Measuring cultural values and beliefs about environment to identify their role in climate change responses

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Abstract -Cultural theory elucidates conflicting opinions driving the climate change debate. Patterns of shared values and beliefs are described as cultural biases. These partial perspectives about society and environment legitimize four ways of life - worldviews. This research tests whether cultural biases about the environment have the same structure as those about society to clarify their role in climate change responses. Study 1 details psychometric measures developed through an online survey of Australians (n=290). Study 2 replicates the measures (n=5081), and assesses their predictive validity in relation to climate change beliefs and carbon-relevant behaviors. Two negatively correlated dimensions were identified that differ from the grid-group framework and four myths-of-nature described in the theory. Individualistic and fatalistic perspectives frame the environment as ‘elastic’ to justify damaging behaviours. Hierarchical and egalitarian perspectives frame the environment as ‘ductile’ to justify collective action to conserve the environment. Arguments regarding social prescriptions constraining behavior (grid) are collapsed into arguments regarding the role of the collective (group). Notions of human agency and environmental resilience justify different behaviors. These measures demonstrate inverse direct relationships with carbon-relevant behaviors, climate change beliefs, and environmental concern. Implications for cultural theory, and ways that measurement shapes understanding of these concepts, are discussed.

Keywords: Myths of nature; cultural bias; cultural theory; measurement; scale; environmental values, beliefs and behavior; climate change

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1 Introduction

Cultural theory (Douglas, 1978, 1985; Douglas & Wildavsky 1982) is an effective framework for understanding the conflicting opinions about society and the environment that drive the climate change debate (Adger et al. 2009; Leiserowitz, 2006, 2005; O'Riordan & Jordan, 1999; Pendergraft, 1998; Thompson, 2003). It explains why people perceive dangers differently and selectively attend to information providing useful insights into contested risks. Patterns of shared values and beliefs about society and the environment are described as 'cultural biases[3]', which represent partial perspectives about reality (Wildavsky, 1987). These perspectives are plausible but not provable, and have accordingly been termed 'myths' of human-nature and physical-nature. Different opinions about the setting, problem, and protagonists result in different policy preferences and behavioral strategies for managing risk (Verweij et al 2006). Cultural biases legitimize four ways of life which have been variously termed cultural 'rationalities', 'solidarities' or 'worldviews'[4] (Thompson, Ellis & Wildavsky, 1990). These ways of life were originally derived from cultural biases about social relations and human nature (Douglas, 1978). Cultural biases about the environment were later integrated into the four worldviews in a post hoc fashion, upon identification of patterns in ecosystem management (Schwarz & Thompson, 1990; Thompson, 1990). It was assumed that they would fit within earlier formulations of cultural biases about society; however, empirical results suggest that they may not be as linked as previously thought (Grendstad & Selle, 2000). The current research explores whether cultural biases about the environment have the same structure as those about society in order to clarify their influence on climate change attitudes and behaviors.

Although originally developed from ethnographic studies as socially constructed patterns of values and beliefs (Douglas, 1985; Douglas & Wildavsky, 1982) cultural biases have been applied quantitatively in surveys as traits, or orienting dispositions, in risk perception (Dake, 1991; Jenkins-Smith & Herron, 2009; Kahan, et al. 2007; Lima et al., 2005; Peters et al., 1996; Steg & Seivers, 2000; Silva & Jenkins-Smith, 2007). The

[3] The word 'bias' does not connote prejudice when used in this context. It describes partial perspectives that exclude other equally valid perspectives.

[4] Alternative representations of worldview include 'Contemporary worldview A and B' (Buss & Craik, 1983) 'Amount of Regulation' & 'Amount of Social Contact' (O'Riordan et al., 1999), 'Malthusianism-Cornucopiansim' & 'Holism-Mechanism' (Jackson, 1995).

overwhelming majority of this research has been concerned with cultural biases about social relations (Grensted et al., 2000), resulting in the development of several dimensional measures (Dake, 1992; Ellis & Thompson, 1997; Grendstad, 2003; Kahan, 2007; Marris, Langford, & O'Riordan, 1998; Rippl, 2002). To our knowledge, there is just one dimensional measure of cultural environmental biases (Lima & Castro, 2005). This measure reflects the assumption that cultural biases about environment have the same dimensional structure as those about society. As this is yet to be rigorously tested, the influence of cultural environmental biases on environmental attitudes and behaviours remains unclear. Sound psychometric measures are required to clarify what role they play in the climate change debate. It is precisely this gap that the current research addresses. Study 1 details the development of a dimensional measure of cultural environmental bias. Study 2 builds on this by replicating the measure and assessing its predictive validity in relation to climate change beliefs and carbon-relevant behaviors. Seeking to assess whether cultural biases about the environment and social relations have similar structures, as suggested by cultural theory, we discuss how measurement shapes the way these concepts are understood. Cultural biases about society and the environment, and the policy preferences thought to stem from them, are discussed below and presented in figure 1.

1.1 Cultural biases about society

Cultural biases about society, often termed myths of human-nature, are distinguished along two dimensions in cultural theory's grid–group framework (Douglas, 1970; Dake, 1991), forming four different worldviews. The grid dimension describes the extent of social prescriptions constraining individual behavior, or the degree of social regulation and role definition in a culture (Wildavsky, 1987). The group dimension describes the strength of group boundaries and ties among members, or the emphasis placed on the needs of the collective compared to the individual. Wildavsky (1987) suggests that a hierarchical worldview is formed in strong groups with clearly defined social roles and constraints on behavior. Institutionalized authority and inequality are justified, and humanity is viewed as flawed unless regulated (O'Riordan & Jordan, 1999). Strong groups with few constraints on behavior are thought to form an egalitarian worldview that emphasizes equality and voluntary consent. Humanity is framed here as essentially altruistic but perverted by capitalist economic models. Groups with few behavioral constraints and weak boundaries and ties are thought to form an individualistic worldview which emphasizes competition and self-regulation. Humanity is framed as self-serving, and individual freedoms are privileged

(O’Riordan & Jordan, 1999). Finally, groups with weak boundaries and ties combined with constrained behavior may form a fatalistic worldview where people feel controlled and apathetic. Humanity is framed as unpredictable, capricious and unfair (O’Riordan & Jordan, 1999).

Dimensional measures of cultural biases about society have either: four correlated factors tapping egalitarian, hierarchical, individualistic and fatalistic worldviews (Dake, 1992; Ellis & Thompson, 1997; Grendstad, 2003; Marris, Langford, & O'Riordan, 1998; Rippl 2002); or two orthogonal factors reflecting the grid-group framework (Kahan et al., 2007, 2009, 2011). The first measurement model assumes that multiple cultural biases coexist within individuals and groups, and the second that cultural biases are mutually exclusive. The latter is more consistent with original formulations of worldviews as competing rationalities that seem illogical to each other, and exist singularly within groups and individuals at any one time (Thompson et al. 1990). The “cultural cognition thesis” (Kahan et al., 2007) frames cultural biases as relatively stable traits. This formulation characterises preferences for how to organise society along two continuous attitudinal dimensions that reflect grid and group: hierarchy vs egalitarianism; and individualism vs communitarianism. This perspective identifies cultural biases as a point along two independent axes. By using two continuous scales, rather than the four commonly-used scales developed by Dake (1992), this perspective precludes the possibility of a single individual exhibiting multiple competing orientations at once. This measurement demonstrates better psychometric properties than the four scales offered by Dake (1992), which despite their popularity have been criticised as having questionable reliability and factor structure, and low predictive power (Sjoberg, 2000; Slimak & Dietz, 2006; Rippl, 2002).

Dimensional measures of cultural biases about society have strong links with environmental attitudes and behaviors, particularly in relation to climate change. Cultural cognition research suggests that people with hierarchical and individualistic perspectives are more likely to deny that global temperatures are increasing, and that humans are causing climate change compared to those with egalitarian and communitarian perspectives (Kahan, Jenkins-Smith, & Braman, 2010). Furthermore, these two groups significantly disagree about the extent of expert consensus on climate change when presented with exactly the same information. They are motivated to selectively process information to reinforce their existing cultural perspectives. Research using four scales of cultural biases about society has consistently demonstrated positive relationships between the egalitarian outlook and environmentalism, whereas the inverse is true of individualistic perspectives (Dake, 1992). Egalitarian cultural biases about society are linked to support for raising energy taxes, slowing industrial growth (Carlisle & Smith, 2005), climate change policies (Leiserowitz, 2006); and being concerned about technology and the environment (Peters & Slovic, 1996). Empirical findings regarding the hierarchical and fatalistic perspectives are inconsistent (Ellis & Thompson, 1997; Marris et al. 1998; Carlisle & Smith, 2005); however, the questionable internal consistency of the dominant measure (Dake, 1992) may prevent such relationships from being accurately identified.

1.2 Cultural biases about environment

The cultural theory literature assumes that cultural biases about society and the environment are entwined and cannot be mixed and matched (Thompson, Ellis & Wildavsky, 1990). Cultural environmental biases, often termed myths of physical-nature, are presented as both influencing and being influenced by cultural biases about social relations (Thompson, Ellis & Wildavsky, 1990); however, their post-hoc integration into the grid-group framework suggests they are actually conceptualized as subordinate to cultural biases about society. Representing simple models of how stable the ecosystem is, they justify the four ways of life by providing rationale for certain attitudes, behaviors, and policy preferences. Egalitarian perspectives frame the natural environment as ‘ephemeral’. It is seen as fragile, interconnected and at serious peril. Radical changes in human behavior and society are presented as the only way to protect the environment (Dake, 1992).This cultural bias justifies individual pro-social behaviors, like voluntary simplicity, and the precautionary principle regarding environmental conservation and protection. The natural environment is framed as ‘perverse/tolerant’ in hierarchical perspectives (Thompson, Ellis & Wildavsky, 1990). It is seen as resilient, but only up to a point defined by experts from established social institutions, beyond which irreparable damage is incurred. This cultural bias justifies restrictions on individual behavior based on science and policy. The environment is presented as ‘benign’ and able to adapt to human activity in individualistic perspectives. Deregulation and technological solutions are viewed as the best strategy for environmental management. This cultural bias justifies laissez fare attitudes, privileging the economy above the environment. The natural environment is framed as ‘capricious’ in the fatalistic worldview. It is unpredictable and uncontrollable. This cultural bias justifies inaction and pessimism and policy preferences are varied (Dake, 1992).

