Predicting pro-environmental behaviours: the role of environmental values, attitudes and knowledge

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Abstract

Purpose – This study aims to investigate the effect of prosocial values on pro-environmental behaviours via attitudes in which environmental knowledge and proself values moderate the relationship. This study also examines the application of the Theory of Planned Behaviour and Cognitive Dissonance.

Design/methodology/approach – This study employed a quantitative method to examine potential positive or negative moderating effects of environmental knowledge and proself values on environmental attitudes and behaviour. Participants were undergraduate students recruited from a state university in the eastern part of Indonesia. The online survey link was randomly sent to 500 students in 14 different Faculties with a response rate of 57% (285) participants (80% female). Data were analysed using a moderated-mediation regression technique.

Findings – The results suggested that only biospheric value positively affected pro-environmental behaviours. Environmental knowledge negatively moderated the relationship between prosocial values and environmental attitudes. Similarly, high egoistic value potentially reduced the effect of environmental attitude on pro-environmental behaviours. Environmental knowledge could impede the positive impacts of prosocial values while egoistic value negates the effect of attitude on pro-environmental attitude.

Research limitations/implications – Although the findings supported most hypotheses, this study did not control the effect of some demographic variables such as education and social-economic status. Participants tended to share some similar characteristics, which potentially influenced the results.

Originality/value – This study challenged some common antecedents of pro-environmental behaviours and offered some alternative explanations. This study has offered a new insight in understanding unique interactions among values, knowledge and attitude.

Keywords Environment, Values, Attitudes, Knowledge, and Pro-environmental behaviours

Paper type Research paper

Introduction

Environmental behaviour has emerged as one of the most investigated factors among environment-related issues. Environmental issue has become an urgent topic, and it has attracted scholars' attention across different fields. In the field of psychology, environmental

psychology studies focus on the complex interaction between human behaviours and the environment. The focus eventually shifted from describing environmental behaviour to the determinants of pro-environmental behaviours (Kothe *et al.*, 2019; Paswan *et al.*, 2017). This endeavour is considered crucial as it promotes positive environmental behaviours and at the same time, reduces negative environmental behaviours (Kollmuss and Agyeman, 2002).

Scholars have identified some significant determinants of pro-environmental behaviours. Firstly, knowledge has been found as the predictor of pro-environmental behaviours (Ajzen *et al.*, 2011; Carmi *et al.*, 2015; Zsóka *et al.*, 2013). However, a recent study suggested that knowledge had insignificant impacts on energy consumption and climate change mitigation (Jakučionytė-Skodienė *et al.*, 2020). Knowledge is only one part of the whole story, another flip of the coin is the effect of value orientation on pro-environmental behaviours (Bouman *et al.*, 2018; de Groot and Steg, 2007, 2010). It is believed that values are relatively stable over time, and they affect a wide range of environmental beliefs and behaviours. Attitude also contributes immediate impact on pro-environmental behaviours as previously found by Meinhold and Malkus (2005), Jakučionytė-Skodienė *et al.* (2020) and Paswan *et al.* (2017). The link between the predictors (i.e. knowledge, values and attitudes) and environmental behaviour could be more complicated than it has appeared.

In many decades, scholars have put serious efforts to explore the determinants of pro-environmental behaviours. Kothe *et al.* (2019), in their review, suggested that future studies should examine some potential predictors of environmental behaviours by investigating the role of attitudes, intention, knowledge, and values. In addition, these studies should put more attention on the non-western population, as most studies were previously conducted in western culture. Further investigation is necessary to reveal the role of each predictor and finally to create a valid and reliable theoretical model. Thus, considering the above discussion, this study will investigate the effect of knowledge, values and attitudes on pro-environmental behaviours.

Regarding the effect of environmental knowledge, some recent findings have confirmed that knowledge had weak or no effects on environmental behaviour (Gkargkavouzi *et al.*, 2019; Braun and Dierkes, 2017) while Casaló *et al.* (2019) and Wang *et al.* (2020) strong effects. Earlier, Courtenay-Hall and Rogers (2002) argued that environmental knowledge and environmental behaviours were separated by a gap in people's mind and although knowledge is necessary it is not sufficient to predict environmental behaviours (Kollmuss and Agyeman, 2002).

The link between knowledge and environmental behaviours may have been influenced by other factors. For instance, the level of information accuracy determines how people perceive information and evaluate the connection between specific information and certain behaviours. Therefore, environmental knowledge may not always predict pro-environmental behaviours because the information is general rather than specific to particular pro-environmental behaviours, such as energy conservation (Ajzen *et al.*, 2011). Similarly, a study also indicated that although environmental education successfully improved knowledge, attitudes and pro-environmental behaviours, the role of knowledge does not reflect in daily activities (Zsóka *et al.*, 2013). It seems that knowledge interacts with other factors to predict pro-environmental behaviours such as attitudes (Meinhold and Malkus, 2005), emotion (Carmi *et al.*, 2015), motives and barriers (Gkargkavouzi *et al.*, 2019). Unfortunately, little is known about these interactions. Therefore, it is necessary to investigate the role of knowledge in predicting pro-environmental behaviours.

