

1 **Measuring Brazilians' Environmental Attitudes: A Systematic Review and Empirical Analysis of the NEP**
2 **Scale**

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Abstract

The New Environmental Paradigm (NEP) scale is the most widely used instrument to assess environmental attitudes (EA). However, the validity of its use in developing countries has been overlooked. Considering the importance of Brazil for the future of the environment, we present two complementary studies to examine how the NEP scale has been used in Brazil, its validity to evaluate Brazilians' EA, and possible ways to improve this instrument. In the first study, we present a systematic review of studies that used the NEP scale (original and revised versions) with Brazilians. In the second study, we conduct an empirical analysis using the revised NEP scale. Results from both studies show that the NEP scale's factorial structure can be influenced by the items' positive and negative wording, Brazilians hold medium-high pro-EA, and that the scale presents low internal consistency. Study 1 showed that the scale's convergent, predictive, and known-group validity differs across studies. In Study 2, the revised NEP scale was significantly associated with connectedness to nature, pro-environmental behavior, gender, and political ideology. These results support its convergent, predictive, and known-group validity. We conclude that the validity of using the NEP scale with Brazilians is questionable and discuss ways of improving this instrument.

Keywords: scale validity; developing countries; environmental beliefs; environmental concern; New Ecological Paradigm.

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4 **Introduction**

5 Human actions affect nature in ways that may endanger the balance of the ecological system,
6 threatening humans and other species (Evans 2019; Milfont and Schultz 2016; Steffen et al. 2015). Researchers
7 have long tried to understand what drives people to act in a sustainable way (Gifford, 2011; Schutte and Bhullar
8 2017), and environmental attitudes (EA) have been pointed out as one of the main predictors of pro-
9 environmental behavior (Bamberg and Möser 2007; Stern et al. 1995), together with other factors such as
10 environmental knowledge, norms, and circumstances (e.g., the existence of cycling lanes on the route to work)
11 (Bamberg and Möser 2007; Hines et al. 1987).

12 Most of the studies regarding the factors and processes leading people to behave in a pro-environmental
13 way have been conducted in developed countries (Clayton et al. 2016; Larson et al. 2015; Poškus 2018; Truelove
14 and Gillis 2018), also referred to as Western, Educated, Industrialized, Rich, and Democratic (WEIRD) societies
15 (Henrich et al. 2010). This tendency leaves out a large portion of the population (non-WEIRD societies) whose
16 decisions and actions are becoming increasingly relevant for the future of the planet (World Trade Organization
17 [WTO] 2014). Given this situation, it is crucial to understand how people in non-WEIRD countries think and act
18 in relation to the environment, both theoretically and for practical reasons. An important step towards this end is
19 to assess the EA of people living in non-WEIRD countries in a reliable way.

20 EA are seen as a “collection of beliefs, affect, and behavioral intentions a person holds regarding
21 environmentally related activities or issues” (Schultz et al. 2005; p. 458). The New Environmental Paradigm
22 (NEP) (Dunlap and Van Liere 1978) scale is the most widely accepted measure of EA (Hawcroft and Milfont
23 2010). According to Dunlap et al. (2000), the NEP scale evaluates fundamental beliefs or worldviews, which are
24 seen as indicators of EA (Hawcroft and Milfont 2010; Schultz et al. 2005). Despite its extensive use across many
25 different countries (Dunlap 2008; Hawcroft and Milfont 2010), its psychometric properties tend to be poorer
26 when used in non-WEIRD countries, compared to when used in WEIRD countries (Schultz et al. 2005; Zhu and
27 Lu 2017). For example, whereas a high internal consistency ($\alpha > 0.80$) was reported when using the NEP scale in
28 Washington (USA) (Dunlap and Van Liere 1978; Dunlap et al. 2000), lower internal consistency ($\alpha < 0.70$) was
29 found in studies with Turks (Atav et al. 2015), Brazilians (Bechtel et al. 1999), Nigerians (Ogunbode 2013), and
30 Indians (Schultz et al. 2005). Moreover, the dimensionality of the NEP scale tends to vary across samples

1 (Hawcroft and Milfont 2010), and differences in the number of factors have been found between WEIRD and
2 non-WEIRD societies (Bechtel et al. 1999). Bechtel et al. (1999) found a bi-factorial structure with a sample of
3 North Americans and a solution with three factors for Brazilians and Mexicans. According to Zhu and Lu
4 (2017), the positive and negative wording of the NEP scale's items seems to influence its factorial structure. The
5 authors noted a tendency for even-numbered items to form a cluster, and this method effect appears to be
6 influencing the NEP scale's factorial structure with samples of several non-WEIRD countries (Atav et al. 2015;
7 Freire et al. 2013; Moyano-Díaz and Palomo-Vélez 2014; Reyna et al. 2018; Xie et al. 2017; Zhu and Lu 2017).

8 The above-mentioned results question the validity of the NEP scale to adequately evaluate the EA of
9 people living in non-WEIRD countries. However, to the best of our knowledge, there are no published studies in
10 which the NEP scale's validity in non-WEIRD countries has been examined. In the present paper, we focus on
11 the use of the NEP scale in Brazil. We chose this specific sample for three main reasons. First, Brazil is a non-
12 WEIRD country that plays an important role in mitigating environmental problems (Overbeck et al. 2018;
13 Strassburg et al. 2017). Second, the NEP scale has been previously used with Brazilians, both in national studies
14 and in large cross-cultural analyses of EA (Broomell et al. 2015; Schultz et al. 2014; Xiao and Dunlap 2007).
15 Third, the use of the NEP scale has been especially problematic when it comes to studies with Brazilians, leading
16 to mixed results, including variation in the scale's dimensionality and reliability. For example, the scale's
17 internal consistency tends to be low ($\alpha < 0.70$), and its factorial structure usually varies across studies from
18 unidimensional (Pires et al. 2016) to two (Kruter et al. 2012), three (Freire et al. 2013), four (Battistella et al.
19 2012), five (Vikan et al. 2007), and six dimensions (Silva-Filho et al. 2009). Thus, it is difficult to determine
20 whether conclusions about Brazilians' EA in previous studies (Bechtel et al. 1999; Schultz et al. 2005; Vikan et
21 al. 2007) are valid.