The dominant measures of cultural environmental biases are nominal, with participants forced to select a hierarchical, egalitarian, individualistic or fatalistic option. The options frame nature as either perverse/tolerant, ephemeral, benign or capricious, and also include policy preferences thought to stem from these myths of physical-nature (Steg & Seivers, 2000; Poortinga, Steg & Vlek, 2002). Although demonstrating good criterion validity these measures are unable to provide information about the underlying structure of this concept. Much like the cultural cognition perspective this measurement model assumes that different cultural perspectives cannot exist simultaneously within individuals; however, unlike cultural cognition this measurement model does not assess grid and group dimensions, and cannot identify the extent to which an individual endorses a way of life. Moderate correlations between the four options when trialled in Likert-scale, rather than forced-choice, format indicates that cultural environmental biases may not be independent (Boschetti et al. 2012); however, these single-item measures cannot provide information about dimensional structure or internal consistency. When asked to rank the four options participants from environmental organisations tended to select the hierarchical and egalitarian options as their first and second priorities respectively (Grendstad & Selle, 2000). The ability of these participants to prioritise each option contradicts the theory by indicating that worldview perspectives are not irrational when viewed from other perspectives. Based on the weak pattern between cultural biases about the environment and society observed in this sample the authors concluded that they are distinct constructs. The use of just two items to measure each cultural bias about society, and failure to attain adequate internal consistency (Cronbach alpha as low as .19), brings the reliability of this conclusion into question.

The only dimensional measure of cultural environmental biases, to our knowledge, identifies four inter-related factors aligned with the four worldviews (Lima & Castro, 2005). Egalitarian and hierarchical indexes were found to be positively correlated, as were individualistic and fatalistic indexes. This suggests that cultural biases may be related along the group dimension only. The authors concluded that “more efforts should be made in this area, as the sample was quite specific and some items (namely, the hierarchy dimension) show only tangentially acceptable levels of reliability” (p.33). With a Cronbach alpha of only .54, their hierarchy dimension demonstrated poor internal consistency. The remaining dimensions had modest internal consistency, with alphas ranging from .6 to .7 (Kline, 1999; Cortina, 1993). The lack of sound psychometric measures of cultural environmental biases may prevent relationships with environmental attitudes and behaviors from being accurately identified.

Despite this, existing measures of cultural environmental biases have demonstrated relationships with environmental attitudes and behaviors. When measured continuously, rather than nominally, cultural biases about the environment have been linked to support for climate change science (Boschetti et al. 2012) and environmental concern (Lima & Castro, 2005; Steg & Seivers, 2000). People scoring highly on an egalitarian index demonstrated significantly higher levels of concern about global environmental problems, but not local environmental problems (Lima & Castro, 2005). Lima and Castro conclude that egalitarian perspectives are most sensitive to 'environmental hyperopia' whereby local problems are of less concern than global ones, whereas individualistic perspectives are least sensitive to this effect, perhaps as a result of the 'not-in-my-backyard' syndrome. Research with nominal measures indicates that the egalitarian perspective demonstrates the highest level of concern about climate change, and support for behavioral energy-saving strategies such as increased efficiency, carpooling, using public transport, and reducing air-travel (Poortinga, Steg & Vlek, 2002). Despite the clear link to indices of environmentalism, it remains unclear whether cultural environmental biases are directly related to environmental behaviors. For instance, cultural environmental biases have been linked to attitudes regarding carbon-relevant behaviors like car use, but not car-use itself (Steg & Seivers 2000). No significant difference in annual kilometres travelled by car was observed for people selecting different cultural environmental biases using a nominal measure. Differences were observed in awareness, perceived responsibility and support for policies associated with car use problems. Steg and Seivers conclude that cultural environmental biases influence specific environmental beliefs but do not translate into action.

The inability of research to demonstrate a direct relationship between cultural environmental biases and environmental behavior may be a function of the well-documented gap between environmental knowledge, attitudes and pro-environmental behaviors (Kollmuss & Agyeman, 2002). It is possible, however, that it is related to how these constructs have been operationalised and measured. Cultural biases about the environment were integrated post hoc into the four worldviews (Schwarz & Thompson, 1990; Thompson, 1990). It has been assumed that they would neatly fit within earlier formulations of cultural biases about society, but this is yet to be empirically tested with sound measures. The current research explores whether cultural environmental biases have the same structure as those about human relationships. As such we explore the dimensional structure of cultural environmental biases to clarify if they demonstrate two orthogonal dimensions reflecting grid and group, or four dimensions reflecting hierarchical, egalitarian, individualistic and fatalistic ways of life.

As the underlying structure of cultural environmental biases is yet to be identified it is also possible that they reflect measures of environmental attitudes and values already detailed environmental psychology: the New Environmental Paradigm - NEP, and Dominant Social Paradigm - DSP perspective (Dunlap & Van Liere, 1978; Dunlap et al. 2000); and Egoistic, Biospheric and Social-altruistic environmental concern (Schultz, 2000; 2001). The NEP was developed in the 1970s in recognition of changing attitudes challenging the anthropocentric Dominant Social Paradigm. Humans are framed as being part of, rather than independent from, natural systems (Dunlap & Van Liere, 1978). The NEP was designed to measure ecocentric attitudes by tapping beliefs regarding the balance of nature, limits to growth, and human superiority over nature. This shares features with egalitarian cultural environmental bias. Indeed, those who endorse egalitarian concepts of the environment record the highest level of NEP, which suggests these are overlapping constructs (Poortinga, Steg, & Vlek, 2002). The NEP provides little account of how environmental attitudes are socially and discursively constructed or what psychological and cultural function they serve. The measure of cultural environmental biases presented in this paper may compliment the NEP perspective by providing insights into cultural mechanisms by which environmental beliefs are formed and maintained.

2 Study 1

The first study was developed to investigate the underlying structure of cultural environmental biases when measured as a dimensional construct. It was driven by the following research question: Do cultural environmental biases demonstrate the same structure as cultural biases regarding social relations, as has been suggested by the cultural theory literature? More specifically we explore whether cultural environmental biases demonstrate two orthogonal factors as per Kahan et al.'s (2007, 2009, 2011) cultural cognition perspective; or four correlated factors of hierarchical, egalitarian, individualistic and fatalistic dimensions in line with Lima and Castro (2005) and Dake (1992).

2.1 Method

A survey was conducted in May 2012 with 290 Australian participants recruited nationally using an on-line research only internet panel.[5] The online panel consisted of a

[5] The panel used is administered by ORU, an online fieldwork company with QSOAP 'Gold Standard' and the new Global ISO 26362 standard accreditation. The ORU has a database of over 300,000 individuals from across Australia (http://www.theoru.com/).

group of community members who have explicitly agreed to take part in web-based surveys from time to time. In return they are offered a small non-cash incentive for completing such tasks, such as points towards shopping credits. The gender (female=151; male = 139) and age (18-30 yrs = 31; 31-45 yrs =95; 46-60 yrs=76; 61-75 yrs= 71; >75 yrs= 17) profile of the sample accords with the known population characteristics of Australians (Australian Bureau of Statistics, 2012).

2.1.1 Instruments

Cultural environmental biases - A pool of 40 items measuring the cultural environmental biases, or myths of nature, were derived from the Cultural Theory literature. Specific attention was paid to the seminal works from Douglas (1996), Thompson et al. (1990), Wildavsky (1987), and Dake (1992). The content of the items was also informed by piloting workshops conducted with nine university students in May 2012. The workshops were designed to explore conceptual differences between existing worldview measures. Participants were asked questions about items from the following measures: Short form Cultural Cognition (Kahan et al. 2010); Cultural biases (Dake, 1992): Cultural syndromes (Triandis, 1996); Revised New Environmental Paradigm (Dunlap et al. 2000); and Myths of physical nature (Steg & Seivers, 2000). Workshop results informed item wording and content, identifying ambiguous language and concepts open to multiple interpretations.

The pool of items was iteratively developed, with the three authors debating each item and subsequent revisions until consensus was achieved. For each worldview there were five items describing beliefs about humans' relationship to the natural environment and five items describing policy solutions for managing the natural environment. For instance the egalitarian worldview frames physical nature as fragile, e.g. "*If the balance of the natural environment is upset the whole system will collapse*", and proposes a policy solution of voluntary simplicity, e.g. "*We all have a moral obligation to protect the environment and consume fewer resources". Participants were asked to indicate their level of agreement with each statement on a 5-point scale (1= strongly disagree; 2= disagree; 3=neutral; 4= agree; 5= strongly agree). The 40 items are listed in Appendix 1.

2.2 Results

There is conflicting evidence regarding the dimensional structure of cultural environmental biases. As such confirmatory factor analyses were conducted to test hypothesised structures emerging from the cultural theory literature and from exploratory factor analysis (see table 1). The pool of 40 items were first input to test a four factor solution using Mplus software (Muthén & Muthén, 2010) as they were designed to measure egalitarian, hierarchical, individualistic and fatalistic perspectives. Confirmatory factor analyses did not support a four factor solution, however, as a congeneric model could not be achieved with appropriate fit statistics (see table 1).

The 40 items were then subject to exploratory factor analyses (maximum likelihood extraction with oblimin rotation) using SPSS version 20 to identify the underlying structure. Maximum likelihood analysis revealed the presence of eight components with eigenvalues exceeding 1, explaining 28.1%, 8.3%, 5.9%, 4.9%, 3.8%, 3.2%, 2.7% and 2.6% of the variance respectively. Appendix 2 details the extracted and rotated components for the eight factor solution. No clear pattern was evident in the factor loadings, and many items loaded significantly on several factors in the rotated solution. An inspection of the scree-plot revealed a clear break after the second component. Using Cattell's (1966) scree test, it was decided to retain only two components for further investigation. The two-component solution explained 36.4% of the variance with Component 1 contributing 28.1% and Component 2 contributing 8.3%. To aid in the interpretation of these two components, oblimin rotation was performed. An oblique rotation was deemed necessary as there is evidence that cultural environmental biases are inter-correlated (Boschetti et al. 2012; Lima & Castro, 2005).

The rotated solution revealed the presence of simple structure (Thurstone, 1947), with both components showing a number of strong loadings and all variables loading substantially on only one component (see table 2). Items measuring individualistic and fatalistic perspectives loaded substantially and positively on component one, whilst hierarchical and egalitarian items loaded on component two. This indicates that component one measures individualized cultural environmental biases that are positioned low on the group dimension. Component two measures collectivized cultural environmental biases that are high on the group dimension. The first component taps arguments that negate collective action to conserve the environment; whereas the second component is comprised of arguments that support collective action to conserve the environment. There was a weak-moderate negative correlation between the factors (r=-.28).

