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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 reveals 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

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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 (Brown 2017; Gifford and Nilsson 2014; Halkos and Matsiori 2012a, b, 2013, 2014; Kaida and Kaida 2016), connectedness to nature (Mayer and Frantz 2004), environmental concern and ecological worldview (Dunlap et al. 2000; Givens and Jorgenson 2013). 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 and Kaiser 2012, p. 662). Nonetheless, comparatively few studies focus on the dimensionality of environmental behavior (Larson et al. 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 and 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 and 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 and 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 and 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 (Gatersleben 2013, p. 137), suggesting that it is not valid to cluster a range of different behaviors along one dimension, because these behaviors are not necessarily correlated. Larson et al. (2015) studied the multi-dimensional structure of behavior

and pointed out that dimensionality of environmental behavior is justified for four major reasons. First, dimensionality lies on difficulty levels of engagement in a particular behavior and multiple social, individual and contextual factors such as norms, values, attitudes, financial costs, availability of materials, existence of facilities or services (Gatersleben et al. 2002; Steg and Vlek 2009). Additionally, many researchers consider that different behaviors may be motivated by different antecedents (Steg et al. 2014; Larson et al. 2015). Consequently, people may rely on normative (what a person ought to do), hedonic (feel better right now) or gain (benefit me) motives to act (Lindenberg and Steg 2007). Another important consideration when examining environmental behavior is the direct or indirect impact of a specific behavior (Stern 2000; Poortinga et al. 2004; 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 (Ramkissoon et al. 2013). Kaiser and Wilson (2004), however, developed a unidimensional measure of goal-directed environmental behavior, suggesting that people generally are motivated to act considering only one underlying goal, environmental conservation. This, in turn, means that different behaviors (e.g. recycling, transportation habits, donate money for environmental causes) can be mapped onto one dimension, and therefore these behaviors are distinct only in terms of their difficulties.

Many scholars have proposed different behavioral typologies inspired by the distinct domains of EB. Typology of Stern's (2000) environmentally significant behavior differentiates between four major types of conservation behavior that people can engage in. The first broad category called environmental activism includes highly committed behaviors such as participation in public demonstrations and being an active member of an environmental organization. The next category, non-activist behaviors in the public sphere, refers to low commitment active citizenship and policy support actions, including signing a petition to demand nature protection and approval of environmental regulations. An additional type of environmentally significant behavior is private sphere practices and subsumes other relevant behaviors such as recycling, transportation choices and purchase decisions. Another well-known typology stems from Corral-Verdugo et al.'s (2011) work that recognizes four types of sustainable actions: Pro-Ecological, Frugal, Equitable and Altruistic Actions that previous studies have theorized them as a uniform higher-order factor (sustainable behavior) subsuming them (De Young 1996; Schultz 2001; Corral-Verdugo et al. 2011).

Other researchers found empirical evidence of only two distinct categories of environmental behavior, personal practices and civic or environmental actions (Dono et al. 2010; Alisat and Riemer 2015; Larson et al. 2015). Alisat and Riemer (2015), critically reviewing the existing literature, concluded that there are two broad categories of environmental behavior, environmental actions, and personal practices. Larson et al. (2015) also suggested that there are two main suites of behaviors that have generated substantial interest among EB studies, those focused on private sphere, and other high or low committed civic actions. Environmental actions are engaged citizen behaviors (Riemer et al. 2013) and refer to actions such as donating money to environmental causes, signing petitions, organizing a boycott, voting, participation in environmental organizations or in protests, and talking to others about environmental issues. 'Personal practices' is an umbrella term to refer to any behavior take place in the private sphere, such as waste management in the household setting, as well as energy and water conservation behaviors, transportation choices and consumerism. Personal practices are commonly referred in the literature as "pro-environmental behavior" (e.g. Kollmuss and Agyeman 2002; Bamberg and Möser 2007) or conservation lifestyle behaviors (Larson et al. 2015).

