A multi-dimensional measure of environmental behavior: Exploring the predictive power of connectedness to nature, ecological worldview and environmental concern

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Abstract
In this study we examine the multi-dimensional structure of environmental behavior and its potential domains. Factor analysis reveal six behavioral domains: civic actions, policy support, recycling, transportation choices, behaviors in a household setting and consumerism. We use the Connectedness to Nature and Inclusion of Nature in Self scales to measure connection with nature, the New Environmental Paradigm to measure ecological worldviews, and Environmental Motives Scale to assess people's environmental concern. We further explore the predictive power of connectedness to nature, ecological worldview, and environmental concern for explaining the diverse behavioral domains. Connectedness to nature and ecological worldview were more predictive of civic actions, recycling, household behaviors, and consumerism than were environmental concerns. In the case of policy support and transportation choices, environmental concerns explained more variance than the other constructs.

Keywords: Environmental behavior; connectedness to nature; ecological worldview; environmental concern.

JEL Codes: A14; C38; Q00; Q51; Q56; Q59.

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1. INTRODUCTION

Several environmental problems are rooted in human behavior, thus it is crucial to identify the underlying motives and factors that influence people to adopt a sustainable lifestyle (Gifford, 2008). A growing body of research has studied the predictors of environmental behavior including general attitudes, values, normative beliefs (Gifford & Nilsson, 2014 Halkos and Matsiori 2012a,b, 2013, 2014), connectedness to nature (Mayer & Frantz, 2004), environmental concern and ecological worldview (Dunlap, Van Liere, Merting, & Jones, 2000). A rigorous examination of these factors is a prerequisite in order to promote environmental behavior.

Despite the attention that environmental behavior has gained in the literature, there is still confusion regarding the type of behaviors that should be considered as "environmental" (Schultz & Kaiser, 2012; p.662). Nonetheless, comparatively few studies focus on the dimensionality of environmental behavior (Larson, Stedman, Cooper, & Decker, 2015). In this study, we aimed to determine the diverse suite of actions that compose "environmental behavior" and the potential domains, and develop a multi-dimensional measure of these behaviors. We used well-established measures of environmental concern, ecological worldview and connectedness to nature to predict environmental behavior.

1.1. Defining environmental behavior

Two dominant approaches have been used to study environmental behaviors, one focused on impact, and a second focused on intention (Stern, 2000). The intention perspective refers to behaviors that contribute to the sustainability of the natural environment and emphasizes to the outcome of the behavior. The impact-oriented approach makes no assumptions of underlying motivations and focuses on behaviors

that move the individual in the direction of a smaller impact (Poortinga et al., 2004). Within the impact-oriented conceptualization, pro-environmental behavior represents any behavior that "harms the environment as little as possible or even benefits it" (Steg & Vlek, 2009; p. 309), or "the extent to which it changes the availability of materials or energy from the environment or alters the structure and dynamics of ecosystems or the biosphere itself" (Stern, 2000; p.408).

Considering the intention-oriented approach, pro-environmental behaviors are those who "consciously seek to minimize the negative impact on one's actions on the natural and built world" (Kollmuss & Agyeman, 2002; p. 240), or "any behavior that is undertaken with the intention to change the environment" (Stern, 2000; p.408). Pro-environmental behavior, whether goal-directed or not, should be distinguished from the broader term environmental behavior; the latter indicates all types of behaviors that affect natural environment's ecological balance and biodiversity (Steg & Vlek, 2009; Halkos 2011, 2015; Halkos and Jones 2012). In this study, we use the term "environmental behavior" (EB) to refer to "any behavior intended by the individual to have a positive impact on the environment" (Alisat & Riemer, 2015; p.14).

1.2. *Multi-dimensional structure of environmental behavior and potential domains*

In environmental psychology, various studies conceptualize environmental behavior as multidimensional. Dimensionality lies on difficulty levels of engagement to a particular behavior and on multiple social, individual and contextual factors such as norms, values, attitudes, personal costs and availability of materials (Gatersleben, 2013; p.137). Additionally, many researchers consider that different behaviors may be motivated by different antecedents and people may rely on normative, hedonic or gain motives to act (Lindenberg & Steg, 2007). Another important consideration

when examining environmental behavior is the direct or indirect impact of a specific behaviors (Larson et al., 2015) and the intention to contribute to natural conservation at a local or global level. For instance, reducing car use and buying green products may result in long-term environmental benefits, while a host of windmills in a local community may lead on to greater ecological impact.

Stern (2000) proposed four major types of conservation behavior: environmental activism (highly committed behaviors such as participation in public demonstrations), non-activist behaviors in the public sphere (low commitment active citizenship and policy support actions), and private sphere practices (e.g purchase decisions). Other researchers differentiate between two distinct categories of environmental behavior, personal practices and civic or environmental actions (Dono et al., 2010). Environmental actions are connected with citizen behaviors such as donating money to environmental causes, signing petitions, organizing a boycott, policy support behaviors, participating in environmental organizations or in protests, and talking to others about environmental issues.

'Personal practices' or "pro-environmental behaviors" (Bamberg & Möser, 2007) or conservation lifestyle behaviors (Larson et al., 2015) are umbrella terms to refer to any behavior in the household setting that can possibly affect environmental sustainability. Private-sphere behaviors encompass multiple domains including recycling water and energy conservation, transportation choices, and green purchasing. Moreover, environmental actions illustrate policy support and environmental citizenship domains (Larson et al., 2015).

1.3. *Connectedness to nature and environmental behavior*

An increasing amount of empirical work revealed the importance of humans' connection with nature for explaining pro-environmental behavior (Lokhorst et al.,

2014). Connectedness to nature is an individual's belief about the extent to which s/he is part of the natural environment (Schultz, 2002). Mayer & Frantz (2004) developed the Connectedness to Nature Scale (CNS) to measure "individuals' experiential sense of oneness with the natural world" (p.504), while Schultz (2001) developed the Inclusion of Nature in Self scale (INS), a single-item explicit measure of connectedness, that measures the extent to which people include nature in their self-construal. Research has shown that the notion of connectivity with nature is significantly associated with pro-environmental behaviors (Barbaro & Pickett, 2016), indicating that feeling interconnected with nature can lead to eco-friendly behaviors.

