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Exploring the Influence of Nature Relatedness and Perceived Science Knowledge on Proenvironmental Behavior

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Abstract: This study was undertaken to investigate the factors influencing proenvironmental behavior of individuals residing in the Northern Rocky Mountains (*N* = 267). Measures of relatedness to nature and perceived science knowledge were collected through a convenience sample approach using multiple avenues such as city email lists, organizational newsletters, and social media channels. Analysis of the data was conducted using both partial least squares and covariance based structural equation modeling to explore the relationships between the constructs. Additionally, qualitative definitions of proenvironmental behavior were investigated in order to address potential gaps between self-reported and observed behaviors. Quantitative findings show a renewed positive connection between science education, nature relatedness, and proenvironmental behaviors. Furthermore, qualitative findings suggest positive relationships between how publicly people are willing to share their passion for the outdoors and their willingness to engage in proenvironmental behaviors.

Keywords: nature relatedness; proenvironmental behavior; science education; partial least squares structural equation modeling (PLS-SEM); covariance based structural equation modeling (CB-PLS)

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1. Introduction

As the Earth is facing unprecedented environmental changes, it is potentially more imperative than ever that sustainable lifestyles and behaviors are adopted [1]. Though there continues to be debate about the factors that influence or encourage proenvironmental behaviors, understanding what drives humans to care for the environment and fostering these behaviors continues to be at the forefront of environmental education [2,3].

In an attempt to synthesize the growing literature on models describing the factors that influence proenvironmental behaviors, Hines, Hungerford, and Tomera [4] completed a landmark meta-analysis which found the main factors predicting proenvironmental behavior relate to personality, attitudes, knowledge, and skills; findings that have largely been confirmed in subsequent analyses [5,6]. However, more recently, clear arguments have been made for the role of context, including subjective norms, perceived behavioral control [5,7,8], as well as identity constructs including ecological identity and/or the relationship one has with the environment [9–11]. Given the diversity of perspectives, many factors and models for proenvironmental behavior exist and each has varying degrees of validity in specific contexts [12], suggesting that "a primary goal of researchers now should be to learn more about how these many influences moderate and mediate one another to determining pro-environmental behavior" [2] (p. 141).

To understand the nature and scope of the major determinants of behavior, various instruments attempt to measure the diversity of the concepts dealing with personality, attitude, and knowledge as they relate to the environment [13–16]. A number of these scales theoretically explore human's relationship with the environment, which has its foundations in nature studies [17], and ecopsychology [18]. One example is Nature Relatedness (NR) [15,16] which is based on E. O. Wilson's [10] biophila hypothesis. NR strives to understand the human-nature connection, the biospheric predisposition that encourages a response to environmental destruction. NR is similar to ecological identity; however, it contains broader measures that look at both the awareness of nature and larger understanding of the natural world and is said to correlate with behavior [16]. The scale includes measures of affective, cognitive and physical relationships between humans and nature [15], which factor into three domains: NR-Self (internalized identification with nature), NR-Perspective (external worldview of nature), and NR-Experience (physical relationship with nature).

The NR Scale has survey items that are intended to measure cognitive awareness of the environment (e.g., I am very aware of environmental issues). The inclusion of knowledge about the environment in the NR scale highlights the controversial issue concerning the degree to which knowledge or education plays in determining behavior [6,19,20]. For example, Steg and Vlek [21] (p. 313) argue that, "information campaigns hardly result in behavior changes". Known as information deficit models, utilizing content knowledge or environmental awareness models as the primary strategy to change behavior has been shown to have little to no effect or even a negative effect on the supposed beneficiary [20,22]. Research shows that while people identify as an environmentalist or anti-environmentalist, the average content knowledge about environmental issues is low [23], suggesting that factual knowledge may not be a driver of behavior. However, Kempton's et al. work [24] (pp. 218–219) argues that cultural models influence how people interpret new environmental information and guide action, which implies some degree of personal perception of knowledge driving behavior rather than scientific facts. This subjective knowledge of the environment is relatively unexplored; however, studies do show that higher levels of perceived knowledge do relate to higher levels of behavioral intention [25–27]. Coupled with an overall low objective knowledge of the environment in the public, this study investigates the impact of perceived (self-reported) understandings rather than specific content-based questions as a measure of environmental knowledge on behavior.