22 Considering the above, our objectives are to understand (1) if the NEP scale is a valid instrument to
23 assess Brazilians' EA; (2) what the scores obtained with this scale reflect about the EA of this population group;
24 and (3) how to improve the use of the NEP scale with Brazilians. Our evaluation of the validity of using the NEP
25 scale with Brazilians involves analyzing whether the theoretical construct proposed by Dunlap and Van Liere
26 (1978), and by Dunlap et al. (2000), is adequately captured by the NEP scale (Otto et al. 2018). In order to test
27 this, we focus on four aspects: (1) dimensionality, as the first step in construct validity analyses is the definition
28 and empirical verification of a construct's theoretical domains (Nunnally and Bernstein 1994); (2) convergent
29 validity (Pasquali 2007), because theoretical development is carried out by analyzing the correlations between a
30 construct registered by a specific scale and measures of constructs theoretically related to it (Whitburn et al.

1 2018); (3) predictive validity, as one the main objectives of a better understanding of attitudes is to predict
2 behavior (Hawcroft and Milfont 2010; Tarrant and Green 1999), although considering that the NEP scale
3 evaluates general environmental beliefs, we do not expect to find a strong relation between the NEP scale and
4 specific environmental behaviors (Dunlap et al 2000); and (4) known-group validity (Terwee et al. 2007),
5 because interventions need to considerer group differences. Throughout the text, we use the term construct
6 validity to refer to the NEP scale's dimensionality. Other aspects of validity (convergent, predictive, and known-
7 group) help us to understand whether the NEP scale assesses the theoretical construct for which it was designed
8 (Nunnally and Bernstein 1994). We also examine whether all the items of the NEP scale assess the same
9 construct and how precise this measurement is (i.e., the NEP scale's reliability; Nunnally and Bernstein 1994)
10 via its Cronbach's alpha (Schmitt 1996; Thompson et al. 2005).

11 To accomplish these goals, we present two complementary studies. The first one consists of a
12 systematic review of the use of the NEP scale with Brazilians (study 1). In this review, we analyze the NEP
13 scale's validity by assessing its dimensionality, as well as its convergent, predictive, and known-group validity.

14 In the second study, we present an empirical investigation in which we check the replicability of study 1's
15 findings and explore two possible pathways to improve the use of the NEP scale with Brazilians.

16 Several versions of the NEP scale have been used since its development, both in its original language
17 (Dunlap and Van Liere 1978; Dunlap et al. 2000; Manoli et al. 2007) and after adaptation to different cultures
18 (Atav et al. 2015; Corraliza et al. 2013; Moyano-Diaz and Palomo-Vélez 2014; Ogunbode 2013; Pires et al.
19 2016). There are, at least, four versions: the original one, formed by 12 items (Dunlap and Van Liere 1978); the
20 shortened 6-item version, which lacks a study reporting its development (Dunlap 2008; Hawcroft and Milfont
21 2010); the revised NEP scale, formed by 15 items (Dunlap et al. 2000); and the NEP scale, adapted for use with
22 children (Manoli et al. 2007).

23 To the best of our knowledge, there are no studies with Brazilians in which the 6-item version or the
24 NEP scale to be used with children are employed. Hence, in the present study, we focus on the original and
25 revised versions of the scale. The original NEP scale was developed to evaluate the new environmental paradigm
26 (Dunlap and Van Liere 1978). This paradigm considers humans to be part of nature, in opposition to the
27 dominant social paradigm, that consider humans to be superior to other species and that the planet has unlimited
28 resources for humans to use. The 12 scale items focus on beliefs about three dimensions of the paradigm:
29 *balance of nature*, the existence of *limits to growth* for human societies, and *humanity's right to rule over the*
30 *rest of nature* (Dunlap et al. 2000). Dunlap et al. (2000) reviewed the original NEP scale in order to improve the

1 balance between pro and anti-NEP items, update the terminology of some of the items, and broaden the scale's
2 content. To broaden the scale's content, items focusing on the notion of *human exemptionalism*—the idea that
3 humans are exempt from nature's constraints—and on the *likelihood of an ecological crisis*, were added. Dunlap
4 et al. (2000) named the revised NEP scale as the New Ecological Paradigm scale. To avoid confusion and
5 maintain the clarity throughout the text, we use the term new environmental paradigm for the original and
6 revised scales. In the next sections, we present the objectives, method, and results of studies 1 and 2,
7 respectively, followed by a general discussion.

8 **Study 1 – The NEP Scale's Validity and Environmental Attitudes in Brazil**

9 This study reports a systematic review of the use of the NEP scale in Brazil. It is based on articles
10 published in peer-reviewed journals. The following characteristics were examined: the scale's dimensionality
11 (construct validity), mean, reliability (internal consistency), and convergent, predictive, and known-group
12 validity.

13 **Method**

14 **Procedure**

15 For this systematic review we followed the steps suggested by Tricco et al. (2011). First, we conducted
16 a literature review looking for studies in which the NEP scale was administered to Brazilians. As a requirement,
17 these studies had to be published in peer-review journals. The following databases were used: Periódicos
18 CAPES, SCOPUS, and PsycINFO. We used the following terms in English and Portuguese: "New Ecological
19 Paradigm," "New Environmental Paradigm," and "NEP." In PsycINFO, the term "Brazil" (e.g., "New
20 Environmental Paradigm" and "Brazil") was added. Our inclusion criteria are described below. In an attempt to
21 include other studies that met our inclusion criteria, we also checked the references of the articles found and
22 considered other studies that cited them via Google Scholar. This search phase finished on June 06, 2018.