1.4. Ecological worldview and environmental behavior

Ecological worldview is a construct that refers to primitive beliefs about the human-nature relationship. The revised New Environmental Paradigm (Dunlap et al., 2000) is a widely used and well-validated measure designed to assess individual's belief system concerning nature. NEP includes 15 items reflecting five components of ecological worldview: limits to growth, anti-anthropocentrism, and fragility of nature's balance, rejection of exceptionalism and possibility of an eco-crisis. The NEP has been found to be positively related to self-reported environmental behaviors (Davis, Le, & Coy, 2011), suggesting that individual's ecological worldview is a strong predictor of environmental behavior (Brügger et al., 2011).

1.5. Environmental concern and environmental behavior

Environmental concern represents the degree to which people are aware of environmental problems and indicate a willingness to contribute personally to their solution (Dunlap & Michelson, 2002, p.485). It refers to the evaluation of environmental issues including general attitudes, emotional beliefs or worries about

environmental problems, and the importance of consequences of environmental problems for oneself, others, and the biosphere (Steg & de Groot, 2012; p.122).

Empirical research has brought into light evidence supporting the existence of value-based environmental concern. Schultz (2002) proposed that environmental concerns can be clustered into egoistic, altruistic and biospheric concerns, based on the negative consequences that could result for self, other people, and other living things respectively, and developed a 12- item Environmental Motives Scale (EMS) to measure these concerns. A number of studies has examined environmental concern as a predictive component of pro-environmental behavior. Individuals who hold biospheric environmental concerns are more likely to engage in a pro-environmental behavior, while those with egoistic concerns are less likely to behave in an eco-friendly way (Steg et al., 2014). Environmental concern is positively related to pro-environmental behaviors, although relationships are often weak (Thøgersen & Ölander, 2006).

1.6. Overview and hypothesis

Our primary aim was to explore the dimensionality of environmental behavior and reveal the underlying domains. Based on previous studies (Larson et al., 2015, Alisat & Riemer, 2015), we hypothesized that environmental behavior is a multi-dimensional construct (Hypothesis 1). We expected more engaged environmental behaviors (civic actions) to be more strongly related to biospheric concerns than low commitment environmental behaviors (personal practices), and negatively correlated to egoistic concerns (Hypothesis 2). The CNS, INS, and NEP were found to correlate with pro-environmental behaviors on private-sphere (Mayer & Frantz, 2004; Brügger et al., 2011), so we expected personal practices to be positively correlated to these constructs (Hypothesis 3).

Second, we aimed to compare the predictive power of connectedness to nature, ecological worldview, and environmental concern in explaining the distinct behavioral domains, by examining two competing hypotheses: Connectedness to nature and ecological worldview are better predictors of environmental behavior than environmental concern (Hypothesis 4). On the other hand, environmental concerns are more powerful in explaining the multiple environmental behavior domains that connectedness to nature measures and ecological worldview (Hypothesis 5).

2. Studies and methodology

2.1 Study 1: An exploratory research

2.1.1 Participants

A total of 150 Greek citizens completed in a written format a self-administer questionnaire including behavioral and basic demographic variables (87 were female and 63 were male with a mean age of 40.32 years and standard deviation of 9.23). We used non-probabilistic snowball sampling beginning with a small population of known individuals (undergraduate students in the University of Thessaly) and expanded the sample by asking those initial participants to identify others that should participate in the study. 22% of the final sample was college students, 46% were employees in the private sector and 32% were state employees. Around 34% of the participants in the survey had university degree and 39% had a secondary education level (high-school graduates).

2.1.2 Measuring environmental behavior

We have generated 30 items to measure environmental behavior based on the General Ecological Behavior scale (GEB) (Kaiser & Wilson, 2004), the Environmental Action Scale (EAS) (Alisat & Riemer, 2015), and Larson et al.'s (2015) multi-dimensional measure of behavior. Some items were adapted per se, new

items were developed and others were eliminated, resulting in a 22-item measure (Table 1). Participants responded how often performed, the last six months (in the past 8 years for the policy support items), these behaviors, rating each item on a 5-point Likert scale (1= never and 5=always/every day).

2.1.3 Preliminary results

A Principal Component Analysis (PCA) was first carried out with an oblique rotation. Six components with eigenvalues above 1.0 emerged and the scree plot suggested the same structure as well. All six factors accounted for 66.71% of total variance and inter-factor correlations varied from .19 to .52. Table 1 shows the 22 behavioral items and the results of the PCA. The exploratory procedure confirmed the multidimensional structure of environmental behavior, as six domains were found, providing support to Hypothesis 1.

2.2 Study 2: Confirmatory and regression analyses

2.2.1 Participants

A total of 400 Greek citizens completed a self-administer questionnaire which contained attitudinal, behavioral and socioeconomic variables. The measurement tools described below were all translated in Greek prior to the research The measurement tools described below were all translated in Greek prior to the research. 49% were male and 51% females with a mean age of 38.59 years (sd= 15.04) and personal mean income per month at € 755.36 (sd= 509.08). A 40.8% of the participants had a secondary education level (high-school graduates) and 73.7% were rural residents.

2,2,2 Measuring environmental behavior and other psychological variables

Environmental behavior

We used the 22-item measure of environmental behavior that emerged through Sample's 1 exploratory procedure and conducted a Confirmatory Factor Analysis.

Table 1: Results of Principal Components Analysis.

