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Measuring pro-environmental orientation: Testing and building scales

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Abstract

A pro-environmental orientation is theorized to be an important predictor of public and private pro-environmental behavior. As such, measuring pro-environmental orientation is an important component in environmental psychology and politics research. In this paper, we assess two well-established scales, the New Ecological Paradigm (NEP) and the Connectedness to Nature Scale (CNS), on how well they measure the underlying construct of pro-environmental orientation. The items of these scales offer strong face validity, but mainly from a politically left tradition, which may reduce validity among political conservatives. Previous attempts at scale validation have mostly focused on predictive validity with pro-environmental behavior and have not tested how the items measure the latent construct itself. Additionally, we present a novel measure of environmental orientation using diverse moral language to avoid ideological framing: the Moral Environmentalism Scale (MES). The MES is validated here using MTurk workers ($n=448$), and a more representative sample from Survey Sampling International ($n=499$). In these validation

studies, the MES moderated the relationship between party identification and behavior while CNS and NEP did not. Item-level analyses of the MES scale using two measurement periods revealed robust item characteristics. Seen together, all three scales offer a more complete picture of pro-environmental orientation measurement validity and inform scale selection for future research. All study materials, data, and analysis code are available at https://osf.io/d4ume/?view_only=05d5cfb5a76a4f11b339290913da96f6.

Keywords: Environmentalism; conservatism; environmental attitudes; morals; politics; measurement

1. Introduction

Accurately measuring pro-environmental orientation is necessary to understand the causes of pro-environmental behaviors, which are critical to address environmental challenges like climate change (Gifford & Sussman, 2012). Meta-analyses support that, among other factors, environmental attitudes¹ are a moderate predictor of environmental behavior (Hines et al, 1987; Bamber & Moser, 2007). However, with a stronger theoretical and methodological approach, Kaiser and colleagues (1999) found that environmental attitudes are a strong predictor of behavior. Alongside attitudes or orientation, knowledge is also an important contributor to more pro-environmental behavior (Frick et al, 2004). Among all these approaches, measurement of the latent construct is paramount.

Dozens of scales and hundreds of items have been created by scholars of environmental psychology to measure environmental attitudes, or more broadly, a pro-environmental orientation (Milfont & Duckitt, 2010). Although this diversity has benefits—measures are context specific and may be tailored to address specific motivations for certain types of behavior—the lack of consistency makes it difficult to obtain cumulative, reliable findings across different studies that measure pro-environmental orientation.

There are two main problems with how pro-environmental orientation is currently measured. First, scale items are confounded with political progressivism and thus do not include items that capture pro-environmental attitudes among ideological conservatives. Second, the New Ecological Paradigm (NEP; Dunlap et al., 2000) has only been subjected to item analysis in one paper (Zhu & Lu, 2017), and the Connectedness to Nature Scale (CNS; Mayer & Frantz,

¹ The current paper uses *pro-environmental orientation* to describe what is measured by the New Ecological Paradigm (Dunlap et al, 2000), the Connectedness to Nature Scale (Mayer & Frantz, 2004), and the novel Moral Environmentalism Scale. The cited meta-analyses use *environmental attitude*.

2004) has not been subjected to item analysis, which identifies how well the items of a scale measure the latent construct the items are intended to measure. Below, we assess the NEP and the CNS, two of the most widely used scales to measure environmental orientation from the perspective of face validity and item analysis. We then present the Moral Environmentalism Scale as an alternative measure that uses diverse language and item content that can be used as a tool to demonstrate content bias in existing scales.

1.1 Progressive bias

Scholars who are dedicated to researching solutions to environmental problems are likely to be ideologically progressive. When these scholars construct an instrument to measure pro-environmental orientation, there may be a blind spot when imagining how conservatives relate to environmental issues. Indeed, many political conservatives also support pro-environmental policies (Ehret, Sparks, & Sherman, 2017) and engage in pro-environmental behaviors from recycling (DeSilver, 2016) to alternative transportation, and installing solar panels (Mildenberger, Howe, & Miljanich, 2019). Further, politically conservative groups such as fishers and hunters have long been champions of environmental conservation (Love-Nichols, 2020). We observe that existing measures, on their face, have items that appeal to progressives and may alienate conservationists on the political right. Thus, current scales may not capture enough concept breadth in pro-environmental orientation nor accurately reveal attitude-behavior relationships among conservatives.

Because of the potential bias in existing scales, we developed a novel Moral Environmentalism Scale (MES) using language from diverse moral domains. Scale construction was based on moral foundations theory, which we describe below. The MES has items that may better measure pro-environmental orientation among the total population, including

conservatives.

1.2 Lack of validation

Another concern regarding current scales of pro-environmental orientation is the lack of item-level validation. Item analysis methods, such as Rasch modeling (Rasch, 1960), can map each scale item on the continuum of pro-environmental orientation from low to high difficulty of endorsement. Rasch modeling also estimates how well the item discriminates individuals who are low and high on the construct. These analyses are critical for validating measures as they determine how well each item measures the latent construct. We are only aware of one study that reported item analysis for the NEP (Zhu & Lu, 2017) and none for the CNS.

The one study to report item level analysis of the NEP was conducted by Zhu and Lu (2017) in China. This study considered all 15 items of the NEP, translated into Chinese. First, the study authors removed several items that did not strongly load on a single environmental attitude factor. In the resulting 12 item scale, they found all but one item to have moderate to high discrimination values; however, their analysis showed that NEP may not be adequate to discern differences among individuals high on environmental attitudes. They also found many items to have similar response curves, meaning they are redundant. Further, the middle response, “neutral,” was found to provide very little information. Looking at the scale as a whole, they found measurement precision to become less reliable at higher ends of the environmental attitude continuum. Taken altogether, Zhu and Lu (2017) conclude that the issues uncovered, “may cause various errors in measuring individuals’ environmental attitudes when used in the Chinese context” (p. 88). This finding necessitates further investigation of the NEP’s measurement precision and item characteristics.

We develop a new measure and use item level analysis as tools to search for evidence of the limitations of the NEP and CNS. Once the limitations are known, then, solutions can be

developed. We are helping with that first step—identifying the problems and supporting solutions with evidence. To that end, we ask three related questions: 1) How do the NEP and CNS perform across the ideological spectrum compared to a scale developed with moral language from the ideological left and right (MES)? 2) Does the MES show convergent validity with related constructs? 3) How does the MES compare to the NEP and CNS with regards to item analysis?

Our approach follows Flake and colleagues' (2017) three phases of construct validation. First, we provide substantive validity by arguing that the NEP and CNS items best measure pro-environmental orientation among political progressives, and are unlikely to fully capture the environmental orientation held by conservatives. As an alternative, we develop the Moral Environmentalism Scale (MES) based on moral foundations theory (Graham et al., 2013). In Study 1 and 2, we provide evidence of structural validity of MES by reporting internal reliability as captured by Cronbach's alpha. Further evidence of structural validity is presented in Study 3 with results from item analysis. External validity is demonstrated with evidence of convergent validity with NEP and CNS and predictive validity in Studies 1 and 2.

2. Theoretical development and scale construction

Scales that measure environmental attitudes often include items measuring multiple psychological constructs that focus on natural ecosystems, processes, resources, and human-nature interactions such as sustainability. This conceptual breadth could mask poor construct validity and even explain partly widely observed attitude-behavior gaps in conservation. One goal of this paper is to test whether existing scales can identify pro-environmental orientation in populations such as political conservatives in the United States who may not want to identify with environmental social groups (item wording for each scale can be found below in Tables 11 to 13). For example, seeing oneself as an environmentalist appears strongly associated with pro-

environmental behavior (Brick & Lai, 2018). Our goal in this section is to provide evidence of substantive validity (Flake et al., 2017) through a critique of existing measures of pro-environmental orientation and the construction of a new scale.

The most commonly used measure of pro-environmental orientation is the New Ecological Paradigm (NEP) scale (Dunlap & Van Liere, 1978; Dunlap et al., 2000). Another prominent measure is the Connectedness to Nature Scale (CNS) (Mayer & Frantz, 2004). The CNS is designed to measure an individual's emotional connection to nature, and has more affective content than the NEP. An unresolved question is why the NEP and CNS explain relatively little variance in pro-environmental behaviors; for example Sparks et al. (2020) found the NEP with controls to explain only 12% of the variance on a range of environmental behaviors, and the CNS with the same controls to account for 35% of the variance (see also, Brick & Lewis, 2016). This is not an uncommon problem in social science, but is one that could be improved on with more attention to measurement. Potential explanations include typical attitude-behavior gaps or possible measurement problems with self-reported pro-environmental behaviors (Lange & Dewitte, 2019). We observe another potential explanation: the NEP and CNS contain language that is more consistent with liberal than conservative environmentalism, and so responses may be confounded with political ideology or partisan identification and therefore introduce noise into the measurement of pro-environmental orientation (see discussion in Brick & Lewis, 2016). Controlling for political ideology in analyses does not resolve this issue since the measure itself is not fully capturing environmental orientation among Republicans/conservatives.

Robust measures of environmental orientation should be based in theory and have solid psychometrics: that is, for a unidimensional construct, only including items that load strongly on

a single latent construct of environmentalism. The items should range in difficulty, meaning some would be easy to endorse even for an ardent anti-environmentalist (e.g., wanting clean air and water), and some would be more difficult to endorse (e.g., whether all animals should have equal legal rights to humans). In other words, a valid measure captures the floor and the ceiling of the construct it is attempting to measure. Importantly for political science and environmental psychology, an ideal scale should predict who would engage in pro-environmental behavior. We meet these criteria with our new scale, the MES, below.