Private-sphere behaviors have been the focus of most studies in the EB literature (e.g. Stern 2000; Gatersleben et al. 2002; Steg and Vlek 2009). This category encompasses many potential EB domains including recycling (Corral-Verdugo1997; Oreg and Katz-Gerro 2006; Kaiser et al. 2007), water and energy conservation (Gatersleben et al. 2002; Abrahamse et al. 2005; Kaiser et al. 2005), transportation choices (Kaiser et al. 2005; Oreg and Katz-Gerro 2006) and green purchasing (Kaiser and Wilson 2004; Young et al. 2010). Environmental actions illustrate multiple domains, including policy support (Stern 2000; Poortinga et al. 2004; Larson et al. 2015) and environmental citizenship (Stern 2000; Alisat and Riemer 2015). Within the environmental psychology's content, many studies have considered other ecological behaviors that particularly improve environmental features of a certain place and referred to as "environmental stewardship" (Huddart-Kennedy, et al. 2009). These actions constitute a distinct domain and rely on the relationship between place attachment and EB (Scannell and Gifford 2010; Raymond et al. 2011).

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 and 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 and intentions, indicating that feeling interconnected with nature can lead to eco-friendly behaviors (Kals et al. 1999; Mayer and Frantz 2004; Dutcher et al. 2007; Nisbet et al. 2011; Brügger et al. 2011; Beery and Wolf-Watz 2014; Barbaro and Pickett 2016).

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 (Pienaar et al. 2013). 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 et al. 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 and 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 and 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 have 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 and Olander 2006; Best and Kneip 2011).

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 and 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 and 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 Methods

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 (87 were female and 63 were male with a mean age of 40.32 years and standard deviation of 9.23). The questionnaire included several demographic variables, 22 items for measuring environmental behavior and additional environmental scales of connectedness to nature (CNS and INS), environmental concern (EMS) and ecological worldview (NEP) (see the measures section for an overview). The mean time to answer the survey items was 20 min. We only used for further analysis those questionnaires with no missing data. We used non-probabilistic snowball sampling beginning with a small population of known individuals

(undergraduate students in the University of Thessaly, Greece) 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 Measures

Environmental behavior We draw on the work of Kaiser and Wilson (2004), Alisat and Riemer (2015) and Larson et al. (2015) to develop a multi-dimensional measure of environmental behavior. Kaiser and Wilson (2004) presented the GEB scale, a one-dimensional measure of environmental behavior that includes 30–65 different performances (Kaiser and Gütscher 2003) and measures a wide range of ecological behaviors as well as their counterpart behaviors. Alisat and Riemer (2015) developed the 18-item Environmental Action Scale (EAS) in order to measure leadership and participatory actions, while Larson et al. (2015) used a 13-item measure of environmental behavior including social environmentalism, land stewardship, conservation lifestyle and environmental citizenship behaviors.

In our measure of environmental behavior some items were retained per se or slightly rephrased from the original GEB and EAS scales, some new items were developed and a few items were eliminated due to their poor psychometric characteristics (low communalities and corrected item-total correlations, cross-loading or factor loading <0.4, see DeVellis 2017 for an overview), so that the final version of the scale consisted of 22 items. Despite that policy support is a clear highly committed civic action, there are only a few empirical studies that attempted to measure this type of environmental behavior (e.g. Cottrell 2003; Poortinga et al. 2004; Oreg and Katz-Gerro 2006; Larson et al. 2015). For instance, Stern et al. (1999) included policy support type in the environmental significant behavior typology, but he only used one item measuring an intention rather than a purely political action. Larson et al. (2015) included only one political action item ("Voted to support a policy regulation that affects the local environment"), considering that policy support is not a distinct domain. Although policy support domain has not been sufficiently operationalized, we considered this category further for the purpose of this study and include items that measure political activism (e.g. "I vote a political party that supports environmental conservation policies through legislations").

The final version of the scale encompasses six potential behavior domains: civic actions, policy support, recycling, transportation, behavior in the household setting (e.g. water and energy conservation) and consumerism (e.g. "I buy seasonal grocery"). Participants responded how often the last six months (or in the past 8 years for the policy support items) performed these behaviors, rating each item on a 5-point Likert scale (1 = never and 5 = always/every day). Table 1 shows the final 22 behavioral items. Mean scores were computed on the items included in each of the 6 subscales.