23 The articles needed to meet the following criteria to be included in subsequent analyses: (1) have used
24 at least five items of the NEP scale (Hawcroft and Milfont 2010); (2) have been published in a peer-reviewed
25 journal; and (3) have reported the scale's dimensionality, mean, or internal consistency. The first criterion was
26 used to ensure that a minimum number of items was found across studies. The second criterion guaranteed the
27 quality of the studies included. The third criterion was established because the scale's dimensionality, internal
28 consistency, and mean shed light on the NEP scale's construct validity, reliability, and upon Brazilians' EA. In
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1 addition, when the same sample was used in two studies, we selected the study that provided more information
2 about the NEP scale.

3 Once the criteria were established, we first read the title and the abstract of the articles found through
4 our search strategy. When this first reading was not enough to determine whether an article should be included in
5 our review, we read the method and, in some cases, the full manuscript. Only articles that met our inclusion
6 criteria were selected.

7 Our last step was to tabulate the relevant data in Excel and SPSS 21 and check the NEP scale's
8 dimensionality (construct validity), mean, internal consistency, and convergent, predictive, and known-group
9 validity. The first author coded all the articles.

11 Results

12 Thirteen studies were selected. Most (61.5%) were published in the previous six years, the first one in
13 1999 and the last one in 2016. The studies included fourteen adult samples (3,600 Brazilians) and eight of them
14 were published in Brazilian journals. Summary statistics for the studies and samples included in the systematic
15 review are shown in Table 1.

16 Participants were generally university students (number of samples, $k = 13$, 43.9% men, one study did
17 not report the percentage of men/women), with mean ages varying between 22.6 and 31.7 years old ($k = 6$, $M =$
18 25.1 , $SD = 3.7$). Three articles used the original NEP scale and 10 used the revised one. The studies generally
19 used the complete scale. However, one of the studies applied just 14 items of the revised NEP scale (Polli and
20 Camargo 2016), and another one applied only seven items from the original NEP scale (Kruter et al. 2012). The
21 average EA of Brazilians ranged from 3.55 to 4.20, with an overall average of 3.80 ($k = 10$, $SD = 0.21$). The
22 internal consistency (α) of the scales used ranged from 0.53 to 0.76, with a mean of 0.65 ($k = 11$, $SD = 0.07$).

23 Our findings showed that the scale's dimensionality varied across studies, from a unidimensional
24 structure (e.g., Iglesias et al. 2014) to up to six factors (Silva-Filho et al. 2009). In many of the samples included
25 in the review (Bechtel et al. 1999; Freire et al. 2013; Kruter et al. 2012) the even-numbered items grouped
26 forming a factor. The researchers used exploratory factors analysis (EFA) to examine the scale's dimensionality,
27 with the exception of two studies (Bechtel et al. 1999; Pires et al. 2016). There was only one study in which the
28 dimensions found were equal to the three dimensions proposed by Dunlap and Van Liere (1978) for the original
29 NEP scale (Bechtel et al. 1999). Similarly, there was only one study in which the five theoretical dimensions
30 proposed for the revised NEP scale (Dunlap et al. 2000) were found (Vikan et al. 2007). Thus, the dimensionally

1 of the scale matched the theoretically proposed number of factors in two out of 13 studies. However, these two
2 studies identified several problematic items (e.g., no significant item-total correlation), indicating that some
3 items may be not measuring the same construct (Table 1 in Supplementary Material).

4

<Please, insert Table 1 here>

1 Next, we examined the scale's convergent and predictive validity. Eight studies analyzed the NEP's
2 convergent or predictive validity by checking the correlation between the NEP scale and associated constructs or
3 pro-environmental behaviors, respectively. Of these eight studies, five found correlations in the theoretically
4 expected direction and three found mixed results (correlations in the expected direction and correlations in the
5 opposite direction, or non-significant correlations) (Table 2). For example, Iglesias et al. (2014) found, as
6 expected, a significant negative correlation between the NEP scale and the Psychological Barriers Scale for Pro-
7 environmental Behavior ($r = -0.34, p < 0.01$). However, the correlations found between the NEP scale and pro-
8 environmental behaviors in a previous study (Kruter et al. 2012) were mixed. Specifically, the pro-NEP items
9 formed a dimension that significantly predicted the intention to purchase green plastic ($B = 0.13, p = 0.007$). On
10 the contrary, the *man over nature dimension* formed by three anti-NEP items was not associated with the
11 intention to buy green plastic ($B = 0.02, p = 0.70$).

12 <Please, insert Table 2 here>

13 Considering the known-group validity, only seven studies reported the relation between the NEP scale
14 and Brazilians' sociodemographic characteristics. It is hard to synthesize the results for two reasons. First, there
15 is variability in the way in which some of the sociodemographic characteristics were used in different studies
16 (e.g., age is used as a continuous or as a dichotomous variable). Second, the way in which the relation between
17 the NEP scale and sociodemographic characteristics was checked also varied across studies (e.g., considering
18 each item of the scale, some dimensions, or the full scale). The most significant findings refer to the relationship
19 between the NEP scale and participants' gender. Of the five studies that checked differences in the NEP scale's
20 scores across genders, two found that men's and women's scores were similar (Kim et al. 2006; Vikan et al.
21 2007), and three reported that women tend to score higher on the NEP scale than men (Battistella et al. 2012;
22 Kruter et al. 2012; Teixeira et al. 2016).