It could be argued that existing measures along with controls for political ideology and morality would be sufficient to account potential bias in the measurement of pro-environmental orientation. This is reasonable, and many studies do just that. However, in this paper we are concerned with improving the measurement of the construct pro-environmental orientation. Controls in a regression may “correct” the measurement and improve performance of the regression, but they do not provide a more valid measurement of the construct itself. If an individual’s environmental orientation is not measured and therefore not in the data, no correction can overcome these absent data.

Researchers studying environmental attitudes, behaviors, and policy support may find the MES useful, particularly to identify people who may lean conservative and but also support environmental goals when framed in appealing ways. Because people who identify as Republican (in the United States) and/or conservative may sometimes veil their environmental preferences to maintain their social identity and reputation (Brick & Lai, 2018), they may be a difficult population in which to detect latent pro-environmental orientation. Thus, the MES was designed with broad moral language and item content that could appeal to individuals across the political spectrum.

2.1 Bias in existing measures

2.1.1 *The New Ecological Paradigm (NEP)*

The NEP contains 15 five-point Likert-scale items assessing perceptions of these environmental concerns: reality of limits to growth, anti-anthropocentrism, fragility of nature's balance, rejection of exceptionalism, and the possibility of an eco-crisis (Dunlap et al., 2000, p. 432).

The NEP is very widely used, but its limitations are increasingly recognized. One study applying scale analysis of the NEP based on a sample of Norwegians found that the scale is not unidimensional as is often assumed. Little support was found for the five purported sub-dimensions. Perhaps more problematically, in that sample there was little convergent validity because the NEP did not correlate with other measures of environmental concern (Grendstad, 1999). More broadly, an exhaustive meta-analysis of 69 studies in 36 countries showed instability in the measurement of the underlying construct (Hawcroft & Milfont, 2010). However, in a recent paper, Xiao and colleagues maintain that NEP is “the key source for a coherent environmental belief system” (Xiao et al., 2019, p. 54). One potential cause of these issues may be that the NEP items are abstract and concentrate on the global ecological crisis. Environmentalists may have previous exposure to these abstract topics, but most individuals may not.

Political left ideology in the contemporary United States is associated with environmentalism, as in many Western countries. Since President Nixon's embrace of environmentalism, the U.S. Republican party has moved to the right on environmental issues and pro-environmental attitudes have become aligned with progressives and the Democratic party (Karol, 2019). However, some of the apparent alignment between the NEP and liberalism might

be a methodological artifact related to the wording. For example, consider the item “Humans are severely abusing the environment;” the words ‘severely abusing’ are particularly emotive. The environment is anthropomorphized as something that can be abused. Abuse is also a keyword in the harm/care moral foundation (Graham, Haidt, & Nosek, 2009), which is one of the two hallmarks of liberal morality, although conservatives also emphasize harm/care to a lesser extent than liberals.

A second example is “Plants and animals have as much right as humans to exist.” The right to exist taps the concept of fairness, which is the other moral dimension of particular concern to liberals and to a smaller degree conservatives (Graham et al., 2009). Moreover, placing plants and non-human animals on equal footing with humans is contradictory to the notion of dominion over nature held by many conservative Christians (White, 1967). Even environmentally inclined Christians may hold on to the claim of dominion, but in terms of stewardship rather than exploitation (see Van Dyke, 1996 for this theological argument). None of the NEP items appear to tap non-liberal environmentalism.

As the NEP authors intended, endorsing the new ecological paradigm requires also rejecting the dominant social paradigm (DSP; Dunlap et al., 2000). Thus, by design, the NEP is a poor measure of environmentalism in political conservatives who might uphold the DSP while supporting business friendly policies that address environmental problems such as green technology.

2.1.2 The Connectedness to Nature Scale (CNS)

The CNS is composed of 14 Likert-scale items (Mayer & Frantz, 2004) and appears biased towards liberal environmentalism. The wording of the questions evokes stereotypical leftist environmentalists much more than the environmental conservationists on the political

right, which includes conservation organizations such as hunting groups (e.g., Ducks Unlimited 2017, with 700,000 members) or the Green Tea Coalition, not to mention those in the middle or center left on environmental issues.

Consider the CNS item, “I feel as though I belong to the Earth as equally as it belongs to me.” Belonging to the Earth may relate to a sense of community, which tends to be more important to conservatives (Nisbet, Markowitz, & Kotcher, 2012). However, belonging to the Earth could be construed more abstractly as a global community, which contradicts the ingroup loyalty represented in conservative ideology. Moreover, ‘equally’ suggests equality between the self and the rest of nature, and equality is associated with liberal/progressive ideals.

Another example is, “I often feel part of the web of life,” which suggests humanity’s place in a wider ecosystem. Feeling part of such an ecosystem suggests an emotional solidarity with the non-human world. On its face, this item sounds easier for liberal environmentalists to endorse than conservative conservationists who would view protecting nature as a way to promote the sustainability of resources.

A third CNS example is, “I feel that all inhabitants of Earth, human, and nonhuman, share a common ‘life force.’” This item suggests solidarity with non-human life. However, the words ‘life force’ may also suggest an esoteric, new-age spirituality. A political conservative might believe that humans and other living things deserve equal moral standing but not want to endorse a claim about ‘life force.’

The NEP and the CNS only modestly predict pro-environmental behaviors, perhaps in part because of confounding with ideology and morality. One study provides a comparison of how much the NEP and the CNS separately predict a wide range of self-reported pro-environmental behaviors (Brick & Lewis, 2016). The personality traits openness and

conscientiousness uniquely predicted environmental behavior. Those authors suggest that the progressive ideological wording of the NEP and CNS may be responsible for some of the unexplained variance between personality and behavior. A measure of pro-environmental orientation that is less confounded with left-leaning political ideology would help test these ideas. We present such a measure below.

2.2 Moral psychology and environmentalism

We refer to morality as “prescriptive judgments of justice, rights, and welfare pertaining to how people ought to relate to each other” (Turiel, 1983, p. 3). Moral intuitions are thought to be innate and a product of co-evolution with social norms and rules. These intuitions become the moral foundation parents use to teach their children about the proper way to behave (Graham, Haidt, & Nosek, 2009), hence the moral foundations theory. There is some evidence that liberals and conservatives are influenced by differing moral backgrounds (Graham, Haidt, & Nosek, 2009); however, more recent work argues that political ideology causes moral foundations (Smith et al., 2017; Hatem, Crabtree & Smith, 2019). There is currently a lack of experimental evidence or studies with other proper causal identification strategies to determine causal direction or to rule out confounds. Other research has shown that liberal and conservative attitudes and behaviors correlate with the moral framing of the environmental issues (Nisbet, Markowitz, & Kotcher 2012; Feinberg & Willer, 2013). For example, U.S. political conservatives are less willing than liberals to purchase an energy-efficient lightbulb when it comes with a sticker saying “Protect the Environment” (Gromet et al., 2013). This example suggests the importance of pro-environmental orientation and behavior scales being inclusive to individuals across the political spectrum.

Moral foundations can be divided into two approaches: individualizing and binding.

Individualizing morality is focused on protecting the individual, and binding morality focuses on group protection (Graham, Haidt, & Nosek, 2009) (see Table 1). Political liberals are characterized by a focus on the harm/care and fairness/cheating foundations over the other four (authority/subversion, loyalty/betrayal, sanctity/degradation, liberty/oppression). On the other hand, conservatives tend to endorse all six foundations more equally (Graham, Haidt, & Nosek, 2009). Table 1 summarizes each moral foundation, shows how they relate to the individualizing versus binding approaches, and the “concerns” of each foundation are definitional.

Table 1: Summary of moral foundations

Approach	Foundation	Concern
Individualizing	Harm/care	Caring for and protecting others
	Fairness/cheating	Justice and altruism
Binding	Authority/subversion	Deference to authority and respect for tradition
	Loyalty/betrayal	Loyalty to group at local and national level
	Sanctity/degradation	Purity and lack of degradation
	Liberty/oppression	Personal freedoms

Note. Based on Graham et al., 2009; Nisbet et al., 2012.

Liberty was proposed as an additional sixth primary moral foundation (Iyer et al., 2012). The liberty foundation helps explain the moral intuitions of political libertarians who are economically conservative but socially progressive. For example, in the United States libertarians do not fall neatly along the traditional left-right political spectrum, and their moral foundations are less understood. One cluster analysis revealed that libertarians have a unique

moral framework because they value individual freedom above other moral concerns (Iyer et al., 2012).

Liberals tend to frame environmental appeals in terms of the harm/care, fairness/cheating, and to a lesser extent, the liberty/oppression foundations. This language appeals to other liberals but fails to convince conservatives of the urgency needed for action. Al Gore's documentary "An Inconvenient Truth" is a prime example (Nisbet et al., 2012) that focuses on the destructive forces of a warming planet. The content appears to focus on the liberal concern for the harm/care moral foundation. In contrast, political conservatism is more associated with sanctity and concern for duty (Graham et al., 2009).

Alternatively, one could use conservative moral frames such as the threat to farms and local communities. When framing environmental issues in terms of purity/sanctity there is little difference between liberal and conservative attitude endorsement (Feinberg & Willer, 2013). We designed the MES to minimize these framing effects by including all six of the moral foundations including those endorsed by political conservatives. As a result, the MES may reduce political bias in responding and therefore more accurately measure pro-environmental orientation across the political spectrum. This reduction in bias can theoretically be achieved by including moral framing and item content that appeals to people across party affiliations and ideologies. In a sense, the MES aims to offer something for everyone who has a pro-environmental orientation, not just liberal environmentalists.

2.3 MES scale construction

With the concerns of the NEP and CNS in mind, we start with a conceptual definition of moral environmentalism and operationalize it through an iterative process of scale development. Our conceptual definition of moral environmentalism is that environmentalism can be thought of

in moral terms and the construct of a pro-environmental orientation thus has a moral dimension. We use the moral foundation theory six-dimensional framework and research showing that liberals and conservatives use different moral language to talk about the environment and think of moral environmentalism as a continuous construct.