Apart from the impact of knowledge on environmental behaviours, values also play a pivotal role in pro-environmental behaviours. Value has been defined as a trans-situational goal which varies in degree of importance and serves as a guiding principle in one's life (Bilsky and Schwartz, 1994; Schwartz, 1994). An early survey of fundamental human values discovered that values could act as an efficient instrument for describing and explaining differences among individuals, groups, nations and cultures (Rokeach and Ball-Rokeach,

1989). Therefore, value orientation towards environmental behaviours should be considered as one of the critical antecedents for pro-environmental behaviours.

Scholars in the area of environmental psychology have found many desirable impacts of values on pro-environmental behaviours. For example, values predicted willingness to accept climate change policy (Nilsson *et al.*, 2004) and reduce personal car use (Nordlund and Garvill, 2003). Intention to perform pro-environmental behaviours depends on prosocial and proself values (Gärling *et al.*, 2003). Some recent studies also suggested that certain types of values (e.g. egoistic and social-altruistic) impacted positive environmental behaviours such as controlling human consumptions (Helm *et al.*, 2019), promoting green lifestyle (Sony and Ferguson, 2017), encouraging social environmentalism, conservation and environmental citizenship (van Riper *et al.*, 2019). Considering these findings, one should also note that each value has a different effect on environmental behaviours.

This study also considers the importance of attitude in shaping pro-environmental behaviours. Attitude towards a particular object or event will associate with the emergence of some behaviours (Ajzen and Fishbein, 1977; Bohner and Dickel, 2011). Bohner and Dickel (2011) defined attitude as an evaluative response, whether it was positive or negative, toward an object of thought which encompasses affective, behavioural and cognitive responses. The environmental attitude has become a fundamental construct in environmental psychology studies (Kaiser *et al.*, 1999). Environmental attitudes referred to a set of beliefs and values of an individual towards nature or environmental issues (VandenBos, 2015). Some early investigations have confirmed that environmental attitudes are associated with environmental values (Milfont *et al.*, 2010; Stern *et al.*, 1995), environmental knowledge and behaviours (Arcury, 1990; Bradley *et al.*, 1999; Fujii, 2006; Juvan and Dolnicar, 2014; Kaiser *et al.*, 1999; Stern *et al.*, 1995; Vermeir and Verbeke, 2006). These associations could be direct (Tian *et al.*, 2020; Liu and Feng, 2019), influenced by other variables (Tian *et al.*, 2020), and indirect (Janmaimool and Khajohnmanee, 2019; Liu *et al.*, 2020).

The proximal and distal predictive model of pro-environmental behaviours were more complicated than a single theoretical model. Stern *et al.* (1995), for instance, discovered a new theoretical model to examine how the environmental attitude was formed. Further, this model was also exerted to predict environmental behaviours in a meta-analysis study (Klöckner, 2013). However, this meta-analysis study put less attention on the importance of environmental knowledge and prosocial vs. proself values. Therefore, this current study is intended to close this gap by proposing a new approach to understanding the relationship between the most common variables in the study of environmental psychology.

Literature review and hypotheses

This study proposed that two prosocial values (i.e. biospheric and altruistic) predicted environmental behaviour via environmental attitude. Secondly, the effect of prosocial values on attitude is moderated by environmental knowledge. Lastly, the direct effect of environmental attitude on environmental behaviour is moderated by proself values (i.e. egoistic and hedonistic). In order to firmly explain this model, this study employs the theory of planned behaviour (TPB) and the theory of cognitive dissonance (TCD).

In terms of predicting pro-environmental behaviours, some scholars have implemented TPB to examine the antecedents of pro-environmental behaviours (Greaves *et al.*, 2013; Oreg and Katz-Gerro, 2006; Paul *et al.*, 2016). The TPB was used to explain motivational factors in individual behaviours (Ajzen, 2002, 2011; Madden *et al.*, 1992). This theory has become a prominent way of explaining behaviours, and it is also used as a framework for designing behavioural change interventions. The theory proposed that human behaviours were determined by behavioural intention in which the intention was initially triggered by one's attitudes, subjective norms and perceived behavioural control (Ajzen, 1991, 2012a). Although intentions can affect the outcome behaviours, the performance of one individual might also be

affected by non-motivational factors such as resources and opportunities (Ajzen, 2002; Madden *et al.*, 1992). The intended behaviours will be performed if one has an opportunity and adequate resources (Ajzen, 1991).

There is a plausible argument that human values influence motivation and behaviour (Howell and Allen, 2016; Parks and Guay, 2009; Brown, 1976), including pro-environmental behaviours (Stern, 2000). According to TPB and TRA, human intention is determined by motivational factors. Furthermore, as previously mentioned that intention to perform a particular behaviour is influenced by attitude. Human attitudes are also strongly influenced by values (Liu and Chen, 2019; Steg *et al.*, 2012), and this notion also applies for attitudes toward the environment (Milfont and Gouveia, 2006). In brief, human values predict human behaviour through their influence on attitudes.

