

Why validation is important: an example using the NEP scales

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ABSTRACT

This paper describes how a widely used and reliable measure can be invalid within the context of its use. The “New Environmental/Ecological Paradigm” (NEP) is widely used as a benchmark for pro-environmental attitudes. However, the NEP was designed to measure the worldview paradigm that exists in the social domain, rather than attitudes that focus on the personal domain. We suggest that the scale may not capture personal attitudes towards the environment; rather, it measures how society relates to the natural environment. We thus outline the important differences between alternative domains such as values, beliefs, attitudes, worldviews and environmental concerns, since the NEP scale has been used to measure all of these concepts. To explore the validity of the NEP scale, we tested two versions of the NEP scale and this provided an indication that the scale was unreliable in these applications. We conclude that reliable but invalid scales are not useful in the marketing and social research space. We present a method of establishing the semantic and face validity of such scales.

Keywords: NEP scale, sustainability, attitudes, environmental behaviour, measurement validity.

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1. INTRODUCTION

Marketing and market researchers are concerned to ensure that their evaluations of human behaviours are both valid and reliable. There are a number of different types of validity and these can be categorised into whether they are formative or prognosticative (Brennan, Voros & Brady 2011). Formative validity consists of the steps taken to ensure that what is measured, 1) actually exists and 2) has adequate theoretical foundation for any testing. This type of validation occurs before data are collected. Prognosticative validity is the assessment of the predictive, descriptive and reflective measures of validity after data are collected (Brennan & Camm 2007). Underpinning the principles of formative validity is the notion of semantic validity: ensuring that the words mean ‘something’ that is transferable from one person to another (Teas & Palan 1997). In order to ensure that meaning is transferred between questioner and responder, there has to be a shared frame of reference and alignment between notional objects (Krippendorf 2007). For example, comparing apples with apples, not apples with oranges. Formative validation of measures results in theoretically meaningful scientific measures to be established as a precursor to prediction. However, it appears that little *formative* validation is conducted prior to using measures to measure (Brennan & Camm 2007; Brennan, Voros & Brady 2011). This results in reliable but invalid predictions.

To illustrate this case, this paper examines these concerns using the widely-used measure(s) of the New Environmental Paradigm (NEP).

1.1 The NEP in its context of use.

In line with increasing concerns regarding environmental sustainability, research on how consumers’ pro-environmental values, beliefs and attitudes relate to sustainable practices has continued to grow substantially (Antil 1984; Kilbourne & Carlson 2008; Pelton et al. 1993; Best, Henning & Mayerl 2013). A particular stream of work within marketing and environmental psychology has explored how individuals’ values, beliefs and attitudes shape their pro-environmental behaviour (e.g. Garling et al. 2003; Hodgkinson & Innes 2000; McKenzie-Mohr 2000; Sandford 1992). However, only weak links have been found between key latent variables such as attitudes, beliefs or values and actual pro-environmental behaviour (e.g. Scott & Willits 1994; Bamberg & Moser 2007). In most studies, researchers have focused on the effects of these antecedent factors on behavioural intentions rather than behaviour (Milfont & Duckitt 2004, 2010; Stern, Dietz, & Guagnano 1995).

One of the most used measures to assess attitudes towards the environment has been the New Environmental/Ecological Paradigm (NEP) scale, developed by Dunlap and Van Liere (1978) and

Dunlap et al. (2000). However (as will be discussed in more detail later), the NEP scale was originally designed to assess a new paradigm - a worldview of how mankind interacts with the environment - and not to assess individuals' values or attitudes towards the environment. A worldview, as conceptualised by Dunlap and Van Liere was based on the Kuhnian idea of scientific paradigms (perspectives from which the issue is viewed). However, Dunlap (2008) later referred to the NEP scale as a 'broad attitude measure', while also recognising that attitude is a weak predictor of behaviour. As a result, the validity of the NEP scale for measuring individuals' attitudes, that is, a concept for which it was not initially designed, could be questioned.

Hawcroft and Milfont (2010) have highlighted that the NEP scale has been 'used and abused' for over 30 years. As was suggested earlier, this scale is often used as a proxy for individuals' attitudes towards the environment (EA) [see, for example, Milfont & Duckitt 2004, 2010; Sandford 1992; Scott & Willits 1994; Sidiquea, Lupib, & Joshi 2010; Stern, Dietz, Kalof, & Guagnano 1995; Uittoa & Salorantaa 2010], despite the fact that the original authors did not intend the scale to be used as a proxy for EA (Hawcroft & Milfont 2010). Dunlap and Van Liere (1978) initially proposed that the scale was designed to indirectly measure people's endorsement of a particular worldview (paradigm) of environmental concerns (i.e. not an attitude). Although in saying this, they still referred to 'attitude measurement' items within the NEP scale, which may have contributed to the confusion. This leads us to question whether the (original) NEP scale with more than 2,000 citations (Google Scholar 2014) is a measure of attitudes (albeit a proxy measure) or the measurement of some sort of a worldview.

