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The structure of environmental attitudes: A first- and second-order confirmatory factor analysis

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Abstract

This paper addressed two questions: (1) Do environmental attitudes form a two-factor second-order structure as proposed by (Pers. Individ. Diff. 34 (2003) 783) and others? If so, (2) do these two factors differentially predict self-reported ecological behaviour and economic liberalism? A questionnaire with 99 items from established measures of environmental attitudes was administered to 455 undergraduate students and two procedures were used to test the higher-order factor structure of these attitudes. First, all the items were forced into two-factor and one-factor solutions using exploratory factor analysis (EFA), and the fit of these solutions then tested using confirmatory factor analysis (CFA). Second, EFA was used to extract first-order factors, which were themselves factor analysed to extract second-order factors. CFA indicated that a correlated two-factor solution, consisting of a Preservation factor and an Utilization factor, provided the best fit to the data. Discriminant validity was demonstrated by showing that self-reported ecological behaviour was predicted by the Preservation factor, and not by Utilization, while attitudes toward economic liberalism were predicted by Utilization, and not by Preservation.

1. Introduction

During the last few decades, the relationship between human beings and the environment has been an important issue due to the fact that natural resources have been used up at a faster pace than they can be restored. Environmental problems are viewed by many as caused by maladaptive human behaviour (Maloney & Ward, 1973), and psychology, therefore, can have an important role in the amelioration of these problems by improving ecological behaviour (Maloney & Ward, 1973; Weigel & Weigel, 1978; Oskamp, 2000; Schmuck & Schultz, 2002; Schmuck & Vlek, 2003). One way to contribute to this is through the study of environmental attitudes (EA) that may underlie ecological behaviour.

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2. Literature review

"Environment concern" is the term typically used in empirical literature to refer to EA (Fransson & Gärling, 1999; Dunlap & Jones, 2002). Many researchers use the two terms as synonymous (Van Liere & Dunlap, 1981; Dunlap & Jones, 2003), whereas others have differentiated them (Stern & Dietz, 1994; Schultz, Shriver, Tabanico, & Khazian, 2004). Nevertheless, EA seems to be the preferred term in psychology, because environmental concern is viewed now as a general attitude (Bamberg, 2003), and EA are the psychological index term generally used (American Psychological Association, 2001). EA have been defined as "the collection of beliefs, affect, and behavioural intentions a person holds regarding environmentally related activities or issues" (Schultz et al., 2004, p. 31).

Few meta-analyses had been published in the field of Environmental Psychology (Stamps, 2002), and only the article by Hines, Hungerford, and Tomera (1986/87) has reviewed findings about the relationship between EA

and ecological behaviour. The main objective of their study was to identify, analyse and synthesize those variables identified in research reported from 1971 to 1987 that have been most strongly associated with responsible environmental behaviour. They analysed 128 studies and grouped the predictor variables into four categories: (1) cognitive variables (knowledge), (2) psycho-social variables (attitude, locus of control, verbal commitment, personal responsibility, and economic orientation), (3) demographic variables (educational level, income, age and gender) and (4) experimental studies. Results indicated that verbal commitment was the most important variable related to responsible environmental behaviour ($r = .49$), and gender was the least important ($r = .08$). EA was the third most important variable ($r = .35$).

Previous results therefore suggest that EA predict ecological behaviour, but this prediction was low to moderate in terms of effect size magnitude (Bamberg, 2003). One reason for this low-to-moderate relationship may be that the dimensionality of EA has not yet been clarified adequately (Costarelli & Colloca, in press). As attested by Schultz (2000), EA has been traditionally viewed as a unidimensional construct ranging from *unconcerned* about the environment at the low end to *concerned* at the high end, as measured by the New Environmental Paradigm (NEP) scale (Dunlap & Van Liere, 1978; Dunlap, Van Liere, Mertig, & Jones, 2000). However, other approaches have understood EA in terms of multidimensional value-based orientations. Thompson and Barton (1994) presented a classification of EA as rooted either in a concern for all living things (*Ecocentric*) or in a concern for humans (*Anthropocentric*). On the other hand, Schultz (2000, 2001), proposed that environmental concerns have three correlated factors: concern for the self (*Egoistic*), other people (*Altruistic*), and the biosphere (*Biospheric*).

Other researchers have been more concerned with the measurement of primary attitudes factors (Wiseman & Bogner, 2003) and this has lead to a large number of EA measures, probably at least 700 (Dunlap & Jones, 2002). McCrae and John (1992) discussing the questionnaire tradition of the five-factor model of personality noted that "until recently, only a small minority of questionnaire researchers were concerned with the issue of consensus—most preferred to generate new scales rather than organize those already available" (p. 186). The same seems to be true for the study of EA, where only two studies seem to have tried to clarify previous findings through factor analyses of established measures. These two studies will be discussed in turn.

The first of these studies was conducted by Blaikie (1992) who factor analysed 24 items from established scales and reported seven first-order factors descriptive of general ecological viewpoints (use/abuse of the natural environment, precariousness of the natural environment, conservation of the natural environment, confidence in science and technology, problems of economic growth, and conservation of natural resources). This stimulated a series of studies by Bogner and his associates (e.g. Bogner & Wiseman, 1997, 1999; Bogner, Brengelmann, & Wiseman, 2000; Wiseman & Bogner, 2003) who felt that these findings contained the germ of a possible ecological attitudes theory contrasting the dilemmas confronting people in trying to balance the conservation of the natural environment with the need for some forms of exploitation of the environment.

Following Blaikie's approach, Bogner and Wiseman (1999) factor analysed an item-pool and found five first-order factors with each having four items. The selected 20 items formed their ENV scale and the five factors were labelled: intent of support, care with resources, enjoyment of nature, human dominance, and altering nature. In a further study, these authors (Bogner & Wiseman, 2002) factor analysed the five first-order factors of their ENV scale together with three first-order factors of the NEP scale (balance of nature, human over nature and limits of growth) to investigate their second-order factor structure. Two factors emerged; the first was labeled *Preservation*, which was formed by four first-order factors (intent of support, enjoyment of nature, limits of growth, and care with resources), and the second labelled *Utilization*, formed by the others four first-order factors (man over nature, altering nature, human dominance, and balance of nature). These two secondary factors were negatively correlated ($r = -.26$).

In a more recent paper, Wiseman and Bogner (2003) used these findings to propose a two-dimensional Model of Ecological Values (MEV), with two orthogonal dimensions, *Preservation* and *Utilization*. The former reflects conservation and protection of the environment (i.e. biocentric preservation), and the latter the utilization of natural resources (i.e. anthropocentric utilization). They describe their model as follow: "Ecological Values are determined by one's position on two orthogonal dimensions, a biocentric dimension that reflects conservation and protection of the environment (Preservation); and an anthropocentric dimension that reflects the utilization of natural resources (Utilization)" (Wiseman & Bogner, 2003, p. 787).