We developed a battery of moral environmental orientation items that vary in difficulty. Difficulty here reflects how relatively easy or hard it would be for people with different levels of moral environmental orientation to agree with an item (e.g., it is harder, or requires greater levels of moral environmentalism, to agree with never eating meat than recycling). We followed Wilson's (2004) guidance of concept mapping, where each item can be placed within a concept space that ranged from low to high in the underlying concept. Practically, this means that items with varying difficulty capture more of the concept space for each moral foundation. On each of the six dimensions we wrote items that varied in difficulty for a typical respondent to endorse. In this type of construct mapping (Wilson, 2004), multiple items tap into the same underlying construct. All item responses are on a five-point Likert scale, allowing for additional variation in how strongly the respondent endorsed the item.

We repeated this process for each of the six moral foundations using the moral language dictionary (Graham & Haidt, accessed ca. September 2015). Each item included one of the key words for that dimension and avoided using terms from any of the other foundations. To improve these items and incorporate insights outside the authors, we went through several iterations of this process with students and in consultation with colleagues with relevant expertise. We used exploratory factor analysis to find poorly fitting items. These items were either dropped or reworded. The final instrument contains 27 items.

3. Method: Study 1: MTurk Data

Pilot studies showed strong internal properties and expected relationships with existing environmental orientation scales; we do not report these here as they would be redundant and employed smaller samples. The next step in the scale development process tested for convergent validity. The purpose of Study 1 is to demonstrate the convergent validity of the MES. The NEP is also correlated with the behavioral outcome to support the claim of a positive relationship, as has been found in prior research.

3.1 Data and participants

We used Amazon Mechanical Turk (MTurk) to recruit 448 participants based on funding availability; they were randomly divided into two groups. Half the participants only answered the MES items, and the other half only answered the NEP items. The CNS was left out to reduce cost and because the NEP provides a better comparison given the higher correlation found between the NEP and MES in the pilot studies. IRB approval was granted by the University of California, Santa Barbara Human Subjects Committee on February 19, 2016, submission id: 16-0130.

3.2 Measures

Study 1 used two dependent variables. First, a single-item self-reported measure of pro-environmental behavior, which asked, “How often do you engage in pro-environmental behaviors such as recycling, conserving energy or water, or avoiding car use?” on a five-point scale from 1=*never* to 5=*always*, $M(SD)=3.56 (0.86)$. The second dependent variable was an observed behavior of clicking or not on an internet link. For the link, participants were shown a message “Additional ways to help the environment (opens new window).” The generic text may sound enticing even to people who already think they privately act in a pro-environmental way.

Twenty-seven percent of respondents clicked on the link.

MTurk workers who completed a pilot study were excluded from this sample. MTurk workers are more representative of the U.S. population than student samples, but not completely aligned: for example, they are more educated and more skilled with computers (Berinsky et al., 2012). Because MTurk workers can be low-quality respondents, proper screening is necessary (Goodman et al., 2012). We employed several techniques to reduce potential bias and noise. First, we recorded how long each respondent took to complete the survey. There were no meaningful differences in the main outcomes between fast and slow survey-takers. Second, we used an open-response attention item. Only 1.5% of the sample failed the test. Because those that failed also completed all the items and responded to short written answer items included as additional attention checks, they were kept in the sample (this decision was made prior to hypothesis testing). Third, we reverse-coded half of the MES items to prevent any systematic bias toward one side of the screen.

Key demographics were measured to describe the sample and provide control variables in regression (many studies have shown the link between these covariates and different measures of environmental support, for example see Van Liere & Dunlap, 1982; Guber, 2003). To measure education we asked, “What is your highest level of education?” with six response categories from “some high school or less” to “Master’s Degree or higher.” To measure income we used a six-response category (“\$25,000 or less” to “\$165,001 or more”) item that asked, “What is the total income in your household?” Party identification was measured using a branched (two-part) question beginning with: “Generally speaking, do you think of yourself as a Democrat, a Republican, an Independent, or what?” For respondents who answered Democrat or Republican, we asked how strongly they associated with that group, and for those who did not choose either

of the two major parties we asked: “Are your political beliefs closer to the Democrats or the Republicans?” See Table S1 in the supplement for descriptive statistics.

4. Results

4.1 Predictive validity

Summary statistics for the key variables are presented in Table S2 in the supplement. Respondents were randomly assigned to either the MES or the NEP to reduce fatigue. The subsamples were well-balanced in terms of demographics, with one notable difference that the NEP sample was 8% more Republican than the MES sample (35% vs. 43%; see supplement for descriptive statistics of each subsample). The split sample makes it impossible to look at correlations between orientation scales. The two scales were similarly endorsed, MES $M(SD) = 4.11(0.56)$, NEP $M(SD) = 3.96(0.95)$, both on a five-point scale. Both the MES and NEP were internally consistent with Cronbach’s alphas = .94 and .93, respectively. Internal consistency is evidence of structural validity (Flake et al., 2017). Many studies would report results from factor analysis here; however, we used Rasch models instead and present those results in full in Study 3.

Results from OLS regression analysis on the single-item measure of self-reported pro-environmental behavior are presented in Table 2. The goal of this analysis was to demonstrate the predictive validity (Flake et al, 2017) of the MES by showing it predicts behavior. As expected, both the MES and NEP positively predicted environmental behavior.

Table 2: MES, NEP, and control variables predict single-item self-reported environmental behavior in linear regression

	Model 1			Model 2		
	<i>b</i>	<i>se</i>	Partial ω^2	<i>b</i>	<i>se</i>	Partial ω^2
MES	0.41***	0.10	.09			
NEP				0.29***	0.07	.10
Republican	-0.12*	0.15	-.01	0.05	0.17	.00
Age	0.02***	0.01	.09	0.01	0.01	.02
Education	0.08	0.05	.01	0.10	0.06	.01
Women	-0.07	0.12	.00	0.09	0.12	.00
Observations	185			193		
Adjusted R^2	.16			.11		

Note: Unstandardized OLS regression coefficients. * $p < .05$, *** $p < .001$

Table 3: Interaction effect of Republican party identification with MES and NEP on single-item self-reported environmental behavior in linear regression

	Model 1		Model 2	
	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>
MES	0.27*	0.11		
NEP			0.34*	0.08
Republican	-2.43*	0.93	0.71	0.58
MES*Republican	0.60*	0.23		
NEP*Republican			-0.20	0.13
Observations	223		224	
Adjusted R^2	.09		.07	

Note: Unstandardized OLS regression coefficient. * $p < .05$

To compare the strength of MES and the NEP on environmental behavior, we use partial omega squared values to compare effect sizes. The NEP might have a slightly larger effect ($\omega^2 = .095$) than the MES ($\omega^2 = .086$). In other words, the NEP explains about 1% more of the variance in the single-item, self-reported behavior measure than the MES. Because this is a split sample, the effect size comparisons cannot be directly compared and fully interpreted as if it was the same sample. Additional regression models examined the observed behavior of clicking on the

link to learn more about environmental behaviors. Neither the MES nor the NEP predicted the link-clicking behavior and the main results did not differ using logistic regression ($ps > .10$).

To test whether the MES uniquely predicted environmental behavior among Republicans, we separately multiplied each of the MES and the NEP with a dummy variable of partisan identification as Republican to see the impact of increasing pro-environmental orientation among Republicans on environmental behavior. Too many independents left the branching item blank so we could not determine their lean. As such we used the single-item measure of party identification and coded it into a dummy variable (Republican = 1, not Republican = 0). We also tested this for Democrats, and found no significant interaction effect (see supplement Table S3).

Results are in Table 3, and Figures 1 and 2 display the interaction plots. In Figure 1, we observed as MES increases, there was a stronger effect (steeper slope) for Republicans than non-Republicans on self-reported environmental behavior. The NEP did not uniquely predict Republican environmental behavior ($b=-0.20$, $p=.13$; Figure 2). That is, the effect of NEP on behavior is the same for Republicans and non-Republicans.

Figure 1 *Interaction plot of MES and Republican on environmental behavior.* The minimum MES score was 2.20. Model did not include other covariates.

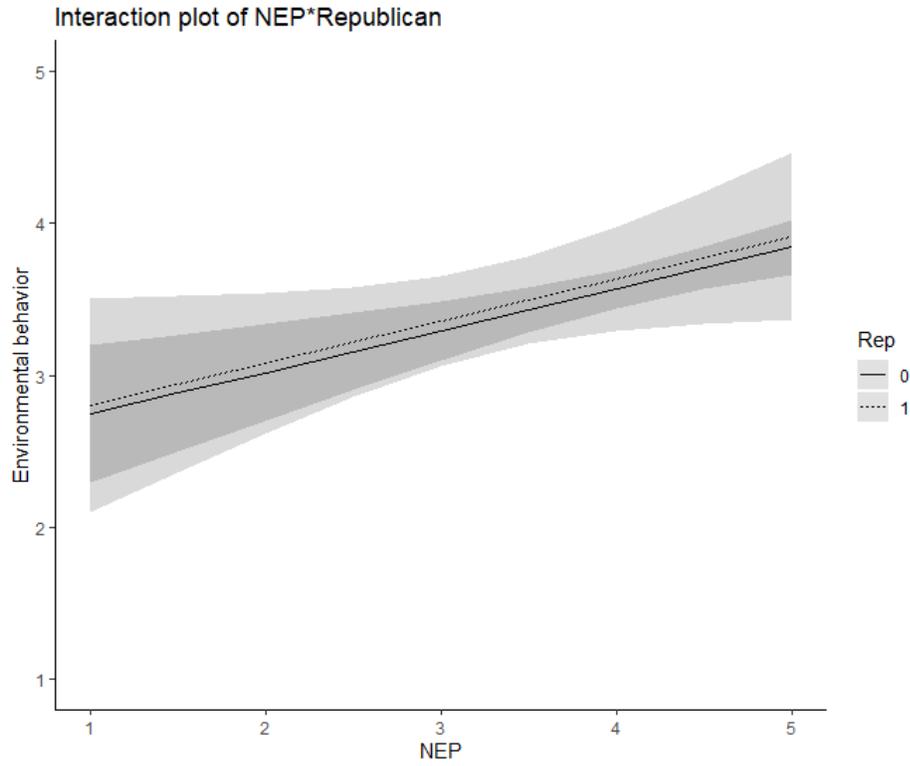


Figure 2 Interaction plot of NEP and Republican on environmental behavior

4. Discussion

The results from Study 1 support the convergent validity of the MES. Further, the MES uniquely predicted environmental behavior among Republicans and the NEP did not (non-significant interaction term, Table 3). Items using conservative moral language appeared to capture useful variance in pro-environmental orientation among Republicans that existing scales may not be able to access.