Biospheric and altruistic values were found to be desirable prosocial values, and they contributed a positive effect on pro-environmental behaviours. In contrast, egoistic value showed a negative relationship (de Groot and Steg, 2007, 2009, 2010; Nordlund and Garvill, 2016). de Groot and Steg (2007) postulated that people with prosocial values would behave pro-environmentally by considering the costs and benefits of their behaviours for ecosystems (biospheric value) or other people (altruistic value). Given the TPB and TRA and some supporting evidence, prosocial values provide an individual with motivational factors to engage in desired environmental behaviour through their influence on attitudes. Therefore, this study proposes that:

H1. Prosocial values will directly predict pro-environmental behaviour

H2. Prosocial values will predict pro-environmental behaviour via environmental attitude

Furthermore, this study employs the TCD to explain the moderating effect of environmental knowledge and proself values (egoistic and hedonistic). Cognitive dissonance is defined as an unpleasant psychological state resulting from inconsistency between two or more elements that can be relevant or irrelevant to one another in a cognitive system (Harmon-Jones and Mills, 2019; Festinger, 1965). Cognitive dissonance also helps to understand the attention selection process and the condition to which they will seek out or ignore the information (Harmon-Jones and Mills, 2019).

Experiencing cognitive dissonance causes an unpleasant feeling and confusion. During this stage, people intend to calibrate or balance the consistency between elements in their cognitive system. Consequently, this leads individuals to avoidance of information and the individual will tune-out or limit the importance of information, although the information is genuinely important (Harmon-Jones and Mills, 2019). Dissonance can be reduced by adding new and more consistent elements to the system. For example, a person knows that littering can harm the environment. On the other hand, he or she was either careless enough to locate a nearby trash can while driving or disturbed to keep the trash inside the car. As a result, the person will reduce the importance of that information and will throw the trash on the road.

The TCD has been implemented in many areas to understand conflicting situations such as parent's attitude toward youth's drinking issues (Glatz *et al.*, 2012), understanding consumers' existing beliefs against negative word-of-mouth (Kim, 2011), and to explain the (in)consistency of environmentally responsible behaviours (Thogersen, 2004). This theory potentially opens new insight into the understanding of the impact of environmental knowledge on attitudes and pro-environmental behaviours. Generally, once people gain more information, they will behave according to their knowledge. However, knowing more could also cause confusions as more elements should be considered at the same time during the cognitive process. Consequently, people potentially ignore the importance of information to reduce unpleasant

psychological state due to confusions. Therefore, environmental knowledge could buffer the positive effect of prosocial values on attitudes. The next hypothesis will be:

H3. The effect of two prosocial values on attitudes will be negatively moderated by environmental knowledge.

While prosocial values favour environmental behaviours, proself values (egoistic and hedonistic) are more likely to be the opposite (Nordlund and Garvill, 2016; de Groot and Steg, 2007, 2009, 2010). de Groot and Steg (2007) and de Groot and Steg (2009) suggested that people with proself values will behave based on the costs or benefits of the behaviours for them personally (egoistic value) or based on pleasure or pain related to the behaviours (hedonistic value). Possessing proself values may change the effect of attitude on environmental behaviour. Although environmental attitudes are strongly in-line with pro-environmental behaviours, proself values could change individual preference. People would take actions that are more favourable to his/her ego. According to TCD, the existence of pro-environmental attitudes and proself values could cause conflict in the cognitive process. Thus, as proself values dominate individual, the effect of attitude on environmental behaviours would be reduced to provide the individuals with the less confusing and unpleasant psychological state. This leads to the last hypothesis:

H4. The effect of the two prosocial values on environmental behaviours via attitudes will be moderated by environmental knowledge and proself values.

Method
This study employed a quantitative method with moderated-mediation technique. This method allows researchers to test interactions between variables using empirical data. The statistical techniques will explain the negative or positive moderating effect of knowledge and proself values in predicting attitudes and behaviours. To support this method, this study recruited participants from a non-specific group such as military or political parties where their values could cause systematic bias in the study.

Participants and procedure
Participants were undergraduate students recruited from the largest state university in the eastern part of Indonesia. The university was selected as it had the most diverse course programme, located in the most populated city in Indonesia, and it also hosted more than 21,000 students coming from different cities across Indonesia. Thus, students from this university represent the population from non-specific groups. The university was awarded a grade A accreditation from the Board of National Accreditation of Indonesia, and it was among the top 10 national universities. The students were diverse in terms of gender, race, ethnicity and social-economic status. Participants were randomly recruited using an online survey platform. The link contained a briefing and debriefing form, demographic information, and questionnaires. The students indicated in the survey whether or not they agree to participate. They were free to discontinue the survey without any effects on their grades or courses. The link was randomly sent to 500 students in 14 different Faculties with response rate 57% (285) participants with most of the participants were female (80%). Only completed and submitted responses were recorded and used in the data analysis.