While Bogner and associates appear to have proposed an important new approach to the structure of EA, their research and theory are open to certain criticisms. First, they reported a significant correlation between their two secondary factors (Bogner & Wiseman, 2002, p. 229; Wiseman & Bogner, 2003, p. 789), but they presented the model as composed of two orthogonal dimensions, with this orthogonality treated as theoretically desirable (Wiseman & Bogner, 2003, p. 787). Second, their ENV scale contains five unbalanced EA subscales, and may therefore be open to acquiescence bias. For example, all

the ENV first-order factors that formed the Preservation second-order factor have only protrait items, while the Utilization second-order factor consisted of ENV first-order factors having only contrait items. Direction of wording effects might therefore be responsible for the relative independence between their two factors. A third criticism is related to this point. Although Wiseman and Bogner (2003) had related Preservation and Utilization with Eysenck's personality factors, they did not clearly demonstrate the discriminant validity of their two higher-order factors. Since factors derived from factor analysis are purely empirical and can reflect various method artefacts, such as direction of wording effects, the ultimate test of whether such factors are theoretically and empirically meaningful is that of whether the factors do clearly predict important external variables differently, that is, the test of discriminant validity.

Fourth, their 5 first-order factors were derived from 20 items, plus 12 items that formed 3 factors from the NEP scale. This raises the possibility that the 8 first-order factors they factor analysed to obtain second-order factors might not adequately cover the full range of possible first-order EA factors. A more adequate sampling of first-order factors and a more extensive item set might reveal a more complex second-order factor structure than was revealed by their analysis. And fifth, Bogner and his colleagues used only exploratory factor analysis (EFA) to investigate the second-order structure. Factor solutions derived from EFA might not provide good fitting factor solutions. Ideally such solutions should be checked by confirmatory factor analysis (CFA), which provides indices of goodness of fit that would indicate the adequacy of the factor solution.

To sum up, therefore, although several important theoretical formulations have been proposed, there is no consensus about the structure of EA. A recent approach argues that EA are formed by two higher-order factors, Preservation and Utilization, but the empirical basis for this appears to be open to important criticisms. The aim of this research was therefore to investigate the higher-order structure of EA, and particularly Wiseman and Bogner's (2003) model. As factors obtained will inevitably reflect the items included in a factor analysis, this study goes beyond previous research in using an extensive set of EA items including well established and well used measures of EA, and using both EFA to explore factor structures inductively, followed by CFA to test the adequacy of different factor solutions, and particularly one versus two dimensional higher-order factor solutions. By drawing on a broader range of items than used previously, and by including specially written items to balance existing measures that contained either all pro-environment or anti-environment items, it was hoped to minimize direction of wording effects with the factors emerging including both pro- and anti-items. Finally, if two distinct higher-order factors, such as Preservation and Utilization, did emerge, the study set out to test their discriminant validity. In this case it was hypothesized that Preservation should predict self-reported ecological behaviour while Utilization would predict economic attitudes.

3. Methods

3.1. Sample and procedure

An anonymous questionnaire was administered to 455 introductory psychology students from the University of Auckland (319 females; 136 males), with ages ranging from 17 to 48 years ($M = 20$; s.d. = 4.31). The ethnic composition of the sample was 256 Pakeha/NZ European, 99 Asian, 21 Pacific Islanders, 4 Maori, and 27 who gave ethnic identity as "other". Pakeha/NZ European is the ethnic majority group in New Zealand (comprising about 80% of the population), and Asians, Maori and Pacific Islanders (predominantly Polynesians) are the main minority groups.

3.2. Instruments

The questionnaire included questions assessing demographic information (e.g. age, gender, ethnic affiliation), self-reports of behaviour, and items measuring EA.

The two measures included to assess discriminant validity were the *Proenvironmental Behavior Scale* and *Economic Liberalism Scale*. The former consisted of 8 items previously used (Schultz & Zelezny, 1998; Schultz, Zelezny, & Dalrymple, 2000), selected to provide a measure of ecological behaviour (American Psychological Association, 2001). Participants were asked to indicate how often they had engaged in each of eight specific behaviours in the last year (looked for ways to reuse things, recycled newspaper, recycled cans or bottles, encouraged friends of family to recycle, purchased products in reusable or recyclable containers, picked up litter that was not your own, composted food scraps, conserved gasoline by walking or bicycling) on a five-point rating scale from 1 (*never*) to 5 (*very often*). Schultz (2001) reported an alpha coefficient of .83 for the full scale (12 items). In our study, the alpha coefficient for this 8-item scale was .77, and the average score was 3.40 (s.d. = .73), with women ($M = 3.45$, s.d. = .72) scoring significantly higher than men ($M = 3.24$, s.d. = .73), t (453) = 2.82, $p < .01$. The Economic Liberalism Scale was a 3-item scale that had been developed to assess the economic dimension of the Dominant Social Paradigm (DSP) (Kilbourne, Beckmann, & Thelen, 2002). The items are "Individual behaviour should be determined by economic self-interest, not politics", "The best measure of progress is economic", and "If the economy continues to grow,

everyone benefits''. Responses were on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Kilbourne et al. (2002) reported an alpha coefficient of .61. In our study, the alpha coefficient was .66, and the average score was 3.36 (S.D. = .90), with no significant gender difference.

The following well-established measures of EA and some specially written items to balance direction of wording effects were included in the questionnaire, giving a total of 99 items.[1] Responses were on a 7-point Likert rating scale (1 = *strongly disagree*; 7 = *strongly agree*).

New Ecological Paradigm (*NEP*) *Scale* (Dunlap & Van Liere, 1978). The NEP scale was developed to measure the overall relationship between humans and the environment, and is the most widely used measure to investigate environmental concern (Stern, Dietz, & Guagnano, 1995; Dunlap & Jones, 2003). The revised NEP scale (Dunlap et al., 2000) contains 15 balanced items that are designed to tap each of the five hypothesized facets of an ecological worldview: the reality of limits to growth, antianthropocentrism, the fragility of nature's balance, rejection of exemptionalism, and the possibility of an ecocrisis.

Ecocentric and Anthropocentric Environmental Attitude Scales. Thompson and Barton's (1994) scales were developed to measure two motives/values that underlie support for environmental issues: Ecocentric (12 items) and Anthropocentric (12 items). While ecocentric motives imply the protection of nature because of its intrinsic values, anthropocentric motives imply that the environment should be protected for human wellbeing. All 24 items are protrait items.

Ecological World View Scale. This 24-item scale was developed from an analysis of items from existing scales (Blaikie, 1992). It contains seven unbalanced subscales that aim to measure levels of environment/ecological commitment. These subscales are use/abuse of the natural environment, precariousness of the natural environment, conservation of the natural environment, confidence in science and technology, problems of economic growth, and conservation of natural resources. Three of the items duplicated NEP items and were therefore discarded, and one item (''The remaining forests in the world should be conserved at all costs'') was unfortunately omitted during printing so that just 20 items of this scale were used.

ENV Scale. This 20-item scale was developed from a factor analyses of a broader item pool (Bogner & Wiseman, 1999). It contains five unbalanced EA subscales, with four items each. These subscales are intent of support, care with resources, enjoyment of nature, human dominance and altering nature. The first three subscales have only protrait items toward environmental issues, while the last two present only contrait items.

ENV Contrait Items Scale. In order to reduce direction of wording effects, 20 items were written to produce reversals of the 20 ENV items, thus producing new contrait items for the three protrait only ENV subscales (intent of support, care with resources and enjoyment of nature), and new protrait items for the two contrait only ENV subscales (human dominance and altering nature).