Regardless of individual understanding about the environment, to remove or excise the role that content knowledge plays in environmental education may be to its detriment. Gough [28] (p. 1211) contends that "environmental education needs science education . . . to provide it with a legitimate space in the curriculum to meet its goals because they are very unlikely to be achieved from the margins". In its limited approach measuring cognitive aspects of the environmental relationship, NR potentially misses the ability to provide evidence of the value of formal or informal environmental education. In linking NR and knowledge, this study may show the potential of education to impact both a connection to nature and proenvironmental behavior.

More recently research related to proenvironmental behaviors has recognized the need to understand the influence of collective and community factors and structures on individual choices [21,29]. This emphasis is not without precedent, as context or subjective norms are included in the Theory of Planned Behavior [6] and the impact of physical and social places on individuals cannot be underestimated [30,31]. It is suggested that an underlying thread of environmental communication when assessing beliefs and attitudes about the environment through self-report measures [32]. Understanding that communities create shared meaning about the environment through communication [33] (p. 9), gaining a sense of how people share their attitudes and beliefs concerning the outdoors may shed light about the nature of how cultural models shape one's environmental behaviors. Thus, the study includes an open-ended question aimed at understanding how participants share their attitudes and beliefs about the environment.

In addition, while a number of studies aim to understand specific populations such as college students [34], recreational users [35,36], or particular programs [37], this study differs in that it aims to explore perceptions of environmental behaviors of individual residing in Northern Rocky Mountains. In exploring dynamics between people's attitudes, beliefs, connections (NR), their perceived science knowledge, and proenvironmental behavior, this study is situated to have a holistic understanding of the cultural models and norms to enable educational or outreach efforts to take a more targeted and contextualized approach toward increasing positive environmental behaviors.

Finally, while some studies have shown that self-reported measures of behavior do accurately mirror observed behaviors [38], there may be a difference between behavioral intention (self-reported measures of behavior) and what people actually do [5,39]. "The considerable amount of unexplained variance between self-reports and objective measures suggests that these measures are not as isomorphic as some might think . . . " [38] (p. 369). Therefore, self-reported levels of proenvironmental behavior should aim to include either direct or indirect measures of actual behavior [40]. Additionally, as a goal of this exploratory study is to understand factors that influence behavior, study participants residing in the Northern Rocky Mountain likely hold different understandings of what constitutes an environmental behavior [3,41]. To keep the study broad enough to understand the scope of these behaviors, this study does not provide an a priori definition of behaviors to participants. Instead, it includes self-reported fixed-response measures of behavior in addition to open-ended questions asking participants for qualitative descriptions of the behaviors as an indirect approximation of their actual behavior.

Considering prior research and current views of proenvironmental behaviors, this study is guided by the following research questions:

(1) How does perceived science knowledge and nature relatedness impact proenvironmental behaviors?
(2) What are the relationships between self-reported, fixed-response and open-ended qualitative measures of proenvironmental behavior?
(3) What is the impact of how individuals communicate their attitudes towards the environment have on self-reported, fixed-response measure of proenvironmental behavior?

2. Materials and Methods

2.1. Context and Sample Characteristics

The intent of the study is to explore the relationship between individuals' perception of their science knowledge, nature relatedness and proenvironmental behavior. The participants in this study all self-reported to reside within 15 miles of the city center of a town with approximately 39,000 people in the Northern Rocky Mountain region [42]. Further contextualizing this study, the largest university in the state is located in this town and is surrounded by numerous mountain ranges and diverse ecosystems.

The sample collected represents a convenience sample as it was non-randomly collected. Mailing lists for this city exist for purchase, but as this study was unfunded, a randomly generated sample was not possible. However, the survey was disseminated through a myriad of avenues in order to obtain the maximum possible variation of participants. For example, some of the methods used include posting flyers in public spaces, attending meetings of organizations, email list-servs, business and retail associations, community and church organizational newsletters, and social media outlets. The communication strategies included either a link to the survey website or provided a QR code in order to allow for easy access to the survey tool powered by SurveyMonkey. Data was collected for a period of three weeks.