Items	Civic actions	Policy support	Recycling	Transportation choices	Household setting	Consume
I am active member of an environmental group	.719					
I systematically take part in protests regarding environmental protection.	.709					
I sign pro-environmental petitions	.722					
I participate in community events/workshops which focus on environmental awareness	.609					
I donate money for conservation causes	.738					
I take part in reforestation or beach cleaning actions	.589					
Eigenvalue= 2.66, M=1.82, SD=.78, a = 0.85						
I systematically write letters to politicians or candidates for environmental issues.		.783				
I vote a political party that support environmental conservation policies through legislations.		.860				
I vote a political party that support stronger environmental laws.		.723				
Eigenvalue=1.95, M= 2.47, SD=1.08, a =.793						
I recycle paper, glass and aluminum packages			.669			
I put dead batteries in the garbage			.757			
I recycle old electric machines			.765			
Eigenvalue= 1.64, M=3.06, SD=.77 , a =.734						
I ride a bicycle or take public transportation to work or school				.926		
In nearby areas (around 30 km), I use public transportation or ride a bike				.908		
For longer journeys (more than 6 h), I take an airplane/train/bus				.606		
Eigenvalue= 3.44, M=3.27, SD=1.15, a =.776						
I buy energy saving lightbulbs					.557	
I wait until I have a full load before doing my laundry					.644	
In winter, I turn down the heat when I leave my apartment for more than 4 h or at night					.727	
Eigenvalue= 1.43, M=3.74, SD= .90, a =.67						
I buy products in refillable packages						.527
I buy seasonal produce						.562
I buy meat and produce with ecolabels						.723
I use paper bags instead of plastic ones when I go shopping						.719
Eigenvalue= 9.21, M=3.01 SD=.95, a =.742						
KMO= .8512						
Bartlett's test of sphericity χ^2=3962.54, df=231, p =.000						

Connectedness to nature measures

We used the 14-item Connectedness to nature Scale (Mayer & Frantz, 2004) to assess the degree to which people feel emotionally interconnected with nature. Respondents were asked to rate each item on a 5- point Likert scale (1= completely disagree; 5= completely agree). In order to create a composite index for the scale, we averaged participants' responses (M=3.72, sd= .98, a=.78). The INS scale measures the interconnectedness of individuals with the natural environment using overlapping circles that represent self and nature (Schultz, 2001). Participants had seven possible options of overlapped circles and selected which diagram fit them the most (1= least overlap; 7= greatest overlap; M= 4.68, sd=1.43).

Ecological worldview

We measured primitive beliefs about human's relationship with nature using the revised 15-item New Ecological Paradigm (Dunlap et al., 2000). Participants responded to each item on a 5-point Likert scale ranging from 1 (Strongly disagree) to 5 (Strongly agree). We created a composite index for the NEP by averaging responses to all 15 items (M= 3.52, sd=.91, a=.77).

Environmental concern

Environmental Motives Scale (Schultz 2002) is a measure of concern toward valued objects. Respondents were asked to rate 12 items from 1 (not important) to 5 (supreme important). The EMS is designed to illustrate egoistic (me, my future, my prosperity, my health), altruistic (future generations, humanity, people in the community, children) and biospheric (plants, animals, birds, marine life) concerns. Following Schultz et al. (2004) the mean corrected egoistic (M= .66, sd=.46, a=.90), biospheric (M= -.29, sd=.59, a=.94), and altruistic scores (M= .22, sd=.57, a=.78)

were calculated by computing the average score to all EMS items and subtracting the result from each of the three scale scores.

2.2.3 Statistical Analysis

We applied Confirmatory Factor Analysis to the 22 behavioral items and to the EMS scale (details are presented in the results subsection). We examined the predictive power and relationships between behavioral domains, connectedness to nature and ecological worldview, and behavioral types and environmental concern separately, by means of multiple regression (Table 4). Before conducting the analyses, we checked multicollinearity (relying on the Variance Inflation Factor with values less than 10 taking place when $R_j^2 < 0,90$; Halkos, 2006, 2007) and possible outliers (Standardized residuals were within the limits of ± 3.3) to ensure that all Regression assumptions were met (Tabachnick & Fidell, 2013).

Hierarchical multiple regression analysis was used to further test the strength of difference in predictive power. If connectedness to nature and ecological worldview predict the diverse environmental behavior types over and above the variance explained by environmental concern, then this provides support for Hypothesis 3. In contrast, if environmental concern explains additional variance over and above the variance predicted by connectedness and worldview measures, then we accept Hypothesis 4.

2.2.4 Results

Simple correlations

Table 2 shows the correlations between all the constructs of the study. Egoistic concerns were negatively and significantly related to the CNS (r= -.18), the INS (r= -.13) and NEP (r= -.24). Altruistic concerns showed significant but negative correlations with CNS (r= -.17), INS (r= -.28) and NEP (r= - .18). Biospheric

concerns were significantly correlated with CNS (r=.31), INS (r=.38) and NEP (r= .37). CNS and INS showed a positive correlation (r= .57), CNS was also correlated to NEP (r= .52), and the latter was correlated to INS (r= .41). Egoistic concerns were negatively correlated to both altruistic (r= -.35) and biospheric concerns (r= -.43).

Egoistic concerns showed low and negative correlations with the civic actions, transportation choices, and household setting domains, ranging from -.09 to .22, and non-significant correlation with the policy support, recycling, and consumerism domains. Biospheric concerns showed low to moderate correlations with all behavioral domains (r's ranged from .21 to .40), except from the recycling domain (r=. 08, p>.05). Altruistic concerns were significantly but negatively correlated to all behavioral domains (correlation coefficients (r) were between -.10 and -.34). CNS, INS, and NEP were positively correlated to every behavioral domain respectively. CNS's and environmental behavior's correlations ranged from .21 to.46. INS's and environmental behavior's correlates were between .24 and .53. NEP was correlated to all domains (r's ranged from .19 to .45) but not with the civic action domain (r= .09).