3.3. Data analyses

Prior to analyses, data were examined for the presence of univariate and multivariate outliers (McClelland, 2000; Tabachnick & Fidell, 2001), which might attenuate the results. The former was analysed through standardized scores ($|z| \geqslant 3.30$) and the latter thought Mahalanobis Distance ($p < .001$) and Studentized Deleted Residual (greater than ± 4.00). Few univariate outliers were identified as having high z scores while no multivariate outliers were found. Also the normality of each of the 99 items was investigated in terms of its skewness (−1.33 to .94, $|M| = .33$) and kurtosis (−.88 to 2.21, $|M| = .05$). These values were all within the level recommended for a CFA with maximum-likelihood estimation (skew > 2, kurtosis > 7; West, Finch, & Curran, 1995), supporting the normality assumption for all variables. For this reason, no cases were deleted. Multiple Imputation using the EM algorithm (Jöreskog & Sörbom, 1996) was used to replace isolated missing values (0.24%) in the data set.

4. Results

Exploratory and confirmatory factor analyses were used to investigate the factor structure of the items from the six EA scales described above. Two procedures were used. First, all 99 items were forced to a two-factor solution and CFA was used to assess the fit of that two-factor solution and compare it to the fit of a one-factor solution. Second, first-order factors were extracted from the 99 items using EFA, followed by a second EFA of these factors to extract second-order factor(s) (Thurstone, 1947, p. 411).

4.1. Procedure 1—Forcing two-factor EFA solution and using CFA to test competing one- and two-factor models

The goal of this procedure was to test whether a one-factor solution would be better than a two-factor

[1] We also included Shultz's (2001) *Environmental Motives Scale* in our item pool. However, because these 12-items scale are in a completely different format to all the other Likert format items they produced just a single separate factor on their own, suggesting a purely method (item format) factor. We therefore excluded these 12 items from the factor analysis.

solution. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy showed adequate fit (KMO = .900). Following previous recommendations (Fabrigar, MacCallum, Wegener, & Strahan, 1999; Russell, 2002), Exploratory Principal Axis Factoring (PAF) analyses with subsequent oblique rotation (promax rotation with Kaiser normalization) were performed, forcing all 99 items to a two-factor solution.[2] Two criteria were used to determine the factor structure: (a) retain items with a factor loading equal to or greater than .30, and (b) exclude items with double loadings. Twenty-one items did not fit these criteria and were deleted for subsequent analyses.[3] The forced two-factor solution explained 22.9% of the total variance, and the eigenvalues for the two factors were 17.9 and 4.7, respectively. The intercorrelation of these two factors was −.49 ($p < .001$). The first factor consisted of fifty items, with 38 pro- and 12 anti-environment items, explained 18.1% of the total variance, and its factor loadings ranged from .30 to .80. Examples of items are "I need time in nature to be happy" and "I don't think I would help to raise funds for environmental protection" (reverse). The items from this factor had a Cronbach's alpha of .94, with a mean inter-item correlation of .25. As the strongest loading items of this factor expressed enjoyment of nature and conservation of natural resources, it was named *Preservation*. The average score was 5.0 (S.D. = .71), with women ($M = 5.06$, S.D. = .71) scoring significantly higher than men ($M = 4.72$, S.D. = .65), t (453) = 4.81, $p < .001$.

The second factor consisted of 28 items, with two contrait items, explained 4.8% of the total variance, and its factor loadings ranged from .31 to .60. Items examples are "One of the most important reasons to conserve is to ensure a continued high standard of living" and "Draining swamps should be opposed even if pests such as mosquitoes and flies breed in them" (reverse). This factor was named *Utilization* because its strongest loading items expressed human dominance over nature and humans altering natural resources. The items from this factor had a Cronbach's alpha of .88, with a mean inter-item correlation of .20. The average score was 3.60 (S.D. = .69), with men ($M = 3.70$, S.D. = .65) scoring significantly higher than women ($M = 3.52$, S.D. = .71), t (453) = −2.50, $p < .05$.

Confirmatory Maximum Likelihood Factor Analysis was used to test the goodness of fit of competing one- and two-factor models of the structure of EA.[4] Four models were tested. Model 1 tested a single, general factor including all 99 items in the item pool. Model 2 also tested the one-factor structure but used only the 77 items that loaded above .30 for an EFA forcing a one-factor solution. Model 3 was a nested model within Model 4 (Klem, 2000), testing a uncorrelated two-factor first-order model. Finally, Model 4 tested a correlated two-factor first-order model. The two first models were therefore consistent with the idea of EA as a unidimensional construct (Schultz, 2000, 2001; Dunlap & Jones, 2002), while the third model was consistent with the two uncorrelated dimensions proposed by Wiseman and Bogner (2003), and the last model with two correlated dimensions.

As numerous fit statistics consider different aspects of fit, it has been recommended that researchers should report multiple fit statistics in structural equation model (SEM) studies (Thompson, 2000). For this reason, five indices were used to assess the degree to which the data fit the model: the ratio of chi-square to degree of freedom (χ^2/df), the root mean square error of approximation (RMSEA), the standardized root mean square residual (SRMR), and comparative fit index (CFI). A χ^2/df ratio in the range of 2–3 is viewed as indicating acceptable fit (Carmines & McIver, 1981). Good fit was also viewed as indicated by RMSEA, SRMR, and CFI respectively having values close to .06, .08 and .95 or better (Hu & Bentler, 1999). Further, the χ^2 difference test and the Consistent Akaike Information Criterion (CAIC) were used to assess significant improvement over competing models. The latter is used to compare nonhierarchical as well as hierarchical (nested) models, while the former is used to compare nested models (Garson, 2003). Lower CAIC values reflect the model with the better fit. As the χ^2 difference test has the problem of being influenced by sample size, fit improvement in terms of the other indices were also considered for evaluating overall model fit (Hong, Malik, & Lee, 2003).

The fit indices for the four models are shown in Table 1. Fit for Model 2 was slightly better than Model 1, but the indices for both indicated poor fit. Model 3 presented an improvement over Model 2, but still with overall poor fit. Finally, Model 4 showed overall acceptable fit. Because Model 3 is nested under Model 4, a χ^2 difference test could be performed. Results indicated that Model 4 was a significant [$\chi^2(1) = 13.38$, $p < 0.001$; CAIC = 13909.93] improvement over the third model. It can be concluded that the correlated two-

[2] As most of the scales included in our study were not fully unidimensional, and would typically generate two or even more factors, we used item rather than scales scores. We did, however, repeat the analysis using scale scores and it also generated a better two-factor than one-factor solution. We also obtained the same pattern of findings using direct oblimin rotation.

[3] These were 10 items from the NEP scale (items 01, 02, 03, 05, 06, 09, 10, 11, 12, and 13), one from the Ecocentric scale (item 12), one from the Anthropocentric scale (item 02), six from the Ecological World View scale (items 04, 06, 07, 12, 15, and 20), and three from the ENV Contrait Items scale.

[4] Because of the size of the covariance matrices, these are not presented here. However, the data are available on request from the first author.

Table 1
Fit indices for competing models of the structure of environmental attitudes

	χ^2	df	χ^2/df	RMSEA	SRMR	CFI	CAIC
Model 1. One-factor structure with 99 items	46,376.96	8127	5.71	.10	.094	.86	48,214.00
Model 2. One-factor structure with 77 items	39,350.60	6554	6.00	.10	.096	.87	41,002.51
Model 3. Uncorrelated two-factor first-order model	12,698.62	2989	4.25	.085	.12	.91	13,916.19
Model 4. Correlated two-factor first-order model	12,685.24	2988	4.24	.085	.078	.91	13,909.93

Note: RMSEA—Root mean square error of approximation; SRMR—Standardized root mean square residual; CFI—Comparative fit index; CAIC—Consistent Akaike Information Criterion.

factor model was statistically better fitting than the others models, and also provided the best fit to the data. This suggested that EA do comprise two distinct factors with a strong negative correlation between them ($\Phi = -.61$, $p < .05$).