Connectedness to nature We used the 14-item Connectedness to nature Scale (Mayer and 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 ($M=3.72$, $sd=.98$, Cronbach $\alpha=.78$). 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

Table 1 Results of principal components analysis

Items	Civic actions	Policy support	Recycling	Transportation choices	Household setting	Consume
I am an 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, Cronbach α = 0.8						
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, mean = 2.47, sd = 1.08, Cronbach α = .79						
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, mean = 3.06, sd = .77, Cronbach α = .73						
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, mean = 3.27, sd = 1.15, Cronbach α = .77						
I buy energy saving light bulbs****					.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	

Table 1 (continued)

Items	Civic actions	Policy support	Recycling	Transportation choices	Household setting	Consume
Eigenvalue = 1.43, mean = 3.74, sd = .90, Cronbach α = .67						
I buy products in refillable packages***						.527
I buy seasonal produce****						.562
I buy meat and produce with eco-labels***						.723
I use paper bags instead of plastic ones when I go shopping***						.719
Eigenvalue = 9.21, mean = 3.01 sd = .95, Cronbach α = .74						
KMO = .8512						
Bartlett's test of sphericity $\chi^2 = 3962.54$, df = 231, $p = .000$						

* Indicates items adopted from Larson et al. (2015); ** indicates items adopted from Alisat and Riemer (2015); ***indicated items adopted from GEB scale (Kaiser and Wilson 2004); **** indicate new items

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, Cronbach = .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, Cronbach = .90), biospheric (M = − .29, sd = .59, Cronbach = .94), and altruistic scores (M = .22, sd = .57, Cronbach = .78) were calculated by computing the average score to all EMS items and subtracting the result from each of the three scale scores.

The measurement tools described above were all translated in Greek prior to the research following the procedures described in the international literature (Beaton et al. 2000; Zidan et al. 2016). All items from all scales were initially translated from English to Greek by two Greek bilingual translators by creating two versions of the scales. In turn, these versions were analyzed by an expert panel composed of four Professors of the Environmental Science field in order to create a third version of the scales in Greek. Then, a back translation was made from Greek to English by two American translator professionals that resulted in two additional versions of the scale items. All these five scale versions were compared by the same panel of experts in order to develop the final form of the items to use in the subsequent studies.

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 socioeconomic variables, the 22 behavioral items and NEP, CNS, INS and EMS scales. We applied random systematic sampling using the telephone directory of the city of Thessaloniki, Greece (Response rate 75.19%). Questionnaires were delivered through the local post-offices with prepaid envelopes. The average time to complete the questionnaire was 20 min and there were no missing data. 48% were male and 52% females with a mean age of 38.36 years (sd = 14.29) and personal mean income per month at € 755.36 (sd = 509.08). 40.8% of the participants had a secondary education level (high-school graduates) and 73.7% were urban residents.

2.2.2 Measuring Environmental Behavior and Other Psychological Variables

We used the 22-item measure of environmental behavior that emerged through Sample's 1 exploratory procedure and conducted a Confirmatory Factor Analysis (CFA). We also used the same measures as in Study 1 to measure connectedness to nature, environmental

concern and ecological worldviews and confirm their structure.[1] Specifically we used CNS (Cronbach α = .73), INS (Cronbach α = .80), EMS (egoistic Cronbach α = 81; biospheric Cronbach α = .79; altruistic Cronbach α = .82) and NEP scales (Cronbach α = .73).

The measurement tools were all translated in Greek prior to the research following the same procedure described for Study 1.

3 Results

3.1 Study 1

3.1.1 Exploratory Factor Analysis of Scales

A Principal Component Analysis (PCA) was first carried out with an oblique rotation to assess the factorial structure of the environmental behavior measure. 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. We further applied EFA to reveal the structure of the NEP, EMS and NEP scales. The results indicated that NEP (Dunlap et al. 2000) and CNS are uni-dimensional measures (Mayer and Frantz 2004). EMS is a three-factor scale as the other researchers have also suggested (Schultz 2001).[2]

3.1.2 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

[1] The INS scale is a single-item measure and therefore, CFA is not applicable.

[2] The detailed EFA results are available on request.

