Psychometric Properties for the Brazilian Version of the New Ecological Paradigm – Revised

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Abstract

The New Ecological Paradigm (NEP-R) is one of the hallmarks for the measurement of ecological attitudes. Attention has been given to its psychometric properties during the last ten years, but no analyses have been conducted until now using an Item Response Theory (IRT) approach. With this purpose, a sample of 410 recruited responders answered the NEP-R's 15 items in Brazilian Portuguese. An item analysis was conducted considering: dimensionality; reliability; discrimination; item information; and item/person hierarchy. The results for the principal component analysis of standardized residues supports a unidimensional structure. Results for item fit coefficients (INFIT and OUTFIT) indicate that the items have good predictive power for the response patterns in the latent trait *continuum* representing ecocentrism. In turn, the results for person discrimination and item hierarchy point out that the scale is restricted as to the levels of difficulty it represents. The findings include that the most revealing items for environmental attitudes in a Brazilian sample consist of the set of items representing the "limits of growth" facet.

Keywords*:* Ecocentrism, environmental attitudes, values, item analysis.

Propriedades Psicométricas da Versão Brasileira da Escala de Novo Paradigma Ecológico – Revisada

Resumo

O Novo Paradigma Ecológico (NPE-R) é um dos marcos na medida de atitudes ecológicas. Suas propriedades psicométricas têm sido investigadas durante os últimos dez anos, mas não há na literatura

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análises disponíveis utilizando a Teoria de Resposta ao Item (TRI). Com esse objetivo, foram recrutados 410 participantes para responder os 15 itens da NPE-R em português brasileiro. Uma análise de itens foi conduzida considerando: dimensionalidade, confiabilidade, discriminação, informação do item e hierarquia de itens/pessoas. A análise de componentes principais dos resíduos padronizados suporta uma estrutura unidimensional. Resultados do ajuste dos itens pelos coeficientes de *INFIT* e *OUTFIT* indicam que os itens possuem bom poder preditivo para os padrões de resposta no *continuum* de traço latente representativo do ecocentrismo. Por sua vez, os resultados para o poder de discriminação da escala e a hierarquia de itens apontam que a escala é restrita quanto aos níveis de dificuldade que abarca. Os achados incluem que os itens mais reveladores de atitudes ambientais para a amostra brasileira consistem no conjunto que representa a faceta de "limites de crescimento".

Palavras-chave*: Ecocentrismo, atitudes ambientais, valores, análise de itens.

Propiedades Psicométricas de la Versión Brasileña de la Escala Nuevo Paradigma Ecológico – Revisado

Resumen

El Nuevo Paradigma Ecológico (NPE-R) es uno de los marcos en la medida de las actitudes ecológicas. Sus propiedades psicométricas han sido investigadas en los últimos diez años, pero no hay un análisis de la literatura disponible usando la Teoría de Respuesta al Ítem (TRI). Para esto, 410 participantes fueron reclutados para responder los 15 ítems de la NPE-R en portugués de Brasil. Se realizó un análisis de ítems considerando: dimensionalidad, fiabilidad, la discriminación, la información de los ítems y de la jerarquía de los ítems/personas. El análisis de componentes principales de los residuos estandarizados soporta una estructura unidimensional. Los resultados del ajuste de los ítems por los coeficientes de *INFIT* y *OUTFIT* indican que los ítems tienen un buen poder predictivo de los patrones de respuesta en el *continuum* latent representativo del ecocentrismo. A su vez, los resultados para el poder de la discriminación escala y jerarquía de ítems señalan que la escala está restringida en cuanto a los niveles de dificultad. Los hallazgos incluyen que los elementos más reveladores de las actitudes ambientales para la muestra brasileña son formados por el conjunto de ítems de la faceta de "límites del crecimiento".

Palabras clave: Ecocentrismo, actitudes ambientales, valores, análisis de ítems.

The relationship between humankind and the environment has been a major concern worldwide throughout the past four decades, which started with the United Nations Stockholm Conference in 1972 (U.N., 1972). This relationship is of great importance for all segments of society and across all spectrums of sciences. Evidence supports that humans indeed impact and change the environment which can lead to consequences such as climate change (Rogelj, McCollum, Reisinger, Meinshausen, & Riahi, 2013), carbon dioxide emission into the atmosphere (Cole, Elliott, Okubo, & Zhou, 2013), and increasing air pollution (Fang, Naik, Horowitz, & Mauzerall, 2013). In fact, some researchers address this issue through social and psychological points of view. On that perspective, one of the current challenges has been the constant development of measures and mapping of constructs relevant to understanding ecological attitudes (e.g., Dunlap, 2008; Hawcroft & Milfont, 2010).

The New Ecological Paradigm Revised (NEP-R) proposed by Dunlap, Van Liere, Mertig and Jones (2000) is one of the hallmarks on providing measure on the psychological aspects of the ecological beliefs. The NEP-R aims to measure core beliefs about the relationship between the human civilization and nature. This type of information may provide key aspects for the success of social policies in education, regulation and ways to endorse ecofriendly

behaviors. Those are reasons why NEP-R has been used extensively in the United States of America and translated into other languages (Hawcroft & Milfont, 2010).