2. THEORY

MacInnis (2011) has recently pointed out that theory development is hampered without good construct development and definition. However, in a review of moral responsibility in marketing, Mick (2007) showed that social science definitions necessarily tend towards an endless spiral of ambiguity. Indeed, as Brennan and Camm (2007) illustrate, validity itself has multiple meanings. Social science definitions can reflect conceptual threads linking observations, but cannot ever be context-free (Gabbott & Jevons 2009). Thus, for a precise, measurable construct to be used in prediction, it needs to have clearly established *a priori* validities (Borsboom 2005; Cook & Beckman 2006) within the *context* of prediction. While there are various types of validity used in the domain, those most applicable to this research are construct and content, or semantic validity. To

predict \leftarrow something \rightarrow is the primary purpose of construct development (Churchill 1979; Nunnally 1967; Peter 1979; De Vellis 2003) that is, to make (construct) a concrete, measurable 'object' from an abstract idea (Borsboom 2005). Given this, it would also seem logical to extend the idea that an 'attitude' is an abstract 'construct' which has the capacity to be concretised (and, therefore, observed and measured) using a construct development procedure. The construct development procedure would, of necessity, validate the measure. The term validity implies that there is general agreement that the measure measures what it purports to measure. We must ask at this point whether an attitude can be a value, a worldview and a belief at the same time and still serve the purpose of prediction of individual behaviours? For example, while Fishbein and Ajzen (1975, 2010) have forcefully argued for the need for clear distinctions between attitudes, values and beliefs for over 35 years, there still seems to be confusion in the literature, despite the apparent popularity of their planned behaviour research (and notwithstanding Allport's 1935 classic chapter on Attitudes).

There are those who posit that behavioural change is determined by individual or personal factors, as well as external factors in a contextual domain (Maio et al. 2007; Stern 1999). Personal domain factors are those that guide the motivation of the individual, such as values, beliefs, attitudes and norms. Contextual domain factors are attributes, acquired capabilities, the immediate situation, and external constraints, such as education, religion, income and government regulation. It has been argued that these personal and contextual factors will influence individuals' behaviours because of the ways these aspects interact and of the ways they can significantly influence the success of interventions designed to change behaviour (Maio et al. 2007; Stern 1999).

Underpinning much research in behavioural science is the assumption that we can understand the link between various personal domain variables, intentions and behaviour. This assumption is based on the vast array of research using the Theory of Reasoned Action (TRA) and the later variant, the Theory of Planned Behaviour (TPB). To illustrate its popularity, at the end of 2014 there were 51,100 hits on Google Scholar for the "Theory of Planned Behaviour" using the Boolean delimiters to limit the search to only those articles using the term in full. The TPB suggests there is a causal relationship between attitudes \rightarrow intentions \rightarrow behaviours, where the process begins with beliefs about an action

(based on background factors), followed by attitudes about an action and then ending with a targeted behaviour (Fishbein & Ajzen 1975, 2010; Fishbein et al. 2003).

Fishbein and Ajzen (2010) listed three general areas of 'background factors' to attitude formation: individual, social and informational. While the personal background factors include values and personality, the social factors include religion and culture, and informational factors include the media. Arguably, a worldview (i.e. NEP) is a social background factor in line with religion and culture. An attitude may be inferred at an individual level, while a worldview, on the other hand, relates to a belief or value *system* in a community or the broader society (Cobern 1996). The frequent use of the NEP scale for measuring concepts it was not constructed to measure, leads to a serious concern about its validity in these applications (Deshpandé 1983).

The TPB model portrays a theoretical link between attitudes, norms, beliefs and behaviour. The theory implies that if we can tap into, understand and change people's attitudes, we will have the ability to change their behaviours (Chung & Poon 2001; Clark, Kotchen, & Moore 2003; Deng, Walker, & Swinnerton 2006). Given the diversity of contexts used to examine the TPB, numerous attitude scales have been developed (see Bearden, Netemeyer, & Mobley 1993; Bruner & Hensel 1992; Bruner, Hensel, & James 2005; Bruner & Hensel 1998; Bruner, James, & Hensel 2001). As a consequence, it appears that much of the environmental behaviour literature has been loosely linked to the Theory of Planned Behaviour. However, the literature in this field seems to use concepts including attitudes, values, beliefs, concerns, or worldviews interchangeably and inconsistently. The work of Stern, Dunlap and their colleagues has been integrated into much of the current research on the personal domain factors of pro-environmental behaviour (De Groot & Steg 2008; Dunlap 2008; Lucas et al. 2008; Steg & Vlek 2009; Stern 2000; Stern, Dietz, & Kalof 1993; Stern et al. 1995). While Stern et al. (1995) discussed the differences between social and personal domains, others seemed uncritical as to whether the scale they used measured attitudes, values, beliefs or worldviews, and whether those variables related to personal or contextual domain factors (Dunlap 2008; Dunlap & Van Liere 1978; Dunlap et al. 2000). This warrants a closer examination of the differences between the concepts.