In order to assess discriminant validity for the two correlated factors of Preservation and Utilization, two hierarchical multiple regression analyses were conducted, one for the self-reported ecological behaviour scale and another for the economic liberalism scale. The demographic variables (age, gender, religiosity and income) were entered on the first step. The two factors from the EFA were then blocked together on the second step. The results of the regression analyses on self-reported ecological behaviour and economic liberalism are presented in Table 2. The results indicated that after controlling for demographic variables, the Preservation factor predicted self-reported ecological behaviour ($\beta = .53$, $p < .001$; but not expressed attitudes toward economic liberalism), whereas the Utilization factor predicted attitudes toward economic liberalism ($\beta = .79$, $p < .001$; but not self-reported ecological behaviour). Despite their high intercorrelation, Utilization and Preservation factors did therefore differentially predict these validity criteria.

Table 2
Summary of hierarchical multiple regression analysis of the utilization and preservation factor scores on ecological behaviour and economic liberalism

Variable	β	S.E.	p
A. Ecological behaviour			
Preservation items	.53	.05	.001
Utilization items	−.07	.05	.155
B. Economic liberalism			
Preservation items	−.10	.07	.125
Utilization items	.79	.07	.001

Note: S.E. = Standard error. Ecological behaviour: $R = .54$, $R^2 = .29$, $\Delta R^2 = .28$ (F [6, 446] = 30.54, $p < .001$), S.E. of the estimate: .62. Economic liberalism: $R = .58$, $R^2 = .34$, $\Delta R^2 = .33$ (F [6, 446] = 38.52, $p < .001$), S.E. of the estimate: .83.

4.2. Procedure 2—Finding environmental attitude first-order factors and then second-order factor(s)

The goal of the second procedure was to first extract first-order factors from the 99 EA items, and than perform another factor analysis to extract the second-order factor(s) from the first-order factors.

Exploratory PAF analyses were again performed followed by oblique rotation (promax rotation with Kaiser normalization). A number of procedures were used to determine the number of factors to extract: The Kaiser's (1970) rule (or the eigenvalues-greater-than-one rule), Cattel's (1966) scree test from the Principal Component Analysis (PCA) and PAF eigenvalues, and parallel analysis based on PCA eigenvalues (Beauducel, 2001; Watkins, 2000). Because the purpose of this EFA was to establish meaningful factors underlying the 99 EA items, the same two criteria to determine the factor structure described above were employed.

Twenty-four eigenvalues greater than one emerged; six with eigenvalues greater than two. The first 10 eigenvalues were 18.70, 5.50, 3.84, 3.62, 2.80, 2.40, 2.00, 1.90, 1.82, 1.71. The eigenvalues-greater-than-one rule suggested a large number of factors, but the eigenvalue pattern suggested only six large factors. Scree plots from the PCA and PAF eigenvalues were ambiguous indicating a substantial drop after the sixth eigenvalues with another smaller but still substantial drop after the tenth. From the parallel analysis performed on the PCA eigenvalues, the first 10 eigenvalues expected for random data (2.10, 2.02, 2.00, 1.91, 1.90, 1.83, 1.80, 1.80, 1.73, 1.70; to 99 variables, 455 subjects and 100 replications) fall below the observed eigenvalues. This suggested that 10 factors should be extracted. This factor structure explained 38.6% of the total variance.

The 10 primary factors were labelled: Enjoyment of Nature (12 items), External Control/Effective Commitment (16 items), Intent of Support (8 items), Anthropocentric Concern (6 items), Rejection of Exemptionalism/Confidence in Science and Technology (7 items), Ecocrisis/Limits to Growth/Nature's Balance (7 items), Human Dominance/Altering Nature (6 items), Care with Resources (6 items), Antianthropocentrism (5 items), and Necessity of Development (4 items). These

factors accounted for 18.3%, 4.9%, 3.3%, 3.1%, 2.2%, 1.8%, 1.4%, 1.3%, 1.3%, and 1.1% of the total variance, respectively. The reliability, means, standard deviations, factor loadings and communalities for the 77 items loading significantly on these 10 factors are shown in Table 3.[5]

A number of the factors had clear content similarities to factors reported in previous studies. Factor 1 was a combination of Bogner and Wiseman's (1999) "enjoyment of nature" subscale with Thompson and Barton's (1994) "ecocentric" scale. Factor 2 was similar to Blaikie's (1992) "sacrifices for the environment" subscale. Factor 3 combined Bogner and Wiseman's (1999) "intent of support" subscale, Iwata's (2001) "approach to information on environmental problems" factor, and Lounsbury and Tornatzky (1977) "environmental action" dimension. Factor 4 formed the anthropocentric concern factor proposed by Thompson and Barton (1994). Factor 5 had items from the "confidence in science and technology" dimension (Blaikie, 1992) and "rejection of exemptionalism"(Dunlap et al., 2000), and was also similar to Grob's (1995) "perceived control" third subcomponent. Factor 7 was a combination of the Bogner and Wiseman's (1999) "human dominance" and "altering nature" subscales, and Factor 8 matched these authors "care with resources" subscale. Factor 9 combined Albrecht, Bultena, Hoiberg, and Nowak (1982) "man over nature" dimension, Blaikie's (1992) "use/abuse of the natural environment" subscale, Dunlap et al. (2000) "antianthropocentrism" facet, Iwata's (2001) "rejection of driving one's own car", and La Trobe and Acott's (2000) "humans and economy over nature" factors.

Using a random procedure, the data was split in two and the 10-factor model was then separately tested using CFA in the first ($n = 223$) and second ($n = 232$) subsamples. The results indicated acceptable fit for both subsamples ($\chi^2 = 4538.67$; df = 2804; $\chi^2/df = 1.62$; RMSEA = .053; SRMR = .071; CFI = .93, and $\chi^2 = 5169.33$; df = 2804; $\chi^2/df = 1.84$; RMSEA = .060; SRMR = .076; CFI = .92, respectively). CFA also indicated that this 10-factor model had an acceptable fit for the overall data ($\chi^2 = 6252.48$; df = 2804; $\chi^2/df = 2.23$; RMSEA = .052; SRMR = .062; CFI = .95), supporting treating the 10 latent variables identified by the EFA as unidimensional EA first-order factors.

Another EFA was done using scale scores for each of the 10 primary factors. The KMO measure of sampling adequacy presented acceptable fit (KMO = .881). Two eigenvalues greater than one emerged (4.16, 1.17). These observed eigenvalues were above the first two eigenvalues (1.24, 1.16) expected for random data by parallel analysis based on PCA eigenvalues (10 variables, 455 subjects and 100 replications; Watkins, 2000). Furthermore, the scree plot from the unreduced correlation matrix indicated a substantial drop after the second eigenvalue. These results therefore suggest that the 10 primary factors generate two higher-order factors. As shown in Table 4, Factor I (Intent of Support, Enjoyment of Nature and Care with Resources) seems to represent Preservation and Factor II (Necessity of Development, Anthropocentric Concern, Antianthropocentrism, Rejection of Exemptionalism/Confidence in Science and Technology, Ecocrisis/Limits to Growth/Nature's Balance and Human Dominance/Altering Nature) seems to represent Utilization. One primary factor (External Control/Effective Commitment) loaded on both these two second-order factors.