23 24 **Study 2 – Empirical Analysis of the Use of the Revised NEP Scale with Brazilians**

25 Our systematic review showed two results that are consistent across studies: Brazilians present medium-
26 high EA and the NEP scale's internal consistency tends to be low. Moreover, our findings regarding the NEP
27 scale's dimensionality (construct validity), and convergent, predictive, and known-group validity are mixed,
28 partially supporting the theoretical background of the scale. Considering this, the aim of the second study is
29 twofold. We first want to check the replicability of the consistent results found across the studies included in
30 study 1. Second, we aim to examine two possible pathways to improve the use of the NEP scale with Brazilians.

1 To achieve these aims, we will first analyze the psychometric properties of the NEP scale, and then
2 check whether a method effect (positive and negative wording of items) exists when examining the scale's
3 dimensionality. Zhu and Lu (2017) suggested that when using the revised NEP scale, negatively worded items
4 tend to form a single factor (method effect). Our systematic review also pointed towards this method effect, as
5 the even-numbered items tend to form one factor (Bechtel et al. 1999; Freire et al. 2013; Kruter et al. 2012).
6 Following Zhu and Lu's (2017) suggestion, if this method effect is identified in the present study, the internal
7 consistency and construct validity of an 8-items version of the NEP scale formed by the odd-numbered items
8 will be checked. Additionally, we will examine the NEP scale's association with connectedness to nature
9 (convergent validity), pro-environmental behaviors (predictive validity), and sociodemographic characteristics
10 (know-group validity).

11 **Method**

12 **Participants**

13 Two hundred and twenty-four undergraduate students (140 women) from a university in Brazil
14 participated in the study. The mean age was 23.64 years ($SD = 5.96$).

15 **Measures**

16 The following measures were used:

17 *a) The New Environmental Paradigm scale (NEP) scale:* we used the revised NEP scale (Dunlap et al. 2000)
18 adapted to the Brazilian context (Pires et al. 2016). Participants reported their agreement/disagreement with the
19 items in a 5-point Likert response format from 1 (strongly disagree) to 5 (strongly agree).

20 *b) The Connectedness to Nature Scale (CNS):* the Brazilian version (Pessoa et al. 2016) of the CNS
21 (Mayer and Frantz 2004) was used. It consists of 13 items and assesses "[...] individuals' trait levels of feeling
22 emotionally connected to the natural world" (Mayer and Frantz 2004; p. 503). Its unidimensional structure has
23 been confirmed when used with Brazilians (Pessoa et al. 2016). The response format was similar to the one used
24 in the NEP scale. Cronbach's alpha for this scale was 0.82. According to Mayer and Frantz (2004), people's
25 connectedness to nature should be positively correlated to their environmental attitudes. Supporting this idea,
26 these authors found a positive and high correlation between CNS and the NEP scale ($r = 0.52, p < .001$).

27 *c) The Self-reported Pro-Environmental Behavior (PEB) scale:* individual self-reported PEB was registered
28 using Larson et al.'s (2015) PEB scale. This scale is formed by 13 items divided into four dimensions:
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1 conservation lifestyle; land stewardship; social environmentalism; and environmental citizenship. In the present
2 study, we report data from a 10 item version, without the land stewardship dimension. This dimension was
3 excluded because it did not apply to the behaviors participants in this sample would normally conduct (e.g.,
4 “made my yard or my land more desirable for wildlife”). Participants’ frequency of engagement in pro-
5 environmental behavior (e.g., conserved water or energy in my home) could vary from 1 (never), to 5 (very
6 often). The Cronbach alpha for this scale was 0.82. Previous studies have proven the NEP scale’s predictive
7 validity (Dunlap and Van Liere 1978; Dunlap et al. 2000; Mayer and Frantz 2004; Stern et al. 1995; Whitburn et
8 al. 2018), although the predictive effects found tend to be low to moderate.

9 *d) Sociodemographic characteristics:* previous studies have shown previous studies have shown that women and
10 people who are younger, better educated, liberal, and wealthier hold stronger pro-EA (Gifford and Nilsson 2014;
11 Hornsey et al. 2016). To assess the revised NEP scale’s known-group validity, data about participants’ gender,
12 age, family income, political ideology, and their current semester at the university were collected. Students’
13 semester at the university was taken as a measure of their educational level. Participants’ gender was
14 operationalized as: 0 = male, and 1 = female. Family income was operationalized on a scale of: 1 = up to half a
15 minimum wage, to six = more than 10 times a minimum wage. Political ideology was operationalized on a scale
16 of: 1 = completely right, to 5 = completely left.

18 Procedure

19 The guidelines from the American Psychological Association and Institutional Review Board for the
20 treatment of participants were followed. Informed consent was obtained from all individual participants included
21 in the study, and data were collected online. The Committee of Ethics in Research with Human Beings gave its
22 authorization for the research execution (No. 2,055,100). Participation was anonymous, voluntary, and took 15
23 minutes on average.

25 Data analyses

26 Two participants were left out of the analyses because they had non-random missing values. Thus, our
27 sample was formed by two hundred and twenty two participants. Missing values (0.34%) were recoded using the
28 mean value of each variable (Tabachnick and Fidell 1996). Following Harrington’s (2009) approach, univariate
29 extreme cases in the items of the NEP, CN, and PEB scales were recoded to retain the highest scores but reduce
30 extreme cases. Exploratory factor analysis (EFA) with a principal axis factoring method and oblique (oblimin)

1 rotation was performed to check the NEP scale's dimensionality. Parallel analysis was used to decide how many
2 factors would be retained (Damásio 2012; Fabrigar et al. 1999) and loadings from the pattern matrix were
3 interpreted (Osborne 2015). Corrected item-total correlations and Cronbach's alpha were checked to analyze the
4 NEP scale's internal consistency. Pearson's product-moment correlation was used to verify the association
5 between the NEP scale and CNS (convergent validity), and PEB (predictive validity). A multiple linear
6 regression was conducted to verify the ability of four sociodemographic characteristics (gender, family income,
7 political ideology, and educational level) to predict the scores on the NEP scale (known-group validity). Age was
8 the only variable that deviated from the assumption of normality (kurtosis = 11.3) and, therefore, was not
9 included in the analyses. The other four sociodemographic variables did not violate this assumption (kurtosis <
10 1.75; skewness < 0.53) (Harrington, 2009). Multicollinearity was not a problem in any of the analyses
11 (Tolerance > 0.42; VIF < 2.38). Graphical analysis of the residuals did not indicate any violation of the
12 assumptions of homoscedasticity and independence of error (Hair et al. 2014). The significance level adopted
13 was $p < 0.05$. All data generated or analyzed during this study are included in this published article (and its
14 supplementary information files).