Measures
This study employed four different measures to capture participant's values, attitudes, knowledge and behaviours. The measures were initially developed in English. They were properly adapted from English to Bahasa Indonesia. All measures were tested for construct validity and reliability. The following will explain more details about each measure.

Environmental Portrait Value Questionnaire (EPVQ) was developed to measure individual value (Bouman *et al.*, 2018). The questionnaire was administered with a seven-point Likert-type scale ranging from 1 (overall not like me) to 7 (very much like me). The Questionnaire consisted of four different value types; they were Biosphere (EPVQ_B), Altruism (EPVQ_A), Egocentric (EPVQ_E) and Hedonistic (EPVQ_H). The Confirmatory Factor Analysis did not confirm the previous theoretical model (RMSEA > 0.10). However, after exploring the construct using the Exploratory Factor Analysis, the results suggested a four-factor solution with two items from EPVQ_E must be grouped with EPVQ_H items. The EPVQ_B and EPVQ_A each had four items while EPVQ_E had three items and EPVQ_H had five items. The results suggested a better model fit with RMSEA = 0.07 and TLI = 0.93. Each sub-scale also yield acceptable reliability ranging from $\alpha = 0.81$ to 0.90 (EPVQ_A = 0.83, EPVQ_B = 0.90, EPVQ_H = 0.87, EPVQ_E = 0.81). The above evidence indicated that the EPVQ was valid and reliable for research purpose. The items included "it is important for him that everyone has an equal chance" (*Penting bagi dia bahwa setiap orang memiliki kesempatan yang sama*).

Environmental Attitude Inventory (EAI) was initially constructed to measure attitudes towards the environment, and this inventory was developed by Uzun *et al.* (2019). The inventory used a Likert-type scale with options ranged from 1 (strongly disagree) to 7 (strongly agree). The Confirmatory Factor Analysis confirmed that the inventory was a good fit with two factors (RMSEA = 0.08). Also, inter-item correlation for reliability test yielded $\alpha = 0.77$, suggesting that the inventory was valid and reliable for research. A sample of items was "I am not sad when seeing the environment is being destroyed" (*Saya tidak sedih ketika melihat lingkungan alam hancur*).

Kaiser and Frick (2002) developed an Environmental Knowledge (EK) test to measure the knowledge related to the environment. The test initially contained 26 items, nine items for each sub-test System Knowledge (SK), Action Related Knowledge (ARK), and eight items for Effectiveness Knowledge (EK), with score 1 for correct answer and 0 for the wrong answer. The test was delivered with multiple choices, where participants selected one correct answer in each item. The Confirmatory Factor Analysis suggested that the test had three factors with RMSEA = 0.07. The reliability was lower than the other measures in this study ($\alpha = 0.50$). However, after dropping ten items with low inter-item correlations, the Cronbach's alpha was more acceptable for research purpose ($\alpha = 0.63$). The final form of the test had five items for SK, seven items for ARK and four items for EK. Therefore, this measure was considered valid and reliable for research. The items included "water and air pollution impact health" (*Pencemaran air dan udara berdampak pada kesehatan*).

The General Environmental Behaviour Scale (GEBS) was intended to measure pro-environmental behaviours. The scale was first developed by Kaiser (1998) with response options ranged from 1 (never) to 5 (always). Based on the results from the Confirmatory Factor Analysis, the scale consistently had six behavioural dimensions, (Mobility and Transportation, Consumerism, Energy Conservation, Waste Avoidance, Social Behaviours toward Conservation, and Recycling) with RMSEA = 0.07. The scale also had an acceptable Cronbach's alpha (0.70), indicating a reliable scale. "I use public transportation to school" (*Saya menggunakan transportasi umum ke kampus*) is one of the items in the scale.

This study questioned the effect of prosocial environmental values on environmental behaviours through attitudes with knowledge and proself environmental values as moderating variables. Each measure, including its dimensions, was correctly arranged to test the hypotheses. The EPVQ had two prosocial subscales (i.e. biospheric and altruistic values) and two proself subscales (i.e. egoistic and hedonistic values). The prosocial subscales were used to predict GEBS directly and indirectly via EAI while the two proself subscales were tested as moderators for EAI–GEBS relationship. The direct effect of the two proself subscales on EAI was also tested using EK as a moderating variable. This testing procedure allows researchers to evaluate the complex interactions between prosocial environmental values and knowledge.

Data analysis procedure
This study performed three different stages of analysis. In the first stage, descriptive statistics and bivariate correlations were computed. In the second stage, multiple regressions were performed to evaluate the relationship between the predictors and the dependent variables. Finally, moderated regressions were performed to evaluate the moderating effect of environmental knowledge and values. The moderated-mediation regression technique allowed researchers to compare the regression models as environmental values and interactions between variables were entered in different steps. For the purpose of plotting interaction effects, each moderator's total score was coded 1 (higher than mean score) and 0 (lower than mean score or low). This procedure could also be performed using Structural Equation Modelling (SEM). However, SEM assumes errors in measurement level, while this study prefers to assume errors in variable level (Hayes *et al.*, 2017). Therefore, this study performed an analysis using the moderated-mediation regression technique to articulate the results and errors from the variable level (e.g. pro-environmental behaviours).