CFA with maximum-likelihood estimation procedures were used to test three further models. Model 1 had a single second-order factor on which all 10 primary factors loaded. Model 2 was a nested model within Model 3, testing an uncorrelated two-factor second-order structure, implying an orthogonal solution. Model 3 tested a correlated two-factor second-order model. To keep the models to a reasonable size an item parcelling strategy was used. This also has the advantage of providing more reliable indicators than individual items and requiring the estimation of fewer parameters (Rindskopf & Rose, 1988; Marsh, Antil, & Cunningham, 1989; Hull, Tedlie, & Lehn, 1995).

Three manifest indicators, consisting of item parcels, were used for each primary factor. These manifest indicators were created by randomly assigning items from each primary factor scale to its three parcels, with pro and contrait items equally represented in each parcel whenever possible, so as to have balanced indicators, where possible. The fit indices demonstrated that the unidimensional model ($\chi^2 = 922.94$; df = 395; $\chi^2/df = 2.34$; RMSEA = .054; SRMR = .061; CFI = .97; CAIC = 1421.36) had a better fit to the data then the uncorrelated two-factor second-order model ($\chi^2 = 938.80$; df = 394; $\chi^2/df = 2.38$; RMSEA = .055; SRMR = .15; CFI = .96; CAIC = 1444.34). However, the correlated two-factor second-order model (Model 3) presented an improvement (CAIC = 1322.39) over the previous models, and clearly had the better overall fit indices ($\chi^2 = 809.73$; df = 393; $\chi^2/df = 2.06$; RMSEA = .048; SRMR = .052; CFI = .97).

An extended model was also tested to verify the relations among the two second-order factors (Utilization and Preservation), and the two indices used to test discriminant validity (self-reported ecological behaviour and economic liberalism). The fit indices indicated good overall fit for this extended model: $\chi^2 = 1735.39$; df = 763; $\chi^2/df = 2.27$; RMSEA = .053; SRMR = .061; CFI = .96. Fig. 1 displays the standardized coefficients for this model. To simplify, the manifest indicators and

[5]Because of the size of the table we have not presented all the item-factor loadings for the all 99 items. However, this information is available on request from the first author.

Table 3
Reliability, means, standard deviations, factor loadings and communalities of exploratory factor analysis of the environmental attitudes items

Item	Exploratory Factor analysis			
	M	s.d.	Loading	h^2
Factor 1: Enjoyment of Nature (α=.91*; mean inter-item correlation*=.47)				
I am NOT the kind of person who loves spending time in wild, untamed wilderness areas. ENV_RE03	2.95	1.60	−.80	.64
I really like going on trips into the countryside, for example to forests or fields. ENV08	5.30	1.40	.79	.60
I find it very boring being out in the wild countryside. ENV_RE08	2.73	1.33	−.75	.60
Sometimes when I am unhappy, I find comfort in nature. ECO06	5.02	1.50	.71	.58
Being out in nature is a great stress reducer for me. ECO09	5.40	1.27	.68	.60
I would rather spend my weekend in the city than in wilderness areas. ENV_RE18	3.84	1.50	−.66	.52
I can enjoy spending time in natural settings just for the sake of being out in nature. ECO02	5.71	1.21	.66	.47
I have a sense of wellbeing in the silence of nature. ENV03	5.24	1.29	.64	.57
I find it more interesting in a shopping mall than out in the forest looking at trees and birds. ENV_RE13	3.71	1.53	−.60	.52
I need time in nature to be happy. ECO05	4.80	1.49	.58	.58
I would really enjoy sitting at the edge of a pond watching dragonflies in flight. ENV18	4.40	1.59	.49	.45
I specially love the soft rustling of leaves when the wind blows through the treetops. ENV13	5.03	1.40	.46	.33
Factor 2: External control/effective commitment (α=.86; *mean inter-item correlation*=.28)				
Industry should be required to use recycled materials even when it costs less to make the same products from new raw materials. EWV17	5.30	1.19	.76	.50
Governments should control the rate at which raw materials are used, to ensure that they last as long as possible. EWV10	5.30	1.25	.71	.39
Controls should be placed on industry to protect the environment from pollution, even if it means things will cost more. EWV14	5.32	1.14	.68	.42
People in developed societies are going to have to adopt a more conserving life-style in the future. EWV13	5.20	1.23	.66	.46
The government should give generous financial support to research related to the development of solar energy. EWV19	5.37	1.27	.62	.35
Priority should be given to developing alternatives to fossil and nuclear fuel as primary energy sources. EWV01	5.33	1.46	.57	.37
Humans must live in harmony with nature in order for it to survive. EWV05	5.78	1.18	.54	.40
It makes me sad to see natural environments destroyed. ECO07	5.94	1.10	.50	.49
Nature is valuable for its own sake. ECO08	5.84	1.15	.44	.38
One of the worst things about overpopulation is that many natural areas are getting destroyed. ECO01	5.64	1.20	.40	.31
I prefer wildlife reserves to zoos. ECO04	5.60	1.43	.38	.27
I do not believe protecting the environment is an important issue. ENV_RE10	2.24	1.23	−.37	.39
Despite our special abilities humans are still subject to the laws of nature. NEP09	5.48	1.16	.34	.26
The so-called "ecological crisis" facing humankind has been greatly exaggerated. NEP10	3.44	1.22	−.33	.32
Draining swamps should be opposed even if pests such as mosquitoes and flies breed in them. ENV_RE06	4.37	1.30	.31	.30
Sometimes it makes me sad to see forests cleared for agriculture. ECO03	5.44	1.22	.30	.31
Factor 3: Intent of support (α=.89*; mean inter-item correlation*=.51)				
If I ever get extra income I will donate some money to an environmental organization. ENV01	4.48	1.66	.71	.54
I would like to join and actively participate in an environmentalist group. ENV11	3.60	1.45	.71	.65
I don't think I would help to raise funds for environmental protection. ENV_RE15	3.44	1.40	−.71	.60
I would NOT get involved in an environmentalist organization. ENV_RE07	3.71	1.50	−.67	.59
Environmental protection costs a lot of money. I am prepared to help out in a fund-raising effort. ENV06	4.34	1.38	.65	.59
I would not want to donate money to support an environmentalist cause. ENV_RE20	3.16	1.39	−.62	.50
I would NOT go out of my way to help recycling campaigns. ENV_RE05	3.30	1.42	−.48	.42
I often try to persuade others that the environment is an important thing. ENV16	4.30	1.50	.43	.47
Factor 4: Anthropocentric concern (α=.72*; mean inter-item correlation*=.31)				
One of the most important reasons to conserve is to ensure a continued high standard of living. ANTHR11	4.37	1.31	.76	.54
One of the best things about recycling is that it saves money. ANTHR08	3.63	1.52	.66	.40
The worst thing about the loss of the rain forest is that it will restrict the development of new medicines. ANTHR01	3.71	1.48	.55	.29
One of the most important reasons to keep lakes and rivers clean is so that people have a place to enjoy water sports. ANTHR06	3.51	1.60	.55	.31
Nature is important because of what it can contribute to the pleasure and welfare of humans. ANTHR09	4.66	1.46	.55	.29
The thing that concerns me most about deforestation is that there will not be enough lumber for future generations. ANTHR05	3.60	1.60	.49	.38
Factor 5: Rejection of exemptionalism/Confidence in Science and Technology (α=.74*; mean inter-item correlation*=.29)				
Most problems can be solved by applying more and better technology. EWV16	3.79	1.33	.70	.45
Science and technology will eventually solve our problems with pollution, overpopulation, and diminishing resources. ANTHR04	3.61	1.44	.68	.47