Out of the 318 that responded, 33 were removed due to incomplete responses and an additional 18 were removed for out of area zip codes, leaving a final sample of 267 people. Given this sample size with a 6% margin of error, the confidence level of the study is 95%. About 75% of the responses to the survey come from female participants. Ages of participants range from 18 to over 70, with about 50%

of the respondents being between the ages of 20–40, about 30% being between 41–60, and about 20% being either over 60 or under 20. Of special note are the overall education levels of the respondents, of which approximately 44% have graduate degrees while only 2% have not taken any college courses. These percentages are also reflected in the 2014 Census, which reports that this geographic location has a 97.5% high school graduate rate and that 54.4% of the population have bachelor's degrees or higher [22].

As a limitation of the study, the occupational information categories on the survey instrument did not match those of North American Industry Classification System (NAICS) codes, thus making a comparison between the scope of occupations presented in the data set and those in the population being sampled difficult. However, despite this, the occupation information collected from the participants completing the survey for this study represents diverse occupational backgrounds with 20 occupations representing broad categories such as administration, education, law/legal, manufacturing, ranching/agriculture, and retail. Furthermore, it is possible that because the sample collected represents categories not collected through occupational surveys such as full-time students, unemployed, and retired individuals, it may be a better reflection of the natural diversity present in the geographic region under study.

2.2. Survey Design

The instrument developed and used intended to explore factors that influence proenvironmental behaviors at multiple levels and contained both quantitative and qualitative questions. This study focuses in on the factors that significantly predicted aggregated measures of proenvironmental behaviors, nature relatedness and self-reported measures of science knowledge. Other questions pertaining to how often and what people do when they go outside, as well as who they get outside with, were in the survey but did not significantly predict behaviors and are not included in the study.

For the purposes of this study, proenvironmental behavior is not defined intentionally in order to allow the participants to use their own operationalization of environmentalism as these can differ from those used in the scientific community [24]. This distinction is of critical importance as the intent of the study is not to ascertain change on any particular behavior, but rather to identify the scope of behaviors and indicators related to proenvironmental behaviors. Furthermore, as suggested by the behavior–intention gap [5,43,44], self-reported measures may be poor predictors of actual behavior, enabling participants to explain their behaviors as a way to contextualize their results and be a more accurate, if indirect, understanding of their actual behaviors.

The three constructs under consideration within this study are Nature Relatedness, perceived science knowledge, and proenvironmental behavior. The NR-6 scale, an abbreviated validated and reliable measure of the full Nature Relatedness was included in this survey [16]. The NR-6 scale is, among other measures, highly correlated ($r = 0.90$, $p < 0.00$) with the original 21-item Nature Relatedness Scale, and "offers an alternate [scale to others measuring nature relatedness] when time and space are limited" [15] (p. 8). To explore potential connections to education, several Likert scale questions concerning science knowledge ("I understand a lot about the natural world", "As a result of my education, I learned about how humans interact with nature", etc.) were included. Several Likert scale questions about proenvironmental behaviors ("I participate in pro-environmental behaviors", "I do things to help conserve natural environments") aim to understand broadly participant's perception of their overall behaviors. Finally, two open-ended questions concerning these behaviors and communication ("What do you do to help the environment?" "How do you share your passion for the outdoors?") were added to the survey.

2.3. Limitations and Delimitations

While this study aims to understand the factors that influence proenvironmental behaviors, using all of the factors identified in the research that may influence a person's willingness to engage in proenvironmental behaviors as well as the longevity of these behaviors remain outside the scope of this study [3–5,12]. As with many other research projects looking at the determinants of proenvironmental behavior, this study uses a self-report survey and thus the data is subject to the participants' own perceptions and potentially flawed view of their actual behavior [21,38]. However, in trying to establish a holistic understanding of environmental behaviors for a large sample, self-report surveys remain the most efficient way to gather data.