Confirmatory Factor Analysis of environmental behavior

We performed a Confirmatory Factor Analysis using LISREL 8.80 statistical software. Skewness and kurtosis values were not near the acceptable limits (skewness around 0 amd kurtosis around 3; Halkos, 2007) for the 22 behavioral variables, but Mahalanobis distance (D_M >65.0) and tests for multivariate normality (Mardia's test; Henze-Zirkler; Doornik-Hansen; p= 0.000) did not support normality hypothesis (Tabachnick & Fidell, 2013; p.78). We used the robust Maximum Likelihood method of parameter estimation and covariance and asymptotic covariance matrices as inputs (Brown, 2015; p.346). Model fit was assessed using

the Sattora-Bentler (SB) χ^2 value and multiple fit indices. Although χ^2 values indicated that the measurement model did not advocate for a good fit of the model (χ^2= 495.29, df= 194, p<0.001), fit indexes revealed adequate fit (RMSEA=.06, SRMR=.08, CFI=.96, NNFI=.95). Modification indexes showed that fit could be improved by adding covariance paths between the behavioral items' errors of all domains.

Table 2: Bivariate correlation between CNS, INS, NEP, EMS and environmental behaviour's domains

	1	2	3	4	5	6	7	8	9	10	11	12
1.NEP												
2.CNS	.520**											
3.INS	.410**	.572**										
4.Ego	-.240**	-.183**	-.137**									
5.Bio	.370**	.312**	.384**	-.437**								
6.Altr	-.189**	-.176**	-.287**	-.357**	-.685**							
7.F1	0.093	.244**	.334**	-.099*	.217**	-.145**						
8.F2	.273**	.357**	.419**	-0.049	.263**	-.234**	.467**					
9.F3	.353**	.438**	.333**	0.043	0.086	-.124*	.279**	.338**				
10.F4	.196**	.214**	.248**	-.152**	.216**	-.101*	.259**	.235**	.196**			
11.F5	.454**	.468**	.536**	-.222**	.406**	-.242**	.225**	.368**	.315**	.293**		
12.F6	.284**	.384**	.496**	-0.061	.382**	-.348**	.485**	.501**	.353**	.245**	.523**	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

NOTES.F's are components of environmental behaviour. F1 represents environmental action domain; F2 political action; F3 Recycling; F4 Transportation choices; F5 Household setting; F6 Consumerism. Ego, Bio, Altr represent egoistic, altruistic and biospheric concerns.

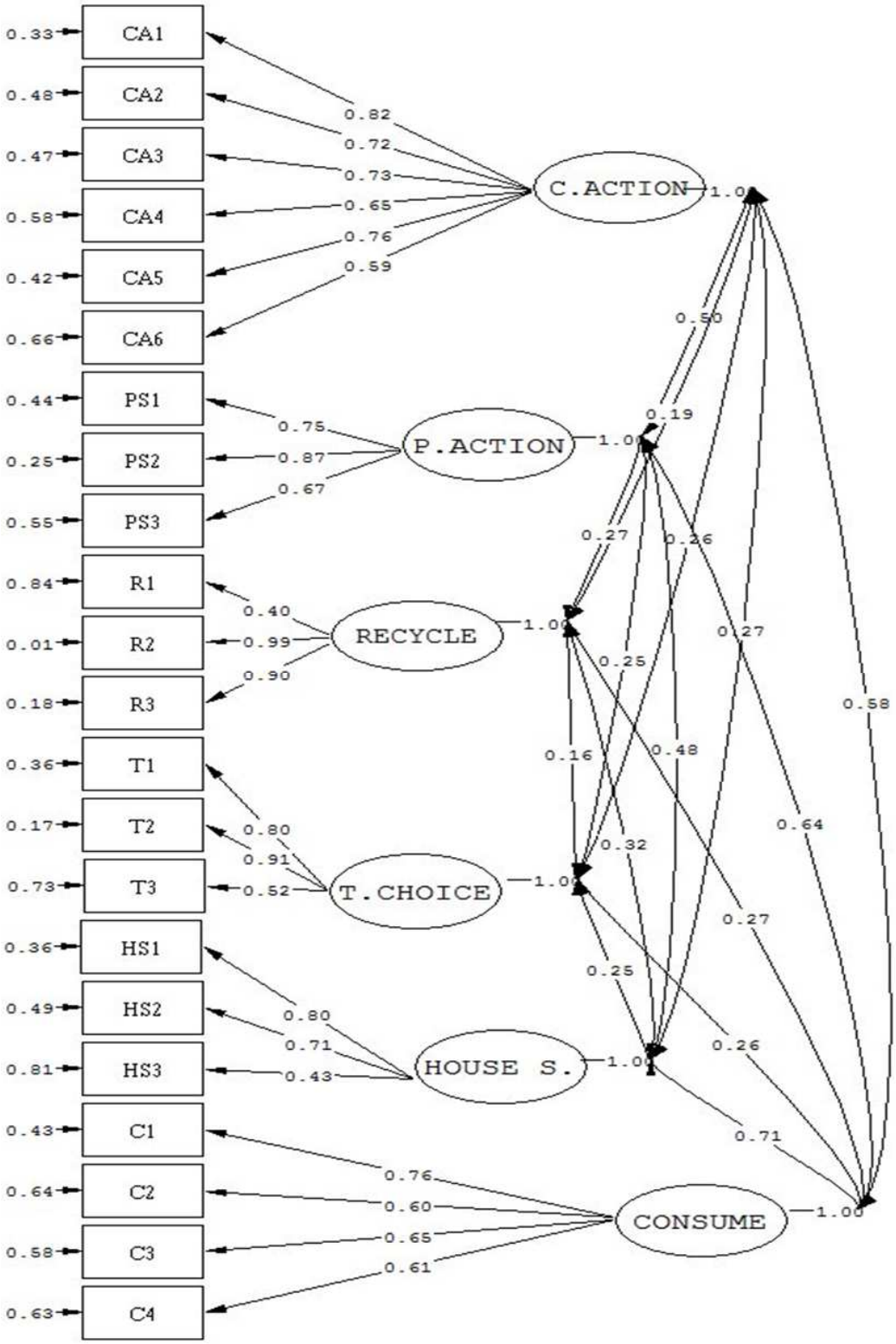

Figure 1: Confirmatory Factor Analysis of environmental behavior. C.Action are civic actions; P.action represent policy support items, T.Choice are transportation choices; House S. indicate household setting; Consume is consumer behavior.