Results and discussions
Results
The following table shows descriptive statistics and correlations:

Table 1 showed the relationships between variables in the study as well as the variable's mean and standard deviation. Generally, most variables were positively correlated, and only some did not show a significant relation. EPVB had a positive and significant correlation with all variables, excluding EK ($r = 0.11$, $p > 0.05$) with correlations ranged from $r = 0.19$ to $r = 0.76$ ($p < 0.01$ to $p < 0.001$). Similarly, EPVA had a positive and significant relationship with all variables with $r = 0.15$ to $r = 0.59$ ($p < 0.01$ to $p < 0.001$). EPVE was found to be significantly correlated with EPVH ($r = 0.56$, $p < 0.001$) while EPVH significantly related to EAI ($r = 0.13$, $p < 0.05$). Attitudes (EAI) and knowledge (EK) were also positively and significantly correlated ($r = 0.35$, $p < 0.001$). Interestingly, GEB only significantly associated with the two prosocial environmental values (i.e. EPVB and EVPA) while proself values (EPVE and EPVH), attitudes (EAI), and knowledge (EK) were not significantly correlated with GEB.

Furthermore, Table 2 shows the effect of environmental values, attitudes, and knowledge on pro-environmental behaviours. The incremental values of all predictors were tested using a multiple regression technique where total GEB was set as a dependent variable. The results found that the model significantly predicted total GEB ($R^2 = 0.05$, $p = 0.05$). The results also showed that only one prosocial value (i.e. biospheric value) significantly predicted the total

Variable	M	SD	1	2	3	4	5	6
1. EPVB	21.50	4.52	–					
2. EPVA	21.70	4.48	0.76***	–				
3. EPVE	11.83	3.81	0.47***	0.43***	–			
4. EPVH	23.98	5.76	0.61***	0.59***	0.56***	–		
5. Total EAI	66.11	8.40	0.36***	0.27***	−0.01	0.13*	–	
6. Total EK	10.22	2.47	0.11	0.15**	−0.01	0.11	0.35***	–
7. Total GEB	59.34	9.77	0.19**	0.17**	0.03	0.06	0.07	0.02

Note(s): $N = 285$, M = rata-rata, SD = standard deviation, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$
EPV = Environmental Portrait Values (B = Biospheric, A = Altruistic, E = Egocentric, and H = Hedonic), EAI = Environmental Attitude Inventory, EK = Environmental Knowledge, GEB = General Environmental Behaviours

Table 1.
Descriptive statistics
and bivariate
correlations

Variable	R	R^2	Adj. R^2	SEE	β	t
1. Total EPVB	0.21	0.05[*]	0.03	0.22	0.22[*]	2.14
2. Total EPVA				0.20	0.08	0.88
3. Total EPVE				0.19	−0.05	−0.74
4. Total EPVH				0.14	−0.09	−1.05
5. Total EAI				0.08	−0.02	−0.36
6. Total EK				0.25	0.01	0.05

Dependent Variable: Total GEB

Note(s): $N = 285$, [*]$p < 0.05$, [**]$p < 0.01$, [***]$p < 0.001$, β = Standardized Beta Weight, SEE = Standard Error of the Estimate, Adj. = Adjusted
EPV = Environmental Portrait Values (B = Biospheric, A = Altruistic, E = Egocentric, and H = Hedonic), EAI = Environmental Attitude Inventory, EK = Environmental Knowledge, GEB = General Environmental Behaviours

Table 2.
The effect of EPVs, EAI and EK on GEB

GEB ($\beta = 0.22$, $p < 0.05$). Therefore, H1 was partially supported because only biospheric value predicted pro-environmental behaviour.

After completing the multiple regression analysis, moderated regressions were performed. At this stage, all predictors were centred at the mean to reduce multicollinearity (Hayes, 2018). The moderating effect of EK was computed with EPVB and EPVA included as predictors (see Table 3). Overall, all moderated regression models significantly predicted EAI (Model 1 and 2). Model 1 showed that both interactions between EK and EPVB, and EK and EPVB negatively predicted EAI with $\beta = -0.65$ ($p < 0.05$) and $\beta = -0.73$, ($p < 0.05$) respectively. The results suggested a negative moderating effect of EK on the EPVB-EAI and EPVA-EAI relationships. However, this moderation was found to be negative, meaning the increase of environmental knowledge would weaken the relationships and vice versa. The moderating effect of EK can be seen in the following Figures 1 and 2:

Considering the above results, EK significantly buffered the positive effect of biospheric and altruistic value on environmental attitude, and this fully supported H3. In contrast, as the direct effect of attitude on pro-environmental behaviours was not found, attitude did not mediate the effect of prosocial values on pro-environmental behaviours (H2 was rejected).