The NEP was equal or slightly stronger in predicting environmental behavior than the MES in this split sample. There are several potential explanations for this finding. First, the NEP items are more focused on beliefs and attitudes, which may be more linked to pro-environmental behavior than morals. Second, the finding may be due to these particular pro-environmental behavior measures, which are not representative of all pro-environmental behavior (Lange & Dewitte, 2019).

5. Methods: Study 2: SSI Data

The primary goal of Study 2 was to show further evidence of structural and predictive validity with a larger, more representative sample of potentially higher quality than MTurk. The MES items in Study 2 were identical to Study 1.

5.1 Data and participants

We contracted with Survey Sampling International (SSI) to poll 1,000 U.S. adults in July 2017. Sample size was determined by cost and funding availability. The survey instrument was approved by the University of California, Santa Barbara Human Subjects Committee on April 3, 2017, protocol number 37-17-0256. We were invited to submit the MES as a module as part of a larger study, thus half of the sample was randomized to complete the MES ($n=499$) and every respondent completed the NEP and CNS. Like other internet surveys, this sample is not fully

representative of the U.S. population (Berrens et al., 2003; Malhotra & Krosnick, 2007).

However, this sample was broadly reflective of the population: 51% women, 67% White, and age $M(SD) = 43.8(17.01)$. The median person in our sample attended some college and reported a household income between \$130,001-\$165,000. This sample leaned slightly liberal (3.84 on a 1-7 scale from liberal to conservative) and 58% identified as Democrats and Democratic leaners, with the other 42% identifying as Republicans and Republican leaners. This pattern is more representative of the U.S. population on ideology and provides a better context to validate the MES than the MTurk sample in Study 1. The descriptive statistics of the sample are presented in Table 4 along with a comparison to the U.S. population.

Table 4. *Study 2 sample demographics compared to the U.S. population*

	Sample			U.S.
<i>N=499</i>	<i>M</i>	<i>SD</i>	%	
Education (6 categories)	3.73 (Some college)	1.44		Some college
Household income (6 categories)	4.60 (\$95,000- \$130,000)	2.60		\$56,000
Democrats			58%	46%
Women			51%	51%
White			67%	61%
Age	44	17.01		38
Urban (3-point scale)	2.04 (Suburban)	0.7		53% Suburban
Ideology (Lib-Con)	3.84 (Moderate)	1.62		5 (Slightly conservative)

Note. Sources of U.S. data: Party and ideology are from the 2016 American National Election Studies. All other data are from U.S. Census 2016 estimates. Lib-Con = Liberal-Conservative.

5.2 Measures

All respondents completed the battery of NEP, CNS, and environmental behavior items and half completed the MES. The sets of questions were asked in random order. MES had high internal reliability with a Cronbach's alpha of .92. Cronbach's alpha for the NEP was .82 and .78 for the CNS.

The dependent variable used in regression analyses was the 2000 Gallup Earth Day Poll, a 13-item battery including public and private pro-environmental behaviors measured as yes=1 or no=0 (see items in supplement Table S9). We created an index by summing the responses with public and private subscales and also a composite. All three versions of the measure were acceptably reliable with Cronbach's alphas $\geq .70$.

6. Results

11.1 Convergent and predictive validity

Convergent validity was assessed through the zero-order correlations between the MES, CNS, and NEP. Predictive validity was assessed by examining how predictive they were of pro-environmental behavior in regression. The MES correlated strongly with the NEP, $r(497) = .70$, $p < .001$, and with the CNS, $r(497) = .55$, $p < .001$. CNS and NEP correlated moderately, $r(998) = .46$, $p < .001$. This overlap suggests that all three scales tapped into shared aspects of pro-environmental orientation. MES moderately correlated with pro-environmental behavior frequency, $r(497) = .40$, $p < .001$. The NEP had a weaker correlation with behavior $r(998) = .26$, $p < .001$. The CNS had the strongest correlation with behavior at $r(998) = .46$, $p < .001$. In summary, these correlations suggest the MES has good convergent validity.

To further assess predictive validity, we test the predictive ability of the MES in a regression framework (see Table 5). There are three models for each one each for the composite scale, public behaviors, and private behaviors. We also included several control variables to account for party identification, income, education, ideology, gender, and age which are known covariates of pro-environmental behavior (Van Liere & Dunlap, 1982; Guber, 2003). These controls were measured using the same language that we provided in Study 1. Simple correlations between the covariates, main predictor variables, and the dependent variables can be

found supplement Table S5.

Table 5: Relationship between MES and pro-environmental behavior

	Model 1 (composite)	Model 2 (private)	Model 3 (public)
MES	1.73 (0.23)** {.16}	1.28 (0.13)** {.21}	0.46 (0.16)* {.05}
Income	0.03 (0.05) {-.00}	0.05 (0.03) {.01}	-0.02 (0.04) {.00}
Republican (1 = Republican, 0 = non- Republican)	0.06 (0.29) {.01}	-0.08 (0.03) {.00}	0.14 (0.19) {.02}
Age	-0.01 (0.01) {.01}	0.00 (0.00) {.00}	-0.02 (0.01)* {.02}
Woman (1 = woman, 0 = not woman)	0.18 (0.25) {.00}	0.17(0.14) {.00}	-0.01 (0.16) {.00}
Liberal-Conservative self- placement (1-7)	-0.31 (0.09)** {.02}	-0.06 (0.05) {.00}	-0.25 (0.06)** {.03}
Education	0.12 (0.10) {.00}	0.02 (0.05) {.00}	0.09 (0.06) {.00}
Observations	499	499	499
Adjusted R^2	.19	.21	.12

Note: OLS regression coefficients. Standard errors in parentheses. Effect size (partial omega squared) in brackets. * $p < .05$; ** $p < .01$; Lib-Con = Liberal-Conservative.

Across all three models, the MES predicted pro-environmental behavior while controlling for income, party identification, age, gender, education, and ideology. The R^2 and regression coefficients suggest that the MES was better at explaining private ($\omega^2 = .21$) than public environmental behavior ($\omega^2 = .05$). Table 6 shows the MES, CNS, and NEP in a single regression predicting the composite behavior scale. The scaled coefficients are visualized in Figure 4.

Table 6: Relationship between MES, NEP, and CNS and composite environmental behavior

	<i>b</i>	<i>se</i>	Scaled coefficient	<i>se</i>	ω^2
MES	1.22**	0.31	1.41***	0.35	.18
NEP	-0.67*	0.26	-0.88**	0.33	.00
CNS	1.86 **	0.26	2.00***	0.28	.09
Income	0.03	0.05	0.16	0.26	.00
Republican (1 = Republican, 0 = non- Republican)	-0.29	0.28	0.31	0.28	.02
Age	-0.01	0.01	-0.36	0.24	.01
Woman (1 = woman, 0 = non-woman)	0.07	0.24	0.07	0.24	.00
Liberal- Conservative self- placement (1-7)	-0.28*	0.09	-0.91**	0.28	.02
Education	0.13	0.09	0.38	0.27	.00
Observations	499		499		
Adjusted R^2	.27		.28		

Note: * $p < .05$; ** $p < .01$; *** $p < .001$; Lib-Con = Liberal-Conservative.

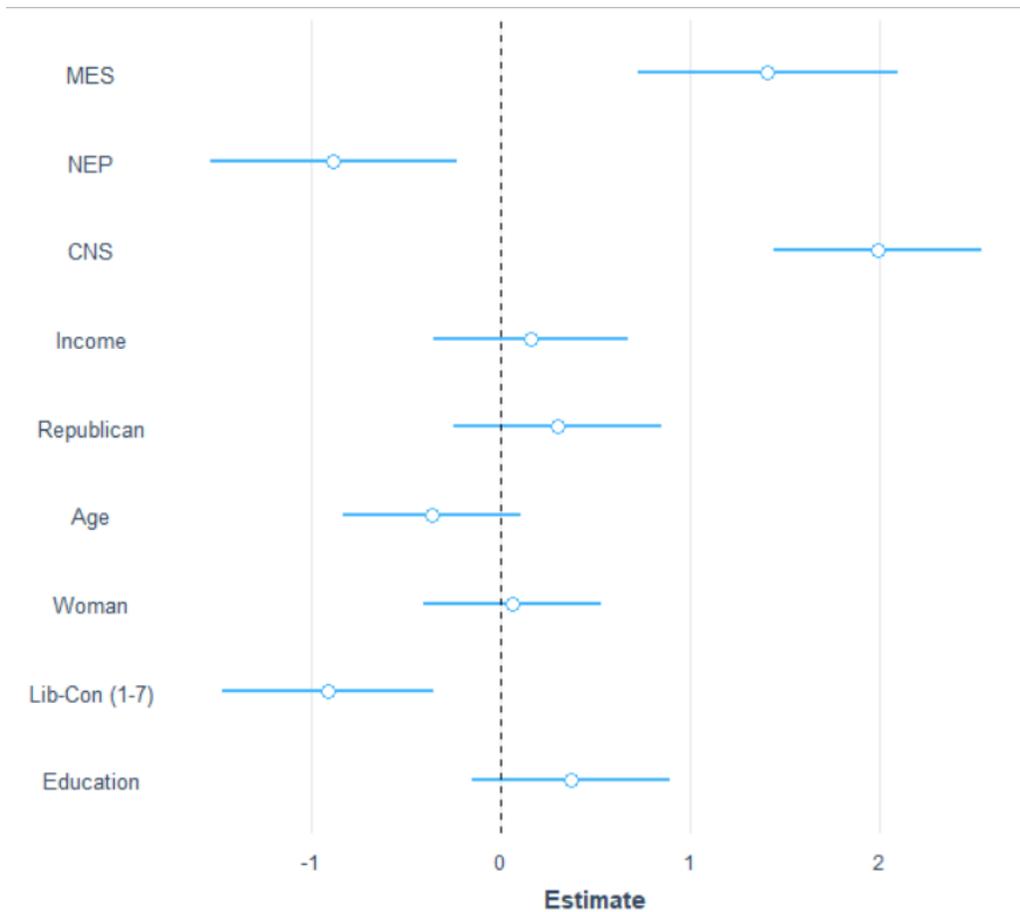


Figure 4: Scaled OLS coefficients (mean centered on 0 and divided by 2 standard deviations) on composite environmental behavior, all covariates shown.