During the last review on the use of the NEP-R, Dunlap (2008) states two important observations that were assumed as goals for the current paper: (a) the possibility of adapting the NEP-R into different cultural contexts due to implications of the environmental concern as a trait; and (b) unidimensionality as a problem, because NEP-R results are usually measured with a singular general score.

The New Environmental Paradigm (NEP)

The NEP-R had its first version during the 1970's, when Dunlap and Van Liere (1978) created the scale New Environmental Paradigm (NEP). The original NEP is a 12-item scale measuring three theoretical dimensions – facets – that can be listed as:

1. Humans' ability to upset the balance of nature;
2. The existence of limits of growth; and
3. Human's right to rule over the rest of nature-thus, 4 items for each facet.

Despite its theoretical structure, NEP has been used mostly as a unidimensional measure for ecological attitudes – items were summed to result in a general score. High NEP scores were treated as evidence for an ecocentric orientation. The NEP scale held good predictive validity distinguishing between environmentalists and general population (Dunlap & Van Liere, 1978). The paper from 1978 also reports a high internal consistency level and a unidimensional structure through unrotated principal factors analysis.

While providing the reviewed version for NEP, Dunlap et al. (2000) argued that there was small consensus on whether the scale measured a single or multiple constructs (multidimensional) – in the last case, evidence appeared towards a three – or even a four-dimensional structure (e.g., Roberts & Bacon, 1997; Shetzer, Stackman, & Moore, 1991). Dunlap et al. (2000) also suggested that the 1978 version had

an artifact dimension derived from the unbalanced wording in the scale - only 4, among the total of 12 items were worded in an anti-NEP direction.

The New Ecological Paradigm (NEP-R)

Considering the criticism against NEP, Dunlap et al. (2000) proposed a revision of the scale. The name changed into New Ecological Paradigm Revised (NEP-R). The revision aimed problems known from the 1978's version, especially some of the outdated content and terminology (e.g., mankind). Dunlap (2008) stated that the environment as an attitude object had changed since 1978, where environmental problems evolved into a more complex structure as well as the knowledge on ecology. Other important targets of the revision include:

1. Achieving a better balance between pro- and anti-NEP statements;
2. Content was broadened beyond the original three facets;
3. A midpoint response category was also included giving it a five response categories structure; and
4. The number of items increased to tap the two new facets of the scale (Dunlap et al. 2000).

The final form of NEP-R consists in a set of 15 items. Each subset of three items reflects one facet. NEP-R's facets (and respective items) are: the reality of limits of growth (1, 6, 11), antianthropocentrism (2, 7, 12), the fragility of nature's balance (3, 8, 13), rejection of exemptionalism (4, 9, 14) and the possibility of an ecocrisis (5, 10, 15). Considering the anti- and pro-NEP wording, the eight odd-numbered items were worded in the direction of pro-NEP beliefs and the seven even-numbered towards anti-NEP beliefs. The scoring system remained the same as in the 1978 version.

NEP-R: Consistency and Dimensionality. According to an extensive meta-analysis provided by Hawcroft and Milfont (2010), the reliability indexes tend to vary in a wide range from .35 to .87, with an average of .68 (*SD* = .11). The authors suggest that the variability of

methods and samples applied among the NEP-R studies might be the main reason for differences between reliability indexes. Nonetheless, translations might also vary in terms of the quality and amount of preserved content. Culture as well might pose changes on the representation of constructs (International Test Commission, 2010).

Dimensionality for the NEP-R has been controversial since its beginning when Dunlap et al. (2000) opted for an orthogonal method to rotate factors, while the concept of the scale actually represents a high order model – with five facets representing the environmental concern (Amburgey & Thoman, 2012). Regardless, the scale has been largely used as a unidimensional scale in most of the contributions. Dunlap et al. (2000) presents only a single score, not proposing scores upon the different facets, although Dunlap (2008) stated that the next steps on NEP-R's measures would be to develop an understanding of its structure with confirmatory models. Hawcroft and Milfont (2010) provide a deeper reference on the dimensional issues concerning NEP-R.

NEP-R and Brazil. According to Dunlap (2008), one of the intriguing questions about the instrument is whether NEP-R would be able to represent universal values, which would mean carrying the same dimensional structure/concept into different cultures, or not (Chatterjee, 2008). Hawcroft and Milfont (2010) reported that there are 69 studies in 36 countries considering every different version of the NEP, including the New Environmental Paradigm (Dunlap & Van Liere, 1978).

During a bibliographic review, a Brazilian-adapted and valid version of NEP-R was not detected as published. The availability of the NEP-R in Brazilian Portuguese can represent an important contribution to the scenario considering Ecological Attitudes researches in Brazil and important cues on measurement for Portuguese speaking countries. This does not mean that measures in this topic are non-existent in Brazil, but still there is only a handful of contributions and even fewer directed towards a psychometric assessment or providing

adaptation of measures on ecocentrism (e.g. Coelho, Gouveia, & Milfont, 2006; Gouveia, Martinez, Meira, & Milfont, 2001).

The purpose of the present study is to investigate the psychometric properties of the Brazilian-adapted version of the NEP-R. We conducted the psychometric assessment using Item Response Theory (IRT) techniques. IRT provides a practical approach where information is fitted to a single *continuum* representing the latent trait (de Ayala, 2009). A detailed view of the trait levels NEP-R items can provide can inform on which items are the most revealing for ecological attitudes, which may represent a key information for future researches Brazil.