The next part of the moderated regression analysis was to test the moderating effect of proself values on attitudes-behaviours relationships. Model 1 and 2 in Table 4 significantly predicted total GEB with $R^2 = 0.02$ ($p > 0.05$) and 0.04 ($p < 0.01$) respectively. However, the interaction of EAI and EPVE was the only one predicted total GEB ($\beta = -0.20$, $p < 0.001$). EAI did not have a main effect on GEB, indicating that the relationship was fully moderated.

Model		R	R^2	Adj. R^2	SEE	β	t
1	Total EPVB	0.49	0.24[***]	0.23	0.36	0.74[***]	3.81
	Total EK				0.73	0.76[***]	3.56
	EK × EPVB				0.03	−0.65[*]	−2.19
2	Total EPVA	0.43	0.18[***]	0.17	0.37	0.66[***]	3.31
	Total EK				0.76	0.81[***]	3.63
	EK × EPVA				0.03	−0.73[*]	−2.30

Dependent Variable: Total EAI

Note(s): $N = 285$, [*]$p < 0.05$, [**]$p < 0.01$ [***]$p < 0.001$, β = Standardized Beta Weight, SEE = Standard Error of the Estimate, Adj. = Adjusted
EPV = Environmental Portrait Values (B = Biospheric, A = Altruistic, E = Egocentric, and H = Hedonic), EAI = Environmental Attitude Inventory, EK = Environmental Knowledge, GEB = General Environmental Behaviours

Table 3.
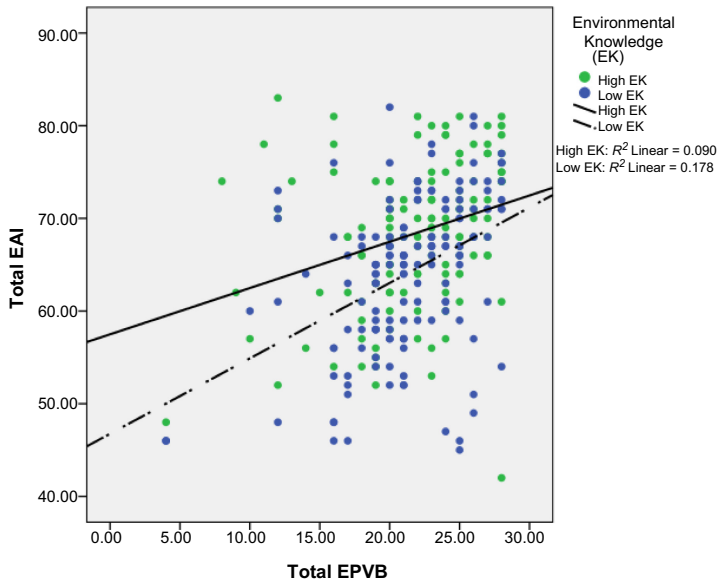The effect of EPVB and EPVA on EAI moderated by EK

Figure 1.
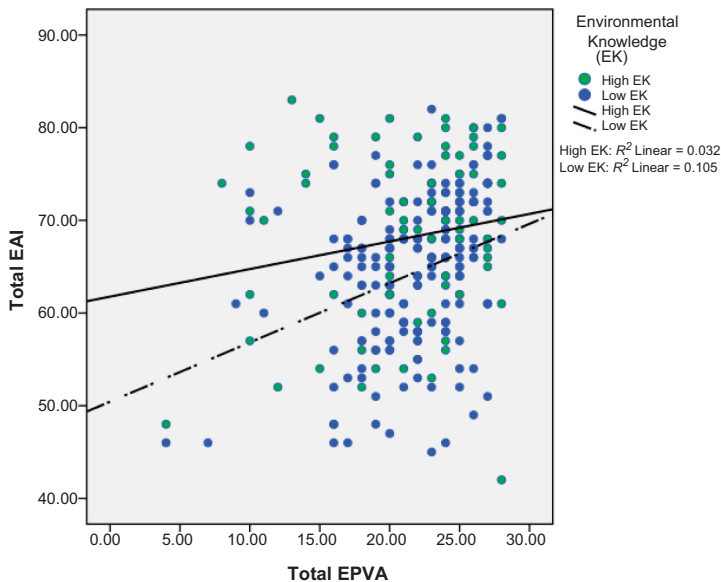Interaction plot of the
effect of EPVB on EAI
moderated by EK

Figure 2.
Interaction plot of the
effect of EPVA on EAI
moderated by EK

The interaction was also found to be negative, meaning the effect of EAI on GEB would be reduced as EPVE increased, or vice versa (see Figure 3). Given the negative moderating effect of environmental knowledge and one proself value (i.e., egoistic value), and the effect of prosocial value on pro-environmental behaviours, H4 was partially supported.