2.1 Worldview and its Relation to Concerns, Attitudes, Values and Beliefs

There are important distinctions between a worldview, concerns, attitudes, values and beliefs that need to be clarified; a summary is shown in Table 1. To define the first of these, a worldview "consists of basic assumptions and images that provide a more or less coherent, though not necessarily accurate, way of thinking about the world" (Kearney 1984 p. 41). This suggests that a worldview is constructed outside the individual and represents a *system* of values or beliefs, based on the means of making assumptions and images (which may not be accurate) available to individuals in their local environment. This indicates that measurements of worldviews relate to value systems constructed in the social domain based on the information that is available in any given environment.

There is a fundamental difference between measurements for a population (i.e. social domain) and measurements for the individual (i.e. personal domain), and worldviews lie outside of the personal domain. For example, it is evidently problematic to use a study relating to the proportion of the population believing in God (worldview) to infer these individuals have a high likelihood of giving to charities. If one wants to assess charitable behaviour, a measure of attitudes towards charities or non-profit organisations would be a more precise measure. The NEP was meant to measure whether the public accepted a new paradigm (Dunlap & Van Liere 1978), or, in other words a measure for environmental orientation in a population outside the personal domain. It seems inappropriate, therefore, to use the NEP for 'individual diagnoses' of pro-environmental attitudes – and further behaviour. Nevertheless, researchers have attempted to close this gap in approaches when it comes to environmental concerns (see for example Milfont and Hawcroft's (2010) meta analysis of studies using the NEP).

2.2 Environmental Concern

Attempts have been made to close the gap between the social worldview concept and the personal attitude concept by introducing measures of 'environmental concern'. Environmental concern refers to the degree to which people are aware of environmental problems and support efforts to solve them, and/or indicate a willingness to contribute personally to proposed solutions (Fernandez-Ballesteros 2003). Two major approaches exist to assess environmental concern: the first is based on efforts to examine policy-relevant aspects of environmental problems, and the second applies the various forms of attitude

theory when examining individuals' assessment of those problems (Dunlap & Michelson 2002).

The 'policy' approach focuses on a population's awareness or understanding of various environmental concerns, while the second approach using 'attitude theory' attempts to measure individuals' concerns. Thus, the dual approach used within the concept of 'environmental concerns' is ambiguous, as it refers to both personal and social domains, as explained earlier. 'Environmental concerns' we believe, is mainly a social variable because both the NEP scales are developed as measures of such. Indeed, the NEP is widely regarded as a measure of environmental/ecological 'consciousness' (Fernandez-Ballesteros 2003), which suggests that it relates to societal awareness of environmental issues rather than individual behaviour.

There is an important difference between a worldview and individuals' environmental concern. Worldview theory suggests that a worldview attempts to establish a complete and coherent view of how the world operates (although not necessarily true or testable) (Cobern 1996). Environmental concerns, on the other hand, tend to change over time (e.g. acid rains are no longer a concern) and may also vary in different locations (Dunlap & Michelson 2002).

The original 1978 NEP publication clearly shows that the authors believed they had developed a measure to capture a worldview in the NEP scale. However, there seems to be some confusion about the NEP scale and what it is supposed to measure because of reference to 'attitude measurement' items within the NEP scale (Dunlap & Van Liere 1978). As previously discussed, we would not expect that individual attitudes could be captured by a scale measuring a worldview or people's environmental

concerns (Dunlap et al. 2000). Thus, the NEP scale measures generalised (social) beliefs about the nature of human-environment interactions that may be influenced by social structure and values, which, in turn, influence attitudes, beliefs and behavioural intentions regarding specific environmental conditions (Stern, Dietz & Guagnano 1995). This supports the view that the NEP relates to the community and the broader society, and cannot, therefore, be used selectively to measure personal attitudes towards the environment. The unit of analyses here are not commensurate with each other (Stevens & Espeland 2005).

It is also important to distinguish the difference between value systems (worldviews) and individual or personal values. Personal values are often seen as antecedents to a worldview because it is assumed that values are learnt earlier in life and are broader as well as more stable over time (Stern et al. 1995). As a result, personal values belong to a different domain from worldviews because individual values vary from person to person, and are transferred within close-knit relations. Even within wider theories, such as the Theory of Planned Behaviour, values are seen as a personal background factor, while worldviews reside with social background factors such as religion or culture (Fishbein & Ajzen 2010). Table 1 summarises the key differences between values, attitudes, beliefs, worldview and environmental concerns including the domain to which they belong. Note: the terms are not immutable and disciplinary differences may exist in both denotations and connotations of terms. However, the information in this summary highlights the differences between these terms and provides justification for our concerns when these terms are used interchangeably.