The IRT approach demonstrated to be not just appropriate for use while assessing NEP-R - as the facets conceptually are represented under the same high order factor and the empirical results fitted further in the current study -, but the modern measurement paradigm also offers three key advantages when compared to Classical Test Theory (CTT).

1. Items and person's trait levels are estimated and located on the same metric *continuum*, providing the possibility of comparing both. This is especially useful on interpreting how well the instrument covers different ability levels and how that corresponds to the sample distribution.

2. In IRT item and person parameters are estimated independently, which provides a less sample dependent estimation approach when compared to CTT and a more robust approach to error.

3. Finally, while in CTT ability levels for items and person tend to change depending on format of the test and sample, in IRT ability levels for both items and person will be invariant across different test formats and different samples (Abedalaziz & Leng, 2013; Adedoyin, Nenty, & Chilisa, 2008).

Method

Sample

The sampling technique of the current research can be better characterized as conve-

nience sampling, with subjects being recruited in the vicinities of the Federal University of Rio de Janeiro by the research team, being invited to voluntarily answer the forms in the Institute of Psychology. A minimum requirement for recruitment was that subjects should have at least completed primary education. The data collection started in March 1st and finished in May 1st of 2013. Most participants were female ($n = 261$, $n = 149$ males, $N = 410$), with a mean age of 31.75 ($SD = 11.11$). Considering the educational level, $n = 25$ (6.1%) of the participants had education below secondary level, $n = 53$ (12.9%) of the participants have completed secondary education, $n = 121$ (29.5%) were undergraduate students, $n = 211$ (51.5%) were professionals with completed undergraduation studies.

Instruments

A translated and adapted version of the NEP scale to the Brazilian Portuguese language was used. The translation process happened through translation and back translation method following the guidelines established by the International Test Commission (2010), with the assistance of a team of social psychologists, with the objective to preserve both the meanings of the NEP-R items and also adapt its content to Brazilian's cultural context. The final version of the measure was called NEP-R-BR for differentiating it from the North-American version. Participants responded to the NEP-R items using 5-point Likert-type scales (1 = Strongly Disagree, 5 = Strongly Agree), preserving the original form. Items were scored according to Dunlap et al. (2000), where even items (2, 4, 6, 8, 10, 12 and 14) were inverted, considering they compose an anti-NEP belief system, while odd items scored normally in a pro-NEP orientation.

Data Analysis

IRT analysis was conducted in the software Winsteps version 2.75 (Linacre, 2012). Wisnteps is a windows-based software, which provides IRT analysis based in Rasch family models. In specific for rating scales, the software offers outputs on Andrich's Rating Scale Model

(RSM) – same number of response categories amongst items – and Master's Partial Credit Model (PCM) – different number of response categories amongst items.

NEP's dimensionality was assessed through a principal components analysis (PCA) of the standardized residuals. According to Linacre (2012), the PCA provides an assessment of the behavior of explained variance and unexplained variance, given by eigenvalues (e). The author affirms that unidimensionality is always approximate as Rasch model constructs from response patterns along with unidimensional latent trait that best explains data. From that approach, imperfection tends to result in multidimensionality and the unexplained variance in a data corresponds to the variance of the residuals. When interference reaches a high degree, there's a decreasing chance that a measure can be accurately represented predominantly in a single latent trait *continuum*. The PCA of the standardized residuals in Winsteps provides information on the amount of variance that the latent trait *continuum* fails to account for. The recommendation is that the first contrast's eigenvalue should not be larger than 2.0 for the unexplained variance. Variance provided by items should be higher than the first contrast as well. It is important to mention that the higher unexplained variance in first contrast would indicate that other dimensions might be generating fit problems.

After unidimensionality assessment, reliability was measured using person and item reliability indexes from RSM; and Cronbach's Alpha (α). According to de Ayala (2009), person reliability is an index provided to verify if the instrument is sensible enough to distinguish between high and low performers, the recommended cut-off point for the index is above 0.80. Item reliability evaluates if sample size is enough to ensure item hierarchical difficulty of the instrument (construct validity). Recommended values for this index are above 0.90. After reliability results, the functioning of the rating scale was analyzed.

The RSM presents the prerogative that each rating should ascend according to the latent trait (e.g., rating 2 requires a higher trait level than

needed for rating 1 and onwards). A general evaluation was conducted using the difficulty level for each answer category (*b*) and infit and outfit statistics. Infit and outfit indexes provide information of the response patterns. The difference between the two measures is that infit indicates unexpected responses to items near a person's ability location, while outfit indicates unexpected responses a person gives to items far from one's ability measure. De Ayala (2009) suggests cut-off point values for both indexes should be between 0.50 and 1.50.

At last, an analysis of the fit for each item inside the scale was conducted, which is also based on infit/outfit statistics. In this case, infit/outfit statistics reveal whether the items serve as predictors for the subjects' response – according to their location (ability) at different levels of the construct. With the evidence on the fit of the items, the investigation proceeded to an analysis of the information in the NEP scale, according to its distribution. The test and item information functions provides on at which levels the NEP

scale offers precision and sensitivity to detect different levels of the trait (ecological concern). Finally, was performed an evaluation of the difficulty levels of the items, with the objective of mapping which beliefs on ecological concern are most revealing in the Brazilian context.