16 Results

17 The EFA of the NEP scale (KMO = 0.702; Bartlett χ^2 (105) = 468, 41, $p < 0.001$) indicated six
18 eigenvalues greater than one (1.02, 1.08, 1.13, 1.23, 1.78, and 3.00). However, the Kaisers' criterion (eigenvalue
19 > 1) tends to overestimate the number of factors (Damásio 2012; Fabrigar et al. 1999). Therefore, we used
20 parallel analysis (1000 replications), which is a more reliable method to decide how many factors to retain
21 (Damásio 2012; Fabrigar et al. 1999). Parallel analysis indicated that only the two largest eigenvalues of the
22 actual data were larger than the two largest eigenvalues of a simulated data analysis. Hence, only two factors
23 were retained. The first factor explained 20.0% of the total variance and the second factor explained 11.8%. The
24 loading of each item on these factors, mean (SD), corrected item-total correlation, and Cronbach's alpha if the
25 item is eliminated can be seen in Table 3.

26 <Please, insert Table 3 here>

27 According to our results, the odd-numbered items (pro-NEP) tend to associate more strongly with the
28 first factor, and the even-numbered items with the second one. By looking at the loadings ≥ 0.32 (Tabachnick
29 and Fidell 1996), it can be noted that none of the even-numbered items loaded on the first factor and that only
30 one odd-numbered item (item 7) loaded on the second factor.

1 The items' mean ranged from 1.83 (item 6) to 4.47 (item 5), with an average of 3.70 ($SD = 0.28$). The
2 corrected item-total correlation ranged from 0.05 (item 9) to 0.46 (item 15), with an average of 0.28. Items nine
3 and six were the ones with the lowest corrected item-total correlation, 0.05 and 0.07, respectively. The
4 Cronbach's alpha for the 15 items was 0.67, and increased slightly if items six and nine were removed (Table 3).

5 Given the above results, the two dimensions seem to have arisen due to the wording of the items and,
6 therefore, have no theoretical meaning. Thus, we consider using this scale as unidimensional measure to be more
7 appropriate than using it as a two-dimensional measure. The NEP scale correlated positively and significantly
8 with CN ($r = 0.38, p < 0.001$), and PEB ($r = 0.16, p = 0.02$).

9 Participants' sociodemographic variables, gender, political ideology, family income, and educational
10 level were inserted simultaneously as independent variables in a multiple regression analysis. These variables
11 explained 9% ($R^2_{\text{adjusted}} = 0.09$) of the NEP scale's variance ($F(4, 217) = 6.54, p < 0.001$). Only gender ($B = 0.24,$
12 $p < 0.001$) and political ideology ($B = 0.20, p = 0.003$) significantly predicted the NEP scores. Women and
13 individuals with a left-wing political orientation tended to score higher on the scale.

14 Following the suggestion of Zhu and Lu (2017), we checked whether the odd-numbered items (pro-
15 NEP) of the NEP scale would be sufficient to form an independent scale. First, Cronbach's alpha of this sub-scale
16 was calculated. It was 0.63 and increased slightly with the removal of item nine ($\alpha = 0.64$). Similar to the results
17 obtained with the 15 items scale, participants' scores on this sub-scale were positively and significantly
18 associated with CNS ($r = 0.36, p < 0.001$), and significantly predicted by participants' gender ($B = .24, p <$
19 0.001). Associations with other variables included in the analyses were not significant.

21 Discussion

22 We conducted two complementary studies in order to analyze the validity of using the NEP scale with
23 Brazilians, to understand what the scores obtained when using the NEP scale with Brazilians reflect about the
24 EA of this population group, and to examine ways of improving the use of this instrument with Brazilians. We
25 first conducted a systematic review of peer-reviewed papers that used the NEP scale (original and revised) with
26 Brazilians (study 1). We then analyzed the replicability of the consistent results found across the studies included
27 in the review, and examined two possible pathways of improving the use of the NEP scale with Brazilians (study
28 2). Additionally, we analyzed the revised NEP scales' convergent, predictive, and known-group validity.

29 Overall, we have six major findings. First, when used with Brazilians, the NEP scale generally presents
30 a factorial structure that differs from the one theoretically proposed. Second, the scale's internal consistency is

1 low. Third, results about the scale's convergent, predictive, and known-group validity were mixed. Fourth,
2 Brazilians tend to exhibit medium-high pro-environmental attitudes, and agree less with the dimension *limits to*
3 *growth* than with the other dimensions of the NEP scale. Fifth, according to our results, it seems more
4 appropriate to use the revised NEP scale than the original one. Sixth, the 15 items NEP scale presents better
5 predictive validity and slightly higher internal consistency than an odd-numbered 8-item version of the scale.
6 Moreover, the 15 item NEP scale's internal consistency improves when items six and nine, found to be
7 problematic in previous studies, are eliminated. In the following paragraphs, we describe these findings in detail,
8 and discuss them in relation to previous studies. We finish the discussion by showing how these finding are
9 relevant to the study of environmental attitudes, and suggest pathways to future studies.