Table 1: Summary of the Semantic Differences between Values, Attitudes, Beliefs, Environmental Concerns and Worldviews

Term	Definition(s)	Semantic differentiation	Domain	Measurement implications
Values (A)	Values are enduring beliefs about desirable goals.	Values focus on abstract ideals. There are at least four concepts with which values are conflated: attitudes, traits, norms, and needs. Values are more abstract than attitudes.	Individual within social	Values are latent guides for evaluating other more observable objects – generalised across all objects (not mutable).
Attitudes (B)	Attitudes are a psychological tendency that is expressed by evaluating an object positively or negatively.	Attitudes are applied to more concrete social objects (e.g. expressions of stance) may be expressive of values in abstraction.	Individual	Attitudes are latent and relate to specific objects. They will change according to context (mutable).
Beliefs (C)	Confidence in the truth or existence of something not immediately susceptible to rigorous proof.	Whereas attitude refers to a person's favourable or unfavourable evaluation of an object, beliefs represent the information a person has about the object.	Individual	Reportable. A belief links an object to some attribute in a generic sense. For example, the belief "humans are destroying the planet" links the object 'humans' to the attribute 'destroying the planet'.
Environmental Concerns (D)	Environmental concern refers to the degree to which people are aware of environmental problems and support efforts to solve them and/or indicate a willingness to contribute personally to their solution.	Two major approaches exist: the first is based on efforts to examine policy-relevant aspects of environmental problems, and the second applies various forms of attitude theory when examining individuals' assessment of these problems. The 'policy' approach focuses on a population's awareness or understanding of various environmental concerns. The 'theory' approach attempts to use attitude theory to measure individual concerns.	Social or individual	The policy approach; reportable social measurement. The theory approach; a latent personal variable. Somewhat problematic, for example, due to the ambiguity and changing nature of the 'environment' concept.
Worldview (E)	Basic assumptions and images that provide a more or less coherent, though not necessarily accurate, way of thinking about the world.	A worldview is based on value systems and culture and is constructed socially in a community. A worldview is a conclusive and consistent picture of how the world operates.	Social	Latent social variables, useful with regard to the proportion of a population who prescribes to a certain belief or value system, e.g. belief in a god.

Source: A: (Hitlin & Piliavin 2004); B: (Fishbein & Ajzen 1972); C: (Fishbein & Ajzen 1975); D: (Dunlap & Michelson 2002; Fernandez-Ballesteros 2003); E: (Cobern 1996; Kearney 1984)

A worldview as defined in the literature (Cobern 1996) sits within the social domain rather than any personal domain. As a measure residing in the social domain, the NEP may be useful to investigate the proportion of a population who subscribes to this particular worldview (similar to measuring the level of religiosity within a population). An attitude, on the other hand, is derived from a person's beliefs, values and indeed their worldview. Attitudes are within the personal domain and can directly influence individual behaviour. Those wishing to investigate how interventions can change pro-environmental behaviours, aim for a measure that captures consumers' attitudes towards such behaviour in their personal domain, rather than focusing on broad, socially-constructed worldviews. The following discussion relates to reasons why the NEP may not be an appropriate measure for this purpose.

2.3 Construct Validity

In terms of scientific precision, the wide range of terminology used to describe the NEP scale and its variants is problematic for a number of reasons. Establishing semantic validity is an important first step in construct development, and a consideration of the connotations and denotations of the terms, as well as the level of abstraction, are also required (Teas & Palan 1997).

According to the Handbook of Marketing Scales (Bruner et al. 2005), a usable scale should, at least, have a reasonable theoretical framework which is generally agreed upon. This is not the case with the NEP scale (Stern, Dietz, & Guagnano 1995). We question the current simultaneous usage of the NEP as a unidimensional scale and as a measure of attitudes (at least from a semantic validity perspective). When Dunlap et al. (2000) revised the NEP scale, they acknowledged that the scale "is treated as a measure of endorsement of a fundamental paradigm or worldview, as well as of environmental attitudes, beliefs, and even values, [and] reflects the ambiguity inherent in measuring these phenomena" (Dunlap et al. 2000, p. 427). This would suggest that any scale that is capturing these multiple phenomena would implicitly need to be multi-dimensional in order to capture attitudes, beliefs, worldviews and values.

Hawcroft and Milfont (2010) have identified that the NEP scale has been viewed in various ways within the literature- environmental concern, environmental values, environmental beliefs and environmental attitudes. From a psychometric perspective, this is particularly problematic because values, beliefs, attitudes and paradigms are conceptually distinct (Fishbein & Ajzen, 1975, 2010). Indeed, Borsboom and

colleagues (2004, p. 321) argued that 'a test X is valid for the measurement of attribute Y if, and only if, the proposition 'Scores on test X measure attribute Y' is true'. If the proposition 'NEP measures an ecological worldview' is true, then it is doubtful that it can also measure environmental attitudes, values, beliefs and concerns; at least not as a unidimensional scale.

The NEP scale has been used for many years as if the scale were developed as rigorously as any psychometric scale, as recommended by several authors (Churchill 1979; De Vellis 2003; Peter, Churchill, & Brown 1993; Rossiter 2002, 2011). This inadequacy has been recognised by the original authors, Dunlap et al. (2000), in their revised NEP scale. However, there is still cause for concern in its development (Hawcroft & Milfont 2010). It becomes reasonably clear from the studies where it has been used, that the scale is somewhat unstable in various contexts, and has been found to vary based on respondents' socio-demographic variables (Dunlap 2008; Milfont & Duckitt 2010).