Confirmatory factor analyses were then conducted to test whether the data fit a hypothesized measurement model of two cultural environmental biases dimensions. In order to assess the construct validity of the hypothesised dimensions those items loading on Component 1 and 2 with coefficients greater than .5 (see Table 2) were input into confirmatory factor analyses using Mplus software (Muthén & Muthén, 2010). Congeneric models were achieved with appropriate fit statistics for an oblique two factor solution, with a subset of 6 low group items loading on Component 1, and 6 high group items loading on Component 2, indicating a good fit (Steiger, 2007) of moderately negatively correlated factors (see table 1). Items were removed to improve model fit based on modification indices. The estimates provided in the standardized model results revealed that factor loadings of the retained items were sound. Items in component 1 had factor loadings ranging from .56 to .82, and items in component 2 had factor loadings ranging from .52 to .74.

In order to assess whether these negatively correlated factors represented ends of a single bipolar scale, rather than two separate scales, congeneric models were run setting the path components at 1, which assumes a perfect relationship, and with components accounted for by a common underlying higher order construct . These models failed to converge, suggesting that data did not fit (see table 1). As such, the 6 items comprising component 1 and the 6 items comprising component 2 were retained as separate scales. Both scales measure beliefs and values about the natural environment and preferred solutions for environmental management. We label component 1 '*environment as elastic'*. The ecosystem is described as resilient and able to bounce back from both damage and efforts to protect it. We label component 2 '*environment as ductile*'. The ecosystem is described as altered by human activity and unable to bounce back from damage or efforts to protect it. Reliability analyses conducted in SPSS, indicate that the 'environment as elastic' items demonstrated good internal consistency (a=.82) as did the 'environment as ductile' items (a=.83). Scores were computed by averaging the sum of the 6 items identified in each congeneric model. The resultant 'ductile' (M=3.57, SD=.69) and 'elastic' (M=2.51, SD=.75) scores demonstrated a significant strong negative relationship ($r=-.62$, $p<.001$) indicating that these dimensions are oblique.

The final sets of items were reviewed for content validity and to ensure they covered the breadth of the construct domain. Component 1, 'environment as elastic', is comprised of arguments that justify individual freedoms over collective action to conserve the environment. In line with individualistic perspectives the environment is framed as able to adapt to human activity: "*The natural environment is capable of recovering from any damage humans may cause";* and *"Human industry and technology has not caused significant damage to the natural environment"*. The value placed on the free market and technology evident in the latter statement also reflects individualistic preferences. Laissez faire attitudes are evident in support for individual behaviors detrimental to the environment: "*Individuals should have freedom of choice regardless of the environmental impacts"*. The environment is simultaneously framed as capricious or uncontrollable, with humans unable to affect change, in line with fatalistic perspectives: *"Ultimately, there's nothing individuals can do to manage or change the natural environment";* and *"Humans can't control what happens in the natural environment*". Environmental management is framed as futile in a fatalistic manner: "*There's no point wasting time, energy and resources on trying to manage the natural environment".*

Component 2, 'environment as ductile', is comprised of arguments that justify collective action to conserve the environment over individual freedoms. In line with hierarchical perspectives the environment is described as resilient up to the point defined by experts and unstable beyond those limits: "*The natural environment will become unstable if humans exceed the limits identified by experts*" and "*When pushed beyond the limits identified by experts the natural environment will not recover"*. A hierarchical preference for institutional intervention in the lives of individuals is also evident: *"The natural environment can be managed if there are clear rules about what is allowed*". The environment is also presented as a fragile, interconnected system at serious peril, in line with egalitarian perspectives: *"If the balance of the natural environment is upset the whole system will collapse*". The egalitarian preference for the precautionary principle of environmental conservation and protection is also evident: "*Conservation and protection is the most rational strategy for managing the natural environment"*. The egalitarian emphasis on pro-social behavioral strategies to reduce inequality, such as voluntary simplicity, is also demonstrated: *"We all have a moral obligation to protect the environment and consume fewer resources"*.

2.3 Discussion

These results indicate that cultural environmental biases form two negatively correlated factors when measured as a dimensional construct, distinguished along the group dimension only. The cultural environmental biases failed to form a second higher order construct which suggests that they are independent and not ends of a single bipolar dimension. The oblique two dimension structure does not reflect the orthogonal two dimension structure of cultural biases about society presented in the grid-group framework and Cultural Cognition thesis (Kahan et al. 2007, 2010). Nor does it reflect the four interrelated dimensions of cultural biases about environment (Lima & Castro, 2005) and society (Dake, 1992; Ellis & Thompson, 1997; Grendstad, 2003; Marris, Langford, &

O'Riordan, 1998; Rippl, 2002) identified elsewhere. These results do support findings that cultural biases can coexist simultaneously in degrees within individuals (Grendstad & Selle, 2000; Lima & Castro, 2005). Individualistic and fatalistic items loaded together, comprising arguments that negate collective action to protect the environment. This ‘environment as elastic’ dimension represents individualized cultural bias about the environment. Egalitarian and hierarchical items loaded together, comprising arguments that support collective action to protect the environment. This ‘environment as ductile’ dimension represents collectivized cultural bias about the environment. This is somewhat consistent with the finding that egalitarian and hierarchical indexes of cultural environmental bias are positively correlated, as are individualistic and fatalistic indexes (Lima & Castro, 2005). Our results suggest that the poor internal consistency of the hierarchical index may be due to its interrelationship with egalitarian cultural environmental bias.

Individualistic and fatalistic perspectives are used to assert the right of the individual to continue behaviors unchecked, despite potential negative environmental impacts. This is justified by framing the environment as being both unaffected and uncontrollable by humans. The ecosystem is described as resilient, yet unpredictable, and able to absorb the effects of human activity. As such, rather than being ‘benign’ or ‘capricious’ the environment is framed as ‘elastic’ and able to bounce back from both damage and efforts to protect it. Human agency or responsibility for the environment is negated by framing collective actions and environmental policies as futile and a waste of resources. Egalitarian and hierarchical perspectives are used to justify restrictions on behaviors that are detrimental to the environment. The moral obligation of the individual to protect the prospects of the group by consuming fewer resources is emphasized as a voluntary restriction on behavior. Adherence to environmental rules and regulations is also emphasized as an institutional restriction on behavior. Deferring to the knowledge and experience of experts is a means of reinforcing the value of the collective and justifying environmental protection. The environment is framed as altered by human activity and unable to recover if pushed beyond the limits that have been identified by experts. As such, rather than being ‘ephemeral’ or ‘perverse/tolerant’ the environment is framed as ‘ductile’ and unable to bounce back from both damage and efforts to protect it. Human agency or control over the environment is implied, as individual behaviors are framed as mitigating damage caused by human activity.

The results indicate that cultural environmental biases collapse arguments regarding social prescriptions constraining behavior (grid), into arguments regarding the role of the collective (group). Cultural biases that frame the environment as ‘elastic’ or ‘ductile’ both use arguments that are high and low on the grid dimension to justify opposing perspectives. ‘Environment as ductile’ positions social relations as constrained because people must respect experts and adhere to rules. But it also presents social relations as unconstrained because voluntary simplicity and human agency are viewed as policy-solutions. Likewise, ‘Environment as elastic’ positions social relations as constrained because human efforts to change or manage the environment are ineffective. It also positions them as unconstrained by valuing individual freedoms above all else. As such, grid arguments appear to be used to very different ends in cultural environmental biases. The two factor oblique solution lends some support to the NEP and DSP perspective, whereby ecocentric and anthropocentric environmental views are positioned as counter-points to each other.

Much like the NEP, ‘environment as ductile’ reflects beliefs regarding the balance of nature and limits to growth. In contrast, it frames humans as having agency or control over the environment which is more aligned with the DSP. Environmental conservation is presented as a means of protecting the group, rather than the biosphere, which is a fairly anthropocentric perspective. This perhaps is more aligned with the social-altruistic and egoistic environmental concern outlined by Schultz (2000; 2001). The way that human agency is framed seems to differentiate these two dimensions from the NEP and DSP perspectives. ‘Environment as ductile’ positions humans as superior to nature in order to justify conservation behaviors. Like the NEP, ‘environment as elastic’ does not position humans as superior to nature; however, by presenting the environment as uncontrollable and unaffected by human activity it justifies damaging behaviors.

These results indicate that cultural biases about environment demonstrate a different structure to those about society, which supports suggestions that they are independent constructs (Grendstad & Selle, 2000). As such, myths of physical-nature may operate differently to myths of human-nature. Further research into the structure of cultural biases regarding the environment and society in conjunction with each other may provide more compelling evidence regarding the possible independence of these constructs. Factor analytic studies may reveal whether cultural biases about society and environment relate directly to each other, or the NEP and DSP perspectives.

3 Study 2

The second study was developed to assess the reliability and criterion validity of the measures developed in the first study. The development of a dimensional measure of cultural environmental biases allows us to clarify their influence on environmental beliefs and behaviors. Study 2 is driven by the following research questions: Can the dimensional structure of cultural environmental beliefs be replicated? Are cultural environmental biases related to environmental attitudes and beliefs associated with climate change? Is there a direction relationship between cultural environmental biases and carbon-relevant behaviors, or is the relationship mediated through climate change beliefs?

3.1 Method

Another online survey was conducted nationally across Australia in all states and territories in July-August of 2012 (N=5081). Participants were again recruited using an on-line research only internet panel. The demographic profile of respondents corresponds with the known population characteristics of Australians (Australian Bureau of Statistics, 2010) and is as follows: gender (female=48.3%; male = 51.7%); age(< 24 years = 4.1%; 25-34= 15.7%; 35-44 = 17.1%; 45-54= 21.7%; 55-64 =18.5%; 65-74 = 17.5%; 75-84 4.7%; > 85 =0.6%); residential location (capital city =55%; regional town =29%; rural area =14%); and annual household income (< $30,000=17.4%; $30,000 - $59,999 = 23.8%; $60,000 - $89,999= 18.0%; $90,000 - $119,999=11.7 %; $120,000 - $149,999= 7.0%; > $150,000 = 5.8%; Unspecified= 16.3%).