We made a decision not to add any parameters, because these type of changes may result in unrealistic models that ignore the true data structure. Standardized path loadings (λ), error variances for the observed variables and covariances between the latent constructs (φ) are reported in Figure 1.

Confirmatory Factor Analysis of EMS scale

A Confirmatory Factor Analysis verified the tripartite structure of environmental concern (Schultz et al. 2004). Tests of univariate and multivariate normality showed that assumption of normality was violated. We used again the robust Maximum likelihood method of parameter estimation and the covariance and asymptotic covariance matrices as inputs. Model fit was assessed using SB χ^2 value and multiple fit indices (Tabachnick & Fidell, 2013). Although χ^2 values suggested that the model did not reproduce the observed covariance well (SB χ^2= 251.03, df=51, p<0.001), fit indexes indicated adequate fit (RMSEA=.08, SRMR=.48, CFI= .97). As before, standardized path loadings (λ), error variances for observed variables and the covariances of latent constructs (φ) are presented in Figure 2.

Regression of environmental behavior on CNS, NEP, INS and EMS

The CNS, INS and NEP explained 20% in variance of the policy support domain (F(3,396)=32.90, p<0.001). Respondents who are strongly connected to nature tend to support environmental policies (β=.14 for CNS and β=. 30 for INS). EMS explained 20.4% in variance of the political action domain (F(3,396)=33.74, p<0.001). Respondents who hold biospheric concerns were more likely to express their support for environmental policies (β=.36), but unexpectedly, those with egoistic concerns endorsed policy support behaviors too (β=.16).

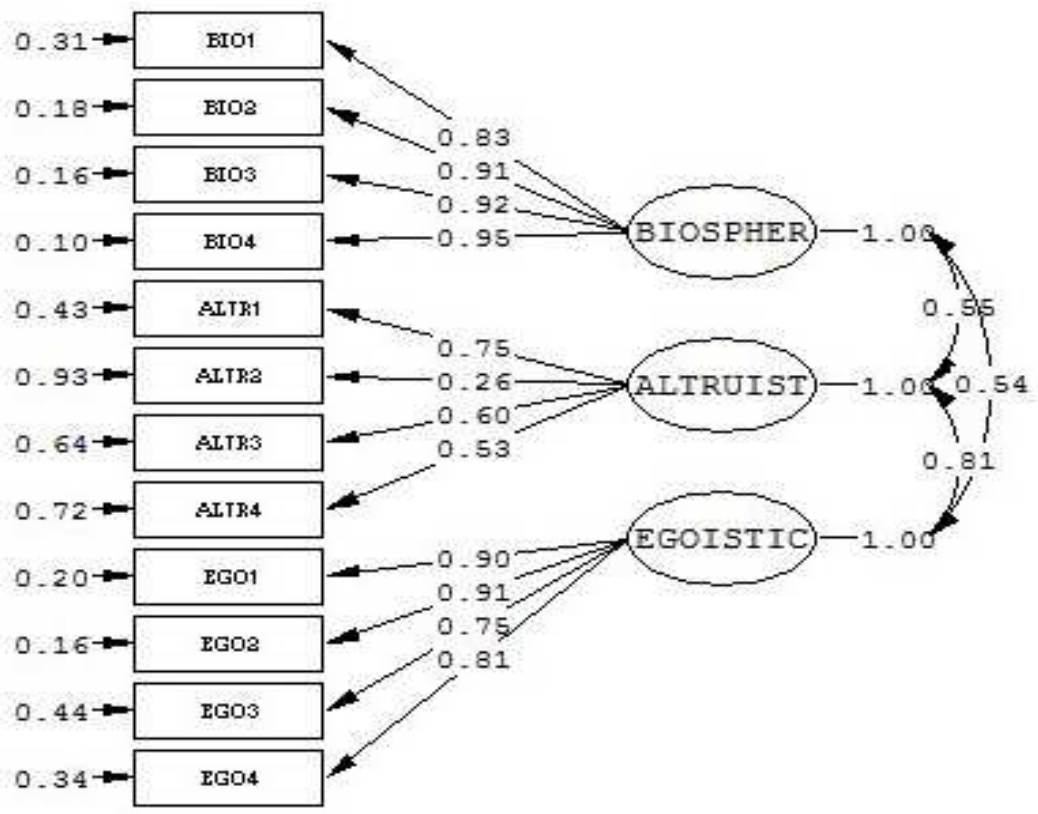

Figure 2: Confirmatory Factor Analysis of environmental concern.

CNS, INS, and NEP explained only 22% in variance of the recycling domain ($F(3,396)=37.16$, $p<0.001$). CNS and NEP made a significant contribution to the regression model ($\beta=.30$ for CNS and $\beta=.15$ for NEP). EMS explained 13% in variance of the recycling domain ($F(3,396)=19.93$, $p<0.001$). Respondents who hold egoistic concerns were more likely to recycle ($\beta=.24$), as well as those with biospheric concerns ($\beta=.15$).

The CNS, INS, and NEP explained only 7% in variance of the transportation choices subscale ($F(3,396)=10.68$, $p<0.001$). Only INS made a significant contribution to the regression model ($\beta=.17$). EMS explained 11% in variance of the transportation domain ($F(3,396)=17.79$, $p<0.001$). Respondents with biospheric concerns were more likely to make eco-friendly transportation choices ($\beta=.32$).

The CNS, INS, and NEP explained 36% in variance of the household setting domain ($F(3,396)=75.70$, $p<0.001$). All three measures made a significant contribution to the regression model ($\beta=.14$ for CNS, $\beta=.35$ for INS and $\beta=.23$ for NEP). EMS explained 32% in variance of the household setting domain ($F(3,396)=62.50$, $p<0.001$). Respondents with biospheric concerns were more likely to behave in an eco-friendly way in a household setting ($\beta=.56$).