Another test of scale or construct validity is that of its consistency, both internally (alpha) and over time. Due to its long duration of use, it would be expected that the NEP is a consistent measure of the pre-cursors that relate to environmental behaviour change, but this is not the case (Hawcroft & Milfont 2010). At the most fundamental level there is the debate about its dimensionality (Nooney et al. 2003). Secondly, variations according to respondents' socio-economic status have been reported (Nooney et al. 2003). Thirdly, alternative forms have been used to assess the NEP. Studies have reported the 6, 12 and 15 items versions and, in general, all are treated as interchangeable scales despite the publicised criticisms (Dunlap 2008).

For a scale to be externally valid and internally consistent, there are a number of benchmarks for 'performance' required. The first of these is ensuring formative validity of the research (Brennan, Voros, & Brady 2011), that is, that the necessary steps taken to ensure that face, semantic and content validity are taken into account in the research design process. Without these formative steps, any construct validation using alpha or some other measure of reliability is relatively baseless.

The NEP, as a new worldview, is a very complex construct. Measuring complex constructs often leads to either aggregation of multiple concepts into a single scale, or the creation of multi-dimensional scales (Rigdon et al. 2011). Rigdon et al. (2011) suggested that some scales are really convenient verbal labels for a set of items in the same general conceptual

domain, but they may not be purposeful constructs measuring definable concepts. This may be the case with the NEP scale, as it was suggested by Dunlap (2008) 'in 1987 they did not know how to measure a new paradigm when developing the scale'.

While summarising the items may be convenient for communication, it may also result in the loss of valuable information on the unique relationships between the items and their outcomes (Franke, Preacher, & Rigdon 2008). In fact, studies that have compared scales composed of conceptually distinct constructs (whether aggregate, higher-order factors, or formative) have consistently found that both prediction and understanding are enhanced by using a larger number of specific variables rather than a smaller number of more global ones (McGrath 2009; Mershon & Gorsuch 1988; Paunonen 1998).

The rigour of research is often assessed on efforts used to ensure that the processes and procedures obtain valid and usable responses. One of the primary types of formative validity is that of semantic validity (Zaltman, McMasters, & Heffring 1982), that is, terms are defined adequately within the research context. For the NEP, a number of authors have refined the scale to be less gender-biased as well as altered the contexts. However, these authors have generally continued to use the scale as a summated scale and as a measure of attitudes towards the environment (see Hawcroft and Milfont's 2010 Meta-Analysis for examples where this summated measure of environmental attitudes is the only component of a theoretical behaviour model).

We also note that many of these articles use Cronbach's (1951) alpha as the only means to establish reliability of the measure (see Milfont & Hawcroft 2010) rather than applying more complex psychometric testing using exploratory factor analysis and confirmatory factor analysis. In only using alpha to determine the reliability, most authors sum items to generate a single measure. Relying on this approach has two major limitations: first, Cronbach's alpha is sensitive to the number of items in the scale and will converge after about 12 items; and second, to use Cronbach's alpha, it is assumed that there is validity of the items which, as identified earlier, may be problematic (Borsboom et al. 2004).

We have argued that the NEP was originally meant to measure a value-system (that is, a worldview). A value-system belongs in the social domain and using the principles of commensuration can, therefore, only be used to measure variations in a population, not in individuals. The worldview perspective means that the NEP is not a valid measure for assessing attitudes,

values or beliefs about the environment. If the NEP is a measure of what is referred to as a 'new social domain', is there a problem if this new domain does not exist (Borsboom 2005)? The NEP, at best, may be a loose set of concerns that are assumed to represent a new worldview about the environment. Summarising the items into one score is also problematic because varying constructs may be combined and, therefore, misrepresented in the results. To explore these issues, we have empirically tested the validity of the two most commonly-used variations of the NEP scales, using two different samples. The NEP1 scale has 12 items, and the NEP2 scale which was revised in 2000 (Dunlap et al. 2000) has 15 items (These items are shown in column one of Table 4 and 5).

2.4 Research Questions

RQ1: Is the NEP scale uni-dimensional or multi-dimensional?

RQ2: Does the NEP scale represent a summated consistent worldview or a set of sub dimensions?

3. METHOD

This research builds on Hawcroft and Milfont's (2010) analysis of the NEP, and examines data along the lines suggested by Dunlap and Van Liere (2000) to ascertain the applicability of the NEP as a measure for environmental researchers. Two independent data sets were generated: one using the original NEP scale (NEP1) was collected from an online sample distributed by email link to MBA students in three Australian universities and one New Zealand university; and the second data set was obtained using the NEP revised scale (NEP2). An email link to an online survey was used to draw a sample from Australian suburban householders interested in sustainable household practices. This gave us two samples with sufficient variation to establish any scale disparities. The sample characteristics are presented in Table 2. To establish formative and prognosticative validities, the samples had to be different 'enough' to ascertain the stability of the measure, including different data collection methods.