Table 3 (*continued*)

Item	Exploratory Factor analysis			
	M	s.d.	Loading	h^2
Through science and technology we can continue to raise our standard of living. EWV04	4.84	1.20	.62	.43
Humans will eventually learn enough about how nature works to be able to control it. NEP14	3.65	1.52	.58	.37
We cannot keep counting on science and technology to solve our problems. EWV12	4.70	1.44	−.54	.38
Human ingenuity will insure that we do NOT make the earth unlivable. NEP04	3.80	1.40	.44	.31
Science and technology do as much harm as good. EWV07	4.50	1.45	−.40	.28
Factor 6: Ecocrisis/limits to growth/nature's balance (α=.73*; mean inter-item correlation*=.29)				
If things continue on their present course, we will soon experience a major ecological catastrophe. NEP15	4.91	1.24	.61	.48
The earth is like a spaceship with very limited room and resources. NEP11	4.45	1.45	.60	.35
We are approaching the limit of the number of people the earth can support. NEP01	4.51	1.41	.50	.30
Rapid economic growth often creates more problems than benefits. EWV02	4.90	1.19	.42	.34
The balance of nature is very delicate and easily upset. NEP13	4.93	1.30	.36	.20
When humans interfere with nature it often produces disastrous consequences. NEP03	5.01	1.41	.35	.21
Humans are severely abusing the environment. NEP05	5.24	1.34	.35	.30
Factor 7: Human dominance/altering nature (α=.68*; mean inter-item correlation*=.26)				
Grass and weeds growing between paving stones may be untidy but it is natural and should be left alone. ENV_RE11	3.81	1.40	.51	.30
Grass and weeds growing between pavement stones really looks untidy. ENV05	4.30	1.60	−.47	.36
I oppose any removal of wilderness areas no matter how economically beneficial their development may be. ENV_RE17	4.20	1.33	.43	.39
I'd prefer a garden that is wild and natural to a well groomed and ordered one. ENV_RE01	4.10	1.49	.42	.37
Human beings should not tamper with nature even when nature is uncomfortable and inconvenient for us. ENV_RE02	4.20	1.30	.41	.35
Turning new unused land over to cultivation and agricultural development should be stopped. ENV_RE12	3.93	1.12	.31	.22
Factor 8: Care with resources (α=.75*; mean inter-item correlation*=.34)				
I always switch the light off when I don't need it any more. ENV02	5.19	1.65	.74	.42
I make sure that during the winter the heating system in my room is not switched on too high. ENV12	4.70	1.52	.72	.42
In my daily life I'm just not interested in trying to conserve water or power. ENV_RE14	3.05	1.35	−.64	.56
Whenever possible, I take a shower instead of a bath in order to conserve water. ENV07	5.39	1.60	.54	.35
I could not be bothered to save water or other natural resources. ENV_RE19	2.71	1.21	−.47	.51
I drive whenever it suits me, even if it does pollute the atmosphere. ENV_RE09	3.87	1.57	−.33	.25
Factor 9: Antianthropocentrism (α=.73*; mean inter-item correlation*=.35)				
Humans were meant to rule over the rest of nature. NEP12	3.25	1.72	.69	.50
Human beings were created or evolved to dominate the rest of nature. EWV03	3.43	1.65	.58	.42
Plants and animals have as much right as humans to exist. NEP07	5.90	1.32	−.49	.40
Plants and animals exist primarily to be used by humans. EWV18	2.54	1.49	.44	.46
Humans are as much a part of the ecosystem as other animals. ECO12	5.60	1.14	−.39	.27
Factor 10: Necessity of development (α=.58*; mean inter-item correlation*=.26)				
A community's standards for the control of pollution should not be so strict that they discourage industrial development. EWV06	3.93	1.30	.52	.25
The positive benefits of economic growth far outweigh any negative consequences. EWV11	3.46	1.19	.44	.41
Weeds should be eradicated because they inhibit the full development of useful and ornamental plants. ENV10	3.90	1.35	.38	.26
Humans need not adapt to the natural environment because they can remake it to suit their needs. EWV09	3.04	1.44	.32	.39

Note. Factor loadings based on Principal Axis Factoring and Promax Rotation with Kaiser Normalization (rotation converged in 9 iterations). The number of factors was specified in 10. In order to save space only loadings above .30 were presented in the table. The percentage of cumulative variance for the 10 factors was 38.6%. ENV_RE = items from the ENV Reversed Items Scale, ENV = items from the ENV Scale, ECO = items from the Ecocentric Scale, EWV = items from the Ecological World View Scale, NEP = items from the New Ecological Paradigm (NEP) Scale, ANTHR = items from the Anthropocentric Scale.

paths from manifest to latent variables were omitted (the weakest path was .47). As can be seen from Fig. 1, the path from Preservation to self-reported ecological behaviours was powerful and significant, but that to economic liberalism was not significant, while the path from Utilization to economic liberalism was significant, but not that to self-reported ecological behaviours. In addition, Preservation and Utilization were highly correlated ($\Phi = -.72$), and this correlation was only slightly reduced (to −.71) if Factor 2, which loaded on both Preservation and Utilization, was excluded from the analysis.

Table 4
Environmental attitudes primary factors, means, standard deviations, and t values by gender and means, standard deviations, factor loadings, and communalities of exploratory factor analysis of the primary factors

Primary factors	*t* test for gender differences					Exploratory factor analysis				
	Female		Male		*t*					
	M	S.D.	*M*	S.D.		*M*	S.D.	Second-order loadings	factor	h^2
Factor III—Intent of support	4.60	1.05	3.90	1.10	6.61***	4.39	1.11	**.94**	−.15	.71
Factor I—Enjoyment of nature	5.05	1.04	4.76	.93	2.90**	4.96	1.02	**.73**	−.03	.51
Factor VIII—Care with resources	5.04	.93	4.68	1.08	3.61***	4.93	1.00	**.65**	−.04	.39
Factor II—External control/effective commitment	5.44	.71	5.27	.67	2.37*	5.39	.70	**.40**	**.40**	.53
Factor X—Necessity of development	3.51	.86	3.75	.92	−2.55*	3.58	.88	.02	**−.69**	.46
Factor IV—Anthropocentric concern	3.88	.97	3.97	.96	−0.91	3.91	1.00	.22	**−.62**	.25
Factor IX—Antianthropocentrism	5.35	1.01	5.01	1.04	3.19**	5.25	1.03	.21	**.50**	.44
Factor V—Rejection of exemptionalism/ confidence in science and technology	4.32	.82	3.94	.95	4.10***	4.21	.88	.06	**.48**	.27
Factor VI—Ecocrisis/limits to growth/ nature's balance	4.90	.81	4.73	.90	2.00	4.84	.83	.24	**.41**	.36
Factor VII—Human dominance/altering nature	3.95	.85	4.21	.81	−3.00**	4.03	.85	−.29	**−.33**	.32

Note. Factor loadings based on Principal Axis Factoring and Promax Rotation with Kaiser Normalization (rotation converged in 3 iterations). Loadings above .30 were given in bold face. Female ($n = 319$), Male ($n = 136$). *$p < .05$. **$p < .01$. ***$p < .001$.