Table 2 Bivariate correlation between CNS, INS, NEP, EMS and environmental behavior's domains (Study 1)

	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	.093	.244**	.334**	−.099*	.217**	−.145**						
8.F2	.273**	.357**	.419**	−.049	.263**	−.234**	.467**					
9.F3	.353**	.438**	.333**	.043	.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**	−.061	.382**	−.348**	.485**	.501**	.353**	.245**	.523**	

F's are components of environmental behavior. 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 respectively. **Correlation is significant at the .01 level (2-tailed). *Correlation is significant at the .05 level (2-tailed)

and .53. NEP was correlated to all domains (r's ranged from .19 to .45) but not with the civic action domain (r = .09).

3.2 Study 2

3.2.1 General Statistical Analysis

We applied Confirmatory Factor Analysis to the 22 behavioral items and to the EMS, CNS and NEP scales (details are presented in the results subsection). Since there are no other studies in Greece that used these scales, it was necessary to confirm their structure. 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 3). 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 and 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.

3.2.2 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 and 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; $p = .000$) did not support normality hypothesis (Tabachnick and 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. The most popular indices are Chi square statistic (χ^2), Comparative fit index (CFI ≥ .95), Tucker-Lewis index or NNFI (TLI ≥ .95) and Root mean square error of approximation (RMSEA < .08) (Hu and Bentler 1999; Hair et al. 2010).

Although χ^2 values indicated that the measurement model did not advocate for a good fit of the model ($\chi^2 = 495.29$, df = 194, $p < .001$), 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. All subscales indicated good internal consistency (Civic actions, Cronbach α = .86; Policy support items, Cronbach α = .80; Transportation choices, Cronbach α = .79; Recycle, Cronbach α = .76; Household setting, Cronbach α = .70; Consumer behavior, Cronbach α = .77).

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),

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 .01 level (2-tailed)

**Significant at .05 level (2-tailed)

*Significant at .1 level (2-tailed)

error variances for the observed variables and covariances between the latent constructs (φ) are reported in Fig. 1.

3.2.3 Confirmatory Factor Analysis of CNS, NEP and EMS Scales

Tests of univariate and multivariate normality for all items of all scales showed that assumption of normality was violated and therefore, we used again the robust Maximum likelihood method of parameter estimation and the covariance and asymptotic covariance matrices as inputs. A Confirmatory Factor Analysis verified the tripartite structure of environmental concern (Schultz et al. 2004). Model fit was assessed using SB χ^2 value and multiple fit indices (Tabachnick and Fidell 2013). Although χ^2 values suggested that the model did not reproduce the observed covariance well (SB $\chi^2 = 251.03$, df = 51, $p < .001$), fit indexes indicated adequate fit (RMSEA = .08, SRMR = .48, CFI = .97). Standardized path loadings (λ) ranged from .53 to .95. The internal consistency of EMS subscales was satisfying (egoistic Cronbach α = 80; biospheric Cronbach α = .81; altruistic Cronbach α = .84). The CFA results of the CNS scale indicated an adequate fit for a one-dimension model (SB$\chi^2 = 193.26$; df = 77; $p < .001$; RMSEA = .06, SRMR = .05, CFI = .94; standardized factor loadings from .45 to .78; Cronbach α = .79). The CFA for the NEP scale revealed a one-factor structure and good model fit (SB$\chi 2 = 205.61$; df = 90; $p < .001$; RMSEA = .07, SRMR = .06, CFI = .93; standardized factor loadings from .42 to .76; Cronbach α = .74).

3.2.4 Regression of Environmental Behavior on CNS, NEP, INS and EMS

The CNS, INS and NEP explained 20% in variance of the policy support domain ($F(3,396) = 32.90$, $p < .001$). 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 ($F(3,396) = 33.74$, $p < .001$). 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).

CNS, INS, and NEP explained only 22% in variance of the recycling domain ($F(3,396) = 37.16$, $p < .001$). CNS and NEP made a significant contribution to the regression model (β = .30 for CNS and β = . 15 for NEP). EMS explained 13% in variance of the recycling domain ($F(3,396) = 19.93$, $p < .001$). Respondents who hold egoistic concerns were more likely to recycle (β = .24), as well as those with biospheric concerns (β = .15).