The CNS, INS, and NEP explained 29% of the variance of the consumerism domain ($F(3,396)=55.98$, $p<0.001$). Respondents that include nature in their self-representation tend to consume in an eco-friendly way ($\beta=.46$). EMS explained 27% in variance of the consumerism domain ($F(3,396)=50.30$, $p<0.001$). Respondents with biospheric concerns were more likely to be "green" consumers ($\beta=.48$), and so were individuals with egoistic concerns ($\beta=.14$), in contrast to respondents with altruistic concerns ($\beta= -.14$).

Table 4 presents the results of the hierarchical multiple regression analysis. In the first step, we included CNS, INS, and NEP only. They accounted for 12% of the variance in civic actions domain, 20% in policy support, 22% in recycling, 7% in transportation choices, 36% of the variance in a household setting and finally, 29% in consumerism. EMS subscales accounted for 1% additional variance in civic actions (F-Change=1.7, p=.055), 4% in policy support (F-Change=4.2, p=.000), 3% in recycling (F-Change=3.3, p=.001), 5% in transportation choices (F-Change=4.7, p=.000), 4% in household behaviors (F-Change=4.3, p=0.000) and 6% in consumerism (F-Change=5.9, p=.000).

Table 3: Regression analysis results

	Dependent variables					
	Environmental action	*Political action*	*Recycling*	*Transportation*	*Household setting*	*Consumption*
Connectedness to nature and worldview only						
NEP	-.94 (-1.676)* [.095]	.073 (1.362) [.174]	.157 2.992*** [.003]	.090 1.576 .116	.233 4.909*** .000	.045 (.898) [.370]
CNS	.119 (1.917)* [.056]	.143 (2.417)** [.016]	.302 5.151*** [.000]	.069 1.075 .283	.142 2.684*** .008	.095 (1.712) [.088]
INS	.304 (5.221)*** [.000]	.307 (5.526)*** [.000]	.096 1.745* [.082]	.172 2.872*** .004	.359 7.247*** .000	.464 (8.908)*** [.000]
R^2	.122	.200	.220	.075	.364	.298
F	18.296	32.906	37.167	10.682	75.703	55.983
Environmental concern only						
Ego	.010 (.167) [.868]	.163 (2.952)*** [.003]	.244 (4.237)*** [.000]	-.011 -.186 .853	-.003 -.062* .951	.147 (2.791)*** [.006]
Bio	.290 (5.161)*** [.000]	.363 (6.937)*** [.000]	.157 (2.878)*** [.004]	.321 5.832*** .000	.562 11.615*** .000	.480 (9.606)*** [.000]
Altr	-.017 (-.314) [.754]	-.040 (-.780) [.436]	.023 (.442) [.659]	.068 1.273 .204	.019 .415 .679	-.147 (-3.029)*** [.003]
R^2	.084	.204	.131	.119	.321	.276
F	12.064	33.743	19.937	17.799	62.505	50.301
Connectedness, worldview, environmental concern						
NEP	.144 (-2.452)** [.015]	.012 (.210) [.834]	.181 (3.318)*** [.001]	.007 (.110) [.912]	.151 (3.115)*** [.002]	-.026 (-.508) [.612]
CNS	.093 (1.471) [.112]	.093 (1.567) [.118]	.291 (4.924)*** [.000]	.007 (.107) [.915]	.094 (1.779)* [.076]	.058 (1.052) [.294]
INS	.242 (3.796)*** [.000]	.193 (3.232)*** [.001]	.082 (1.375) [.170]	.062 (.966) [.334]	.254 (4.814)*** [.000]	.340 (6.184)*** [.000]
Ego	-.037 (-.628) [.530]	.128 (2.345)** [.020]	.216 (3.967)*** [.000]	-.020 (-.339) [.735]	-.042 (-.864) [.383]	.093 (1.843) [.066]
Bio	.191 (2.769)*** [.006]	.209 (3.224)*** [.001]	-.121 (-1.879)* [.061]	.281 (4.034)*** [.000]	.300 (5.241)*** [.000]	.282 (4.737)*** [.000]
Altr	-.015 (-.289) [.772]	-.049 (-.972) [.332]	-.018 (-.360) [.719]	.067 (1.246) [.213]	.001 (.026) [.979]	-.149 (-3.223)*** [.001]
R^2	.139	.242	.253	.122	.407	.357
F	10.536	20.860	22.135	9.062	44.977	36.314

t-values in parentheses and P-values in brackets

*** Significant at 0.01 level (2-tailed)

** Significant at 0.05 level (2-tailed)

* Significant at 0.1 level (2-tailed)

Table 4: Percentage of variance in the environmental behavior's domains accounted for in hierarchical multiple regression analysis.

Outcome variable: Environmental action	
A. Connectedness to nature and ecological worldview first	
Connectedness to nature and ecological worldview	.122
Environmental concern	.139
B. Environmental concern first	
Environmental concern	.084
Connectedness to nature and ecological worldview	.139
Outcome variable: Political action	
C. Connectedness to nature and ecological worldview first	
Connectedness to nature and ecological worldview	.200
Environmental concern	.242
D. Environmental concern first	
Environmental concern	.204
Connectedness to nature and ecological worldview	.242
Outcome variable: Recycling	
E. Connectedness to nature and ecological worldview first	
Connectedness to nature and ecological worldview	.220
Environmental concern	.253
F. Environmental concern first	
Environmental concern	.131
Connectedness to nature and ecological worldview	.253
Outcome variable: Transportation	
G. Connectedness to nature and ecological worldview first	
Connectedness to nature and ecological worldview	.075
Environmental concern	.122
H. Environmental concern first	
Environmental concern	.119
Connectedness to nature and ecological worldview	.122
Outcome variable: Household setting	
I. Connectedness to nature and ecological worldview first	
Connectedness to nature and ecological worldview	.364
Environmental concern	.407
J. Environmental concern first	
Environmental concern	.321
Connectedness to nature and ecological worldview	.407
Outcome variable: Consumption	
K. Connectedness to nature and ecological worldview first	
Connectedness to nature and ecological worldview	.298
Environmental concern	.357
L. Environmental concern first	
Environmental concern	.276
Connectedness to nature and ecological worldview	.357

EMS components accounted for 8% of the variance in civic actions when entered first and connectedness and worldview measures accounted for 5% additional variance. EMS subscales accounted for 20% of the variance in policy support, and connectedness to nature measures together with NEP accounted for 13% additional variance. The R^2-change was significant for all behavioral domains but not for transportation choices ($p>.05$).