5. Discussion

This study aimed to investigate the dimensionality of EA, and to specifically test the two-dimensional model proposed by Wiseman and Bogner (2003) and others. Exploratory and confirmatory factor analyses were used in two ways. First, an EA item pool was forced to a two-factor solution. CFA then demonstrated that the correlated two-factor model showed better fit to the data than a one-factor solution. Second, first-order factors were extracted from the 99 items using EFA. Ten primary factors were extracted, which presented content similarities to factors reported in previous studies and good fit indices, supporting treating them as EA first-order factors. After that, a second EFA was performed with these factors to extract second-order factor(s). Again, CFA suggested that a correlated two factor higher-order structure for EA provided better fit to the data than a single higher-order factor.

The factors obtained in a factor analysis will inevitably reflect the content of the items included in the analysis. However, the broader and more extensive the sample of items used in the analysis, the less likely it will be that any particular items or group of items will unduly influence the solution. Thus, the very broad sampling of items and the very large item pool used, covering most items and measures of EA used in prior research, can be seen a distinct strength of the current research.

Wiseman and Bogner (2003) hypothesized relationships between Preservation and Utilization with Eysenck' personality factors. These factors are Psychoticism (P; characterized by aggressive, tough-minded and egocentric), Extraversion (E; including aspects such as sociability and excitability), and Neuroticism (N; including aspects such as anxiety, emotionality and self-esteem). They found a positive correlation between P and Utilization, N and Preservation, and no relationship between E and either EA factors, and concluded that "the positive correlation of P with UT [Utilization] suggests that utilization is associated with tough-mindedness and egocentricism. The PRE [Preservation] dimension, on the other hand, is associated with anxiety, perhaps tainted with feelings of guilt towards the environment" (Wiseman & Bogner, 2003, p. 791). Additionally, our results indicated that Preservation predicted self-reported ecological behaviour (but not expressed attitudes toward economic liberalism), while Utilization predicted attitudes toward economic liberalism (but not self-reported ecological behaviour). Both these results therefore support the construct and discriminant validity of the EA high-order model.

However, while Wiseman and Bogner's Model of Ecological Values (MEV) viewed its two dimensions as uncorrelated and theoretically orthogonal, the present results indicate two strongly correlated dimensions. Bogner and Wiseman (2002; see also Wiseman and Bogner, 2003), also found a significant, though rather weak correlation, between their two dimensions, but this could have been due to direction of wording effects, since their Preservation factor consisted only of pro-environment items and their Utilization factor of only

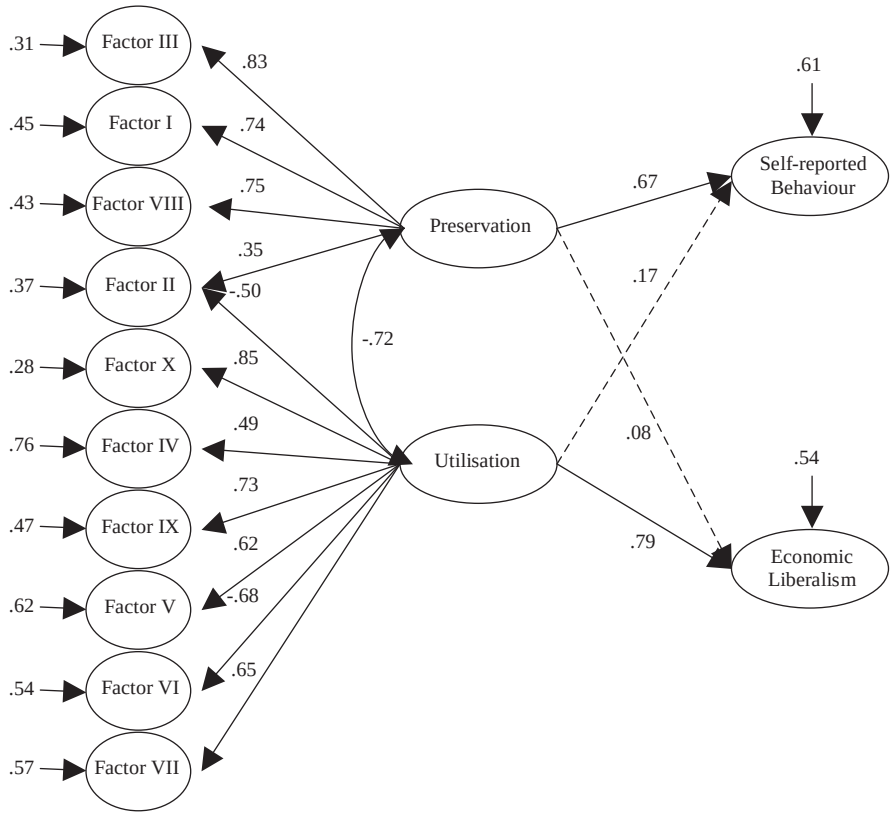

Fig. 1. Standardized multiple regression and correlation coefficients for the structural equation model of environmental attitude's ten primary factors, two higher-order factors and self-reported ecological behaviour and economic liberalism. *Note*. To simplify, manifest variables and the paths from latent to manifest variables are not shown (the weakest path was .47). Dotted arrows represent nonsignificant causal paths ($t<1.96$, $p>0.05$). All other coefficients from normal arrows are significant at the 5% level ($t>1.96$, $p<0.05$). Arrows without origin indicate proportions of error and unexplained variances. Factors labels: Factor III—intent of support, Factor I—enjoyment of nature, Factor VIII—care with resources, Factor II—external control/effective commitment, Factor X—necessity of development, Factor IV—anthropocentric concern, Factor IX—antianthropocentrism, Factor V—rejection of exemptionalism/confidence in science and technology, Factor VI—ecocrisis/limits to growth/nature's balance, Factor VII—human dominance/altering nature.

anti-environment factors. Thus, direction of wording effects could have exaggerated the degree of independence between the Preservation and Utilization factors and weakened the negative correlation between them in their study. In contrast, the factors identified in this study, although not perfectly balanced, did each include both pro- and anti-environment items, which would have reduced, or possibly even have eliminated direction of wording effects.

Clearly the results reported in this paper provide empirical evidence for a two-dimensional model of EA, but has it theoretical support? We believe so. First, it can be pointed out that this model seems to reflect one of the basic issues proposed by Schwartz (1994; Schwartz & Bardi, 1997) that societies must confront in order to regulate human activity. This basic issue is the relation of humans to the natural and social environment that leave societies with two solutions: either to fit harmoniously into the world, trying to preserve it (*Harmony* values, such as, unity with nature, protecting the environment, and world of beauty) or to exploit and change the world (*Mastery* values, such as, ambition, success, and daring). These two values types seem closely related to Preservation and Utilization, respectively, as proposed by Wiseman and Bogner's (2003) MEV. In fact, these authors viewed their two higher-order factors as "values".