Placing the MES, NEP, and CNS in the same regression model revealed how well the MES predicted behavior while holding the other constructs constant. High MES and CNS continued to predict more environmental behaviors, but higher NEP values predicted fewer behaviors (in unique variance explained by NEP after combination with the other measures). We tested for multicollinearity by determining variance inflation factors, all were low with the MES with highest (VIF = 2.26), meaning multicollinearity is not likely to present an estimation problem. We used scaled coefficients. Scaled coefficients were calculated by mean centering the continuous predictors and dividing by two standard deviations. This allows the coefficients of the

continuous predictors to be directly compared to the non-transformed binary variables in the regression (See Gelman [2008] for a complete argument as to why this should be the default for this kind of analysis). The CNS had a larger effect on behavior than the MES ($b=2.00$ and $b=1.41$) and both were clearly favorable to the NEP ($b=-0.88$). Another way to compare effect sizes is with partial omega squared values that determine the variance in the dependent variable while partialing out the effects of the other independent variables. The MES explained 18% of the variance in behavior while the CNS explained 9%. The NEP had no unique effect.

In Study 2, we also explored the interaction between the environmental scales and Republican identifiers (Table 7). We expected to replicate the Study 1 interaction between the MES and Republican identifiers because the SSI sample is more representative and is more ideologically moderate.

Table 7: Regressing MES, NEP, and CNS on composite environmental behavior with interaction effect with Republican party identification

	MES model		CNS model		NEP model	
	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>
MES	1.21***	0.34				
NEP			0.71**	0.22		
CNS					2.40***	0.21
Income	0.03	0.05	0.10*	0.04	0.10**	0.04
Republican (1 = Republican, 0 = non-Republican)	-3.91*	1.83	-1.20	1.08	0.17	1.12
Age	-0.01	0.01	-0.01*	0.01	-0.01*	0.01
Woman (1 = woman, 0 = non-woman)	0.17	0.25	0.16	0.19	0.01	0.17
Liberal-Conservative self-placement (1-7)	-0.32***	0.09	-0.36***	0.28	-0.27***	0.06
Education	0.12	0.10	0.13	0.07	.13	0.06
MES*Republican	0.98*	0.46				
NEP*Republican			0.34	0.31		
CNS*Republican					-0.08	0.31
Observations	499		1000		1000	
Adjusted R^2	.19		.12		.25	

Note: * $p < .05$; ** $p < .01$; *** $p < .001$; Lib-Con = Liberal-Conservative.

Only the MES and Republican interaction term was significant and positive ($b=.98$; $p=.03$). Among Republicans, higher MES predicted higher levels of environmental behavior. The estimated marginal mean for the composite behavior variable for Republicans one standard deviation below the mean level of MES was 4.34 (95% confidence interval: 3.89-4.80) and the estimated marginal mean for Republicans one standard deviation above the mean level of MES was 6.80 (95% confidence interval: 6.20-7.40). The non-overlapping confidence intervals indicated statistical significance. The interaction plots are in Figures 5 (MES), 6 (NEP), and 7 (CNS) which shows that MES was a stronger predictor of environmental behaviors among Republicans (i.e., steeper slope) than among non-Republicans. As the interaction plots show for NEP and CNS, predicted environmental behaviors increase similarly for Republicans and non-Republicans as NEP and CNS increase respectively. The CNS model explained a greater portion of the variance in behavior based on R^2 values (.19 vs. .25), but this could be partially due to smaller standard errors as a result of the larger sample size within this study.

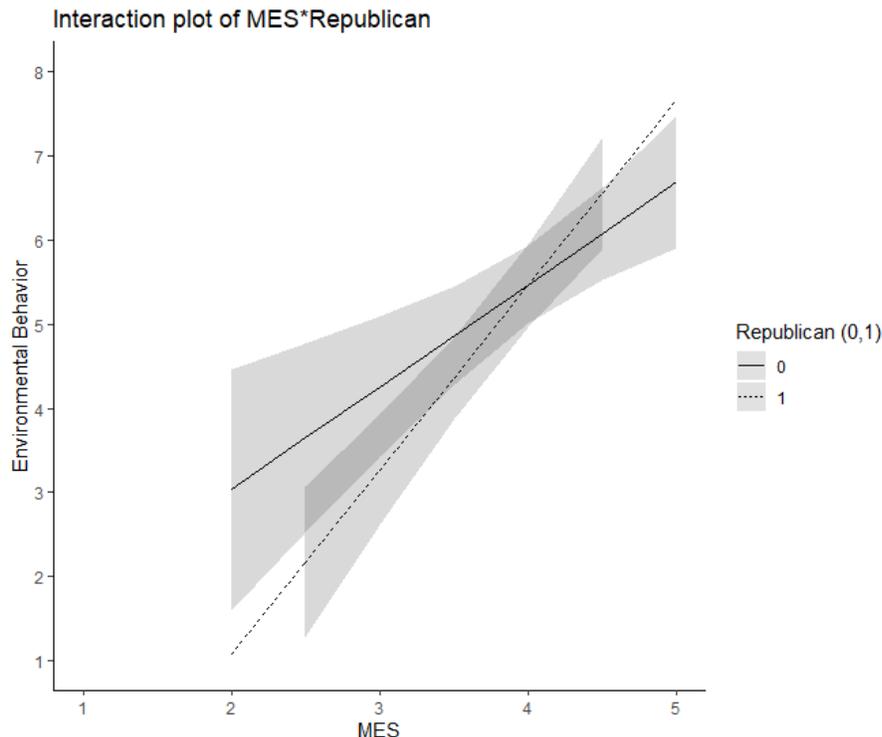


Figure 4 *Interaction plot of MES and Republican on environmental behavior including covariates. The minimum MES score was 2.00.*

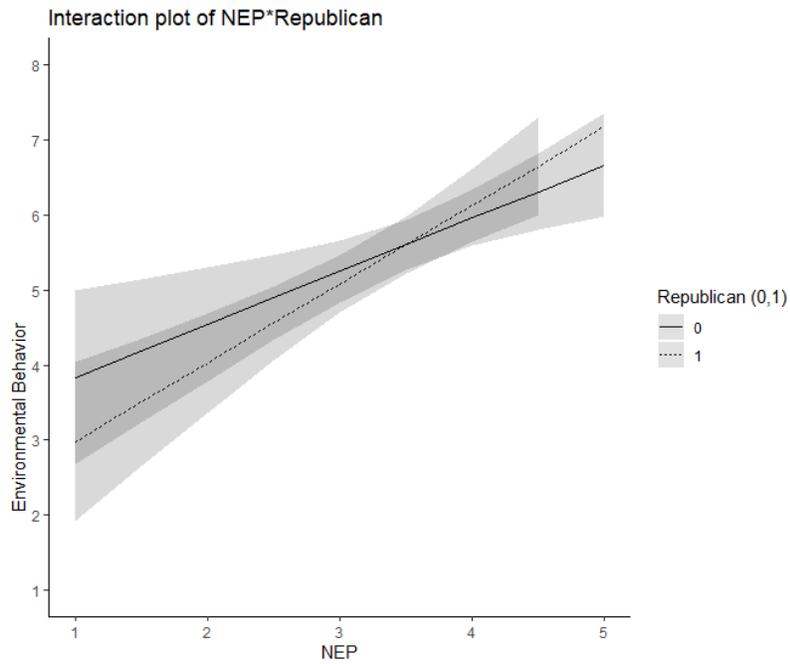


Figure 5 *Interaction plot of NEP and Republican on environmental behavior including covariates.*

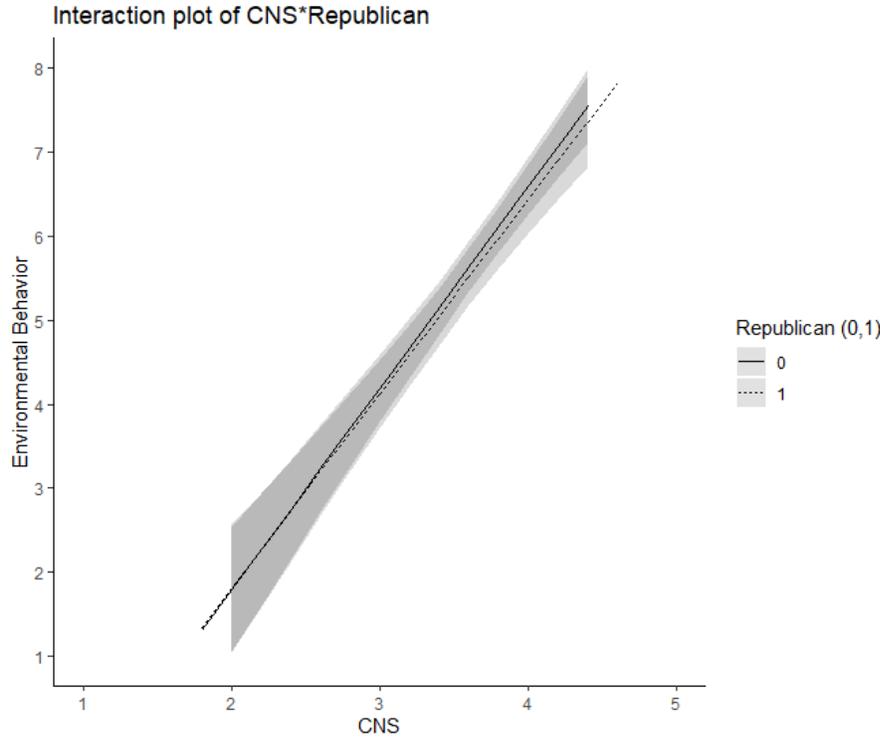


Figure 6 Interaction plot of CNS and Republican on environmental behavior including covariates.