Table 2: Sample Characteristics of NEP1 and NEP2

	NEP1	NEP2
Response size	242	262
Males	130	117
Females	112	145
Mean Av Ages	23	47
Did not complete High School	43	14
Completed High School	44	17
University	124	229
Post-school training	30	
Scale	7-point	5-point

Properties of each of the two data sets were examined to determine whether it was appropriate to undertake more detailed empirical analysis. We first examined the assumptions for Factor Analysis (FA). This requires: (a) the sample size must be greater than 20 cases per item; (b) at least some of the item correlations should be greater than 0.50; (c) the anti-image correlation matrix should be greater than 0.50; (d) the Kaiser-Meyer-Olkin index should be greater than 0.50; (e) Bartlett's test of sphericity should be significant (less than 0.01); (f) the number of iterations for convergence should be low; (g) there should be a number of factors with Eigen values over 1; and (h) there should be low levels of cross-loaded items (Hair et al. 2010).

To examine the dimensionality of the scales, we conducted Exploratory Factor Analysis using Principal Components Analysis with Varimax Rotation with Kaiser Normalisation. Cross-product loadings of less than 0.35 were suppressed in the analysis. The factors were then evaluated using Cronbach's (1951) alpha to ascertain their reliability as a sub-scale. Both NEP variants were analyzed using the same technique. The stability of the summated scale dimensions, identified in the exploratory factor analysis (EFA) across the two samples, was evaluated by comparing variations across respondents' socio-demographic variables. This form of analysis is the principal form used by others when applying the NEP to environmental issues, thus we felt it necessary to apply to this study for the purposes of replication consistency. We acknowledge that PCA has limitations in that it is subject to scale variance, assumes that large variances are the main interest and relies on the assumption that correlations exist, where none might actually be present.

4. RESULTS AND DISCUSSION

As previously discussed in this paper, it has been identified by several authors that the NEP scale has provided somewhat inconsistent data. This study has also identified a number of concerns regarding its application. The two major issues relate to the dimensionality of the NEP scale and the internal consistency (alpha) of the NEP dimensions.

4.1 The Dimensionality of the NEP Scale

The scale has been and is still used both as a summated scale and as a multi-dimensional measure of attitudes (Hawcroft & Milfont 2010). The dimensionality of the NEP has been demonstrated in a number of research articles (Dunlap et al. 2000; Milfont & Duckitt 2004, 2010). These authors argued that there is more than one dimension. Others have shown that the specific composition of the multiple dimensions varies across contexts and samples (Hawcroft & Milfont, 2010). Corral-Verdugo et al. (2008), in their examination, used Confirmatory Factor Analysis to identify dimensions relating to the NHIP (New Human Interdependence Paradigm). They used the NEP scale items to differentiate along two dimensions in addition to their own scale. They found a factor structure that split the NEP into the New Environmental and Human Exception Paradigms. This might be potentially commensurate with the pro and con items in the scale, as identified by others in the early version of the NEP (Dunlap et al. 2000). Corral-Verdugo et al. (2008) also identified the harmony (balance)/ mastery (exception) dimensions. As mentioned previously, for FA to be useful as a tool, a number of assumptions must be tested: the results are outlined in Table 3 below for the data from the two samples.

Table 3: Factorability of the NEP scales

Factorability assumptions	NEP1	NEP2
Sample size Greater than 20 cases per item	242	260
Inter-item correlations at least some should be greater than 0.5	None found (all less than 0.35)	Several items with inter-item correlations greater than 0.5
Anti-image correlation matrix greater than 0.5	Matrix diagonals ranged from 0.53 to 0.68	All matrix diagonals were greater than 0.8
Kaiser-Meyer-Olkin Greater than 0.5	0.663	0.853
Bartlett's test of sphericity Significance level	0.000	0.000
Number of iterations for convergence	12	5
Number of factors with Eigen values over 1	Five	Three
Number of cross-loadings greater than 0.35	Two	Five

These results (Table 3) for the NEP1 and NEP2 data sets show it is permissible to undertake Factor Analysis; however, only minimum requirements were met for NEP1 as there is relatively low inter-item correlation and the anti-image matrix diagonals are also at relatively low levels, with none greater than 0.7 (Hair et al. 2010). The correlation matrix shows a low level of inter-item correlation overall for both the NEP1 and NEP2 scales.

Following this confirmation, we proceeded to examine both scales in accordance with standard Factor Analytical processes for dimensionality (Tables 4 and 5). We also report on the dimension structures within the original works. Variations in the data may suggest that dimensionality varies across contexts (De Vellis 2003; Hair et al. 1995).