3. Discussion and conclusions

The primary aim of our study was to examine the structure of environmental behavior and its potential domains. Results indicated that environmental behavior is a multidimensional construct and confirmed that diverse behaviors are practically but also psychologically meaningless to be clustered into a single dimension (Larson et al., 2015). Thus, we found support for Hypothesis 1. The possible behavioural domains that emerged were slightly different from those reported in other relevant studies that included both environmental actions and private-sphere behaviors (Kaiser & Wilson, 2004) indicating the importance to further investigating the potential behavioral domains with regard to the cultural differences in the diverse samples across of the behavioral studies, within the environmental psychology's content.

The reported correlations are inconsistent with previous studies that examined the relationships between connectedness to nature, ecological worldview, and environmental concern. The results showed that NEP was positively correlated to CNS and INS, while CNS and INS had also a strong correlation (Brügger et al., 2011). Egoistic concerns were negatively correlated to both altruistic and biospheric concerns (Schultz et al., 2004). Biospheric concerns were significantly associated with CNS (Mayer & Frantz, 2004), INS and NEP (Schultz et al., 2004). Egoistic concerns were found to be negatively correlated with CNS (Mayer & Frantz, 2004),

INS, and NEP (Schultz et al., 2004). We reported negative correlational values between altruistic concerns and INS, NEP (Schultz et al., 2004) and CNS. Other researchers showed a positive relationship between altruistic concerns and CNS (Perkins, 2010).

The behavioral domains that correlated highest with the INS were civic actions, policy support, transportation choices, household setting and consumerism, while recycling domain correlated strongly with CNS, indicating that personal practices' domains were significantly correlated to connectedness to nature measures (Hypothesis 3). We expected civic actions and policy support domains to be more strongly related to biospheric concerns than personal practices' domains; in contrast, our findings revealed that consumerism and household practices were more strongly associated with biospheric concerns than civic actions and policy support were.

Egoistic concerns were strongly and negatively related to transportations choices and household practices. Egoistic concerns were correlated weakly with civic actions and showed no significant correlation with policy support. These conclusions suggest that more engaged environmental actions are motivated not only by environmental reasons, but other factors affect conservation behavior as well (Lindenberg & Steg, 2007). Thus, we found no support for Hypothesis 2.

We compared the predictive power of two connectedness to nature measures, ecological worldview and environmental concerns in explaining the multiple domains of environmental behavior. The results of simple and hierarchical multiple regression showed that connectedness to nature and ecological worldview explained more variance in the civic action, recycling, household setting and consumerism domains than environmental concerns (Hypothesis 4). The connectivity construct has been found to predict general environmental behavior (Davis et al.,

2011). On the contrary, egoistic, biospheric and altruistic concerns explained a higher amount of variance in the policy support and transportation domains (Hypothesis 5). These findings confirm that environmental concern is associated with various environmental behaviors (Thøgersen & Ölander, 2006).

Since the predictive power of connectedness, ecological worldview and environmental concern have never been examined with regard to multiple behavioral domains, the conclusions of the current study are tentative and further validation of our findings is essential in order to verify their replicability to future research. It is also crucial to examine other psychological antecedents that predict environmental behavior than those reported in this study, such as norms, gain and hedonic motives, and contextual factors (e.g status, comfort, behavioral opportunities) (Lindenberg & Steg, 2007).

The findings of our work may contribute to practitioners' objective of promoting environmental behavior. For instance, in order to promote environmental actions, policy makers should aim at increasing people's connectedness to nature. This suggestion stems from our conclusion about the interconnectedness that people feel with the natural environment affects their engagement in environmental citizenship behaviors. People's appreciation for nature is a considerable predictor of environmental behavior in several studies (Brügger et al., 2011). Biospheric environmental concerns were more powerful in predicting policy support behaviors and transportations choices. Strong biospheric concern has been proven to result in greater environmental behavior (Steg & De Groot, 2012), while egoistic concern is a limiting factor in engaging in conservation actions (Schultz et al., 2004). The latter indicates the need to make biospheric concerns more salient in certain conditions and weaken egoistic orientation (Steg et al., 2014).

REFERENCES

Alisat, S., & Riemer, M. (2015). The environmental action scale: Development and psychometric evaluation. *Journal of Environmental Psychology*, **43**, 13–23.

Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology,* **27(1)***,* 14–25.

Barbaro, N., & Pickett, S. M. (2016). Mindfully green: Examining the effect of connectedness to nature on the relationship between mindfulness and engagement in pro-environmental behavior. *Personality and Individual Differenc*es, **93***,* 142-147.

Brown, T.A (2015). *Confirmatory Factor Analysis for Applied Research* (2nd ed.). Methodology in the Social Sciences series. New York: The Guilford Press.

Brügger, A., Kaiser, F. G., & Roczen, N. (2011). One for all? Connectedness to nature, inclusion of nature, environmental identity, and implicit association with nature. *European Psychologist,* **16(4)***,* 324–333.

Davis, J. L., Le, B., & Coy, A. E. (2011). Building a model of commitment to the natural environment to predict ecological behavior and willingness to sacrifice. *Journal of Environmental Psychology*, **31(3)***,* 257–265.