To further examine the interaction between MES among Republicans we also used the private and public behavior subscales as dependent variables. We expected the moderation effect to be stronger for private behaviors, given that social identities can reduce public environmental behavior (Brick, Sherman, & Kim 2017). These results are presented in Table 8.

Table 8: MES explains public but not private environmental behavior in Republicans

	Public behavior		Private behavior	
	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>
MES	1.04***	0.17	0.28	0.22
MES*Republican	0.51*	0.24	0.34	0.27
Income	0.05*	0.03	-0.02	0.04
Republican (0,1)	-1.91*	0.94	-1.47	1.21
Age	0.01	0.004	-0.01**	0.005
Woman (0,1)	0.23	0.24	0.01	0.17
Lib-Con (1-7)	-0.05	0.05	-0.25***	0.06
Education	0.02	0.05	0.10	0.06
Observations	499		499	
Adjusted <i>R</i> ²	.24		.12	

Note: * $p < .05$; ** $p < .01$; *** $p < .001$; Lib-Con = Liberal-Conservative.

Overall, Republicans report doing fewer environmental behaviors. Republicans high on MES performed more public behaviors, however this result was just short of statistical significance. The estimated marginal mean of public environmental behaviors for Republicans one standard deviation below the mean level of MES was 1.39 (95% CI: 1.08-1.69). The estimated marginal mean for Republicans one standard deviation above the mean level of MES was 2.08 (95% CI: 1.68-2.48). In the model of private behavior, neither MES, nor the MES-Republican coefficients were significant. Contrast this with Table 7, the same model of private behavior without the interaction included, which showed a main effect of MES ($b=0.46$, $p < .05$). The effect of the interaction seems strong enough to cancel out some of the effect of MES alone, even though neither are large enough to rise above the threshold of significance.

7. Discussion

Overall, the construct validity of the MES was demonstrated by it predicting pro-environmental behavior comparably with the NEP and CNS. This result shows that the MES overlaps with existing and well-cited measures of pro-environmental orientation. In particular, we observed an interaction between MES and Republican party identification in both Study 1 and 2. The interaction was significant for public, but not private behaviors. One interpretation for this discrepancy could be that more environmentally friendly Republicans are pressured by their partisan identity, which may motivate less environmentally friendly behavior. Brick, Sherman, and Kim (2017) showed that visibility reduces pro-environmental behavior. Using this lens, the current results suggest that Republicans, whether high or low on MES, engage in similar levels of private environmental behavior, but only those high on MES are sufficiently motivated for visible pro-environmental action.

The NEP and CNS did not moderate behavior among Republicans. However, this interaction test was likely underpowered. Between-subjects moderation designs, particularly with spreading (rather than cross-over) effects, require as much as 8-16 times the sample size for the same power to detect a main effect of the same size (Gelman, 2018; Giner-Sorolla, 2018). Therefore, this null finding for moderation is not a robust finding and further interpretation would need testing in a larger sample.

It is also worth noting the stronger performance of the CNS over the NEP in predicting pro-environmental behaviors. Although both scales are moderately correlated with one another, these results indicate that an emotional connection to nature may be more important for encouraging environmental behavior than accepting an ecological paradigm based on beliefs.

The main takeaway of Study 2 is the convergent and predictive validity of the MES. While the CNS more strongly predicted behavior demonstrated by its scaled coefficient, the partial omega squared value of MES indicated that it explained more of the variance in behavior than the CNS or NEP.

8. Methods: Study 3: Item-level analyses of combined samples

8.1 Data and analytical plan

It remained unknown how well the data from individual items of each of the scales measured the proposed latent construct of environmental attitudes (Wilson, 2003). To further examine the MES, NEP, and CNS scales, a series of Rasch models were conducted (Rasch, 1960). Rasch models are a form of item analysis, which provide evidence of structural validity (Flake et al., 2017). Specifically, rating scale models were used (Andrich, 2016); this extension of the traditional Rasch model allows an examination of multiple, ordered response options and assumes that all response categories are equally spaced (e.g., the difference between “strongly agree” and “agree” is the same as between “neither agree nor disagree” and “agree”), the same assumption that is nearly always used to treat ordinal Likert response scales as continuous (Borgatta & Bohrnstedt, 1980). This modeling assigns a difficulty score to each item that reflects how much more of a latent construct an individual must have to endorse a given response option. This allows for a more thorough investigation of how well different items that comprise an environmental scale map to those low, medium, and high in environmental orientation, which directly relates to how well the scale measures the entire breadth of the construct. The modeling also estimates respondents’ level of the latent trait (e.g., high or low environmental orientation) and how each scale response option relates to increasing levels of the latent trait being measured (e.g., each increase in agreement relates to an increase of environmental orientation). An additional advantage to Rasch modeling is that the analyses are not dependent on the sample (analyses are assumed to be population invariant), as long as the same latent construct is being measured (Reeve, 2002); thus, we combine the samples from Study 1 and Study 2 to fully leverage the available data on the MES (combined $n=614$). First, item-level statistics are

presented for the MES, NEP, and CNS. Next, Wright maps are provided to compare the item difficulties between the three scales.

9. Results

Overall, each of the MES items performs adequately. Table 9 presents the item difficulty and item fit statistics for the final MES items, using data from both Study 1 and Study 2. The item difficulty estimate determines where a particular item best discriminates between different levels of the construct being measured. For example, a relatively higher item difficulty means that a respondent requires a higher level of the latent construct to endorse higher response options for that item. This also means that a “strongly agree” response on any two items is not equivalent in difficulty. If one item has an overall higher item difficulty, a “strongly agree” response corresponds to higher levels of the latent trait compared to a “strongly agree” response on an item with a relatively lower item difficulty. Thus, the items difficulties are the critical parameters of the Rasch model as they describe how “hard” or “easy” an item is to endorse, and thus how well all the items of a scale together measure a given latent construct. The item fit statistics are a tool for investigating how well responses correspond with the expectations of the model (i.e., do the data match the Rasch measurement model). Reasonable infit and outfit values were calculated to be between 0.89 and 1.11²; mean square (MNSQ) values above 1 indicate underfit (i.e., item does not discriminate well) and MNSQ values below 1 indicate overfit (i.e., item discriminates better than expected) (Wright & Linacre, 1994). MNSQ values lower than 1.00 indicate that the item responses are too predictable and that the data overfit the model. However, they will not adversely affect measurement evaluation. MNSQ values above 1.00 can distort the measurement evaluation. Cut-offs are somewhat arbitrary and depend on the

² The item-fit range was based on the formula provided by Wu and Adams (2013): $1 \pm 2\sqrt{\frac{2}{N}}$

importance of classification, which is for example higher for professional certification tests.

Being moderately strict, there are eight items that show minor overfit, with item 17 exhibiting the worst fit. Item step parameters for all three scales are presented in the supplement.

Table 9. Rasch model MES item fit and parameter estimates for Study 1 and 2 combined

Item	Item difficulty	Item fit	
		Infit MNSQ	Outfit MNSQ
1. Humans have an overall positive effect on the natural environment. (r)	.91	2.35	1.81
2. Unregulated economic growth harms that natural environment.	.51	1.42	1.20
3. The natural environment is being harmed by humans.	.004	1.17	1.06
4. Untouched natural areas should be preserved.	-.24	0.99	0.94
5. We should keep the natural environment clean for future generations.	-.63	0.93	1.00
6. Humans should be more tolerant of the rights of other animals and plants.	-.04	0.89	0.88
7. Protecting the earth protects our children.	-.57	0.81	0.92
8. Protecting the environment does not benefit my community. (r)	-.01	1.38	1.36
9. It is patriotic to consider the environment in our decisions.	.22	1.06	0.94
10. The United States should not reduce pollution when other nations aren't helping. (r)	.16	1.76	1.49
11. United States parks and green spaces are national treasures.	-.56	1.12	1.07
12. It is patriotic to preserve natural resources.	-.13	0.89	0.88
13. It is our duty to protect the earth.	-.62	0.68	0.79
14. Respecting the earth means not polluting.	-.49	0.72	0.79
15. Dominion over the earth means we should protect nature.	-.16	0.97	0.81
16. Reducing our use of fossil fuels will make the United States more independent.	.23	1.33	1.07
17. It should be our tradition to conserve natural resources.	-.24	0.68	0.66
18. Nature is sacred.	-.27	0.99	1.00
19. The purity of nature is threatened by human activities.	-.21	0.75	0.81
20. Nature should be kept wild and free from human encroachment.	.43	1.20	0.97
21. Pollution is gross.	-.70	0.95	1.01
22. People do not benefit from a pristine natural environment. (r)	.14	1.60	1.50
23. Protecting the earth does not protect my freedom. (r)	.69	1.19	1.12
24. Being in nature makes me feel free.	-.17	1.11	1.01
25. Having wild places increases our liberty.	.37	1.15	1.00
26. Private land owners should be forced to stop development that threatens an endangered species.	.49	1.17	1.08
27. Our personal freedoms are more important than environmental protection. (r)	.91	1.18	1.07

Note. Items noted with (r) are reverse scored.