Finally, while this study does use one reliable and valid measure of Nature Relatedness, the other constructs added to the survey may need to be tested in alternative contexts with different communities in order to understand their independent reliability and validity. Further, while the study explored the significant factors that influence proenvironmental behaviors, the results may not generalize to other regions of the United States given different sociocultural, political or geographic locations. However, attempting to understand factors influencing proenvironmental behaviors based on participant responses from a specific geographic region is novel and may inform other regions of the country to seek out ways to enact change around the environment most efficiently.

2.4. Data Analysis

For the quantitative information obtained in the Likert scale responses, the primary analytic techniques used were partial least squares structural equation modeling (PLS-SEM) and covariance-based structural equation modeling. The exploratory theoretical model was developed using SmartPLS 3.2.4 (SmartPLS GmbH, Boenningstedt, Germany) [45]. Covariance-based structural equation modeling (CB-SEM) using Lisrel 9.20 (Scientific Software International, Inc., Skokie, IL, USA) [46] was used as a confirmatory approach to test the fit of the exploratory model to the population model estimated by the sample. CB-SEM unlike PSL-SEM does not assume perfectly reliable measures and accounts for measurement error when testing model fit [47].

The qualitative data, as provided by the open-ended questions, were analyzed following a deductive coding scheme, using a priori codes to guide the coding process [48]. Results were collected and entered into the qualitative data software program, QSR International's NVivo (QSR International Pty Ltd., Doncaster, Australia) [49]. A priori (pre-existing) coding structures for the open-ended question concerning proenvironmental behavior come from Stern's [3] milestone paper. Three types of environmental behavior (private-sphere environmentalism, nonactivism in the public sphere, and activism) were used to code all responses while being open to emergent categories [3]. For the open-ended question on how people choose to share their passion for the outdoors (environmental communication), three levels of communication were determined (private, family and friends, or community) using a constant comparative approach, wherein initial codes were used to create themes [48]. Once coded, the codes were given a numerical value in order to understand the spread of the data and its relationship to proenvironmental behavior.

3. Results

3.1. Quantitative Data

Prior to the analysis, all variables were evaluated for linearity and normality. A principal components factor analysis was conducted using Varimax rotation to determine the underlying structure existing for the 10 items explored in the pro-environmental behavior survey prior to completing the PLS-SEM (see Table 1).

Table 1. Survey item, abbreviation, and factor loadings.

Survey Item	Abbreviation	Nature Relatedness	Perceived Science Knowledge	Proenvironmental Behavior
My connection to nature and the environment is a part of my spirituality.	ConnectS	**0.77**	0.32	0.12
My relationship to nature is an important part of who I am.	Relationship	**0.72**	0.41	0.00
I take notice of wildlife wherever I am.	Notice	**0.70**	0.17	−0.03
I feel very connected to all living things and the earth.	ConnectE	**0.61**	0.51	0.12
I understand a lot about the natural world.	NaturalW	**0.60**	−0.08	0.27
My ideal vacation spot would be a remote, wilderness area.	Vacation	**0.60**	0.14	0.37
In my formal education, I was taught about what it means to live in an environmentally-friendly way.	FormalEd	0.07	**0.85**	0.23
My sincere background provided me with tools to understand the environment.	Science	0.22	**0.76**	0.23
As a result of my education, I learned about how humans interact with nature.	Education	0.44	**0.64**	0.17
I participate in pro-environment behaviors.	ProEnvB	−0.10	0.13	**0.86**
I do things to help conserve natural environments.	Conserve	0.27	0.25	**0.75**
I always think about how my actions affect the environment.	Actions	0.27	0.22	**0.74**

Notes: Bold numbers indicate which components loaded onto each of the three factors.

The analysis yielded three factors: nature relatedness, perceived science knowledge, and proenvironmental behavior. These three factors contributed to over 64% of the total item variance. The first component, nature relatedness, was responsible for almost 26% of the total item variance followed by proenvironmental behavior, responsible for 21% of the total variance, and lastly, perceived science knowledge, responsible for almost 18% of the total item variance.