Dono, J., Webb, J., & Richardson, B. (2010). The relationship between environmental activism, pro-environmental behaviour and social identity. *Journal of Environmental Psychology*, **30(2)***,* 178–186.

Dunlap, R. E., Liere, K. D. Van, Mertig, A. G., & Jones, R. E. (2000). Measuring Endorsement of the New Ecological Paradigm: A Revised NEP Scale. *Journal of Social Issues*, **56(3)***,* 425–442.

Dunlap, R. E., & Michelson, W. (Ed.). (2002). *Handbook of environmental sociology*. Westport, CT, USA: Greenwood.

Gatersleben, B. (2013). Measuring environmental behavior. In Steg, L., Van den Berg, A.E., & de Groot, J.I.M. (Ed.), *Environmental Psychology: An Introduction* (pp.132-140). U.K: British Psychological Society, BPS Blackwell by John Wiley & Sons, Ltd.

Gifford, R. (2008). Psychology's essential role in alleviating the impacts of climate change. *Canadian Psychology*, **49(4)***,* 273-280.

Gifford, R., & Nilsson, A. (2014). Personal and social factors that influence pro-environmental concern and behaviour: A review. *International Journal of Psychology*, **49(3)***,* 141–57.

Halkos G.E. (2006), *Econometrics: Theory and practice.* Giourdas Publications.

Halkos G. (2007). *Econometrics: Theory and Practice: Instructions in using Eviews, Minitab, SPSS and Excel.* Gutenberg: Athens.

Halkos, G. (2011). Nonparametric Modelling of Biodiversity: Determinants of Threatened Species. *Journal of Policy Modelling*, **33(4),** 618 – 635,

Halkos GE (2015). Climate change actions for sustainable development. *International Journal of Innovation and Sustainable Development,* **9,** 118–136,

Halkos, G. and Jones, N. (2012). Modeling the effect of social factors on improving biodiversity protection. *Ecological Economics,* **78,** 90-99.

Halkos, G. and Matsiori, S. (2012a). Assessing the Economic Value of Protecting Artificial Lakes. MRPA Munich Personal RePEc Archive **59211**.

Halkos, G. and Matsiori, S. (2012b). Determinants of willingness to pay for coastal zone quality improvement. *The Journal of SocioEconomics* **41,** 391-399.

Halkos, G. and Matsiori, S. (2013) The Relationship between People's attitude and Willingness to Pay for River Conservation. MPRA - Munich Personal RePEc Archive **50560**.

Halkos, G. and Matsiori, S. (2014). Exploring social attitude and willingness to pay for water resources conservation. *Journal of Behavioral and Experimental Economics*, **49,** 54-62.

Kaiser, F. G., & Wilson, M. (2004). Goal-directed conservation behavior: The specific composition of a general performance. *Personality and Individual Differences,* **36(7)***,* 1531–1544.

Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why Do People Behave Environmentally and What are the Barriers to Pro-Environmental Behaviour. *Environmental Education Research,* **8(3)***,* 239–260.

Larson, L. R., Stedman, R. C., Cooper, C. B., & Decker, D. J. (2015). Understanding the multi-dimensional structure of pro-environmental behavior. *Journal of Environmental Psychology,* **43,** 112–124.

Lindenberg, S., & Steg, L. (2007). Normative, gain and hedonic goal frames guiding environmental behavior. *Journal of Social Issues*, **63(1)***,* 117–137.

Lokhorst, A. M., Hoon, C., le Rutte, R., & de Snoo, G. (2014). There is an I in nature: The crucial role of the self in nature conservation. *Land Use Policy,* **39***,* 121–126.

Mayer, F. S., & Frantz, C. M. (2004). The connectedness to nature scale: A measure of individuals' feeling in community with nature. *Journal of Environmental Psychology*, **24(4)***,* 503–515.

Perkins, H. E. (2010). Measuring love and care for nature. *Journal of Environmental Psychology,* **30(4)**, 455–463.

Poortinga, W., Steg, L., Vlek, C., & Poortinga, N. (2004). Values, environmental concern, and environmental behavior - A study into household energy use. *Environment and Behavior,* **36(1)***,* 70–93.

Schultz, W. P. (2001). the Structure of Environmental Concern: Concern for Self, Other People, and the Biosphere. *Journal of Environmental Psychology*, **21(4)**, 327–339.

Schultz, W. P. (2002). Inclusion with Nature: The Psychology of Human-Nature Relations. In Schmuck, P., & Schultz, W.P. (Ed.), *Psychology of Sustainable Development* (pp.61–78). New York: Kluwer Academic Publishers, Springer Science & Business Media.

Schultz, P. W.,Shriver, C., Tabanico, J.J., & Khazian, A.M (2004). Implicit Connections with Nature. *Journal of Environmental Psychology,* **24**, 31–42.

Schultz, P.W., & Kaiser, F. G. (2012). Promoting Pro-Environmental Behavior. In Clayton, S. (Ed.), *The Oxford Handbook of Environmental and Conservation Psychology* (pp.661-691). New York: Oxford University Press.

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology,* **29(3)**, 309–317.

Steg, L., & De Groot, J. I. M. (2012). Environmental values. In Clayton, S. (Ed.), *The Oxford handbook of environmental and conservation psychology* (pp. 81-92). New York: Oxford University Press.

Steg, L., Bolderdijk, J. W., Keizer, K., & Perlaviciute, G. (2014). An Integrated Framework for Encouraging Pro-environmental Behaviour: The role of values, situational factors and goals. *Journal of Environmental Psychology,* **38**, 104-115.

Stern, P. C. (2000). Toward a Coherent Theory of Environmentally Significant Behavior. *Journal of Social Issues*, **56(3)**, 407–424.

Tabachnick, B. G., & Fidell, L. S. (2013). *Using Multivariate Statistics* (6th ed.). Boston: Pearson Education.

Thøgersen, J., & Olander, F. (2006). The dynamic interaction of personal norms and environment-friendly buying behavior: A panel study. *Journal of Applied Social Psychology*, *36 (7),* 1758-1780.