The same Rasch modeling approach was applied to the NEP and CNS data collected in Study 2. First, the CNS items were modeled. Reasonable infit and outfit values were calculated to be between 0.91 and 1.09. Eight items exhibited overfit, and item 11 is had the worst overfit.

Table 10. *CNS item fit and parameter estimates for Study 1 and 2 combined*

Item	Item difficulty	Item fit	
		Infit MNSQ	Outfit MNSQ
1. I often feel a sense of oneness with the natural world around me.	-0.02	0.92	0.88
2. I think of the natural world as a community to which I belong	0.30	0.72	0.71
3. I recognize and appreciate the intelligence of other living organisms.	0.83	0.72	0.73
4. I often feel disconnected from nature. (r)	-0.13	1.29	1.23
5. When I think of my life, I imagine myself to be part of a larger cyclical process of living.	0.10	0.97	0.94
6. I often feel a kinship with animals and plants.	0.18	0.94	0.96
7. I feel as though I belong to the Earth as equally as it belongs to me.	0.21	0.84	0.84
8. I have a deep understanding of how my actions affect the natural world.	0.32	0.82	0.81
9. I often feel part of the web of life.	0.05	0.80	0.78
10. I feel that all inhabitants of Earth, human, and nonhuman, share a common 'life force'.	0.21	0.88	0.87
11. Like a tree can be part of a forest, I feel embedded within the broader natural world.	0.06	0.75	0.75
12. When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature. (r)	-1.08	1.87	1.69
13. I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees.	-0.26	1.27	1.24
14. My personal welfare is independent of the welfare of the natural world. (r)	-0.76	1.74	1.60

Note. Items noted with (r) are reverse scored.

Next, the NEP items were modeled. Reasonable infit and outfit values were calculated to be between 0.91 and 1.09. Two items exhibited overfit, and item 15 had the worst overfit.

Table 11. *NEP item fit and parameter estimates for Study 1 and 2 combined*

Item	Item difficulty	Item fit	
		Infit MNSQ	Outfit MNSQ
1. We are approaching the limit of the number of people the earth can support.	-0.06	1.08	1.06
2. Humans have the right to modify the natural environment to suit their needs. (r)	-0.30	0.97	0.96
3. When humans interfere with nature it often produces disastrous consequences.	0.40	1.16	1.05
4. Human ingenuity will insure that we do NOT make the earth unlivable. (r)	-0.59	0.96	0.92
5. Humans are severely abusing the environment.	0.51	1.00	1.01
6. The earth has plenty of natural resources if we just learn how to develop them. (r)	-1.13	1.32	1.28
7. Plants and animals have as much right as humans to exist.	0.76	1.16	1.20
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations. (r)	-0.33	0.92	0.92
9. Despite our special abilities humans are still subject to the laws of nature.	0.85	1.12	1.05
10. The so-called “ecological crisis” facing humankind has been greatly exaggerated. (r)	-0.19	0.98	0.99
11. The earth is like a spaceship with very limited room and resources.	0.04	0.98	0.97
12. Humans were meant to rule over the rest of nature. (r)	-0.30	1.07	1.07
13. The balance of nature is very delicate and easily upset.	0.42	0.91	0.88
14. Humans will eventually learn enough about how nature works to be able to control it. (r)	-0.40	1.08	1.02
15. If things continue on their present course, we will soon experience a major ecological catastrophe.	0.31	0.83	0.85

Note. Items noted with (r) are reverse scored.

The Rasch modeling revealed that all three scales had acceptable item-fit statistics, but each has items that did not measure pro environmental orientation as well as the measurement model expected. The NEP had fewer poor fitting items than the CNS or the MES. These measurement differences should not be taken as objective evidence of the superiority of one scale over another, but instead indicate that each of these scales has measurement weaknesses and that there is room for improvement.

10. Discussion

Figure 8 is a Wright Map including each item of all three scales plotted according to each item's difficulty estimate. First, examine the distribution of environmental orientation score levels (Xs on left side of vertical axes). The spread of the distribution represents relative levels of the latent construct the scale was able to measure. Since the distribution was different between the MES, the NEP, and CNS, this suggests that the NEP and CNS are tapping into a consistent latent construct of pro-environmental orientation, and that the MES is capturing a slightly different latent construct. Although it is unlikely the scales are measuring entirely different constructs, it could be that the MES captures a broader definition of environmental orientation (as it was designed to do), and this is reflected in the wider distribution (represented by the Xs). Second, examine the positioning of each scale's individual items (the numbers on the right side of the vertical axis). Ideally, the items would be evenly spread alongside the total range of observed thetas (the Xs); this would mean that each item is uniquely contributing to measure the latent construct at different levels. When items overlap, that indicates two (or more) items are discriminating at the same level of the construct and therefore are redundant. As seen in Figure 8, the MES items were slightly less redundant than the items of the NEP and CNS. Further, the MES items correspond to the lower range of the theta (environmental orientation), suggesting that the MES better measures weak environmental orientation than the other scales which have items clustered more around the middle or high ends of the theta distributions. Nonetheless, all three scales have redundant items, and each would be improved by removing redundant items and adding more items that better discriminate at high and low levels of pro-environmental orientation.

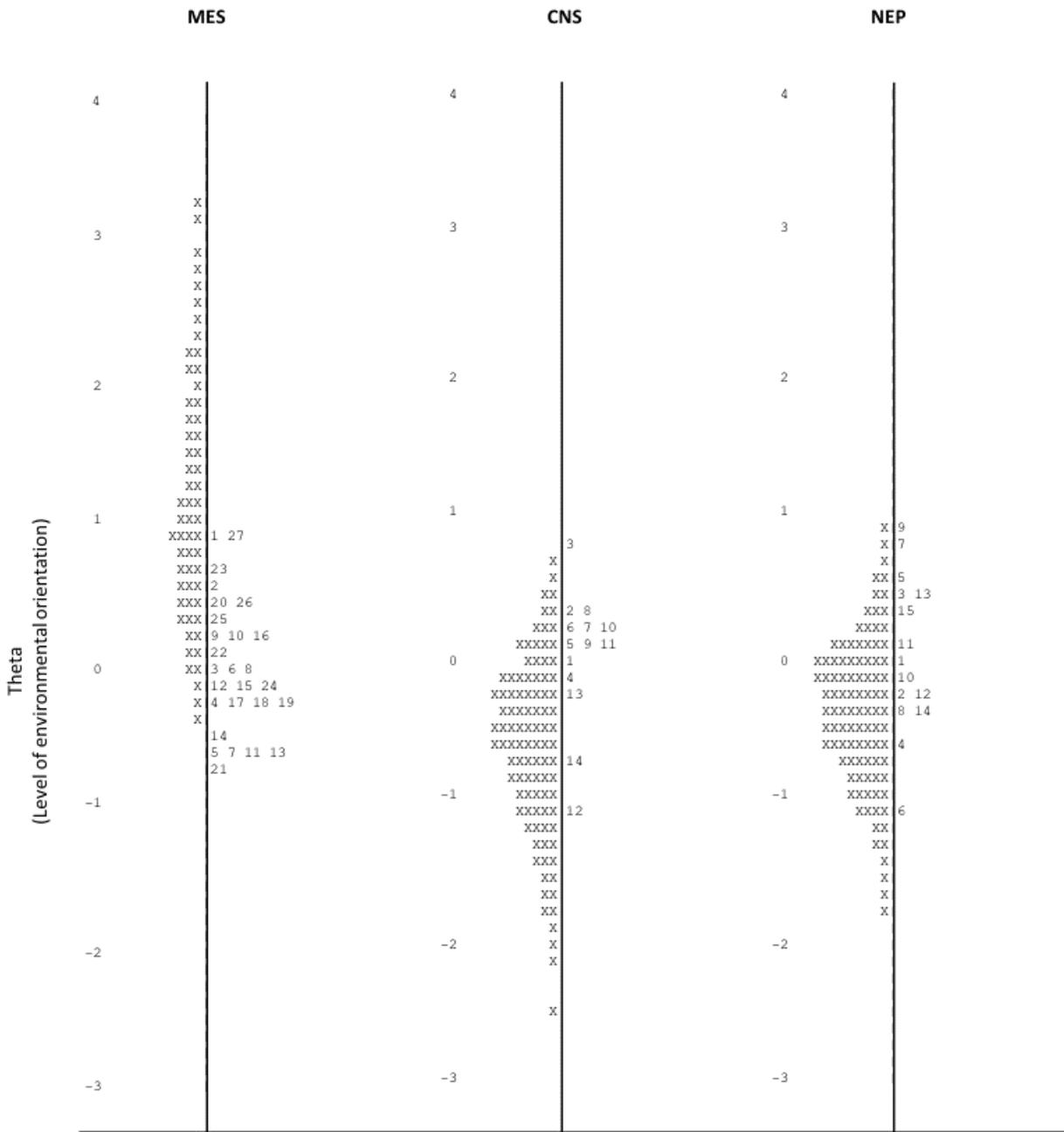


Figure 8: Wright Map of MES, CNS, and NEP. Left side of the vertical axis represents the distribution of participants on theta (the latent construct representing environmental orientation). The right side of each vertical axis represents where each item best discriminates different levels of theta for each scale, respectively. Each X represents 10 cases.