Results

Unidimensionality

The PCA analysis results held the first contrast variance statistics within the limit of *e* = 2.0 (6.4%) and the raw variance explained by the scale's item set alone is of *e* = 11.7 (37.6%), which is higher than the first contrast. Total raw variance in observations considering both person and item measures are *e* = 16.2 (51.9%), while the recommended is at least 50% for the total of explained variance (Linacre, 2012). According to the results obtained, NEP can be treated as unidimensional (Table 1) for statistical analyses thus the Rasch family models can properly model the explained variance.

Table 1
PCA of the Standarized Residual Variance for NEP Scale

Variance Type	Empirical		Modeled
	eigenvalue (*e*)	%	%
Total raw variance in observations	31.2	100.0%	100.0%
Raw variance explained by measures	16.2	51.9%	52.5%
Raw variance explained by persons	4.5	14.4%	14.5%
Raw Variance explained by items	11.7	37.6%	38.0%
Raw unexplained variance (total)	15.0	48.1%	
Unexplned variance in 1st contrast	2.0	6.4%	
Unexplned variance in 2nd contrast	1.7	5.5%	
Unexplned variance in 3rd contrast	1.4	4.3%	
Unexplned variance in 4th contrast	1.2	3.9%	
Unexplned variance in 5th contrast	1.1	3.6%	

Reliability

NEP-R-BR holds person reliability = 0.74 and item reliability = 1.00. These results indicate that measure lacks discrimination to distinguish between high and low performers, however the

sample has a proper size to confirm item hierarchy, according to item reliability. The scale shows a good consistency level of α = 0.76, considering the classification recommended by Cronbach (1951).

Rating Scale Functioning

NEP-R-BR results on the rating scale functioning suggested an adequate ascension of response categories considering the scale as a whole: "strongly disagree" (b = -2.98), "disagree" (b = -1.13), "unsure" (b = 0.01), "agree"

(b = 1.14) and "strongly agree" (b = 2.96). Infit and outfit statistics indicates that all response categories fitted to the limits between 0.50 and 1.50 and, which means that the response patterns behaved as expected, even considering the inversion of the scale (Table 2).

Table 2
Response Category's Structure for the NEP Scale

Response category	Category measure (b)	Infit	Outfit
Strongly disagree	-2.98	1.08	1.11
Disagree	-1.13	1.08	1.09
Unsure	0.01	0.95	0.88
Agree	1.14	1.01	0.98
Strongly agree	2.96	0.94	0.97

A more specific analysis of the rating scale functioning indicates that still there are two items where the response category did not ascend as expected, which are item 3 - "When humans interfere with nature, it often produces disastrous consequences" – and item 9 – "Despite our special abilities, humans are still subject to the laws of nature". On item 3 the issue was detected on the ascension from "disagree" (b = 0.31) to "unsure" (b = 0.16), representing a minor difference of 0.15 logits, although the item 9 had a higher discrepancy in the same categories from "disagree" (b = -0.17) to "unsure" (b = -0.85) representing a major difference of 0.68 logits (more than half logit, or 5 times considering a spatial relationship between item locations).

Item Hierarchy and Difficulty

According to results, on a fit perspective, all items were within the limits of the fit functioning for infit and outfit, which means they serve as reliable predictors of the sample responses (Table 3).

Considering the latent trait level (difficulty) distribution of NEP items, the three most revealing items for the environmental concern were item 6 (b = 2.17, "The earth has plenty of natural resources if we just learn how to develop them"), item 11 (b = 1.06, "The earth is like a spaceship with very limited room and resources") and item

1 (b = 0.92, "We are approaching the limit of the number of people the earth can support"). This result indicates that items related to the facet "limits of growth" represent beliefs that are the most revealing of ecological concern on a Brazilian sample.

The least revealing items for environmental concern were item 7 (b = -1.50, "Plants and animals have as much right as humans to exist"), item 9 (b = -1.42, "Despite our special abilities, humans are still subject to the laws of nature") and item 5 (b = -1.30, "Humans are severely abusing the earth"), which belong respectively to: Antianthropocentrism Human Domination, Antiexemptionalism and Eco-Crisis.

The item and person map (Figure 1) provides more information indicating evidence that NEP might have items overlapping at the least revealing trait levels. This may give explanation on why person reliability was low, which means that the scale has low ability for discriminating high and low levels of environmental concern considering its own latent trait *continuum*. From the total, 85% of items are located in areas below b = 1.00. Also, person location's distribution is graphically placed higher considering the latent trait *continuum* if compared to item locations, which suggests that most of the sample might have ability levels enough to manifest the beliefs listed on NEP-R-BR.