The CNS, INS, and NEP explained only 7% in variance of the transportation choices subscale ($F(3,396) = 10.68$, $p < .001$). Only INS made a significant contribution to the regression model (β = .17). EMS explained 11% in variance of the transportation domain ($F(3,396) = 17.79$, $p < .001$). Respondents with biospheric concerns were more likely to make eco-friendly transportation choices (β = .32).

The CNS, INS, and NEP explained 36% in variance of the household setting domain ($F(3,396) = 75.70$, $p < .001$). All three measures made a significant contribution to the regression model (β = .14 for CNS, β = .35 for INS and β = .23 for NEP). EMS explained 32% in variance of the household setting domain ($F(3,396) = 62.50$, $p < .001$). Respondents with biospheric concerns were more likely to behave in an eco-friendly way in a household setting (β = .56).

The CNS, INS, and NEP explained 29% of the variance of the consumerism domain ($F(3,396) = 55.98$, $p < .001$). Respondents that include nature in their self-representation

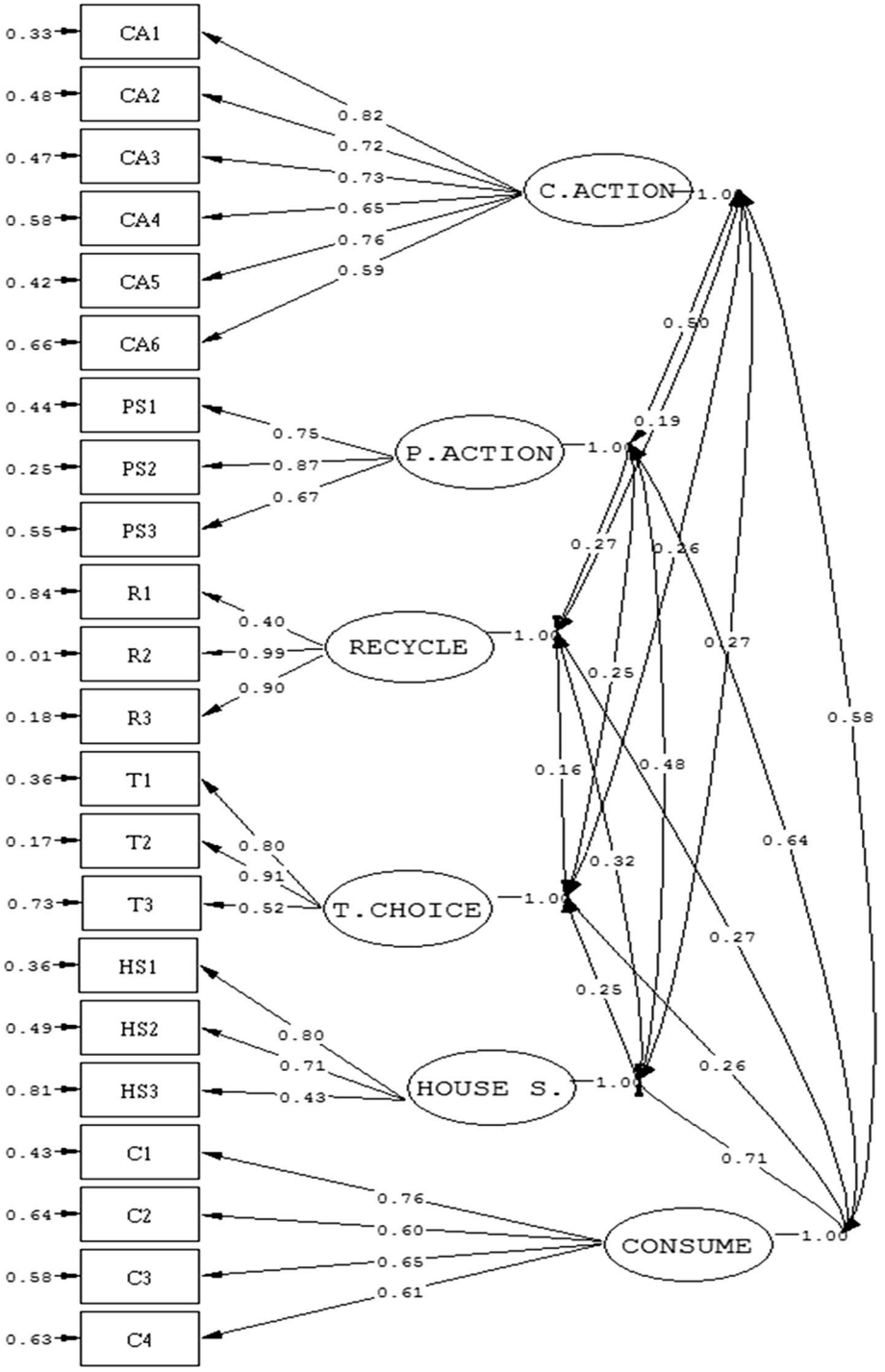

Fig. 1 Confirmatory factor analysis of environmental behavior. C. action is civic actions; P. action represent policy support items, T. choice are transportation choices; House S. indicate household setting; consume is consumer behavior

tend to consume in an eco-friendly way (β = .46). EMS explained 27% in variance of the consumerism domain (F(3,396) = 50.30, $p < .001$). Respondents with biospheric concerns were more likely to be "green" consumers (β = .48), and so were individuals with egoistic concerns (β = .14), in contrast to respondents with altruistic concerns (β = − .14).

Table 3 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, $p = .000$) and 6% in consumerism (F-Change = 5.9, $p = .000$).

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 ($p > .05$).

4 Discussion and Conclusion

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 behavioral domains that emerged were slightly different from those reported in other relevant studies that included both environmental actions and private-sphere behaviors (Kaiser and 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 with CNS and INS, while CNS and INS had also a strong correlation (Brügger et al. 2011). Egoistic concerns were negatively correlated with both altruistic and biospheric concerns (Schultz et al. 2004). Biospheric concerns were significantly associated with CNS (Mayer and Frantz 2004), INS and NEP (Schultz et al. 2004). Egoistic concerns were found to be negatively correlated with CNS (Mayer and 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 and Steg 2007; Jacob et al. 2009). 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 and Olander 2006; Kaida and Kaida 2016).

