proenvironmental behavior. Finally, the final subsection of the introduction outlines the aim and the hypothesis of the current study. Thus, there are four subsections: Sections 1.1–1.4.
1.1. EC and Proenvironmental Behavior

Many scholars have used the Theory of Planned Behavior Framework to understand the association between EC and proenvironmental behavior (e.g., [5,6]), which explains proenvironmental behavior based on three key motivational factors, including attitudes, subjective norms, and perceived behavioral control [7]. Thus, EC belongs to the attitude aspect of this theoretical framework.

Although environmental research has paid attention to proenvironmental attitudes and behaviors, despite the need for individual actions to protect the environment [8], ignoring psychological and socioeconomic insights into environmental behavior may result in ineffective policy instruments based on overly simplistic assumptions about human behavior, which leads to ineffective progress towards sustainability [9,10]. For instance, many policies have extensively emphasized raising awareness about the adverse effects of climate change [11,12]. However, although this kind of campaign helped people to understand climate science and their responsibility [13] towards protecting the environment, it does not always entirely change people’s behavior [1,14–16].

Indeed, evidence has suggested that EC is weakly linked to proenvironmental behavior (e.g., [5,17–20]; For instance, Inglehar et al. [21] found that only 65 percent of individuals who were concerned about the environment were willing to take proenvironmental actions. More recent studies have also examined broad cultural factors that affect the strength of this association [22,23]. One study also highlighted the potential discrepancies between EC and proenvironmental behavior among socioeconomically disadvantaged groups, such as among ethnic minorities [24]. Another cross-sectional study that focused on college students found that learned helplessness moderates the associations between EC and proenvironmental behavior [25].

1.2. Education and Environmental Attitude and Behavior

Education level is closely related to environmental attitudes and behaviors. Indeed, a lot of previous studies have found a positive association between education levels and proenvironmental attitude (e.g., [26–30]), as well as proenvironmental behavior in a range of contexts (e.g., [31–34]). For example, Rowlands et al. (2003) found that people with higher educational qualifications are willing to contribute more to green electricity. De Silva and Pownall (2014) found that college-educated people have a higher likelihood of sacrificing financial well-being in exchange for improving environmental quality. Moreover, Xiao et al. (2013) found that educational level is positively associated with EC in Chinese citizens. Torgler and García-Valiñas [28] showed that both years of formal education and informal education were associated with environmental attitudes.

Regarding the relationship between education level and proenvironmental behavior, several studies have identified that people with higher educational levels are more likely to recycle [31–36]. Moreover, there are several studies that have identified the association between education and food choices that could influence the environment. Specifically, Blend and Van Ravenswaay [37] found that the probability of purchasing eco-labeled apples is associated with higher levels of education. Several other studies have also found that education is positively associated with the likelihood of buying organic food [38–40]. Moreover, there were positive correlations between education levels and water-saving behaviors [41], as well as energy-saving behaviors [42,43]. One more recent study also found that education causes people to act in a more environmentally friendly way [36]. Thus, it is reasonable to speculate that education moderates the longitudinal association between EC and proenvironmental behavior. Given these works, the current study hypothesizes that the longitudinal association between EC and proenvironmental behaviors is stronger in people with at least a college-level education compared to people who did not attend college.
1.3. Urban vs. Rural Differences in Environmental Attitude and Behavior

Although some of the major progress towards environmental psychology has been focused on the relationships between sociodemographic variables and environmental attitude and behavior, less is known about how EC and proenvironmental behavior are affected by the place of residence [44]. Studies from different countries yield conflicting results. For instance, Chinese people who lived in larger cities had a higher probability of engaging in proenvironmental behaviors compared to people living in smaller cities [45]. In Germany, urban people reported greater verbal commitment to environmental issues, but did not have differences in other forms of concern compared to people living in rural areas [46]. However, UK students who grew up in rural areas reported more positive orientations towards the natural environment than students who were raised in cities [47]. Berenguer et al. [48] found that people living in cities have higher environmental responsibility values but show less proenvironmental orientation. However, rural residents show more distinct attitudes towards environmental responsibility and greater consistency in the attitude–behavior relationship. Ecocentric means to put nature’s interests ahead of humanity’s interests, whereas anthropocentric means to want to protect the environment, mainly, so that it can fulfill human needs. Bejerke and Kaltenborn [49] suggested that farmers in Norway are more ecocentric and less anthropocentric than research biologists and wildlife managers. Moreover, urban Trinidadians were also more anthropocentric than rural Trinidadians and Canadians [15,50], although rural Canadians reported participating more in recycling and stewardship behaviors. Rural resident’s anthropocentric tendencies are consistent with their use of natural resources for human ends [51]. Another study on Canadians from British Columbia found high levels of EC among both rural and urban residents [52]. Thus, although there are some controversies in previous findings, it is reasonable to speculate that residence moderates the longitudinal association between EC and proenvironmental behavior.