Table 3
Item Difficulty Levels (b), Standard Errors (SE) and Fit Statistics for the NEP-R-BR

English Version	Portuguese-BR	Facet	*b*	*SE*	Fit Statistics	
					Infit	Outfit
1. We are approaching the limit of the number of people the Earth can support.	1. *Estamos nos aproximando do limite do número de pessoas que a Terra pode suportar.*	LG	0.92	.05	1.04	1.04
2. Humans have the right to modify the natural environment to suit their needs.	2. *Seres humanos tem o direito de modificar o ambiente natural de acordo com as suas necessidades.*	AHD	0.50	.05	1.11	1.12
3. When humans interfere with nature, it often produces disastrous consequences.	3. *Quando humanos interferem com a natureza, normalmente produzem consequências desastrosas.*	BN	-1.24	.08	1.15	1.12
4. Human ingenuity will insure that we do not make the earth unlivable.	4. *A inventividade humana irá assegurar que a Terra não se torne um lugar inviável.*	AE	0.54	.05	0.86	0.91
5. Humans are severely abusing the earth.	5. *Humanos estão abusando severamente a Terra.*	EC	-1.3	.08	0.83	0.75
6. The earth has plenty of natural resources if we just learn how to develop them.	6. *A Terra tem recursos naturais em plenitude, se aprendermos como desenvolvê-los (aproveitá-los).*	LG	2.17	.06	1.19	1.19
7. Plants and animals have as much right as humans to exist.	7. *Plantas e animais tem o mesmo direito de existir que humanos.*	AHD	-1.5	.08	1.1	1.02
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations.	8. *O equilíbrio da natureza é forte o suficiente para suportar os impactos das nações modernas industrializadas.*	BN	-0.55	.06	0.82	0.78
9. Despite our special abilities, humans are still subject to the laws of nature.	9. *Apesar das nossas habilidades especiais, humanos estão sujeitos às leis da natureza.*	AE	-1.42	.08	1.01	0.94
10. The so-called "ecological crisis" facing humankind has been greatly exaggerated.	10. *A chamada "crise ecológica" enfrentada pela humanidade tem sido fortemente exagerada.*	EC	0.72	.05	0.92	0.94
11. The earth is like a spaceship with very limited room and resources.	11. *A Terra é como uma nave espacial com espaço e recursos limitados.*	LG	1.06	.05	1.06	1.06
12. Humans were meant to rule over the rest of nature.	12. *Humanos foram feitos para governar sobre o restante da natureza.*	AHD	-0.05	.06	1.33	1.29
13. The balance of nature is very delicate and easily upset.	13. *O equilíbrio da natureza é muito delicado e facilmente perturbado.*	BN	0.07	.06	1.09	1.12
14. Humans will eventually learn enough about how nature works to be able to control it.	14. *Humanos irão eventualmente aprender o suficiente sobre como a natureza funciona para ser capaz de controlá-la.*	AE	0.55	.05	0.83	0.85
15. If things continue on their present course, we will soon experience a major environmental catastrophe.	15. *Se as coisas persistirem neste curso, em breve passaremos por uma grande catástrofe ambiental.*	EC	-0.47	.06	0.85	0.81

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MEASURE      PERSON - MAP - ITEM
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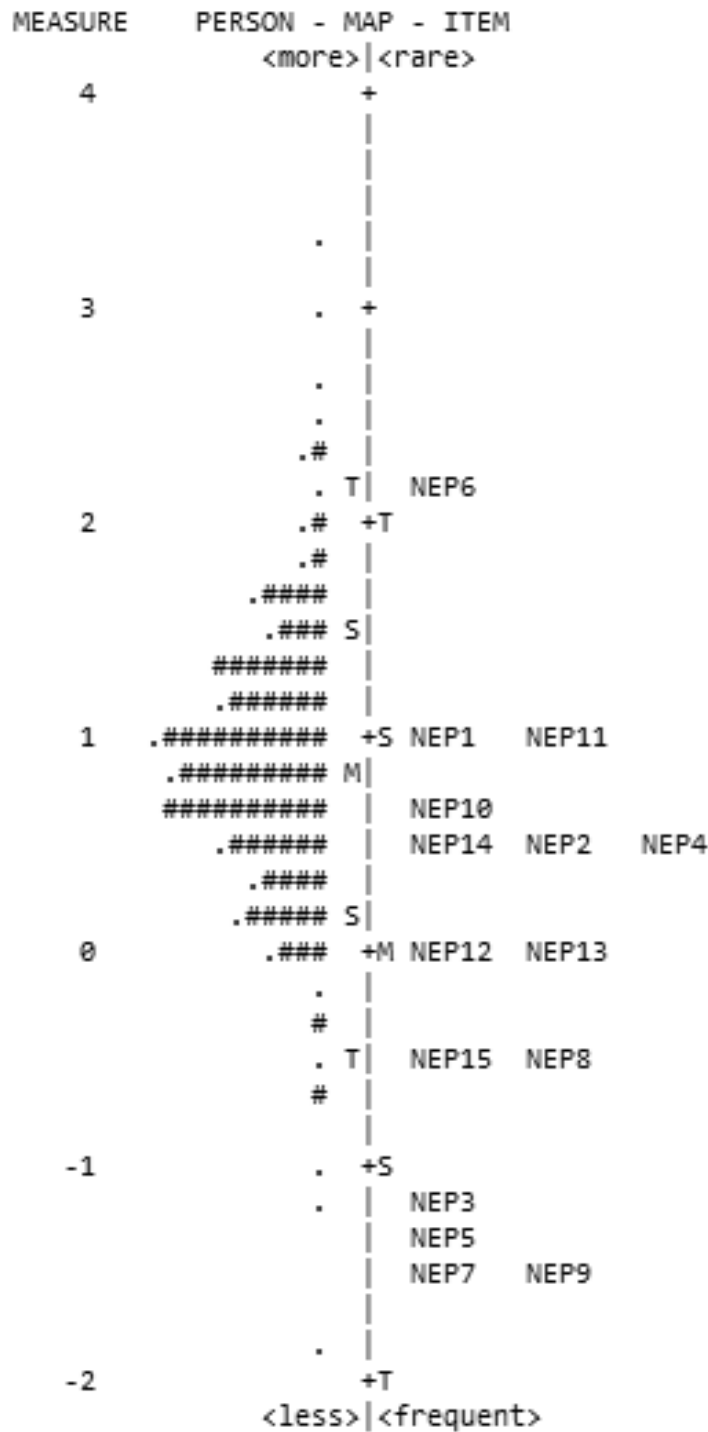
Figure 1. Item and person map of difficulty and ability levels.