3.2 Instruments

Cultural environmental biases - The 12 items identified in study 1 in the ‘environment as elastic’ and ‘environment as ductile’ scales were retested, and demonstrated good internal consistency (Cronbach alpha = .85 and .84 respectively). A nominal cultural environmental bias measure, with four myths of physical nature categories, was also included which was adapted from Steg and Seivers (2000). The rewording was designed to ensure that items were appropriate for an Australian audience, and was first trialled in Likert scale format by Boschetti et al. (2012). A simpler vocabulary was used, the sentence structure in each statement was more consistent, and the referent was neutral (e.g. ‘the environment’ in place of ‘environmental problems’ originally used). Participants were asked ‘which of the following statements best matches your view?: The environment is fragile and will only be protected if there are large changes in human behavior and society [Egalitarian -

‘ephemeral’]; The environment can be managed by the government and experts if there are clear rules about what is allowed [Hierarchical - ‘perverse/tolerant’]; The environment can adapt to changes and technology will solve environmental problems eventually [Individualistic -‘benign’]; The environment is unpredictable and we can't control what happens [Fatalistic -‘capricious’].

Specific environmental beliefs – Participants’ climate change beliefs were assessed via a ratio variable, asking them “Move the cursor to the place on the slide which best represents how certain you are that humans contribute to climate change” with 0 representing completely certain humans are not causing climate change through to 100 representing completely certain humans are causing climate change. Participants’ climate change belief was also assessed by a nominal variable (Leviston & Walker, 2012), asking them to indicate which of “the following best represents your thoughts about climate change”: I don’t think that climate change is happening; I have no idea whether climate change is happening or not; I think that climate change is happening, but it’s just a natural fluctuation in Earths temperatures; I think that climate change is happening, and I think that humans are largely causing it.

Carbon-relevant behavior - Participants were asked to indicate whether they undertook a range of nine activities relevant to greenhouse gas emissions and whether their engagement was mainly for environmental reasons or for other reasons (Leviston & Walker, 2010, 2012). Behavior performed mostly for environmental reasons received a score of 2; mostly for other reasons a score of 1; and behaviors that were not performed a score of 0. Exploratory factor analysis (maximum likelihood extraction with direct oblimin rotation) revealed the presence of one factor with an eigenvalue greater than one explaining 49.3% of variance. Confirmatory factor analysis performed using MPlus software yielded a congeneric model with appropriate fit statistics (4, X^2=5.546, p=0.24) indicating a uni-factorial measure of environmentally motivated carbon-relevant behavior that is consistent with Leviston and Walker. The resultant environmentally motivated behavior scale demonstrated good internal consistency (Cronbach alpha=.84) and was computed by summing the following 6 items (scores ranging from 0-12): Most of my cleaning products are environmentally friendly; I have switched to products that are more environmentally friendly; I have reduced the amount of gas and/or electricity I use around the house; I have reduced the amount of water I use around the house and garden ; I switch lights off around the house whenever possible; and I am on Green Power electricity[6].

Environmental concern- Biospheric , social altruistic and egoistic environmental concern items were adapted from Schultz (2000; 2001) for an Australian audience and demonstrated good internal consistency (Cronbach alpha =.98, .91, and .95 respectively). Participants were asked to “Please rate the following items from 1 (not important) to 7 (supreme importance) in response to the question: I am concerned about environmental problems because of the consequences for:”. Biospheric concern items included: “Plants and trees; Marine life; Birds; and Animals”. Social-altruistic concern items were: “Humanity; children; people in my community; and future generations”. And Egoistic concern items included: “Me; my future; my lifestyle; my health; and my financial security”. A score was computed for each dimension by averaging the sum of the items comprising each scale.

3.3 Results

3.3.1 Structure of cultural environmental biases

The 12 items identified in study 1 were subject to confirmatory factor analyses using Mplus software (Muthén & Muthén, 2010) to test whether the data fit a hypothesized measurement model of ‘environment as ductile’ and ‘environment as elastic’ as separate dimensions. A congeneric model was achieved with appropriate fit statistics ($p>.01$) for an oblique two factor solution (12, X^2=20.43 $p=0.059$), RMSEA=0.012, which indicates a good fit (Steiger, 2007). A good fit was found for ‘elastic’ items loading on Component 1 (5, X2=11.414, p=0.0438), RMSEA=0.016, and ‘ductile’ items loading on Component 2 (3, X2=7.53 p=0.057) RMSEA=0.017. This suggests robust measures of cultural environmental biases that are moderately negatively correlated (-0.32). The estimates provided in the standardized model results revealed that factor loadings of the retained items were sound. Items in the ‘elastic’scale had factor loadings ranging from 0.59 to 0 .77. Items in the ‘ductile’ scale had factor loadings ranging from 0.43 to 0.88.

3.3.2 Assessing convergent and discriminant validity

A one-way between groups analysis of variance was conducted to assess whether different myths of physical-nature in a nominal measure of cultural environmental bias demonstrated differences in ‘environment as elastic’ and ‘environment as ductile’ scores. A large significant difference was observed between the different myths of physical-nature in

[6] Household power sourced from renewable sources provided by Australian electricity suppliers at extra cost

‘ductile’, F(3, 5077)=637.676, p<.001, eta squared=.27, and ‘elastic’ z-scores, F(3, 5077)=517.56, p<.001, eta squared=.23. Post-hoc tests using Tukey’s HSD revealed that participants selecting the egalitarian myth of nature recorded significantly (p<.001) higher ‘ductile’ (M=.54, SD=.83) and significantly lower ‘elastic’ (M=-.52, SD=.87) scores than all other groups. Participants selecting the fatalistic myth recorded significantly lower ‘ductile’ (M=-.68, SD=.94) and significantly higher ‘elastic’ (M=.65, SD=.86) scores than all other groups. Figure 2 details the mean z-scores and confidence intervals for the four myths of nature in the nominal cultural environmental bias measure.

A one-way between groups analysis of variance was conducted to assess whether those with different climate change beliefs demonstrated differences in environment as ‘elastic’ and ‘ductile’ scores. A large significant difference was observed between the climate change belief types in ‘ductile’, F(3, 5077)=551.46, p<.001, eta squared=.25, and ‘elastic’ z-scores, F(3, 5077)=618.116, p<.001, eta squared=.27. Post-hoc tests using Tukey’s HSD revealed that participants who did not believe that climate change is happening recorded significantly (p<.001) lower ‘ductile’ (M=-.82, SD=1.05) scores than all other groups, and significantly higher ‘elastic’ (M=.85, SD=.91) than all other groups, bar those who did not know whether climate change was happening. Figure 3 details the mean z-scores and confidence intervals for the climate change belief types.

The climate change belief types demonstrated differences in the myth of nature they selected in the nominal measure of cultural environmental bias. A Chi-square test for independence indicated a large significant association between climate change belief types and myths of physical-nature, X^2 (9,n=5081)=1769.6, p<.001, phi= .59. The majority of participants that did not believe climate change was happening (n=389) selected the fatalistic myth (59.1%). Those who did not know whether climate change was happening (n=323) tended to select the hierarchical (34.4%) and fatalistic (28.5%) myth. Those who thought that climate change was happening but just a natural fluctuation in temperatures tended to select fatalistic (36%) and individualistic (24.9%) myths. Whereas those who believed climate change was human induced overwhelmingly selected the egalitarian myth (68.5%).

The relationships of environment as ‘elastic’ and ‘ductile’ to environmental attitudes and behaviors are shown in table 3. A range of strong and moderate relationships were observed. Of note is the strong positive relationship between the ‘ductile’ scores and anthropogenic climate change beliefs (r=.58**), Biospheric environmental concern (r=.53**) and Social-altruistic environmental concern (r=.52**). This suggests that framing of the environment as ductile relates to environmentalism. ‘Ductile’ and ‘elastic’ cultural environmental biases demonstrated inverse patterns of relationships when compared to each other. Environmentally motivated carbon-relevant behavior demonstrated moderate relationships with other variables, the strongest of which was certainty in anthropogenic climate change (r=.45), closely followed by ‘ductile’ environmental biases (r=.44), and Biospheric environmental concern (r=.41).

3.3.3 Assessing criterion validity

In order to assess whether the dimensional or nominal measures of cultural environmental biases demonstrated better predictive validity further analyses were conducted with environmentally motivated carbon-relevant behavior as a criterion variable. The nominal measure of cultural environmental biases showed significantly different carbon-relevant behavior for the four myths of nature, $F(3, 5077)=335.07$, $p<.001$, eta squared=.16. Post-hoc tests using Tukeys HSD revealed that the egalitarian myth recorded significantly higher ($p<.001$) levels of carbon-relevant behavior (M=8.6, SD=2.84) than the hierarchical (M=7.22, SD=2.95), individualistic (M=5.67, SD=3.02) and fatalistic (M=5.00, SD=2.81) myths.

After excluding outliers based on residual statistics (Mahalanobis> 20.52; Cook’s distance>1) a standard multiple regression analysis was conducted with the dimensional and nominal measures of cultural environmental biases entered in the same step. The nominal measure was dummy coded (0=absent; 1=present) to create three variables representing the four categories[7]. The model explained 26.3% of the variance in environmentally motivated carbon-relevant behavior, $F(5, 5008)=356.56$, $p<.001$. Inspection of standardised coefficients revealed that the ‘environment as ductile’ measure made the strongest statistically significant unique contribution to carbon-relevant behavior when the variance for the other variables was controlled (beta=.27, $p<.001$). Less of a unique contribution was made by the fatalistic dummy variable (beta=-.16, $p<.001$), ‘environment as elastic’ (beta=-.15, $p<.001$), and individualistic dummy variable (beta=-.09, $p<.001$). The egalitarian dummy variable failed to make a statistically significant unique contribution when the variance for the other variables was controlled (beta=.04, $p>.01$). Semi-partial correlations revealed that ‘environment as ductile’ (0.20) uniquely explained 3.9% of the variance in carbon-relevant behavior. The nominal measure combined (0.03, 0.07, and 0.12) uniquely explained 1.9% and ‘environment

[7] The fourth category does not have to be included in the regression because it is represented by the other three dummy variables all being equal to zero.

as elastic' (-0.12) uniquely explained 1.3% of the variance. Approximately 19.2% of the variance in carbon-relevant behavior was shared by the three variables. The 'ductile' measure has better predictive validity than the nominal measure, explaining more unique variance in environmental behavior, and this predictive validity is improved with the inclusion of the 'elastic' measure.

A two-way between groups analysis of variance was conducted to assess whether environment as 'ductile' and 'elastic' interact to affect environmentally motivated carbon-relevant behavior. Participants were divided into categories (low and high) based on z-scores (lesser and greater than 0). The interaction effect between environment as 'ductile' and 'elastic' was statistically significant, F(1, 5077)=16.44, p<.001, partial eta square = .003, suggesting that levels of caron-relevant behavior are contingent on both; however, the effect size was small. There was a significant moderate main effect for 'ductile', F(1, 5077)=325.683, p<.001, partial eta square = .06, and 'elastic' measures, F(1, 5077)=303.578, p<.001, partial eta square = .06. Figure 4 provides the estimated marginal means of environmentally motivated carbon-relevant behavior for environment as 'ductile' and 'elastic' cultural environmental biases.