10 Considering the NEP scale's dimensionality, the most consistent finding is the presence of a method
11 effect. In many of the studies reviewed in study 1, the even-numbered items grouped forming a factor (Bechtel et
12 al. 1999; Freire et al. 2013; Kruter et al. 2012). Similar results were found in our empirical analysis (study 2).
13 Considering that the factors of the NEP scale should represent its theoretical dimensions (Dunlap et al. 2000;
14 Zhu and Lu 2017), not the wording of the items, this method effect raises concern about the conclusions
15 specified in previous research. Avoiding this method effect is an important step toward establishing the NEP
16 scale's construct validity (Nunnally and Bernstein 1994).

17 Results from studies 1 and 2 indicate that the NEP scale's internal consistency is generally low. Only
18 two out of the 14 samples analyzed in our systematic review presented a Cronbach's alpha > 0.70 , and the
19 internal consistency found in our empirical analysis was $\alpha = 0.67$. This low internal consistency may be
20 problematic (Nunnally and Bernstein 1994). For instance, it may hinder correlations between the NEP scale and
21 theoretically related constructs, such as pro-environmental behaviors. It may also make it difficult to find
22 possible differences in women's and men's EA. As expected, we found just a small correlation between the NEP
23 scale and self-reported pro-environmental behaviors ($r = 0.16$) in our empirical analysis. It is plausible that this
24 correlation may be stronger if the NEP scale had better internal consistency. For instance, studies in which the
25 NEP scale and the scale measuring pro-environmental behaviors presented good internal consistency ($\alpha \geq 0.75$)
26 found a stronger association between these constructs ($r > 0.30$) (e.g., Mayer and Frantz 2004; Whitburn et al.
27 2018).

28 Findings from the systematic review regarding the NEP scale's convergent, predictive, and known-
29 group validity were mixed. Our results from the systematic review showed that in three of the 13 studies, the
30 theoretically expected associations between the NEP scale and related constructs (i.e., convergent and predictive

1 validity) were mixed (Table 2). Moreover, five studies analyzed gender differences (known-group validity) in
2 Brazilians' EA and two of them failed to find the expected difference (Kim et al. 2006; Vikan et al. 2007).
3 Nevertheless, the results of our empirical analysis supported the revised NEP's convergent, predictive, and
4 known-group validity. In line with previous studies (Gifford and Nilsson 2014; Gkargkavouzi et al. 2018;
5 Mayer and Frantz 2004), we found that the revised NEP correlated positively with CNS (convergent validity),
6 and PEB (predictive validity). Participants' EA were also related to gender and political ideology (known-group
7 validity), with women and people with left-wing political orientation showing higher EA. Unexpectedly, we
8 found that income and current semester at university do not predict participants' EA. The reason for this might
9 be the low variation in income among our participants, which hinders the possibility of identifying a significant
10 difference (Tabachnick and Fidell 1996). Also, education provided in Brazilian universities may not be effective
11 to modify students' EA (Teixeira et al. 2016). Considering the NEP scale's convergent validity, the measures
12 used in previous studies, as well as in our own (CNS), do not seem to overlap in content with the items included
13 in the NEP scale. Thus, the correlation found between the variables is not due to item similarities.

14 In line with previous studies, our findings show that Brazilians tend to exhibit medium-high pro-
15 environmental attitudes (Table 1), and have a tendency to agree less with the *limits to growth* dimension than
16 with the other dimensions of the NEP scale (Pires et al. 2016). In our second study, items six and nine from the
17 dimension *limits to growth* had the two lowest means of the scale (Table 3). One reason for this may be that
18 Brazil is a big country, rich in natural resources and, as such, people may believe the Earth has enough resources
19 for everybody. This low agreement with the *limits to growth* dimension would be problematic if it imposes a
20 barrier to pro-environmental behaviors. On the other hand, the wording of item six ("The Earth has plenty of
21 natural resources if we just learn how to develop them") may be problematic. Whereas it is unlikely that just
22 learning how to develop natural resources will solve the problem of resource over-exploitation, some places on
23 Earth have plenty of natural resources (e.g., Brazil) and it is beneficial to learn how to use them. Thus, even
24 people with strong pro-environmental attitudes can agree with this anti-NEP item. Future studies including
25 content analysis, individual interviews, and focus groups could help us to understand these results.

26 As mentioned before, the results of our empirical analysis supported the revised NEP scale's
27 convergent, predictive, and known-group validity. It should be noted that the revised version of the scale was
28 developed to improve the original one. Thus, we encourage researchers to direct their efforts to improve the
29 revised NEP scale instead of using/improving the original one. As a first step towards its improvement, we
30 followed Zhu and Lu's (2017) suggestion and analyzed the internal consistency, predictive, convergent, and

1 known-group validity of the eight odd-numbered items of the revised NEP scale. According to our results, this 8-
2 item NEP version of the scale presented an internal consistency similar to the 15-item version. It also correlated
3 with CNS (convergent validity) and captured gender differences. However, the 8-item version of the scale did
4 not predict pro-environmental behaviors, nor correlated with participants' political ideology. Therefore, this first
5 analysis indicates the odd-numbered sub-scale is not as valid as the 15-item scale (Nunnally and Bernstein
6 1994). In a further attempt to improve the revised NEP scale, we analyzed the internal consistency of the scale if
7 the items that have repeatedly been found to be problematic in previous studies with Brazilians (items six and
8 nine) were eliminated (Table 1, Supplementary Material). In line with previous studies, the scale obtained
9 greater internal consistency without these items (Table 3).