1.4. The Current Study

Thus, although previous studies have shed light on the relationship between EC and proenvironmental behavior, most of them are cross-sectional and focused on a very small sample size of a particular group (e.g., college students; see Section 1.1). Much less is known about the longitudinal associations between EC and proenvironmental behavior and whether education and residence moderate such associations in a nationally representative sample from the UK. The longitudinal associations between EC and proenvironmental behavior are important to establish because they can reflect on how EC can lead to changes in subsequent proenvironmental behavior. The current study hypothesizes that education and residence moderate the longitudinal association between EC and proenvironmental behavior.

2. Methods

This section introduces the specific steps taken for conducting the current study, which involves the dataset being analyzed, questionnaires being administrated to participants, and the statistical analysis methods used to analyze the data. This section is divided into three subsections: Sections 2.1–2.3.

2.1. Data

This study utilized data from Understanding Society: the UK Household Longitudinal Study (UKHLS), which has been collecting annual information from an original sample of UK households since 1991 (when it was previously known as The British Household Panel Study (BHPS)). All data collections have been approved by the University of Essex Ethics Committee. Participants received informed consent before participation in the study. This dataset is publicly available from https://www.understandingsociety.ac.uk (accessed on 12 July 2022). The current study used data from Wave 4 and Wave 10, which were collected from 2012 to 2013 and 2018 to 2019 [53], respectively. After removing individuals
who had any missing variables of interest in both waves, 17,658 participants (42.86% male and 57.14% female) with a mean age of 53.05 ± 16.40 years old in Wave 10 remained for further analysis.

2.2. Measures

This section introduces measures including Sections 2.2.1–2.2.3.

2.2.1. Proenvironmental Behavior

Environmental habits were asked, starting with the sentence “Now a few questions about the environment. Could you tell me how often you personally do each of the following things?” Environmental behaviors included: (1) “leave your TV on standby for the night,” (2) “switch off lights in rooms that aren’t being used,” (3) “keep the tap running while you brush your teeth,” (4) “put more clothes on when you feel cold rather than putting the heating on or turning it up,” (5) “decide not to buy something because you feel it has too much packaging,” (6) “buy recycled paper products such as toilet paper or tissues,” (7) “take your own shopping bag when shopping,” (8) “Use public transport (e.g., bus, train) rather than travel by car,” (9) “walk or cycle for short journeys less than 2 or 3 miles,” (10) “car share with others who need to make a similar journey,” (11) “take fewer flights when possible.” Participants answered these questions using a scale from 1 (“Always”) to 5 (“Never”). All the questions except for Questions 1 and 3 were reverse-coded. The summary scores of these answers were used to represent proenvironmental behavior. Participants completed these questions in both Wave 4 and Wave 10.

2.2.2. EC

Participants were asked to indicate their concerns towards the environment with a Liker scale ranging from 1 (“Strongly agree”) to 5 (“Strongly disagree”), based on four statements including: (1) “The so-called ‘environmental crisis’ facing humanity has been greatly exaggerated.” (2) “If things continue on their current course, we will soon experience a major environmental disaster.” (3) “The effects of climate change are too far in the future to really worry me.” (4) “Climate change is beyond control—it’s too late to do anything about it.” Participants completed these questions for both Wave 4 and Wave 10.

2.2.3. Demographic Variables

Demographic variables including age, sex, monthly income, highest educational qualification, and residence were included in the analysis. Specifically, age and monthly income were coded as what they were (continuous), sex was coded as male (1) vs. female (2), highest educational qualification was coded as below college (1) vs. college (2), and residence was coded as urban (1) vs. rural (2).

2.3. Analyses

This section describes the statistical methods applied to analyze the current data, which include Sections 2.3.1 and 2.3.2.

2.3.1. Factor Model

A confirmatory factor analysis (CFA) with oblique rotation was performed on MATLAB 2018a using the native MATLAB function based on the four questions asked about EC with a customized script. The number of oblique components was specified as 1. This factor score was kept for further analysis. Specifically, this score reflects on how much one is concerned about the environment. The factor loadings for EC in Wave 4 and Wave 10 can be found in Table 1. This factor explained 65.53% of total variances in Wave 4 and 69.78% of variances in Wave 10.
Table 1. The factor loadings for EC questions in Wave 4 and Wave 10.

|          | Wave 4 | Wave 10 |
|----------|--------|---------|
|          | 0.66   | 0.79    |
|          | −0.43  | −0.57   |
|          | 0.71   | 0.70    |
|          | 0.47   | 0.46    |

2.3.2. Multilevel Regression Model

A multilevel regression model was used by taking the EC and proenvironmental behavior in Wave 4 and education, residence, and other demographics in Wave 10 as predictors to predict proenvironmental behavior in Wave 10. Moreover, the education × EC and residence × EC interactions (Aiken et al., 1991 [54]) were included in the model as the predictor as well.