Analyses of simple effects revealed a moderate significant difference in carbon-relevant behaviors of high and low 'elastic' bias when 'ductile' bias was low, F(2365)=213.62, p<.001, eta squared =.08. There was only a small significant difference between high and low 'elastic' bias when 'ductile' bias was high, F(2712)=96.498, p<.001, eta squared=.03. This suggests the difference between low and high 'elastic' cultural environmental bias is lessened when 'ductile' bias is also high. Participants that were high in environment as 'ductile' and 'elastic' (N=672) did not record significantly different carbon-relevant behavior to those who were low in both (N=614), t(613)=-.476, p=.634. This suggests that while those high in 'ductile' cultural environmental bias demonstrate higher levels of environmentally motivated carbon-relevant behavior, this only holds true if they are also low in 'elastic' bias. This indicates that it is important to assess these variables in conjunction with each other.

Path analysis in MPlus was conducted with observed variables to assess whether certainty that climate change is human induced (scores ranging from 0-100) mediated the relationship between cultural environmental biases and environmentally motivated behavior. Standardised model results revealed that the total effect of 'elastic' bias on environmentally motivated carbon-relevant behavior (=-.23**) was partially mediated by climate change beliefs (-.07**). Similarly the total effect of ‘ductile’ bias on behavior (.32**) was partially mediated by climate change beliefs (.11**). The partial mediation suggests that, contrary to the literature, cultural environmental bias may have a direct rather than indirect relationship with environmental behavior. The mediated path analysis indicated that model predicted 27.1% of the variance in environmentally motivated carbon-relevant behavior and 39.2% of the variance in belief that climate is human induced (see figure 5).

3.4 Discussion

The replication of two oblique dimensions of cultural environmental biases indicates that egalitarianism, hierarchy, individualism, and fatalism do not operate as separate dimensions. This suggests that inconsistent empirical findings regarding the role of hierarchal and fatalistic perspectives (Ellis & Thompson, 1997; Grendstad & Selle, 1997; Marris et al. 1998; Carlisle & Smith, 2005; Verweij et al. 2006) could be due to the way cultural environmental biases have been operationalised. When measured nominally, all bar the hierarchical myth of physical nature recorded large differences between individualized and collectivized cultural environmental bias scores. The relatively small difference between the two cultural environmental bias scores observed for the hierarchical myth may account for the inconsistent findings. Worldviews identified as being the ‘border’ of society by Douglas (1996), egalitarian and fatalistic, were in fact the dominant cultural environmental biases in Australia. The relatively large differences in environment as ‘elastic’ and ‘ductile’ recorded for these perspectives suggests that rather than being fringe, they represent a large polarity or extremity in opinion. As such, we suggest that instead of looking at cultural environmental biases as four discrete rationalities, consideration is given to the extent that individuals value collective action to conserve the environment over behaviors that are detrimental to the environment.

The moderate, yet inverse, relationships that ‘elastic’ and ‘ductile’ cultural environmental biases demonstrated with carbon-relevant behaviors, climate change beliefs, and Biospheric concern suggests that they represent pro and anti environmental sentiment. This is somewhat akin to the NEP and DSP perspectives (Dunlap & Van Liere, 1978); supporting findings that these measure of environmental concern are overlapping concepts (Poortinga, Steg, & Vlek, 2002). The findings suggest that those high in environment as ‘ductile’ bias demonstrate higher levels of environmentally motivated carbon-relevant behavior, but only if they are also low in ‘elastic’ bias. The interaction between ‘ductile’ and ‘elastic’ cultural environmental biases to affect environmental behavior suggests that it is important to consider these dimensions together. This is supported by the finding that there is no significant difference between the environmental behaviors of those high on both dimensions compared to those who are low on both.

Contrary to the literature, cultural environmental biases were found to directly influence environmental behavior in the form of carbon-relevant household activities, like conserving energy and water. They also demonstrated an indirect effect on behavior through environmental beliefs regarding climate change causation. The partial mediation of the relationship between cultural environmental biases and environmental behavior was weak. This is not consistent with suggestions that myths of physical-nature are only indirectly related to environmental behavior, such as car-use, through specific environmental beliefs (Steg & Seivers 2000). The inconsistency in these findings could be related to the different measures used, which assume different underlying structures of cultural environmental biases. The ‘environment as ductile’ measure demonstrated better predictive validity alone than the nominal measure. This suggests the role of cultural environmental biases in influencing environmental behavior may have been underestimated in studies using nominal measures.

The relative difficulty of changing car use behaviors compared to other carbon-relevant activities may also account for these conflicting findings. It may be that cultural environmental biases directly influence behaviors that are easier to perform and only indirectly influence behaviors that require greater effort. Conversely, these disparate findings could be related to problems associated with self-reported environmental behavior (Steg & Vlek, 2009b). As such, further research into the relationship between cultural environmental biases and a range of environmental behaviors is required. Rasch analyses that reflect the frequency and difficulty of environmental behaviors may further elucidate the relationship between environmental values, beliefs and behaviors.

4 General discussion and conclusion

By identifying the underlying structure of cultural environmental biases, and developing sound psychometric measures, we were able test the role they play in environmental attitudes and behaviors related to climate change. The cultural environmental bias measures developed here are reliable and have good predictive validity. Cultural biases about the environment did not demonstrate the same structure as those about social relations, as had been assumed in cultural theory. The two oblique dimensions identified reflect only the group axis. This may go some way to explaining the inconsistent results regarding hierarchical and fatalistic perspectives (Ellis & Thompson, 1997; Grendstad & Selle, 1997; Marris et al. 1998; Carlisle & Smith, 2005; Verweij et al. 2006), which may not operate as independent constructs. The presence of cultural environmental biases as moderately correlated factors suggests that competing rationalities regarding the environment can exist simultaneously within individuals. This is perhaps not surprising when one considers the multiple cultural settings and groups that individuals occupy.

A number of our findings are inconsistent with other studies suggesting that more research is required. Cultural environmental biases directly influenced environmental behavior like household carbon-relevant activities, rather than being mediated through specific environmental beliefs as was the case in car use behaviors (Steg & Seivers, 2000). This indicates that further investigation into a range of different behaviors is necessary. The consistent and strong role of fatalism in guiding behaviors and attitudes contradicts much of the literature, raising questions about how the different worldview rationalities may be expressed in different cultures. The cross-cultural applicability of the measures developed in this paper is yet to be assessed. It is possible that cultural environmental biases demonstrate not only structural variations in different nations, but different relationships with environmental beliefs and behaviors.

Research into the role of self-efficacy, socio-political locus of control, and perceived human exemptionalism in shaping cultural environmental biases, or mediating their relationship with environmental behaviors is required. This may clarify whether arguments regarding prescriptions constraining behavior (grid) really do collapse into those regarding the role of the collective (group) when considering the environment. The structure of these environmental values and beliefs in relation to cultural biases about social relations, and the NEP and DSP perspectives remains to be seen. Further factor analytic studies may shed light on the underlying structure of the values and beliefs underpinning worldview. This may clarify whether cultural biases about the environment are independent from those about social relations and other competing theories of environmental beliefs.

The two dimensions of environmental values and beliefs identified here may represent arguments used to justify pro- and anti-environmental behavior. As such, environment as ‘ductile’ and elastic’ cultural biases may represent ‘policy stories’ (Verweij et al., 2006) articulated as the different voices in policy debates justifying attitudes and behavior. It is possible that they arise retrospectively after behavior and attitudes have been formed. As such, they may represent a socially constructed suite of possible rationalisations people can draw upon. Despite being culturally and personally anchored cultural biases may be dynamic and open to influence, but this can only be clarified through longitudinal and experimental research. The stability of cultural biases, proneness to priming, and interaction between competing perspectives may provide significant insights into the extent that they represent socially constructed discursive tools or personality traits. This may provide theoretical implications in terms of how worldview is conceptualised.