3.1.1. Results from the Exploratory PLS-SEM Analysis

The relationships between proenvironmental behavior, perceived science knowledge, and nature relatedness identified by the principal component analysis were then explored using Partial Least Squares Regression Structural Equation Modeling (PLS-SEM; Figure 1). Overall, model fit was evaluated using the Standardized Root Mean Square Residual (SRMR) as this is the most sensitive to issues with simple model misspecification [47]. For the model in Figure 1, the SRMR is 0.09, indicating a mediocre fit [50]. However, as model fit can be misleading with PLS-SEM, the results have been organized into an assessment of the measurement and structural models.

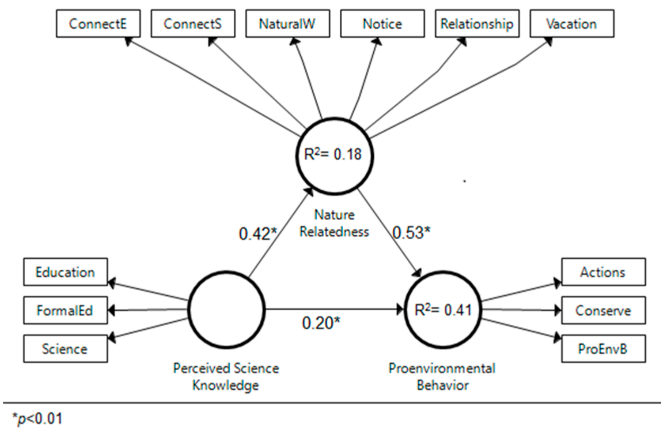

Figure 1. Result from the PLS-SEM.

3.1.2. Measurement Model, PLS-SEM

A correlational analysis, found that Conserve and ProEnvB ($r = 0.72$, $p < 0.05$) were highly correlated items suggesting issues with multicollinearity. However, these items were retained in the sample because the variance inflation factor (VIF) for all variables was above the threshold of 0.20 and less than 5 [47]. Additionally, proenvironmental behaviors (ProEnvB) may describe actions outside of the scope of conserving natural environments (Conserve) and also may be perceived differently in this sample of participants given the number of land-based conservation organizations in the region where they reside.

Results show that the measurement model meets most of the minimum requirements (see Table 2). First, all but three of the indicators loaded above 0.70, providing a measure of the indicators reliability. However, since these indicators meet all other requirements for internal consistency, they were retained. Second, all composite reliabilities are greater than 0.70, and all average variance extracted (AVE) values are above 0.50. As indicated by Hair et al., both show support for the constructs convergent validity. Additionally, the Cronbach's alpha levels for the constructs are considered good (above 0.80) and act as a conservative measure of internal reliability [47,51]. Lastly, discriminant validity is confirmed by the heterotrait-monotrait ratio (HTMT) and the Fornell-Larcker criterion. First, all constructs are below the HTMT conservative threshold of 0.85 [52]. Second, using the Fornell-Larcker criterion, all correlations between constructs fell below the square root of the average variance extracted (AVE), thereby establishing discriminant validity [47].

Table 2. Measurement model [1].

Latent Construct	Item	S. Loading	C. Alpha	C. Reliability	AVE
Nature Relatedness	ConnectE	0.77	0.80	0.86	0.50
	ConnectS	0.75			
	NaturalW	0.68			
	Notice	0.66			
	Relationship	0.81			
	Vacation	0.56			
Proenvironmental Behavior	Actions	0.85	0.83	0.90	0.75
	Conserve	0.89			
	ProEnvB	0.86			
Science Education	Education	0.90	0.81	0.88	0.72
	FormalEd	0.77			
	Science	0.86			

Notes: [1] S. Loading is the standardized loading coefficient; C. Alpha is Cronbach's Alpha; C. Reliability is the composite reliability; AVE is the average variance extracted.

3.1.3. Structural Model, PLS-SEM

In order to look at the overall quality of the structural model, the main criterion is the percent of variance explained (R^2). This model accounts for 18% of the variance present in nature relatedness and a significant portion, 41%, of the variance present in proenvironmental behavior (see Figure 1). Additionally, two significant effect size measurements are present in the model. Nature relatedness on proenvironmental behavior has an effect size of 0.39 ($t = 4.19$, $p < 0.00$), and perceived science knowledge on nature relatedness has an effect size of 0.22 ($t = 3.13$, $p < 0.00$). Both of these are considered large effect sizes adding additional support for the models explanatory power. Lastly, the Q^2 values were obtained and all fall above the threshold of zero, with the largest predictive relevance being 0.30 for proenvironmental behavior [47].