Although these results indicate that MES is comparable to the other measures in terms of predictive validity, and slightly better at measuring low levels of pro-environmental orientation, it is not a clear favorite. We view these results as similar to null findings from a well-designed experiment. Theory predicts that items using language that is more inclusive of the political spectrum should be more appealing than items that do not. We observed a difference, but it was not large which is an important finding on its own. It may be that as environmental politics have become more polarized in the United States (Karol, 2019), the concept of caring for nature itself has become part of liberal ideology, making it difficult to disentangle and measure it in an unbiased way.

The MES may be particularly useful in contexts where researchers are specifically concerned about measuring pro-environmental orientation across the political spectrum, especially within the United States. Ideology and partisanship is a powerful driver of how people view politics and environmental politics in particular. However, there are other individual level characteristics that may interact with environmental orientation that may be of interest to researchers in other contexts. Perhaps existing measures, and the MES, have blind spots around gender or racial/ethnic differences. It may be possible to improve measurement of pro-environmental orientation by bringing in these perspectives as well.

11. Conclusion

We assessed the psychometrics and behavioral prediction of two well-established measures of environmental orientation, the New Ecological Paradigm (Dunlap et al., 2000) and the Connectedness to Nature Scale (Mayer & Frantz, 2004), and compared them to a novel scale designed to measure a broader range of environmental orientations in politically diverse audiences. Both the NEP and CNS contain items that appeal most strongly to progressive

environmentalists and are unlikely to appeal to conservative conservationists. Further, neither had been adequately examined at the item level.

The results from regression analyses support the construct validity of the novel Moral Environmentalism Scale. The MES correlates with the NEP and CNS and predicts pro-environmental behaviors when controlling for other factors better than the NEP and comparable to the CNS. We also presented evidence that MES uniquely predicts Republican environmental behavior in both studies. In future work, the MES could be tested on a wider range of dependent variables, such as support for policy goals or its applicability to environmental organizers trying to identify supporters, or laboratory-based measures of objective pro-environmental behavior (Lange, Brick, & Dewitte, 2019). While the online samples were adequate for testing the psychometric validity of the scale and providing a preliminary analysis of its predictive impact on pro-environmental behavior, a more representative U.S. sample and samples from other populations or countries would provide more external validity. Further, focus groups and think-aloud exercises, especially with politically conservative groups, could yield greater insight into how different people think about the items in these scales.

Rasch modeling suggests that, as intended, the MES is slightly better than the other scales at measuring weak environmental orientation (as evidenced by MES items corresponding to lower levels of the environmental orientation score distribution shown in Figure 8), although all three scales would still benefit from the inclusion of items that better discriminated individuals at lower levels of environmental orientation. The NEP had slightly better item fit characteristics than CNS and MES. These results are important as there is only one study that includes item analysis of NEP and none for the CNS. The one application of item-level analysis on the NEP used a different analytic approach (i.e., graded-response model vs. rating scale Rasch model) and

also did not include all items of the NEP; thus, the numeric results from that study and the current study are not directly comparable. However, Zhu and Lu (2016) found that items adequately fit the measurement model, and we found similar results for nearly all NEP items. Additionally, both studies also found that there is likely redundancy between items, and that designing items that better measured a larger range of environmental attitudes would be beneficial. While Zhu and Lu (2016) found that their selection of NEP items did not measure high level of environmental attitudes well, the current study found that the NEP items measured both low and high environmental orientation poorly. Nevertheless, there is a general consensus between the two sets of results that the NEP does not necessarily have poor items nor is a poor scale overall, but that there are many areas for improvement, particularly with removing redundant items and adding items that better measure the full range of the distribution of environmental orientation.

Measuring environmental orientation is critical, yet complicated. As environmental issues have taken on greater urgency given looming threats such as climate change, research involving environmental orientations has similarly increased. As we show here, there is a need to continue thinking about how we measure this construct—what the strengths and limitations are of established scales, and how future scales can be developed. In these efforts, it may also be worth reconsidering some of the fundamental assumptions of environmental orientations. For example, the CNS, NEP, and MES examined in this paper all assume that an individual's level of environmentalism has linear relationships with other outcomes such as behaviors, in that higher levels relate to an increased likelihood to think and act more environmentally friendly (and endorse items on scales in a corresponding manner). However, it is unlikely that this assumption is completely accurate. The question is then, how influential is a violation of this assumption?

After all, other psychological constructs do not have a linear relationship with outcomes (e.g., Brehm's emotional intensity theory, Brehm, 1999; Yerkes-Dodson law, Yerkes & Dodson, 1908). Similarly, more work is needed to determine the differences and different applications of attitudes versus values versus orientations. In this paper, we treat all these similar constructs under the overarching environmental orientation label; nevertheless, there likely are meaningful differences between these constructs and more work is needed to define and operationalize these concepts. Also, there may be important sub-dimensions of environmental orientation to examine. These subdimensions may be more useful in different contexts, but these extensions first require accurately measuring the unidimensional construct.

Overall, the results suggest that the MES is a valid measure of environmental orientation and has comparable properties with the CNS and NEP. All three scales are similarly predictive of pro-environmental behaviors and have good internal reliability. We suggest that a good measure will be able to index the full range of the construct. The CNS, NEP, and MES all appear to need additional, different items to satisfy this requirement well. In sum, more attention is needed on construct and measurement validity for environmental attitudes and orientations, and Rasch models are one helpful tool for such scale development.

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Supplement

Measuring pro-environmental orientation: Testing and building scales (2022)

Study 1 Demographic characteristics and descriptive statistics

Table S1

Descriptive statistics in Study 1 (MTurk data)

<i>N</i> = 448	<i>M</i>	<i>SD</i>	%
Education (1-5)	2.85	1.08	-
Income (1-6)	2.46	1.12	-
Age (years)	35.3	11.6	-
Republican (0,1)	-	-	17.4%
Democrat (0,1)	-	-	39.0%
Race	-	-	74% White
Gender	-	-	52% Female

Table S2

Descriptive statistics of key measures from Study 1

	<i>M</i>	<i>SD</i>	Cronbach's alpha
Self-reported behavior (1-5)	3.56	0.86	-
Clicked on link	.27	.44	-
MES (1-5)	4.11	0.56	.94
NEP (1-5)	3.96	0.95	.93

Auxiliary analyses

We present results replicating the analysis in study 1 showing the interaction effect between the MES and Democratic party identification and NEP and Democratic party identification on a single-item self-reported environmental behavior. These analyses serve as a robustness check on the findings in the main document in Table 5. The interaction is only observed to be significant for Republicans, not for Democrats.

Table S3

Interaction effect of Democratic party id with MES and NEP on single-item self-reported environmental behavior in linear regression

	Model 1		Model 2	
	<i>b</i>	<i>se</i>	<i>b</i>	<i>se</i>
MES	0.40***	0.11		
NEP			0.34***	0.08
Democrat	0.21	0.93	0.71	0.54
MES*Democrat	-0.03	0.21		
NEP*Democrat			-0.20	0.13
Observations	222		223	
Adjusted <i>R</i> ²	.07		.08	

Note: Unstandardized OLS regression coefficient. ****p*<.01

Table S4

Descriptive statistics of subsamples in Study 1 (MTurk data)

	MES			NEP sub		
	<i>M</i>	<i>SD</i>	%	<i>M</i>	<i>SD</i>	%
Education (1-5)	2.79	1.13	-	2.91	1.03	-
Income (1-6)	2.42	1.11	-	2.49	1.12	-
Age (years)	35.0	11.8	-	35.6	11.37	-
Republican (0,1)	-	-	35%			43%
Race	-	-	73% White			75%
Gender	-	-	44% Female			60%

Table S5

Study 2 correlations between covariates, predictors, and behavior measures

	Composite PEB	Public PEB	Private PEB
MES	0.40	0.23	0.48
NEP	0.25	0.15	0.31
CNS	0.46	0.33	0.44
Income	0.04	-0.02	0.10
Republican (0,1)	-0.22	-0.22	-0.15
Age	-0.10	-0.17	0.04
Woman	.09	.06	.12
LibCon (1-7)	-0.30	-0.31	-0.17
Education	0.11	0.08	0.10

Rasch model item-step parameters

Table S6

Item-step parameters for MES

Response step	Item difficulty	Item fit	
		Infit MNSQ	Outfit MNSQ
0		3.84	111.78
1	-1.05	2.21	2.79
2	-0.32	3.21	2.76
3	-0.26	4.89	4.73
4	1.63	3.70	3.74

Table S7

Item-step parameters for CNS

Response step	Item difficulty	Item fit	
		Infit MNSQ	Outfit MNSQ
0		2.86	2.46
1	-1.85	2.62	2.56
2	-0.09	2.65	2.44
3	0.42	1.64	1.49
4	1.52	2.47	14.98

Table S8

Item-step parameters for NEP

Response step	Item difficulty	Item fit	
		Infit MNSQ	Outfit MNSQ
0		2.50	2.54
1	-0.92	2.20	2.14
2	0.10	2.68	2.52
3	-0.03	1.81	1.63
4	0.86	2.63	2.81

Table S9

Item wording and percent who responded yes to having taken the action (Study 2)

Item	Frequency yes
Avoided using certain products that harm the environment	66%
Tried to use less water in your household	75%
Bought some product specifically because you thought it was better for the environment than competing products.	62%
Voluntarily recycled newspapers, glass, aluminum, motor oil or other items.	79%
Reduced your household's use of energy.	78%
Bought or sold stocks based on the environmental record of the companies.	12%
Been active in a group or organization that works to protect the environment.	19%
Voted for or worked for candidates because of their position on environmental issues.	40%
Contributed money to an environmental, conservation or wildlife preservation group.	34%
Contacted a public official about an environmental issue.	19%
Contacted a business to complain about its products or policies because they harm the environment.	16%
Signed a petition supporting an environmental group or some environmental protection effort.	36%
Attended a meeting concerning the environment.	17%