10 Our results have practical implications for the study of Brazilians' EA. First, our findings showed a
11 need for further analyses of how Brazilians understand the items included in the NEP scale. Poor understanding
12 could be a plausible reason for the low internal consistency found, and the variability in the NEP scale's factorial
13 structure. Second, the results are in line with previous studies suggesting that more research is needed to avoid
14 the effect of positive and negative item wording on the NEP scale's factorial structure (Bechtel et al. 1999; Freire
15 et al. 2013; Kruter et al. 2012). When researchers find a bi-factorial solution for the NEP scale, with even-
16 numbered items loading on one factor and odd-numbered items loading on the other factor, we encourage them
17 to consider the scale as unidimensional. A unidimensional structure makes more sense than a bi-factorial
18 structure derived from a source of measurement error (Pires et al. 2016; Podsakoff et al. 2003; Zhu and Lu
19 2017). In addition, the unidimensional structure is in line with common usage of the NEP scale (Dunlap and Van
20 Liere 1978; Dunlap et al. 2000; Whitburn et al. 2018). Third, similar to Ogunbode (2013), our results highlight
21 the importance of considering participants' local context when interpreting their answers to the NEP scale's
22 items.

23 As suggested by Zhu and Lu (2017), more reliable results could be obtained by re-writing the negative
24 items of the NEP scale in a positive way. Future empirical studies could check whether an NEP scale in which
25 all the items are written in a positive way while keeping their original meaning, reduces the measurement error
26 derived from having items written both in a positive and negative way. The possible acquiescence bias derived
27 from using only pro-NEP items should also be considered (Podsakoff et al. 2003).

28 Considering the results of the present studies, as well as those of previous systematic reviews of the use
29 of the NEP scale (Hawcroft and Milfont, 2010), we believe researchers should exert caution when using the NEP
30 scale to assess EA. According to our results and those of previous studies (Battistella 2012; Bechtel et al. 1999;

1 Freire et al. 2013), the NEP scale does not have strong predictive power and its theoretical dimensionality should
2 be questioned. Moreover, we suggest that future studies conduct a content validation of the NEP scale, as the
3 writing of some items may not be representing the theoretical domain adequately or hindering people's
4 understanding.

5 Considering the differences found in the NEP scale's dimensionality and reliability between WEIRD
6 and non-WEIRD countries (Albrecht et al. 1982; Amburgey and Thoman 2012; Bechtel et al. 1999; Dunlap et al.
7 2000; Dunlap and Van Liere 1978; Schultz et al. 2005), we believe studying the validity of the NEP scale in
8 other non-WEIRD societies is relevant to enhance the generalizability of the results. It may be especially
9 important in Asian and South American countries from where previous studies have reported evidence of a
10 method effect derived from the items' positive and negative wording (Atav et al. 2015; Freire et al. 2013;
11 Moyano-Díaz and Palomo-Vélez 2014; Reyna et al. 2018; Xie et al. 2017; Zhu and Lu, 2017).

12 Some limitations should be considered when interpreting our results. First, both studies drew on non-
13 probabilistic samples of undergraduate students, hindering the generalizability of our results to the wider
14 population. Second, we did not find any studies in our systematic review of the literature that examined the
15 influence of experimental interventions on Brazilians' environmental attitudes, nor any studies with children.

16 Hence, our results are limited to a narrow sample of Brazilian adults. Third, many studies included in the
17 literature review did not report important information needed to evaluate the validity of the NEP scale, such as
18 the scale's internal consistency and the criteria used in their EFA. Considering the latter, some studies took the
19 decision regarding the number of factors to extract by considering Kaiser's criterion (eigenvalue > 1). However,
20 this criterion tends to overestimate the number of factors to be extracted (Damásio 2012; Fabrigar et al. 1999).

21 Also, the orthogonal Varimax rotation, which is not the most appropriate rotation method when factors are
22 correlated, was the rotation method most frequently used (Table 2, Supplementary Material). Thus, we
23 encourage future researchers to consult guidelines on EFA before using this technique with their data (Beavers et
24 al. 2013; Damásio 2012; Fabrigar et al. 1999; Osborne 2015; Sakaluk and Short 2017). Fourth, we could not run
25 an exploratory Structural Equation Model (SEM) due to the small sample, but future studies using more
26 sophisticated statistical techniques such as this might provide additional support for our results. Fifth, it would be
27 relevant to analyze the association between the NEP scale and observed environmental behaviors in a Brazilian
28 sample as people tend to over-report their pro-environmental behaviors (Gifford and Sussman 2012).

29 In addition to improving the revised NEP scale through some of the guidelines reported above, future
30 studies using this scale could test the influence of interventions on environmental attitudes, including

1 participation in environmental education programs and experiences in nature (Duerden and Witt 2010). The use
2 of this scale with children from non-WEIRD countries also requires further examination. This will help us to get
3 closer to an empirical and theoretical integration of the use of the NEP scale and, in turn, a better understanding
4 of environmental attitudes.

6 **Compliance with Ethical Standards**

8 **Ethical approval**

9 **Study 1:** For this type of study formal consent is not required.

10 **Study 2:** All procedures performed in studies involving human participants were in accordance with the ethical
11 standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its
12 later amendments or comparable ethical standards.