3. Results

The current study found that education ($b = 0.30, t = 3.77, p < 0.001, 95\% \text{C.I.} [0.15, 0.46]$) moderates the longitudinal association between EC and proenvironmental behavior. As shown in Figure 1, participants who received college or above-college education had both higher EC and proenvironmental behavior than people who did not. However, the associations between EC and changes in proenvironmental behavior were stronger in college-educated individuals compared to participants who did not attend college. Moreover, residence ($b = 0.30, t = 3.39, p < 0.001, 95\% \text{C.I.} [0.13, 0.47]$) also moderates the longitudinal relationship between EC and proenvironmental behavior (Figure 2). Participants who lived in urban areas had both higher EC and proenvironmental behavior than people who did not. However, the association between EC and changes in proenvironmental behavior was stronger in rural compared to urban participants. The full results can be found in Table 2.

Figure 1. The moderation effect of education on the longitudinal relationship between EC and proenvironmental behavior.
Figure 2. The moderation effect of residence on the longitudinal relationship between EC and proenvironmental behavior.

Table 2. The regression coefficient ($b$) for proenvironmental behavior in Wave 4, demographics, and Residence and Education by EC interactions with the total explained variances ($R^2$).

| Predictors                  | $b$     |
|-----------------------------|---------|
| Proenvironmental behavior in Wave 4 | 0.41 *** |
| Age                         | 0.02 ***|
| Sex                         | 0.53 ***|
| Monthly income              | 0.00 ***|
| Education                   | 0.46 ***|
| Residence                   | −0.42 ***|
| EC in Wave 4                | −0.32   |
| Education $\times$ EC       | 0.30 ***|
| Residence $\times$ EC       | 0.30 ***|
| $R^2$                       | 0.222   |

*p < 0.05, **p < 0.01, ***p < 0.001.

4. Discussion

The aim of the current study was to test if education and residence moderate the longitudinal associations between EC and proenvironmental behavior. The current findings filled the gap in the literature regarding how EC is longitudinally related to changes in proenvironmental behavior in a nationally representative sample from the UK, and demonstrated that education and residence moderate the longitudinal association between EC and proenvironmental behavior.

The finding that, despite the moderation of education and residence, baseline EC is generally positively related to changes in proenvironmental behavior, is largely consistent with the broader literature that characterizes the relationship between EC and proenvironmental behavior (e.g., [5,19,21–25]).

The current study found that education significantly moderates the longitudinal association between EC and proenvironmental behavior, after controlling for demographics (Table 2), which indicates that the longitudinal association between EC and proenvironmental behavior is dependent on education. Specifically, proenvironmental behavior was
at similar levels for college-educated participants and participants without a college degree who had less EC (Figure 1). However, people with at least a college degree with higher EC seemed to take more proenvironmental actions than people who had not received college-level education (e.g., [26–28]). This finding may be explained by considering that college-educated individuals may be more quickly and rightly taking actions that protect the environment, as college-educated individuals may learn this environmental knowledge in college. Similarly, the current study found that residence significantly moderates the longitudinal association between EC and proenvironmental behavior after controlling for demographics (Table 2), which indicates that the longitudinal association between EC and proenvironmental behavior is also dependent on residence. Specifically, urban residents had higher levels of EC and proenvironmental behavior (Figure 2; e.g., [45]). However, the proenvironmental behavior of urban and rural residents was becoming closer for people with high EC. The more proenvironmental behavior among people living in cities may reflect the fact that large cities with political power can afford to promote proenvironmental behavior, whereas small cities which are lacking jobs and political power are compelled to pursue economic growth, even with the environmental costs [45]. However, proenvironmental behavior can be increased in people with high EC.

5. Conclusions

To conclude, the aim of the current study was to establish the longitudinal association between EC and proenvironmental behavior and test if education and residence moderate such an association. By using factor analysis and hierarchical regression to analyze the data from Wave 4 and Wave 10 from UKHLS, the current findings showed that education and residence moderate the longitudinal association between EC and proenvironmental behavior. Given the established associations between EC and proenvironmental behavior so far, findings from the current study have important implications for increasing EC to promote proenvironmental behavior. Policymakers should use this information for proenvironmental campaigns. For instance, proenvironmental behavior in people without a college degree did not show many changes in their proenvironmental behavior with high EC. Thus, campaigns with the aim to promote proenvironmental behavior by increasing EC may be less effective for this group of people. There are many positive features of the current study, including the establishment of the longitudinal relationship between EC and proenvironmental behavior and the use of a nationally representative sample in the UK with a large sample size. However, the present study considered proenvironmental behavior in general. Future research should look at how EC is related to specific proenvironmental behaviors, as there are different barriers to different types of proenvironmental behaviors.

Funding: This research received no external funding.

Institutional Review Board Statement: Ethics approval was received from the University of Essex-Ethics Committee.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Publicly available datasets were analyzed in this study. This data can be found here: https://www.understandingsociety.ac.uk (accessed on 12 July 2022).

Conflicts of Interest: The author declares no conflict of interest.

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