In analyzing the latent constructs, there are strong, significant direct effects between proenvironmental behavior, nature relatedness, and perceived science knowledge (see Figure 1). While perceived science knowledge has a small yet significant direct effect on proenvironmental behavior, (0.20, $p < 0.00$), the total effects are considered large (0.43, $p < 0.00$). Additionally, as seen in Table 3, the total effects of nature relatedness on proenvironmental behavior is quite large (0.53, $p < 0.00$), particularly in light of the confidence interval. These findings indicate strong positive links between all of the latent constructs and add to the predictive relevance of the model.

Table 3. Total effects.

Structural Path	Total Effects	*t*-Value	*p*-Value	95% Confidence Interval
Nature Relatedness -> Proenvironmental Behavior	0.53	10.88	0.00	(0.44, 0.63)
Science Education -> Nature Relatedness	0.42	7.68	0.00	(0.30, 0.53)
Science Education -> Proenvironmental Behavior	0.42	6.57	0.00	(0.29, 0.54)

3.1.4. Confirmatory SEM Analysis, CB-SEM

The exploratory model was then analyzed using Lisrel 9.20 (Scientific Software International, Inc., Skokie, IL, USA) to test the proposed model fit with the estimated population model. The Root Mean Square Error of Approximation (RMSEA) is currently recognized as the key informative index of fit because it provides a value that describes the discrepancy or error between the hypothesized model and an estimated population model derived from the sample. RMSEA values less than 0.05 are indicative of a close fit. Values ranging from 0.05 to 0.08 are indicative of a reasonable fit, with values $\geq$0.9 considered a poor fit [53,54]. Both the Comparative Fit Index (CFI) and the Non-Normed Fit indexes (NNFI) developed by Bentler [55] are also recommended for evaluating model fit because they consider both sample size and model complexity. CFI and NNFI values greater than .90 are indicative of a good model fit.

The confirmatory SEM analysis yielded an RMSEA of 0.069, indicating that the sample model is a reasonable approximation of the expected model found in the population. The 90% confidence interval (0.056–0.09) surrounding the RMSEA provides additional evidence to support that the exploratory model was a "reasonable fit" to the estimated population [53,54]. The "closeness" of this fit to the population model was supported by a CFI of 0.93 and an NNFI of 0.95. For the confirmatory model, perceived science knowledge was found to explain 26% of the variance in nature relatedness. Nature Relatedness, however, was found to mediate a significant proportion (55%) of the direct effects of science knowledge on proenvironmental behavior. Overall, the structural model was found to explain 56% (R^2) of the variability in proenvironmental behaviors. The R^2 produced by this analysis is considered a large effect according to criteria recommended by Cohen [56]. The larger R^2 for the confirmatory model R^2 is likely an artifact of the reduced measurement model that the constraints of CB-SEM force on the researcher [57].

3.2. Qualitative Data

Two of the questions included in the survey (What do you do to help the environment? and How do you share your passion for the outdoors?) asked for open-ended responses. Analysis of the responses followed a constant comparative approach and reinforced the a priori coding structure as discussed previously. Examples of the coding structure for the questions can be found in Table 4 along with coding frequencies.

Once the data was coded for each question, codes were given a numerical value (1–3, private–public, see Table 4). Responses to "What do you do to help the environment?" ($M = 1.69$, $SD = 0.84$) and responses to "How do you share your passion for the outdoors?" ($M = 2.24$, $SD = 0.67$) were used in to explore the relationship between the open-ended responses and proenvironmental behavior, as defined by the average of three Likert scale questions (Conserve, Actions, and ProEnvB) from the quantitative dataset.

Table 4. Examples of coded responses and frequencies.