Table 4: The Dimensionality of the Original NEP (NEP1) Scale (1978)

Q	Item	Hypothesised Dimension	PRO / CON	Overall Mean	Std Dev	Alpha if item deleted	Dimension				
							One	Two	Three	Four	Five
	Total Variance explained (per cent)						14.31	12.95	12.86	12.28	11.58
1	We are approaching the limit of the number of people the earth can support	LTG	PRO	5.17	1.54	.566					.750
2	The balance of nature is very delicate and easily upset	BON	PRO	5.81	1.21	.587					.816
3	Humans have the right to modify the natural environment to suit their needs	HDN	CON	5.14	1.48	.565		.787			
4	Mankind was created to rule over the rest of nature	HDN	CON	3.82	1.66	.566		.670			
5	When humans interfere with nature it often produces disastrous consequences	BON	PRO	5.48	1.44	.546		.554			
6	Plants and animals exist primarily to be used by humans	HDN	CON	4.16	1.63	.588			.667		
7	To maintain a healthy economy we will have to develop a steady state economy where industrial growth is controlled	LTG	PRO	5.16	1.23	.566			.773		
8	Humans must live in harmony with nature in order to survive	BON	PRO	5.84	1.17	.572	.667		.352		
9	The earth is like a spaceship with very limited room and resources	LTG	PRO	5.30	1.52	.575	.377		.454	.403	
10	Humans do not need to adapt to the natural environment because they can remake it to suit their needs	HDN	CON	2.68	1.51	.638	.820				
11	There are limits to growth beyond which our industrial society cannot expand	LTG	PRO	4.69	1.30	.598				.782	
12	Mankind is severely abusing the environment	BON	PRO	5.15	1.38	.588				.681	

BON = Balance of nature, LTG = limits to growth, HDN – Human dominance over nature. EFA conducted using Principal Components Analysis with Varimax Rotation with Kaiser Normalisation. Rotation converged in 14 iterations. Suppression of cross-product loading of ≤ -0.35 , Alpha 0.607 for 12 items.

Table 5: The Dimensionality of the Revised NEP (NEP2) Scale (2000)

Q	Item	Hypothesised Dimension	PRO / CON	Overall Mean	Std Dev	Alpha if item deleted	Dimension		
							One	Two	Three
1	We are approaching the limit of the number of people the earth can support	LTG	PRO	3.57	1.22	.830			.616
2	Humans have the right to modify the natural environment to suit their needs	AAC	CON	3.49	1.27	.833	.413		
3	When humans interfere with nature it often produces disastrous consequences	FBN	PRO	3.92	1.13	.837		.574	
4	Human ingenuity will ensure that we do not make the earth unlivable	RE	CON	3.17	1.19	.832	.623		
5	Humans are severely abusing the environment	ECR	PRO	4.27	.96	.828		.653	.366
6	The earth has plenty of natural resources if we just learn how to develop them	LTG	CON	2.88	1.40	.839	.660		
7	Plants and animals have as much right as humans to exist	AAC	PRO	4.38	.93	.836		.356	.553
8	The balance of nature is strong enough to cope with the impacts of modern industrial nations	FBN	CON	4.07	1.09	.831	.559	.509	
9	Despite our special abilities, humans are still subject to the laws of nature	RE	PRO	4.54	.81	.842	.600		
10	The so-called 'ecological crisis' facing mankind has been greatly exaggerated	ECR	CON	4.03	1.13	.824	.454	.654	
11	The earth is like a spaceship with very limited room and resources	LTG	PRO	3.79	1.20	.829			.720
12	Humans were meant to rule over the rest of nature	AAC	CON	3.93	1.25	.831	.644		
13	The balance of nature is very delicate and easily upset	FBN	PRO	4.13	1.01	.838			.613
14	Humans will eventually learn enough about how nature works to be able to control it	RE	CON	3.68	1.16	.832	.767		
15	If things continue on their present course, we will soon experience a major ecological catastrophe	ECR	PRO	4.03	1.02	.824		.630	.413

LTG = Limits to growth, AAC = anti-anthropocentrism, FBN – Fragility of the balance of nature, RE = Rejection of exemptionalism, ECO = Possibility of eco crisis. EFA conducted using Principal Components Analysis with Varimax Rotation with Kaiser Normalisation. Rotation converged in 4 iterations. Suppressed cross-product loadings of less than 0.35, Alpha 0.893 for 15 items

Dunlap and Van Liere (1978) posited five dimensions for their original scale (NEP1) namely limits to growth, anti-anthropocentrism, fragility of the balance of nature, rejection of exemptionalism, and the possibility of eco-crisis. It can be seen from Tables 4 and 5 (NEP1 and Revised NEP2) that neither of the scales demonstrates either unidimensionality, or multi-dimensionality. In fact, the items load on different dimensions to those identified by Dunlap and Van Liere (1978). Furthermore, there is a reasonably strong variation in the data, as evidenced by the standard deviations. There is no reason to assume that it is appropriate to sum these highly variable scores to produce a generic score. To do so is to lose part of the value of the data, that is, its ability to be used to differentiate between sections of the population. In the next section, we analyze the internal consistency of the scale.