14 **Conflict of interest**

15 On behalf of all authors, the corresponding author states that there is no conflict of interest.

17 **Informed consent**

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

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Table 1

Summary Statistics for Studies using the NEP scale in Brazil Included in the Systematic Review

Study	Brazilian sample size	NEP version	Gender (% men)	Age (mean)	Total items applied	Mean NEP	Standard deviation NEP	** α NEP	Dimensions found
Pires et al. (2016)	410	Revised	36.3	31.7	15	-	-	0.76	1
Polli e Camargo (2016)	150	Revised	50	-	14	4.02	0.50	0.63	-
Teixeira et al. (2016)	123	Revised	68.3	22.3	15	3.76	0.44	0.64	-
Iglesias et al. (2014)	272	Revised	41.7	24,0	15	-	-	0.67	1
Freire et al. (2013)	538	Revised	27.2	-	15	-	-	-	3
Battistella (2012)	206	Original	0	-	12	4.20	0.41	0.64	1
Battistella et al. (2012)	454	Revised	60.6	-	15	3.66	-	0.76	4
Kruter et al. (2012)	283	Original	51.9	-	7	3.99	0.98	0.66	2
Silva-Filho et al. (2009)	277	Revised	55.1	-	15	3.72	0.48	0.61	6
Vikan et al. (2007)*	1. PA: 60	Revised	50	22.7	15	3.73	0.42	0.66	5
	2. JP: 60	Revised	50	22.6	15	3.76	0.35	0.53	5
Kim et al. (2006)*	422	Revised	51.5	-	15	3.59	1.25	-	-
Schultz et al. (2005)*	208	Revised	27	27	15	3.55	0,36	0.56	-
Bechtel et al. (1999)	137	Original	-	-	12	-	-	-	3
Total	3,600	-	43.9	25.1	-	3.80	0.58	0.65	-

Note. - = no data available. *Studies included in the meta-analysis of Hawcroft and Milfont (2010). **When possible, Cronbach's alpha from the largest number of items was considered (e.g., full scale). PA = Porto Alegre, e JP = João Pessoa.

Table 2
NEP scale's predictive and convergent validity

Selected articles	Results	Description of the results
Iglesias et al. (2014)	Expected	A negative correlation was found between the NEP scale score and the Psychological Barriers Scale for pro-environmental behavior ($r = -0.34, p < 0.01$).
Freire et al. (2013)	Mixed	The sum of items 3, 5 and 15 was positively associated with one dimension of pro-environmental behavior (sustainable consumption) and negatively associated with the other dimension (engagement with environmental issues). The sum of items 1 and 11 was positively associated with both dimensions of environmental behavior. The sum of items 12, 8 and 2 was negatively correlated with the consumption dimension and positively correlated with the engagement dimension (Freire et al., 2013 Table 4).
Battistella (2012)	Expected	NEP scale score correlated positively with ecological consumption ($r = 0.36, p < 0.01$), and ecological behavior ($r = 0.17, p < 0.05$).
Kruter et al. (2012)	Mixed	The dimension with pro-NEP items significantly predicted the intention to purchase green plastic ($B = 0.13, p = 0.007$). However, the dimension with anti-NEP items ($B = 0.02, p = 0.70$) did not have a predictive power.
Silva-Filho et al. (2009)	Expected	A positive correlation was found between the NEP scale score and intentions to engage in pro-environmental behaviors ($r = 0.15, p = 0.02$).
Vikan et al. (2007)*	Expected	Significant negative correlations between the NEP scale score and measurements of horizontal ($r = -0.18$) and vertical ($r = -0.19$) individualism were found.
Kim et al. (2006)*	Expected	Higher scores on the NEP scale were associated ($r = 0.19, p < 0.01$) with greater motivation to attend an event because of its attractions (environmental films).
Schultz et al. (2005)*	Mixed	From six countries, the Brazilian sample was the only one in which people's desire for power was not significantly associated with the NEP scale score. Nevertheless, the NEP scale score was significantly associated with universalism ($r = 0.23$), and safety ($r = -0.27$) in the expected directions in the Brazilian sample.

Note. *Articles included in the meta-analysis of Hawcroft and Milfont (2010). Expected = Relations expected were found between NEP scale and constructs theoretically associated; Mixed = Mixed results found (i.e., some in the expected direction and some in the opposite direction or non-significant).

Table 3

Factorial Loadings in each Factor, Mean (SD), Corrected Item-Total Correlation, and Cronbach's Alpha if the Item is Eliminated (n = 222)

NEP scale items	1	2	Mean (SD)	Corrected item-total correlation	α if the item is eliminated
1. We are approaching the limit of the number of people the earth can support.	0.29	0.19	3.03 (1.10)	0.31	0.65
2. Humans have the right to modify the natural environment to suit their needs.	0.10	0.44	3.55 (1.16)	0.36	0.64
3. When humans interfere with nature it often produces disastrous consequences.	0.58	-0.14	3.92 (1.07)	0.21	0.66
4. Human ingenuity will insure that we do not make the earth unlivable.	-0.06	0.37	3.27 (1.10)	0.18	0.67
5. Humans are severely abusing the environment.	0.60	-0.01	4.47 (0.86)	0.34	0.65
6. The earth has plenty of natural resources if we just learn how to develop them.	-0.07	0.13	1.83 (0.81)	0.07	0.68
7. Plants and animals have as much right as humans to exist.	0.28	0.40	4.43 (0.86)	0.39	0.64
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations.	0.23	0.38	4.34 (0.74)	0.42	0.64
9. Despite our special abilities, humans are still subject to the laws of nature.	0.15	-0.05	4.39 (0.67)	0.05	0.68
10. The so-called "ecological crisis" facing humankind has been greatly exaggerated.	0.11	0.52	3.66 (1.06)	0.38	0.64
11. The earth is like a spaceship with very limited room and resources.	0.24	0.004	3.66 (1.09)	0.15	0.67
12. Humans were meant to rule over the rest of nature.	0.01	0.58	3.66 (1.17)	0.35	0.64
13. The balance of nature is very delicate and easily upset.	0.55	0.10	3.74 (1.00)	0.40	0.64
14. Humans will eventually learn enough about how nature works to be able to control it.	-0.09	0.43	3.20 (1.01)	0.22	0.66
15. If things continue on their present course, we will soon experience a major ecological catastrophe.	0.56	0.22	4.29 (0.77)	0.46	0.64
Total	-	-	3.70 (0.39)	0.28	0.67

Note. Loadings ≥ 0.32 bold.