4.1 Limitations and Future Research

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) that previous research has highlighted (Lindenberg and Steg 2007; Ruepert et al. 2016). Furthermore, this study lies in self-reported measures and social desirability might be a limiting factor that biases the responses. Future researches could possibly test for common method bias in the self-reported data. Since this study was carried out in Greece, the results should be also replicated in different socio-cultural contexts.

4.2 Strengths and Potential Implications

This study adds to the existing literature by assessing the predictive power of connectedness, ecological worldview and environmental concern with regard to multiple behavioral domains that previous research has omitted. Moreover, there are only a few empirical studies that explore the relationship of general environmental concern and activism (McFarlane and Boxall 2003; Binder and Blankenberg 2016). In a similar vein, there are no studies, to our knowledge, that investigate the predictive power of connectedness to nature on activism domain. It is of great value that this study was conducted in Greece because there are no other empirical works that use these particular environmental scales to study environmental behavior (only a few studies investigate solely behavioral domains and other constructs such as norms and intentions, e.g. Pothitou et al. 2016).

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 that 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 and De Groot 2012; Ruepert et al. 2016), 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). The most effective conservation strategy might be to enhance both egocentric as well as bio-altruistic concerns of the community to promote ecological behavior (De Dominicis et al. 2017). Likewise, the present work highlights the influence of connectedness to nature feelings in environmental behaviors and its key role to pursue environmental behavior. Hence, it may contribute to the design and implementation of conservation strategies that seek to promote po-environmental actions (Restall and Conrad 2015).

Authors' Contributions Anastasia Gkargkavouzi contributed to conception and design, the collection of the data, analysis, and interpretation of data, and drafting the article. Professor George Halkos contributed to the drafting of the data. Assistant Professor Steriani Matsiori contributed to the drafting of the data and supervised the entire study procedure.

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Compliance with Ethical Standards

Conflict of interest All author declare no conflict of intrest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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