The problems of the instrument related to the distribution of the items through the ecological concern's *continuum* find evidence also in the distribution of the item information functions. While the majority of items are distributed with peaks of information nearby $b = 1,00$ and below, only a single item (item 6) peaks information at a higher trait level (Figure 2).
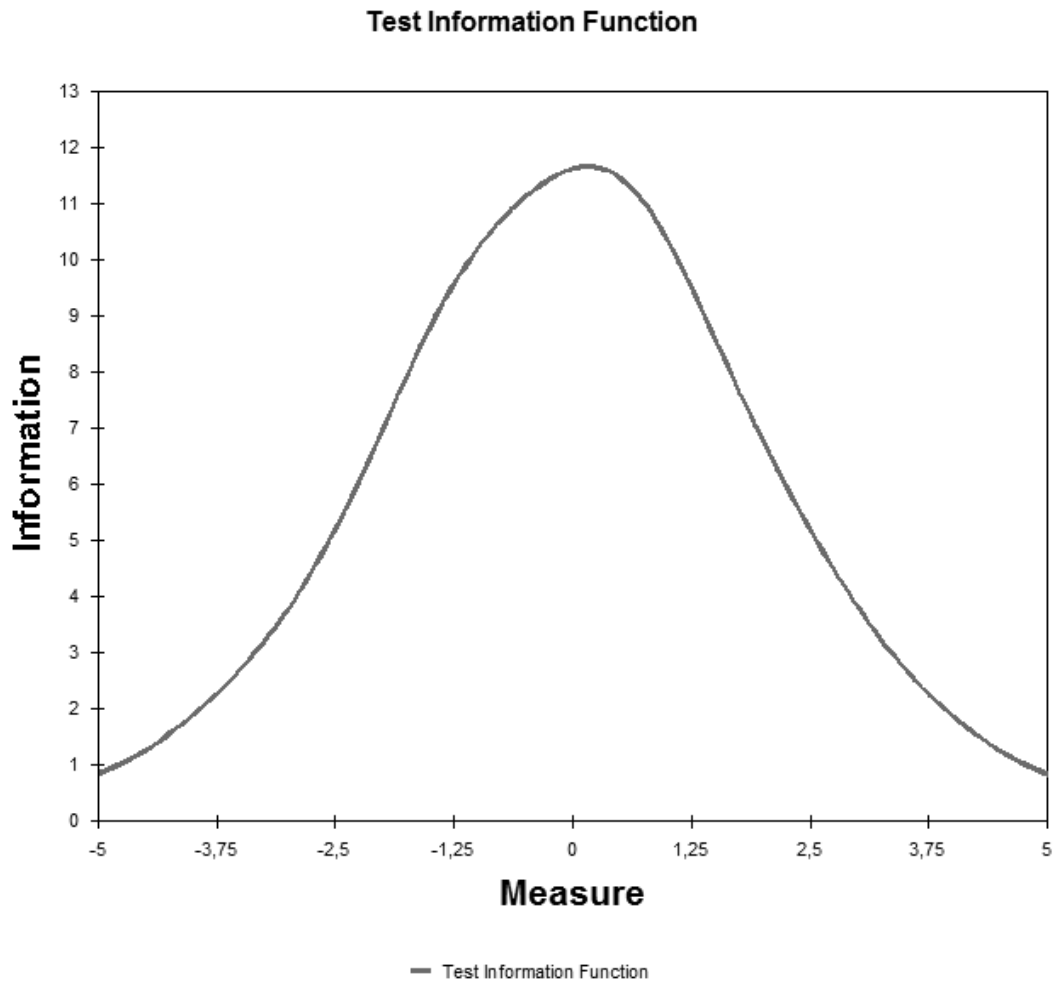
Test Information Function

Figure 2. Test Information Functions for the NEP-R-BR.

Discussion

The results on IRT analysis indicates that NEP-R-BR tends to provide a reliable and valid unidimensional measure. Considering the Brazilian context, for ecological attitudes/concern, there are important issues on it's scalability, the amount of information available by each item and ambiguity problems that need to be addressed. Also the item hierarchy provides an interesting insight over environmental attitudes on the Brazilian sample assessed.