Figure 4 depicts this study's empirical model:

Model		R	R^2	Adj. R^2	SEE	β	t
1	Total EAI	0.21	0.04[**]	0.03	0.07	0.08	1.35
	Total EPVE				0.15	0.03	0.56
	EAI × EPVE				0.01	−0.20[***]	−3.41
2	Total EAI	0.13	0.02	0.01	0.07	0.04	0.70
	Total EPVH				0.10	0.04	0.72
	EAI × EPVH				0.01	−0.10	−1.64

Dependent Variable: Total GEB

Note(s): $N = 285$, [*]$p < 0.05$, [**]$p < 0.01$[***]$p < 0.001$, β = Standardized Beta Weight, SEE = Standard Error of the Estimate, Adj. = Adjusted, Δ = change
EPV = Environmental Portrait Values (B = Biospheric, A = Altruistic, E = Egocentric, and H = Hedonic), EAI = Environmental Attitude Inventory, EK = Environmental Knowledge, GEB = General Environmental Behaviours

Table 4.
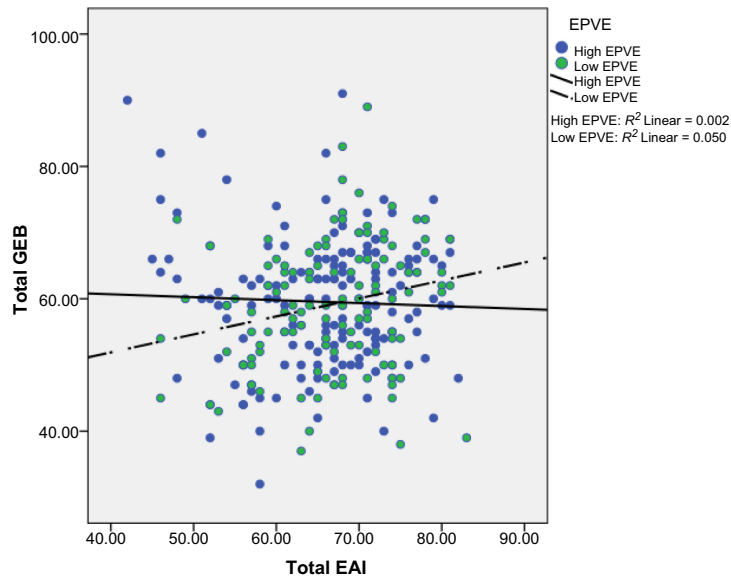The Effect of EAI on GEB with EPVE and EPVH as moderators

Figure 3.
Interaction plot of the effect of EAI on GEB moderated by EPVE

Discussions

This study interestingly discovered that GEB showed non-significant correlations with proself values, attitudes and knowledge. Although it seems intuitive that pro-environmental behaviours are associated with environmental values, attitudes, and knowledge, the association may not always exist in every population. The relationship could be more complicated than previously predicted by some findings. Thus, considering knowledge and proself values as the moderating variables could reveal how pro-environmental behaviour is predicted.

Furthermore, the results confirmed that prosocial values (i.e. biospheric and altruistic) had significant and positive impacts on environmental attitudes and behaviours. However, this study did not find a significant direct effect of altruistic value on pro-environmental behaviours. On the other hand, environmental attitudes did not mediate the effect of prosocial values. Regardless of the role of other variables, the biospheric value plays essential roles in predicting pro-environmental behaviours. This is in-line with the TPB (Ajzen, 1991, 2002, 2012b) and
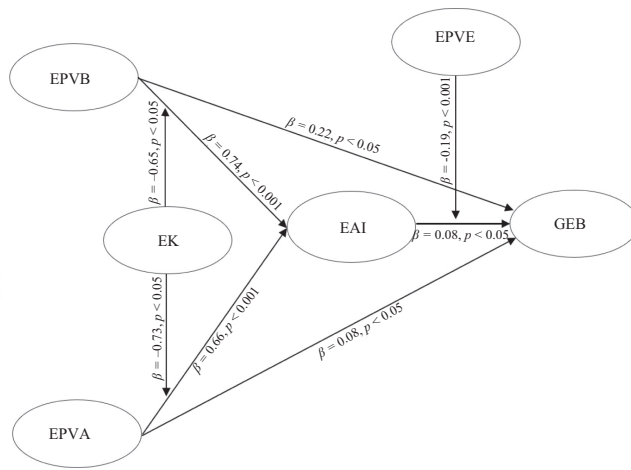
Note(s): $N = 285$, β = Standardized Beta Weight, EPV = Environmental
Portrait Values (B = Biospheric, A = Altruistic, E = Egocentric),
EAI = Environmental Attitude Inventory, EK = Environmental
Knowledge, GEB = General Environmental Behaviours

values-beliefs-norms theory (Stern and Dietz, 1994; Stern *et al.*, 1995) where they have
postulated that individual values potentially serve as a proximal or distal predictor for actions
or behaviours. In addition, this also has supported previous arguments regarding the
importance of prosocial values in improving pro-environmental behaviours (Gärling
et al., 2003).