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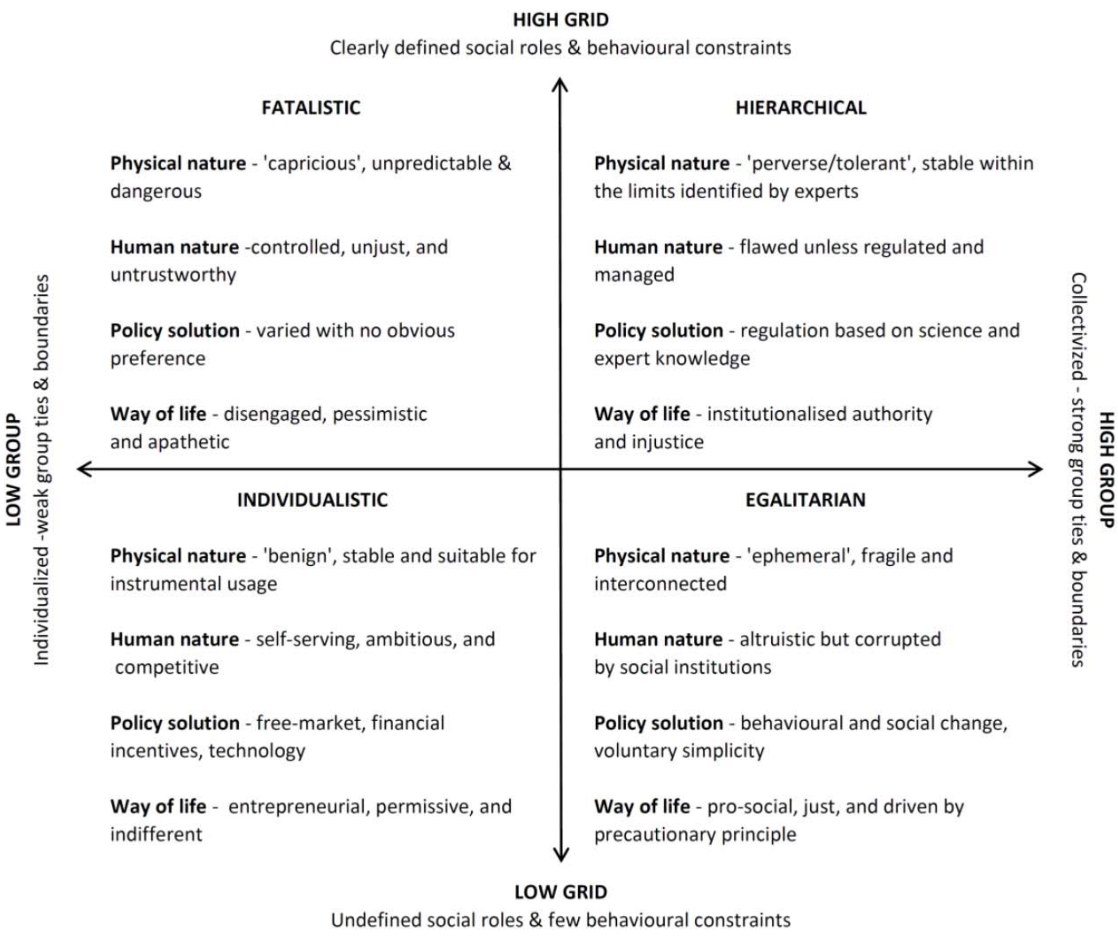
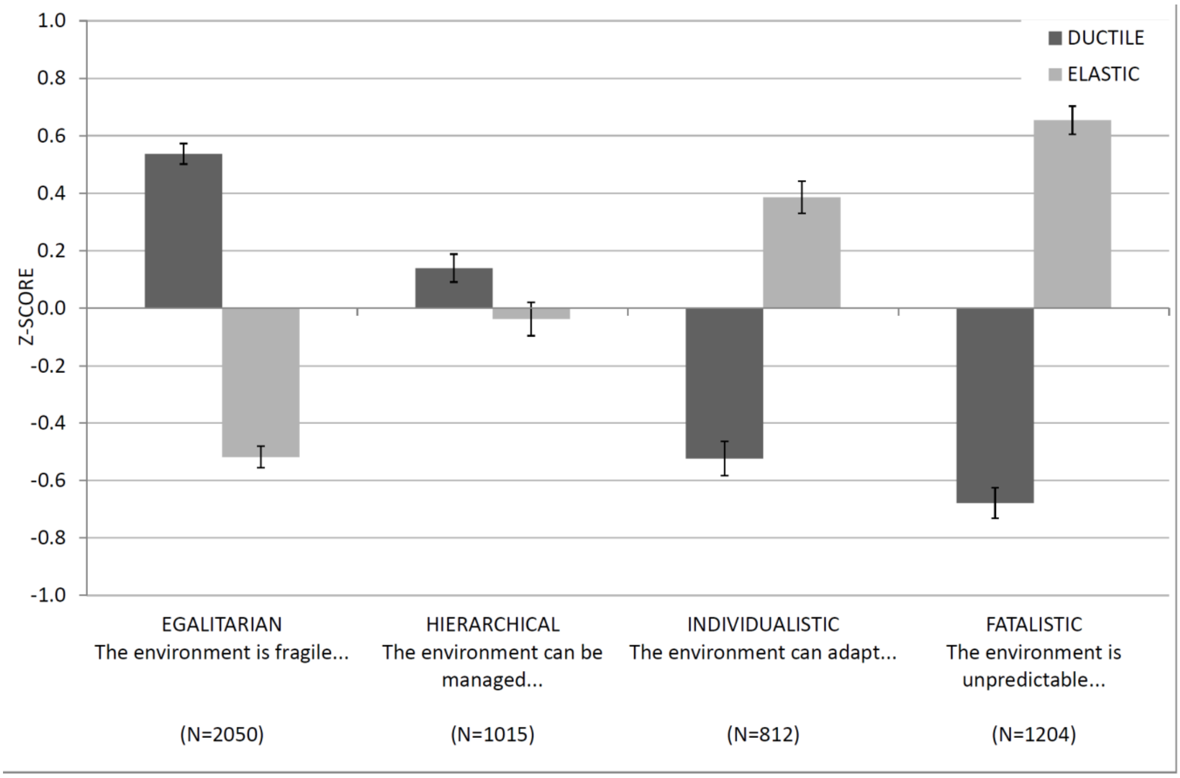
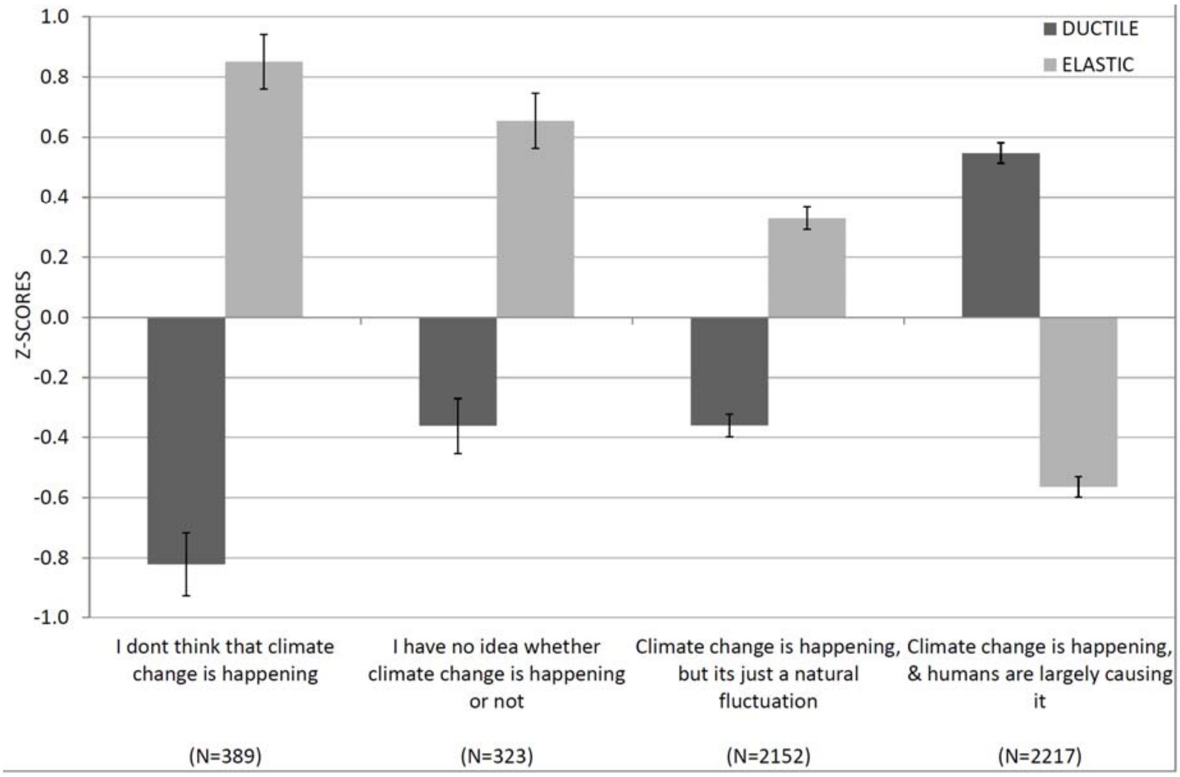


Figure 1. Cultural biases about society and the environment. Adapted from Schwarz and Thompson (1990) and Poortinga et al (2002)



DUCTILE
ELASTIC
Z-SCORE
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
EGALITARIAN
The environment is fragile...
(N=2050)
HIERARCHICAL
The environment can be managed...
(N=1015)
INDIVIDUALISTIC
The environment can adapt...
(N=812)
FATALISTIC
The environment is unpredictable...
(N=1204)


DUCTILE
ELASTIC
Z-SCORES
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
I dont think that climate change is happening
(N=389)
I have no idea whether climate change is happening or not
(N=323)
Climate change is happening, but its just a natural fluctuation
(N=2152)
Climate change is happening, & humans are largely causing it
(N=2217)

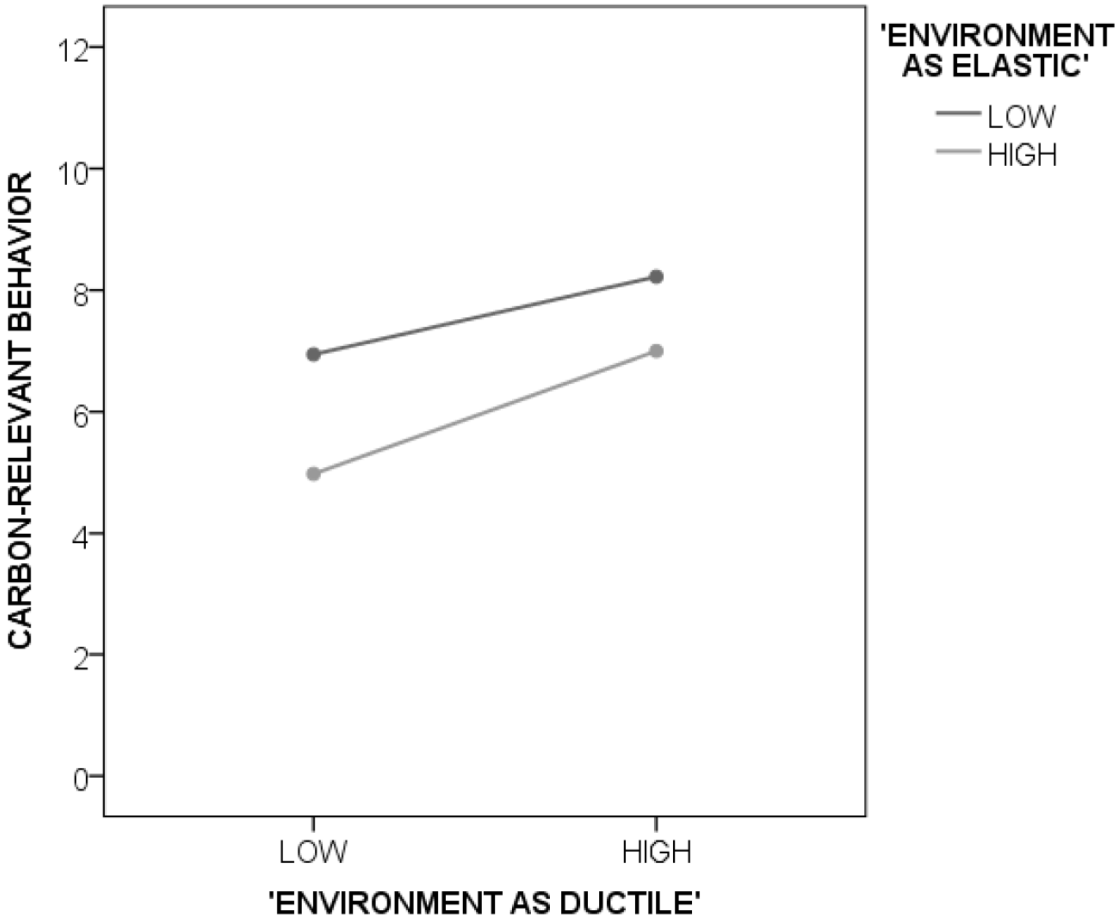


Figure 4. Environmentally motivated carbon-relevant behavior of environment as 'elastic' and 'ductile' cultural biases: Estimated marginal means