Considering both the PCA of standardized residual variance and the Cronbach's Alpha, the data acquired for the current study shows that considering a Brazilian sample, the NEP-R-BR scale can be successfully used as a single construct measure as expected by its original authors (Dunlap et al., 2000). The current Brazil-

ian dataset's alpha was also above the average reported in the meta-analysis provided by Hawcroft and Milfont (2010) meaning that the measure is overall reliable and has good internal consistency. For future researches in environmental and ecological concern, it is important to know the internal consistency as measured by the alpha because the strength of correlations between this and other measures is limited by the extent of its reliability (Furr & Bacharach, 2014).

Besides the dimensionality and reliability results being positive about a NEP-R-BR, the rating scale functioning shows minor problems. In an IRT Rating Scale Model, it is expected that for each category of response, the latent trait location will also progress further in the trait *continuum* ($b_1 < b_2 < b_3 < b_4 < b_5$) according to de Ayala (2009) and Linacre (2012). Still, the behavior observed in the NEP-R-BR consisted of a gen-

eral functioning of the scale being in accordance to expected, although the items 3 and 9, did not have their responses ascending as expected. Both items had issues with the inversion of location between the categories "disagree" and "unsure" whereas the item 9 – "Despite our special abilities, humans are still subject to the laws of nature." – showed a higher and more worrisome discrepancy. This inversion of categories' locations might indicate that those items are in fact biased in the Brazilian culture (i.e., the probability of a person with neutral attitude towards ecological concern responding negatively to those items is greater than responding them neutrally). The dimensionality study provided by Amburgey and Thoman (2012) found measurement issues in item 9 as well, where the item did not load as a significant predictor for ecological concern in a confirmatory factor analysis. Another hypothesis can be found in Adams, Wu and Wilson (2012), where it is discussed that the lack of frequencies in response categories within the rating scale might bias fitting measures – and responses on lower categories were scarce for both items 3 and 9. Further investigation is needed with a balanced sample through response categories.

On the respect of the scalability/item hierarchy and person hierarchy, the scale can be considered to have a low power of discrimination, with most of the subjects located at the higher end of ecological concern as a latent trait. This is also known in many other contributions that used the previous (e.g., Roberts & Bacon, 1997; Shetzer et al., 1991) and current scale version (e.g., Dunlap et al., 2000; Hawcroft & Milfont, 2010), even though the respective studies considered a Classical Test Theory perspective. Thus, according to the results for the Brazilian version, the scale does not discriminate adequately different levels of environmental concern. Linacre (2012) argues that a person reliability index between .50 and .80 is able to discriminate no more than two levels of difficulty. This means that the NEP-R-BR only separates individuals with high or low ecological attitude. Two levels of discrimination are more broadly used by screening measures rather than assessment scales (Furr & Bacharach,

2014), which leads to the conclusion that NEP-R-BR should be treated as a screening measure of the ecological concern in Brazil.

According to Dunlap (2008), even though the items of NEP-R are easy, it is still possible to map how people evaluate different ecological concerns in a relative perspective. This type of comparison is well suited for IRT models, since the items are located along the same *continuum* considering a spatial relationship (Linacre, 2012). Thus, comparatively, the Brazilian sample had as its most revealing beliefs for ecological concern (hardest items) the whole "Limits of Growth" facet. This means that values related to the limits of growth of the human civilization are less likely to manifest considering the current Brazilian sample. On the other hand, the three least revealing items were related to different facets, respectively belonging to ecological crisis (item 5), rejection of human exemption (item 9) and antianthropocentrism (item 7).

Conclusion

Considering the results above, the current study successfully adapted the New Ecological Paradigm Revised for Brazilian Portuguese, considering the outcome of a single-scored construct. Although, further studies with Brazilian samples will need to verify for proper response functioning on item 9 at risk of generating noise in the ecological concern measure. Item 3 has a smaller malfunctioning which was not detected by other studies until now, but being a minor difference this might be a result of the lower power of discrimination from the NEP-R-BR itself, since the trait location of the response categories was too close.

The results considering the item hierarchy requires further investigation on how Brazilians perceive the limits of growth of humanity, in order to provide a higher power of generalization. Nonetheless, IRT showed to be an interesting resource to provide comparative information on how people assess different environmental problems while answering to the NEP-R-BR.

There are still four important weaknesses in our current study that need to be addressed in the future:

1. Having kept the original response form of the NEP-R as a traditional 5 point Likert scale, while there are evidence supporting that this format potentially generates a subsample of central tendency responders.

2. The characteristics of the sample acquired for our study represent an instructed population and is unbalanced, not representing accurately the Brazilian population. Sample balance should also include the concept of sample distribution through the rating scale.

3. The results here reflect a cross-sectional approach to the measure and a longitudinal assessment of the trait levels would contribute on understanding the stability of NEP-R.

4. The current study considered only a unidimensional approach, but the literature includes rising evidence of multidimensionality for the NEP-R despite its current uses (Amburgey & Thoman, 2012; Dunlap, 2008). Our PCA of standardized residuals marginally supported evidence for NEP-R's unidimensionality, which might be indicating other relevant dimensions emerging from the scale. Further research with confirmatory models might bring valuable answers as to the underlying factor structure of the NEP-R.