What Do You Do to Help the Environment				**How You Do Share Your Passion for the Outdoors**			
Proenvironmental Codes	**Open-ended Respondse**	**Frequency**	**Percent**	**Communication Codes**	**Open-Ended Response**	**Frequency**	**Percent**
Private-Sphere Environmentalism, Coded as "1"	"I try to use as little energy as possible, take short showers, recycle, compost, I don't have a front lawn (less water usage), I try to bike often"	127	56.19%	Personal, Coded as "1"	"I don't share it much. it is more personal."	31	13.54%
Non-activism Behavior in the Public Sphere, Coded as "2"	"Conserve water, recycle, create minimal waste, conserve gas and water, grow our own garden, drive a hybrid, consume less, donate money each year to an environment organization."	44	19.47%	Family and Friends, Coded as "2"	"Share photos w/ friends using social media, do outdoor activities with friends/family"	115	50.22%
Environmental Activism, Coded as "3"	"advocate legislation for Wilderness, organize trail work, monitoring, highway cleanup, nurture native landscaping, do trail maintenance, wild land monitoring volunteer"	55	24.34%	Community, Coded as "3"	"Through teaching and writing, as well as spreading the stoke by actually playing in it with others."	83	36.24%

A one-way analysis of variance (ANOVA) was conducted to evaluate how the Likert scale responses of proenvironmental behavior differed based on the open-ended responses to "What do you do to help the environment?" Descriptive statistics are given by Table 5. The data did not meet the assumption of homogeneity of variances ($p = 0.00$). Therefore a Welch's test was used. Results show significant differences between groups, Welch's F (2, 104.50) = 20.58, $p = 0.00$. Post hoc comparisons using the Games–Howell procedure were conducted and results show that participants who engage in environmental activism ($M = 4.71$, $SD = 0.37$) had a significantly higher score ($p < 0.05$) on Likert scale measures of proenvironmental behavior in comparison to those who are non-activists in the public sphere ($M = 4.37$, $SD = 0.52$) or are private sphere environmentalists ($M = 4.29$, $SD = 0.53$). As participants claim to engage in environmental activism, they are more likely to claim to behave in an environmentally-responsive manner.

Table 5. Descriptive statistics for open-ended questions by proenvironmental behavior.

What Do You Do to Help the Environment	*M*	*SD*
Private-Sphere Environmentalism	4.29	0.53
Non-activism in Public Sphere	4.37	0.52
Environmental Activism	4.72	0.37
How Do You Share Your Passion for the Outdoors	***M***	***SD***
Personal	4.12	0.77
Family & Friends	4.38	0.53
Community	4.54	0.46

Another ANOVA was conducted to evaluate how Likert scale responses of proenvironmental behavior differed based on the open-ended responses to "How do you share your passion for the outdoors?" Descriptive statistics are given in Table 5. The ANOVA was significant F (2, 228) = 6.96, $p = 0.00$, and post hoc comparisons using Tukey's Honestly Significant Difference revealed significant differences between reported levels of proenvironmental behavior and how people share their passion for the outdoors. Those who keep their passion to themselves are less likely to engage in proenvironmental behaviors ($M = 4.12$, $SD = 0.77$) than those who share their passion for the outdoors with the community ($M = 4.54$, $SD = 0.46$).

4. Discussion

A goal of the study was to explore the relationship between perceived Science Knowledge, Nature Relatedness and proenvironmental behaviors of individuals residing in a small university town located in the Northern Rocky Mountains. While the factor analysis clearly defined three factors, which later serves as the latent variables for the structural equation modeling, the manner in which the variables loaded in these factors is different than typically observed for nature relatedness [16]. However, five of the six original variables utilized to measure nature relatedness in the abbreviated scale did load together (Vacation, ConnectS, Notice, Relationaship, ConnectE), indicating that the original construct may still hold predictive value. The final abbreviated Nature Relatedness variable "Actions" loaded on the proenvironmental behavior construct. The Nature Relatedness Scale was originally designed to measure three distinct domains: Self, Perspective, and Experience. The variable "Actions" was a part of Self, "representing an internalized identification with nature, reflecting feelings and thoughts about one's personal connection to nature" [15] (p. 723). While Nisbet et al. [15] argue that Nature Relatedness correlates to behavioral changes, in including measures directly related to proenvironmental behavior in the survey, the structure of the Nature Relatedness abbreviated form is called into question. In this instance, while the intent of the variable "Actions" was to focus on the personal reflective thoughts on their actions and the environment, in this study, the participants seemed to focus more on how their actions impact the environment. Thus, the dimensionality of present in the original Nature Relatedness Scale may have issues with validity and/or reliability in the abbreviated form.