Nevertheless, according to Schwartz (1994; Schwartz & Bardi, 1997), Harmony and Mastery values are two contrasting indeed opposing solutions to human–nature dilemma. In other words, his theory implies that these two values types are two opposing poles of the same dimension (i.e. advocating two opposite orientations) suggesting uni, not bi-dimensionality. The idea of these two beliefs as opposite ends of a continuum, and antipodal rather than independent has support in the conceptual literature (Beckmann, Kilbourne, van Dam, & Pardo, 1997). However, our results support a bi-dimensional structure of EA, suggesting that Preservation and Utilization are two distinct, though related, constructs. Researchers from a different tradition have also proposed similar conclusions. For instance, Kaiser and Scheuthle (2003) have argued that "If the evaluative component of people's attitudes consists of at least two

distinguishable lines of values—utilitarian values as well as moral/altruistic ones—then it would be better to consider them independently'' (p. 1041).

We also believe that the finding that EA seems to form two dimensions is consistent with more general theories that argue that the human–nature relation can be viewed in terms of two distinct beliefs. These beliefs have been articulated as Cornucopian versus Malthusian theory (Barbieri, 2002), Cultures of Progress versus Cultures of Survival (Witten-Hannah, 2000), DSP versus NEP (Dunlap & Van Liere, 1978; Corral-Verdugo & Armendáriz, 2000), Anthropocentric versus Ecocentric concerns (Thompson & Barton, 1994; Kortenkamp & Moore, 2001), and the First Concept of Environmental Sustainability versus the Third Concept of Environmental Sustainability (Dobson, 1998). Briefly, Cornucopian theory, Cultures of Progress, DSP, Anthropocentric concern, and the First Concept of Environmental Sustainability express the belief that it is right, appropriate and necessary for nature and all natural phenomena and species to be used and altered for human objectives. On the other hand, Malthusian theory, Culture of Survival, NEP, Ecocentric concern, and the First Concept of Environmental Sustainability prioritize preserving nature and the diversity of natural species in its original natural state and protecting it from human use and alteration.

A bi-dimensional model also seems consistent with the contemporary Sustainable Development (SD) debate (see Schmuck & Schultz, 2002; Schmuck & Vlek, 2003). Although the Utilization dimension did not predict self-reported ecological behaviour in this study, it might have important implications for the way in which people may use and consume natural resources. Thus, both dimensions might have important environmental implications, as well as for the sustainability debate. SD is a particular form of development that aims to guarantee environmental sustainability, and it has become an important developmental paradigm since the 1990s (Lélé, 1991). Following Dobson (1998), Milfont (2004) has argued that sustainable development is the strategy to achieve environmental sustainability. This paradigm suggests a potential complementarity between Environmental Preservation and Utilization. So, environmental sustainability implies that humans need to use natural resources for human wellbeing, but also need to protect the environment at the same time, that is, a balance of utilization with preservation. As suggested by Blaikie (1992), this ''reflects some of the dilemmas which people experience in trying to balance the need both to be aware of the delicate balance between humans and the rest of the natural world, and to conserve the natural environment, while at the same time recognizing that some forms of exploitation of the environment are needed if standards of living are to be maintained'' (p. 161).

Although it seems as if the correlated factor model would only be consistent with the environmental sustainability approach if the correlation was positive, that is, high Preservation associated with high Utilization, the existence of two dimensions is consistent with environmental sustainability, as even though they may be negatively correlated. This means that people can fall into one of four quadrants in terms of these dimensions, and some people may be high on both, even though this may be fairly rare, at least in New Zealand. However, this does need further investigation.

Another point that arises from our results is the relationship between gender and EA. Many researches have proposed that *age*, *gender*, *social-class*, *political-ideology*, and *residence* are the five main socio-demographic determinants of EA (Van Liere & Dunlap, 1980; Fransson & Gärling, 1999). Research, however, has generally found weak relationships between socio-demographic factors and EA, although, younger, female, more educated individuals with liberal political ideologies living in urban areas do tend to have higher EA concern scores (Fransson & Gärling, 1999).

In the present research we have only addressed the relationship between gender and EA. Women scored significantly higher than men on the Preservation factor, whereas men scored significantly higher on the Utilization factor. These results confirm previous findings showing that female tend to have higher EA concern scores. However, this pattern was not as clear on the primary factors (see Table 4). Females scored significantly higher than males on all Preservation primary factors, but an equally consistent gender difference pattern for males was not evident for the Utilization primary factors. In this case, females had higher scores on primary Factor V (confidence in science and technology) and there were no significant differences on primary Factors IV (anthropocentrism concern) and VI (ecocrisis). Thus, the relationship between gender and EA may be more complex, at least in respect of the different facets of Utilization, than previous findings have indicated (for a review see Zelezny, Chua, & Aldrich, 2000)

Several limitations of this research should be noted. First, the sample was small in relation to the number of items used and consisted of only New Zealand students. The findings therefore clearly need to be replicated in other countries and in community samples. A further consideration here is that while Bogner and Wiseman (2002) found a weak negative relationship between the two higher-order EA factors of Preservation and Utilization, this research found a more powerful negative relationship. It was noted that this could have been due to direction of wording effects, which were not controlled in Bogner and Wiseman's research, but which were at least partially controlled in this study. Another

possible difference, however, could be that these findings were obtained in different countries.

Thus, the relationship between Preservation and Utilization might vary substantially in different countries. Research has shown that macro-social and macro-economic variables can influence psychological constructs (see, e.g. Gouveia & Ros, 2000; Gouveia, 2002). One possibility is that the correlation between Preservation and Utilization might be negative in wealthy first world countries with mature economies and high standards of living, where young politically aware and liberal students may perceive a radical antithesis between preservation and utilization. On the other hand, it may not be negative and may even be positive in less economically advantaged developing countries where dealing with poverty and economic underdevelopment are major social issues. Another possibility is that these two factors may be more distinct and independent in industrialized societies than in less industrialized ones. Corral-Verdugo and Armendáriz (2000), for instance, found a high covariances between pro-*human exception* (or *dominant social*) *paradigm* (HEP) and pro-*new environmental paradigm* (NEP) factors in a Mexican community sample. They argue there is a dualism in peoples' environmental beliefs in western countries, where results demonstrated that these two factors are independent (i.e. people are either pro-HEP or pro-NEP), while there is no conflict in holding both belief systems in nonwestern and nonindustrialized countries, such as Mexico and Brazil (Bechtel, Corral-Verdugo, & Pinheiro, 1999).

A second limitation of this research was the use of self-report to measure ecological behaviour. Hines, Hungerford, and Tomera (1986/87) have reported that mode of behavioural assessment (actual behaviour versus self-reported measures) attenuated the attitude–-behaviour relationship, with the relationship stronger when actual behaviour was assessed than when self-report measures were used. It has also been argued that self-reports of positive behaviour can often overestimate actual behaviour (Geller, 1981). A further limitation was that this research did not include a measure of social desirability. Previous research had indicated a tendency to give socially desirable responses in respect to EA (e.g. Schahn, 2002; Wiseman & Bogner, 2003). Thus, replication of these findings using measures of actual behaviour, rather than self-reports, and including a measure of social desirability also seems necessary.

Despite the limitations of the study, the findings clearly support a bi-dimensional structure of EA. They are therefore consistent with several previous investigators who, using different approaches and item sets, have reported findings suggesting a broad higher-order bi-dimensionality of EA (Stern & Dietz, 1994; Thompson & Barton, 1994; Kortenkamp & Moore, 2001; Kaiser & Scheuthle, 2003; Wiseman & Bogner, 2003). Moreover, the findings of this research suggest that the two second-order factors obtained here, Preservation and Utilization, may be particularly useful for investigating the relationship between EA and ecological behaviours.

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