References

Abedalaziz, N., & Leng, C. H. (2013). The relationship between CTT and IRT approaches in Analyzing Item Characteristics. *Malaysian Online Journal of Educational Sciences, 1*(1), 64-70. Retrived from http://repository.um.edu.my/90778/1/v01i01-05.pdf

Adams, R. J., Wu, M. L., & Wilson, M. (2012). The Rasch Rating Model and the Disordered Threshold Controversy. *Educational and Psychological Measurement, 72*(4), 547-573. doi:10.1177/0013164411432166

Adedoyin, O. O., Nenty, H. J., & Chilisa, B. (2008). Investigating the invariance of item difficulty parameter estimates based on CTT and IRT. *Educational Research and Reviews, 3*(2), 83-93. Retrieved from http://www.academicjournals.org/article/article1379586248_Adedoyin%20et%20al..pdf

Amburgey, J., & Thoman, D. (2012). Dimensionality of the New Ecological Paradigm: Issues of factor structure and measurement. *Environment & Behavior,44*, 235-256. doi:10.1177/0013916511402064

Chatterjee, D. (2008). Oriental disadvantage versus occidental exuberance - Appraising environmental concern in India. *International Sociology, 23*, 5-33. doi:10.1177/0268580907084384

Coelho, J. A., Gouveia, V. V., & Milfont, T. L. (2006). Valores humanos como explicadores de atitudes ambientais e intenção de comportamento pró-ambiental [Human values explaining environmental attitudes and the intentions behind pro-environmental behavior]. *Psicologia em Estudo, 11*, 199-207. Retrieved from http://www.scielo.br/pdf/pe/v11n1/v11n1a23.pdf

Cronbach, L. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*, 297-334. Retrieved from http://psych.colorado.edu/~carey/courses/psyc5112/readings/alpha_cronbach.pdf

Cole, M. A., Elliott, R. J. R., Okubo, T., & Zhou, Y. (2013). The carbon dioxide emissions of firms: A spatial analysis. *Journal of Environmental Economics and Management, 65*(2), 290-309. doi:10.1016/j.jeem.2012.07.002

De Ayala, R. J. (2009). *The theory and practice of Item Response Theory*. New York: The Guilford Press.

Dunlap, R. (2008). The new environmental paradigm scale: From marginality to worldwide use. *The Journal of Environmental Education, 40*(1), 3-18. doi:10.3200/JOEE.40.1.3-18

Dunlap, R., & Van Liere, K. (1978). The new environmental paradigm: A proposed measuring instrument and preliminary results. *Journal of Environmental Education, 9*(1), 10-19.

Dunlap, R., Van Liere, K., Mertig, A., & Jones, R. (2000). Measuring endorsement of the new ecological paradigm: A revised NEP scale. *Journal of Social Issues, 56*(3), 425-442. Retrieved from http://ces.ruc.edu.cn/upfile/image/1376370303_103.pdf

Fang, Y., Naik, V., Horowitz, L. W., & Mauzerall, D. L. (2013). Air pollution and associated human mortality: The role of air pollutant emissions, climate change and methane concentration increases from the preindustrial period to present. *Atmospheric Chemistry and Physics,*

13(3), 1377-1394. doi:10.5194/acp-13-1377-2013

Furr, R. M., & Bacharach, V. R. (2014). *Psychometrics: An introduction*. Los Angeles, CA: Sage.

Gouveia, V., Martinez, E., Meira, M., & Milfont, T. (2001). A estrutura e o conteúdo universais dos valores humanos: Análise fatorial confirmatória da tipologia de Schwartz [The structure and universal content of the human values: Confirmatory factor analysis of Schwartz's typology]. *Estudos de Psicologia* (Natal)*, 6,* 133-142. doi:10.1590/S1413-294X2001000200002

Hawcroft, L., & Milfont, T. (2010). The use (and abuse) of the new environmental paradigm scale over the last 30 years: A meta-analysis. *Journal of Environmental Psychology, 30*(2), 143-158. doi:10.1016/j.jenvp.2009.10.003

International Test Commission. (2010). *International Test Commission Guidelines for Translating and Adapting Tests*. Retrieved from http://www.intestcom.org/upload/sitefiles/40.pdf

Linacre, J. M. (2012). *A user's guide to Winsteps Rasch-Model Computer Programs.* Retrieved from www.winsteps.com

Roberts, J., & Bacon, D. (1997). Exploring the subtle relationships between environmental concern and ecologically conscious consumer behavior. *Journal of Business Research, 40*, 78-89. doi:10.1016/S0148-2963(96)00280-9

Rogelj, J., McCollum, D. L., Reisinger, A., Meinshausen, M., & Riahi, K. (2013). Probabilistic cost estimates for climate change mitigation. *Nature, 493*(7430), 79-83. doi:10.1038/nature11787

Shetzer, L., Stackman, R. W., & Moore, L. (1991). Business-Environment Attitude and the New Environmental Paradigm. *The Journal of Environmental Education, 22*(4), 14-21. doi:10.1080/00958964.1991.9943057

United Nations. (1972). *Declaration of the United Nations Conference on the Human Environment*. Stockholm, Sweden: Author. Retrieved from http://www.unep.org/documents.multilingual/default.asp?documentid=97&articleid=1503