Another goal of the study was to explore proenvironmental behaviors through the impact of an individual's nature relatedness and perceived science knowledge. Much as suggested by Nisbet, Zelenski, and Murphy [15], there are direct links between a persons' individual connection with nature (nature relatedness), cognitive aspects such as perceived understanding of science, and proenvironmental behavior. As seen in Figure 1, the constructs being identified do support trends found in the literature showing the positive and significant predictive value of nature relatedness on proenvironmental behavior. This finding strengthens the claims made by Nisbet et al. [15] in nature relatedness being a predictor of proenvironmental behaviors, especially in light of the large and significant direct and total effects.

Results support the notion suggested by Fietkau and Kessel (as cited in [4]), that knowledge's impact on proenvironmental behaviors are mediated by affective constructs. Also as cited in [4], this study provides direct statistical support for Fliegenschnee and Schelakovsky's position that 80% of behavior is not driven by knowledge. However, the participants' high level of education (43% or more have advanced degrees) offered an opportunity to explore this phenomenon more in-depth. Within this population, there are significant total effects on proenvironmental behaviors from perceived science education (0.42, $p < 0.00$). Unlike Kollmuss and Agyeman [4], the findings of this study suggest a direct relationship between science knowledge and proenvironmental behavior. While the direct effect of 0.20 is considered small, given the importance and scope of proenvironmental behavior being explored in this study and the total effect of the construct, the relationship certainly warrants further exploration. Of note is the relationship between perceived knowledge and nature relatedness. While nature relatedness does measure some cognitive aspects of the environment-human relationship, it does not operationalize this relationship in a way that relates to education. Findings from this study do suggest the ability of education to impact nature relatedness (0.42, $p < 0.00$), thus providing evidence to promote the use of environmental education strategies in formal and informal settings.

Interestingly, the comparison between self-reported, fixed-response measures of proenvironmental behavior and the open-ended descriptions of behaviors hint at some unique conclusions. Using Stern's [3] categories, which classify behaviors based on their sphere of influence (private or public sphere), there are significant differences in quantitative measures of proenvironmental, as the participants claim to engage in more public displays of environmental activism. Like Kormos and Gifford [38], results suggest that self-reported quantitative measures of proenvironmental behavior do align with actual behaviors. However, some of the variations present in the scores in this study do appear to be related to the degree to which participants were willing to engage in public displays of environmental activism. Further research should aim to explore this link more specifically with an eye towards the relationship between modes or levels of environmental communication.

Lastly, within this geographic region, almost 25% of those surveyed said that they engaged in behaviors that would constitute them as being classified as environmental activists [3]. Even more, about a third of respondents said that they were vocal in their communities about their passion for the outdoors (environmental communication). This combination within a small geographic region, does point to a unique culture wherein people are supported in sharing their passion for the outdoors, openly engage in environmental activism and then are also engaging in proenvironmental behaviors despite variances in ages and occupations. As such, this study suggests that there are reciprocal and positive relationships between these actions that influence proenvironmental behaviors.

Additional studies examining the value of place, social norming theories, or the role of modeling may be able to better determine the impact of these behaviors and how people communicate about these behaviors to increase other individuals' engagement in proenvironmental behaviors.

5. Conclusions

There are direct links between a persons' individual connection with nature (nature relatedness), cognitive aspects such as perceived understanding of science, and proenvironmental behavior. Increasing a person's relatedness to nature is the most important predictor of proenvironmental behavior (Total effect = 0.53). Finally, as the degree to which people engage in public activism does change the likelihood of behaving in a proenvironmental manner, future research should explore how environmental communication impacts behaviors.

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