Albeit the effect of environmental attitude on environmental behaviours was supported
by the TPB (Ajzen, 1991, 2002, 2012b), this study found contrasting evidence. The theory has
proposed that attitude drives behaviours. However, in terms of environmental behaviours,
the relationship between attitude and behaviour could depend on other factors. A positive
attitude does not always immediately improve pro-environmental behaviours.

Concerning the moderating effect of knowledge, this study found a piece of surprising
evidence. The results indicated that environmental knowledge negatively moderated the effect
of prosocial values on environmental attitudes. Meaning, the effect would be discounted as the
environmental knowledge increased. The prosocial values profoundly impacted environmental
attitudes if knowledge was at a low stage. On the contrary, environmental knowledge reduced
the effect of prosocial values on environmental attitudes. This seems consistent with the TCD
(Harmon-Jones and Mills, 2019; Mills, 2004) as knowledge contributed a negative effect on the
prosocial–attitude relationship. Environmental-conservation knowledge could buffer the
desirable effects of prosocial values. It is fruitful to enhance the role of prosocial values and
employ knowledge as a means to enrich one's prosocial values by integrating knowledge and
values throughout training and education.

This study also revealed that the proself (i.e. egoistic and hedonistic) had a buffering effect on
the attitude–behaviour relationship. Firstly, only the egoistic value tended to reduce the positive
effect of environmental attitude on pro-environmental behaviours. In contrast, the hedonistic
value did not contribute a significant moderating effect on the relationship. This particular
finding supports the notion that people with higher egoistic value may frequently show low pro-
environmental behaviours regardless of the level of their pro-environmental attitudes.

Furthermore, environmental values considerably play a vital part in managing
environmental behaviours. This study has indicated that some values could have various

effects on environmental attitudes and behaviours. Thus, understanding the value network and how each value influence behaviours and socio-ecological system may provide a better insight into how government monitor environmental management. As suggested by a recent investigation, values with environmental behaviours, practices and traditions could potentially decouple individual characteristics from environmental management (Hartel *et al.*, 2020). Hartel *et al.* (2020) also has postulated that the adoption of value network would illuminate our understanding of the connection between people and landscape features, allow the inclusion of values in managing environment, and understanding of how formal policies influence the socio-ecological system.

Knowledge is also an integral part of environmental management. For instance, the advancement of knowledge could improve environmental impact assessment. Development of knowledge in social, political, and technological factors will influence how people approach environmental impacts assessment (Nita, 2019). This study suggested that knowledge potentially buffered the positive effects of prosocial values on attitudes. Nevertheless, knowledge itself could have a positive impact on attitudes. Considering the impact of knowledge, knowledge should not solely use as a driver of human behaviours but also as a tool to improve the socio-ecological system, such as developing technology for environmental impacts assessment.

Research implications
Some previous findings have supported that (pro-)environmental behaviours were influenced by values, attitudes, and knowledge (Wang *et al.*, 2020; Torkar *et al.*, 2020; Tian *et al.*, 2020; Liu *et al.*, 2020; van Riper *et al.*, 2019; Janmaimool and Khajohnmanee, 2019; Casaló *et al.*, 2019). However, researchers should understand that knowledge and egoistic value to some degree could hinder an individual's pro-environmental behaviours.

Environmental-related knowledge, to some extent, could reduce the positive effect of prosocial values on environmental behaviours. Therefore, practitioners, educators, and the government should reconsider the present and future pro-environmental behaviours interventions. The interventions should not solely focus on gaining environmental knowledge but rather to enrich prosocial environmental values, and to integrate prosocial values and knowledge during the intervention.

Furthermore, human attitude is a strong predictor for subsequent behaviours. This notion also applies to environmental behaviour studies (Jakučionytė-Skodienė *et al.*, 2020; Torkar *et al.*, 2020). Although this study found no direct impact of attitude on environmental behaviours, the interaction of attitude and egoistic value deteriorated pro-environmental behaviours. Therefore, any environmental behaviour interventions should also target individual's egoistic value. People should learn to regulate their egoistic value orientation and allow their prosocial values to foster.

Conclusion
The combination of TPB and TCD was able to depict the complex effect of values, knowledge and attitudes on pro-environmental behaviours. Prosocial values (biospheric and altruistic) tended to be consistent as a key predictor for pro-environmental behaviour as well as environmental attitude. However, knowledge appeared to hinder the effect of prosocial values on environmental attitudes. Despite the importance of knowledge in educating people, knowledge should be integrated with prosocial values in order to mitigate the negative moderating effect of knowledge. Finally, proself also played a negative part in weakening the attitude–behaviour relationship, as the egoistic value increased the effect of environmental attitude on environmental behaviours declined, or vice versa. Although many studies have

supported the role of environmental knowledge and attitude, this study has shed light on the importance of understanding the interaction between variables in predicting pro-environmental behaviours.

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