4.2 Internal Consistency (alpha) of the NEP

In addition to the dimensions, Tables 4 and 5 provide results for Cronbach's alpha for each of the scales. In the tables, it can be seen that the NEP1 and NEP2 have different alpha levels, both overall, and item-specific. Some of this may be due to the sample characteristics (for example the variance in the standard deviations indicates differences between samples), however, it may also be due to differences in the scale itself (De Vellis 2003). Cronbach's alpha is sensitive to the number of items included in a scale. The higher the number of items, the larger the coefficient recorded. Indeed, more than about 12 items in the scale will increase the coefficient (Nunnally 1967; Peterson 1994). Both the NEP2 and original NEP1 scales have several commonalities, but the NEP2 has an alpha in the range which would be considered acceptable, that is, greater than 0.7 (Hair et al. 2010). We believe that some of this may be an artefact of the size of the scale and is not necessarily because it is unidimensional. Furthermore, as the point of using alpha is to determine a single global construct and its reliability (Kopalle & Lehmann 1997), it seems to be a somewhat questionable practice to amalgamate items across what were meant to be multiple distinctive dimensions.

In addition to questioning the uni-dimensionality of the items, the homogeneity is also somewhat suspect. Green, Lissitz and Mulaik (1977) advised that homogeneity (single common factor) is one goal of classical test theory on which alpha is based. They argued that internal consistency is evident when there is a high degree of inter-relatedness between items. Thus, a longer scale can have a high alpha but not a commensurately high level of homogeneity. In fact, Dunlap and Van Liere (1978) explicitly

built heterogeneity into the initial survey, as they proposed that they wanted to measure how people were responding to the urgency of the environmental crisis by endorsing the NEP. However, they did not differentiate between values, attitudes or behaviours when developing the scale. They did report using the multi-trait-multi-method approach (Campbell & Fiske 1959) in designing the questions. As such, they clearly had no opportunity to test for convergence or divergence until after they collected the data, by which time the scale was already 'launched'. Thus, our results support that this is the case; there is a high alpha on NEP2 but not NEP1, and both have low levels of homogeneity. This appears to indicate that there are multiple dimensions, however, they are not the dimensions suggested in the original conceptualisation of the scale.

5. CONCLUSION

Measurement is important to those attempting to evaluate 'objects' with a view to making changes to input variables and, therefore, (hopefully) to make changes to the outcomes. In any research, including the study of sustainability, there is a strong need to measure with precision. Precision requires semantic validity, that is, the semantics of the question(s) are unassailable; people know and understand the concepts and their meaning is shared amongst all the parties to the research (including the participants). More precise measures 'should' lead to more precise predictions of behaviours. The theory of planned behaviour/reasoned action is based on the premise that we have accurate measures of attitudes, intentions and behaviours in place.

The NEP scale (1 and 2) has equivocal results across the literature when it comes to semantic validity. The lack of agreement on what the scale purports to measure may overshadow the extensive research examining the scales. Is it a measure of attitudes, a worldview or something else? Regardless, our research suggests that NEP is not unidimensional and, therefore, summation potentially hides the variations in the data. Importantly, the summation process may contribute to the loss of a deeper understanding of participants' responses.

In addition, psychometric theories of scale development and measurement provide advice regarding validity and reliability in measuring attitudes. A valid scale should be grounded in psychometric theory (Stern, Dietz, & Guagnano 1995) and would have formative validity and construct validity clearly presented to the readers (Hawcroft & Milfont 2010). Thus, there should be a replicable process of constructing the items and/or the measures. When reliability is measured, the

scale items and measures should be reliable, that is, measure the same thing and get the same result, however many times you measure it. Reliability is a necessary precursor of predictability. However, validity (face, content, semantic, and construct) is a necessary precursor to reliability. It is axiomatic that it is possible to have very reliable measures that are not valid; consistent scales that are not commensurate in terms of what they measure are of little value.

However, our research suggests that when it comes to the NEP and its variants, we have limited validation (that we can see) within the various contexts where it has been used. Of the validities, construct validity would be important in developing precision (for prediction) but, as our research shows, the measure is not precise, ergo it cannot be used to predict in its current form.

Finally, we question whether the NEP and its variants can be used as a tool for evaluating the level of endorsement for the new ecological/environmental paradigm because of its inability to form a consistent and coherent worldview. If we use it as originally intended, it is too easy to assume that it should be summated even though our, and many other, studies demonstrate that this is not recommended because of the loss of valuable information.

Instead of measuring a worldview or a paradigm, it appears that the NEP measures a loose set of concerns for the environment on a societal basis. The NEP items may be very useful in terms of identifying the proportion of a population who shares various concerns about the environment. By analyzing the level of agreement with each variable, policy makers may suggest those areas where more information is needed. However, as a measure of individuals' attitudes towards environmental sustainability and a predictor of behaviour or intentions, it is somewhat suspect, as we have previously highlighted. The NEP items do not reflect attitudes or behavioural intent in the personal domain. It is time for a new rigorously validated and reliable measure to be developed for this purpose. Such a measure should be based on an in-depth analysis of each item of the NEP scales in order to assess where more information is needed within the social domain. In the interim, environmental sustainability researchers should take care with how the scale is being applied and the consequent reported findings. Beyond this we are suggesting that a more reliable personal domain measure of attitudes towards environmental sustainability, as a predictor of behaviour and intentions, should be developed.

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