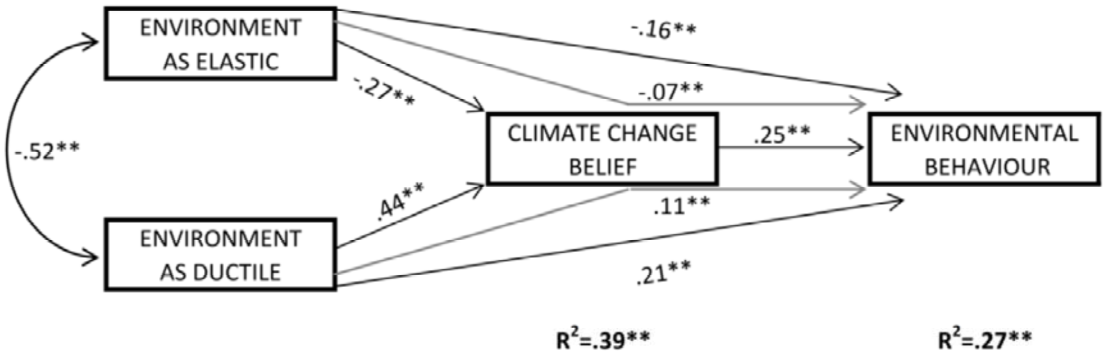


Figure 5. Standardised model results of mediated path analysis.

Table 1: Summary of confirmatory factor analyses testing the structure of cultural environmental biases.

Hypothesis	Statistical result	Conclusion
Cultural environmental biases form four factors of egalitarian, hierarchical, individualistic and fatalistic perspectives.	Four factor solution: (602, X^2=828.61, p<0.00001).	Rejected.
Cultural environmental biases form eight factors of worldview myths of nature and policy solutions as separate dimensions.	Eight factor solution: (694, X^2=1583.952, p<0.00001).	Rejected.
Based on results of exploratory factor analysis, cultural environmental biases are hypothesised as forming two factors of high group (egalitarian, hierarchical) and low group (individualistic, fatalistic) perspectives.	Oblique two factor solution: (44, X2=65.54, p=0.02), RMSEA=.04, (r= -0.35);	Accepted.
	Subset of 6 items tapping individualistic and fatalistic perspectives loading on Component 1: (9, X2=8.307, p=0.5035), RMSEA<0.000;	
	Subset of 6 items tapping egalitarian and hierarchical perspectives loading on Component 2: (6, X2=7.12, p=0.3052), RMSEA=.026.	
Cultural environmental biases form one bipolar scale - high group (egalitarian, hierarchical) to low group (individualistic, fatalistic) perspectives.	Path between high group and low group components set at 1: failed to converge;	Rejected.
	Second order model with high group and low group components accounted for by higher order construct: failed to converge.	

Table 2: Pattern and Structure matrix for maximum likelihood factor analysis with direct Oblimin rotation of two factor solution of myths of nature items.

Item	**Mean**	**Standard deviation**	**Pattern coefficients**		**Structure coefficients**		**Communalities**	
			1	**2**	**1**	**2**	**Initial**	**Extracted**
INDIV_POL4	2.46	1.04	**0.72**	-0.06	**0.73**	-0.26	0.63	0.54
FATAL_POL5	2.23	0.99	**0.69**	-0.21	**0.76**	-0.41	0.65	0.61
FATAL_POL4	2.78	1.22	**0.69**	-0.12	**0.73**	-0.31	0.62	0.54
INDIV_POL2	2.36	0.98	**0.68**	-0.04	**0.69**	-0.24	0.57	0.48
FATAL_POL2	2.00	0.87	**0.63**	-0.25	**0.70**	-0.42	0.64	0.54
INDIV_ENV5	2.61	0.98	**0.63**	-0.19	**0.68**	-0.37	0.61	0.50
FATAL_POL1	2.32	1.06	**0.59**	-0.25	**0.66**	-0.41	0.59	0.49
INDIV_POL5	2.33	0.89	**0.59**	0.32	0.50	0.15	0.49	0.34
FATAL_ENV3	3.04	1.02	**0.58**	0.09	**0.55**	-0.08	0.42	0.31
INDIV_POL3	2.35	0.99	**0.57**	0.31	0.48	0.15	0.42	0.32
INDIV_ENV 4	2.28	1.06	**0.53**	-0.20	**0.59**	-0.35	0.51	0.39
INDIV_ENV 2	2.82	1.08	**0.53**	-0.21	**0.59**	-0.36	0.55	0.39
FATAL_ENV 5	3.03	1.07	**0.52**	-0.09	**0.54**	-0.23	0.50	0.30
FATAL_ENV 4	3.45	0.94	0.48	0.13	0.44	0.00	0.48	0.21
EGAL_ENV 1	3.40	0.87	0.48	0.01	0.47	-0.12	0.38	0.22
INDIV_ENV 3	3.20	1.04	0.47	0.07	0.45	-0.07	0.36	0.21
FATAL_POL3	2.91	0.98	0.46	-0.16	**0.51**	-0.29	0.47	0.28
EGAL_POL4	3.19	0.84	0.41	-0.09	0.44	-0.21	0.48	0.20
INDIV_ENV 1	3.52	0.97	0.40	-0.17	0.45	-0.29	0.48	0.23
FATAL_ENV 1	3.79	0.81	0.38	0.07	0.36	-0.04	0.30	0.13
EGAL_POL5	3.42	0.90	0.32	-0.14	0.36	-0.23	0.43	0.15
EGAL_ENV 4	4.09	0.76	-0.29	0.26	-0.36	0.34	0.44	0.19
FATAL_ENV 2	3.64	0.88	0.12	-0.05	0.13	-0.08	0.25	0.02
HIER_ENV 1	3.49	1.08	-0.34	**0.64**	**-0.52**	**0.73**	0.71	0.65
HIER_POL1	3.64	0.98	-0.32	**0.62**	-0.49	**0.71**	0.68	0.60
HIER_ENV 4	3.25	1.05	-0.28	**0.60**	-0.45	**0.68**	0.72	0.53
HIER_POL5	3.60	0.76	-0.11	**0.58**	-0.27	**0.61**	0.46	0.39
EGAL_POL1	3.69	0.85	-0.15	**0.57**	-0.31	**0.62**	0.51	0.40
EGAL_POL2	4.03	0.88	-0.25	**0.56**	-0.41	**0.64**	0.61	0.46
EGAL_ENV 2	3.43	0.93	-0.22	**0.56**	-0.38	**0.62**	0.59	0.43
HIER_POL2	3.54	0.84	-0.01	**0.56**	-0.17	**0.56**	0.44	0.32
HIER_ENV 3	3.62	1.02	-0.29	0.49	-0.43	**0.57**	0.53	0.40
EGAL_POL3	3.82	0.92	-0.42	0.48	-0.56	**0.60**	0.57	0.52
HIER_POL3	2.94	1.09	0.04	0.44	-0.08	0.43	0.31	0.19
EGAL_ENV 5	3.73	0.89	-0.22	0.40	-0.34	0.46	0.43	0.26
HIER_POL4	3.77	0.82	-0.12	0.40	-0.23	0.43	0.38	0.20
HIER_ENV 5	3.41	0.75	0.14	0.35	0.04	0.31	0.36	0.12
EGAL_ENV 3	4.02	0.81	-0.13	0.24	-0.20	0.28	0.34	0.09
HIER_ENV 2	3.64	0.78	0.05	0.22	-0.01	0.21	0.33	0.05
INDIV_POL1	2.96	0.94	0.09	0.12	0.05	0.10	0.29	0.02

Extraction Method: Maximum Likelihood; Rotation Method: Oblimin with Kaiser Normalization; Rotation converged in 16 iterations.

Table 3. Pearson product-moment correlation matrix

Variable		1	2	3	4	5	6
1	Environment as ductile	-					
2	Environment as elastic	-.52**	-				
3	Environmentally motivated behavior	.44**	-.40**	-			
4	Anthropogenic climate change belief	.58**	-.50**	.45**	-		
5	Biospheric environmental concern	.54**	-.39**	.41**	.36**	-	
6	Social Altruistic environmental concern	.52**	-.38**	. 40**	.37**	.78**	-
7	Egoistic environmental concern	.34**	-.13**	.23**	.23**	.52**	.62**

**Correlation significant at the 0.01 level (2-tailed)

APPENDIX 1:Cultural environmental bias items tested in study 1

Variable label	Item
HIER_ENV 1	The natural environment will become unstable if humans exceed the limits identified by experts.
HIER_ENV 2	The natural environment is strong and stable, but only up to a certain point.
HIER_ENV 3	If we push the natural environment beyond what it can cope with there will be no turning back.
HIER_ENV 4	When pushed beyond the limits identified by experts the natural environment will not recover.
HIER_ENV 5	The natural environment is manageable within the known limits.
HIER_POL1	Individuals should follow environmental rules and regulations regardless of whether they think it's fair.
HIER_POL2	The natural environment can be managed if there are clear rules about what is allowed.
HIER_POL3	The Government and scientists should be responsible for managing the natural environment.
HIER_POL4	Sustainable development is the most rational strategy for managing the natural environment.
HIER_POL5	The natural environment can remain healthy if we follow environmental regulations and laws.
EGAL_ENV 1	The natural environment is in a constant state of change with things only existing for a short time.
EGAL_ENV 2	If the balance of the natural environment is upset the whole system will collapse.
EGAL_ENV 3	Humans are part of the natural environment, not separate from it.
EGAL_ENV 4	All things in the natural environment are interconnected and dependent on each other.
EGAL_ENV 5	The natural environment is fragile and the balance can be easily upset.
EGAL_POL1	Conservation and protection is the most rational strategy for managing the natural environment.
EGAL_POL2	We all have a moral obligation to protect the environment and consume fewer resources.
EGAL_POL3	The natural environment can only be protected if there are large changes in human behavior and society.
EGAL_POL4	Environmental regulations often result in outcomes that are unfair to the natural environment.
EGAL_POL5	Authorities managing the natural environment frequently make unethical decisions.
INDIV_ENV 1	The natural environment is able to cope with a lot more than it is given credit for.
INDIV_ENV2	The natural environment is capable of recovering from any damage humans may cause.
INDIV_ENV3	There are plenty of resources for humans to use in the natural environment.
INDIV_ENV4	Human industry and technology has not caused significant damage to the natural environment.
INDIV_ENV5	The natural environment is strong and can easily adapt to human activity.
INDIV_POL1	Technology can solve environmental problems.

Variable label	Item
INDIV_POL2	Individuals should have freedom of choice regardless of the environmental impacts.
INDIV_POL3	Economic markets are more than capable of managing the natural environment sustainably.
INDIV_POL4	Reducing the amount of environmental regulations will allow society to benefit and grow.
INDIV_POL5	Economic competition and deregulation is the most rational strategy for managing the natural environment.
FATAL_ENV1	The natural environment is unpredictable.
FATAL_ENV2	The natural environment can be harsh and unfair.
FATAL_ENV3	Often there's no explanation or reason for the things that happen in the natural environment.
FATAL_ENV4	The natural environment operates in strange and unknown ways.
FATAL_ENV5	Humans can't control what happens in the natural environment.
FATAL_POL1	Ultimately, there's nothing individuals can do to manage or change the natural environment.
FATAL_POL2	Doing nothing is the most rational strategy for managing the natural environment
FATAL_POL3	Attempts to manage the natural environment usually end in failure.
FATAL_POL4	Environmental rules and regulations are just a way for the authorities and environmentalists to control individuals.
FATAL_POL5	There's no point wasting time, energy and resources on trying to manage the natural environment.

APPENDIX 2: Pattern and Structure matrix for maximum likelihood extraction with direct oblimin rotation

	Pattern Factor								Structure Factor							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
HIER4	1.05	0.10	-0.02	-0.03	0.12	0.01	0.11	0.12	**0.98**	-0.02	**0.51**	-0.31	0.28	-0.18	**-0.35**	-0.16
EGAL2	**0.62**	-0.02	0.17	0.18	0.04	-0.11	-0.08	0.00	**0.72**	-0.12	**0.49**	-0.11	0.14	-0.29	**-0.38**	-0.17
HIER3	**0.47**	-0.01	0.16	-0.11	-0.05	-0.06	0.00	-0.16	**0.64**	-0.13	**0.47**	**-0.32**	0.12	-0.21	**-0.33**	**-0.30**
INDIV5	**-0.33**	0.26	-0.06	0.00	-0.09	-0.04	**0.31**	0.19	**-0.59**	**0.42**	**-0.35**	0.30	-0.31	0.10	**0.59**	**0.39**
INDIVPOL5	0.08	**0.71**	0.09	0.07	-0.12	0.12	-0.07	0.06	-0.03	**0.72**	0.03	0.16	-0.19	0.12	0.13	0.14
INDIVPOL4	-0.06	**0.58**	-0.23	0.23	0.01	-0.02	0.13	-0.03	**-0.37**	**0.66**	-0.42	**0.46**	-0.20	0.18	**0.44**	0.13
INDIVPOL3	0.03	**0.55**	0.11	-0.02	-0.08	0.00	0.12	0.14	-0.10	**0.60**	0.05	0.10	-0.18	0.00	0.25	0.25
FATAL3	-0.09	**0.44**	-0.11	-0.04	**-0.37**	-0.01	0.03	-0.12	-0.25	**0.49**	-0.21	0.22	**-0.44**	0.08	0.29	0.03
INDIVPOL2	-0.13	**0.43**	-0.01	**0.30**	0.00	0.07	0.18	-0.03	-0.38	**0.55**	-0.31	**0.47**	-0.22	0.20	**0.45**	0.13
FATALPOL2	-0.11	**0.34**	-0.14	0.24	0.07	0.14	**0.33**	-0.01	**-0.46**	**0.48**	**-0.46**	**0.47**	-0.16	0.33	**0.58**	0.13
FATALPOL5	-0.15	**0.30**	-0.06	**0.26**	-0.08	0.18	**0.27**	0.08	**-0.50**	**0.47**	**-0.43**	**0.51**	-0.31	0.31	**0.57**	0.23
HIERPOL1	0.17	-0.06	0.79	-0.12	0.03	0.11	0.10	-0.07	**0.59**	-0.13	**0.86**	**-0.47**	0.18	-0.21	**-0.30**	-0.16
HIER1	0.28	0.03	**0.58**	-0.06	0.10	0.05	-0.11	0.00	**0.66**	-0.09	**0.78**	-0.43	0.26	-0.23	**-0.47**	-0.14
HIERPOL3	0.07	0.12	**0.38**	-0.03	-0.05	-0.04	-0.08	**0.22**	0.23	0.11	**0.45**	-0.16	-0.02	-0.22	-0.17	0.20
HIERPOL5	0.11	0.04	**0.36**	-0.16	-0.05	**-0.30**	0.05	-0.05	**0.39**	-0.04	**0.57**	**-0.33**	0.02	**-0.46**	-0.20	-0.06
EGALPOL3	0.15	-0.12	**0.32**	-0.02	0.09	**-0.26**	-0.13	**-0.27**	**0.54**	-0.27	**0.57**	**-0.33**	0.22	**-0.41**	**-0.45**	**-0.35**
EGALPOL5	-0.05	-0.10	0.03	**0.68**	-0.03	-0.04	0.00	-0.05	-0.21	0.01	-0.24	**0.67**	-0.24	0.01	0.19	0.03
EGALPOL4	0.08	0.10	-0.20	**0.64**	-0.08	-0.13	-0.11	-0.03	-0.17	0.17	**-0.34**	**0.69**	-0.28	-0.03	0.14	0.04
FATALPOL3	0.04	0.06	0.01	**0.62**	-0.03	0.15	0.11	-0.01	-0.23	0.20	**-0.31**	**0.67**	-0.24	0.21	**0.32**	0.07
FATALPOL4	-0.08	0.24	-0.14	**0.43**	-0.13	-0.06	0.16	0.06	**-0.42**	**0.39**	-0.41	**0.64**	**-0.39**	0.08	**0.47**	0.22
EGAL1	-0.11	0.01	0.09	**0.28**	-0.22	-0.09	**0.21**	0.07	-0.28	0.15	-0.14	**0.41**	**-0.40**	-0.07	**0.38**	0.21
FATAL4	-0.03	0.13	-0.05	0.01	**-0.76**	-0.03	-0.09	-0.01	-0.18	0.21	-0.11	0.26	**-0.76**	-0.06	0.18	0.11
FATAL5	0.04	0.01	-0.10	0.08	**-0.52**	0.08	0.31	-0.09	-0.28	0.17	**-0.30**	**0.37**	**-0.62**	0.13	**0.50**	0.04
FATAL1	-0.06	0.05	0.09	0.10	**-0.48**	0.07	-0.01	0.04	-0.17	0.15	-0.06	0.25	**-0.52**	0.02	0.18	0.13

	Pattern Factor								Structure Factor							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
FATAL2	-0.05	-0.20	-0.01	0.04	**-0.29**	-0.05	0.03	0.15	-0.14	-0.12	-0.06	0.13	**-0.32**	-0.09	0.12	0.19
HIER2	0.07	-0.10	-0.05	0.01	-0.07	**-0.49**	0.14	0.01	0.07	-0.11	0.11	0.01	-0.13	**-0.48**	0.06	0.07
EGAL3	0.06	-0.16	-0.01	0.06	0.00	**-0.46**	-0.12	0.11	0.18	-0.22	0.21	-0.04	0.00	**-0.51**	-0.21	0.11
HIER5	-0.03	**0.30**	0.02	-0.06	0.14	**-0.45**	-0.06	0.10	0.08	0.24	0.21	-0.09	0.08	**-0.43**	-0.08	0.16
HIERPOL4	0.02	-0.05	0.18	0.00	0.02	**-0.44**	-0.08	0.02	0.25	-0.12	**0.39**	-0.15	0.03	**-0.53**	-0.23	0.03
HIERPOL2	-0.03	0.21	0.28	-0.05	0.07	**-0.44**	-0.14	0.02	0.27	0.11	**0.49**	-0.22	0.08	**-0.53**	-0.27	0.05
EGALPOL2	0.11	0.02	0.20	**-0.28**	-0.26	**-0.40**	-0.09	-0.39	**0.48**	-0.14	**0.54**	**-0.41**	-0.08	**-0.51**	**-0.35**	**-0.39**
EGAL4	0.09	-0.30	0.11	0.14	-0.05	**-0.39**	-0.18	-0.01	**0.30**	**-0.38**	**0.31**	-0.05	0.00	**-0.49**	**-0.34**	-0.06
EGALPOL1	0.25	0.05	0.19	**-0.27**	-0.05	**-0.35**	0.12	-0.09	**0.46**	-0.05	**0.51**	**-0.40**	0.05	**-0.46**	-0.18	-0.13
FATALPOL1	-0.06	0.14	-0.14	0.20	-0.09	0.09	**0.49**	-0.11	**-0.43**	**0.31**	**-0.46**	**0.47**	**-0.31**	0.26	**0.68**	0.04
INDIV2	-0.39	0.09	0.04	0.17	0.11	-0.19	**0.42**	0.10	**-0.59**	0.25	**-0.31**	**0.37**	-0.17	-0.04	**0.61**	**0.32**
INDIV1	-0.23	-0.13	-0.08	0.04	-0.21	**-0.26**	**0.39**	0.11	**-0.46**	0.03	-0.27	0.29	**-0.40**	-0.16	**0.54**	0.29
INDIVPOL1	0.03	0.00	0.05	-0.07	-0.03	-0.09	-0.05	**0.49**	-0.02	0.04	0.13	-0.06	-0.06	-0.18	-0.02	**0.47**
INDIV4	-0.02	**0.21**	**-0.23**	0.05	-0.17	0.13	0.16	**0.29**	**-0.40**	**0.35**	-0.40	**0.32**	**-0.32**	0.22	**0.43**	**0.38**
EGAL5	**0.25**	0.00	0.10	0.10	-0.06	-0.19	-0.22	**-0.28**	**0.47**	-0.13	**0.34**	-0.11	0.05	-0.27	**-0.39**	**-0.36**
INDIV3	-0.07	0.18	-0.03	0.12	-0.16	-0.15	0.09	0.22	-0.25	0.27	-0.13	0.28	**-0.31**	-0.12	0.28	**0.33**

Extraction Method: Maximum Likelihood.
Rotation Method: Oblimin with Kaiser Normalization.
a. Rotation converged in 45 iterations.