2001

Dispositions for Lexicographic Preferences of Evironmental Goods: Integrating Economics, Psychology, and Ethics

Randall S. Rosenberger

George L. Peterson

Andrea Clarke

Thomas C. Brown

Dispositions for Lexicographic Preferences of Environmental Goods: Integrating Economics, Psychology, and Ethics

By

Randall S. Rosenberger[a*], George L. Peterson[b], Andrea Clarke[c] and Thomas C. Brown[b]

RESEARCH PAPER 2001-12
[REVISED]

[a]Regional Research Institute & Division of Resource Management, West Virginia University, Morgantown, WV 26506-6108

[b]Rocky Mountain Research Station, Forest Service, U.S. Department of Agriculture, Fort Collins, CO 80526

[c]Social Sciences Institute, Natural Resources Conservation Service U.S. Department of Agriculture, Port Republic, MD 20676

[*]Corresponding author: FAX + 1-304-293-3752; E-mail address: RROSENBE@WVU.EDU

ABSTRACT: This paper combines the psychometric methods of paired comparisons and environmental disposition measurement to explain seemingly lexicographic behavior in choice experiments. A paired comparison experiment is developed that measures economic values using a choice set composed of public goods, private goods, and sums of money. The method provides a detailed map of each respondent's stated preferences among the choice set elements. Two treatments are used that differ only on the range of the dollar magnitudes – Treatment A ranges from $10 to $700, Treatment B ranges from $10 to $9,000. In either treatment, a proportion of the respondents potentially exhibit lexicographic preferences. The Environmental Response Inventory is used and supplemented with statements regarding environmental ethics issues. Nine disposition scores are calculated for each respondent. Dispositions of pastoralism, antiquarianism, and environmental ethicism tend to correlate positively with increasing preferences for environmental goods, while the disposition of environmental adaptation tended to negatively correlate with preferences for environmental goods. The marginal effects of environmental dispositions were largest for people that did not value environmental goods highly (low valuers) and those that potentially valued the goods lexicographically. The results lend support to the conclusion that people who tend to hold deontological ethical stances toward the natural environment tend to use non-compensatory decision rules when expressing their values.

KEY WORDS: Environmental Dispositions; Environmental Ethics; Lexicographic Preferences; Paired Comparisons; Psychometrics

1. Introduction

Neoclassical utility theory assumes a value monism, i.e., all values are commensurable and ultimately reducible to a single metric. Based on this metric, we should be able to measure people's preferences qua values for environmental goods. However, some people may be using non-compensatory decision processes when making choices regarding environmental issues. That is, some people's values may be formed in a hierarchy; the structure of which being dependent upon the strength of the attitudes, beliefs, or dispositions they hold and the valuation context. If someone bases her responses to a valuation exercise from a hierarchy of values, then she may express her preferences lexicographically – a general unwillingness to trade or accept compensation for changes in an environmental good. Empirical evidence supporting the existence of lexicographic preferences for environmental goods is mounting (see Spash 2000 for a review).

Lexicographic preferences are important to environmental valuation in that they violate the assumption of continuously defined, differentiable, and convex preferences in standard neoclassical theory. Value incommensurability denies the ability to map continuously defined indifference curves among certain values. However, lexicographic preferences may be compatible with consistent (transitive, complete and reflexive) preference expressions in a hierarchical model of values (Lockwood 1996; Spash 2000). The traditional treatment of lexicographic preferences as 'protest responses' in economic assessments of values may limit the scope and quality of the information provided for making policy and social choices (Burney 2000). Lexicographic preferences may be expressed in valuation surveys either as protest bids (zero or infinite bids), non-response (survey or item), or 'unreasonable' sacrifices[1]. In other

words, lexicographic preferences are a violation of the exchange value assumption in neoclassical economics.

Two forms of lexicographic preferences have been offered – strict and modified (Lockwood 1996). Strict lexicographic preferences are the traditional meaning of the concept. That is, preferences for different types of goods are defined by a lexical ordering of these goods based on some perceived or felt attribute(s). In a strict lexicon, certain goods in any quantity or quality always take precedence in our expressions of preferences over all quantities or qualities of other goods. Thus, no indifference functions are definable. Arguably, the case of strict lexicographic preferences is untenable (Spash 1998). The absolute priority of one good may imply total sacrifice on the part of the individual (death before dishonor). A martyr would fit this category, but this type of individual is very rare.

A more tenable position is offered in the form of modified lexicographic preferences. Tracing the theoretical history of modified lexicographic preferences back to Georgescu-Roegen (1954), Lockwood (1996) develops a system of lexicographic preferences based on thresholds. This argument states that there exist certain thresholds, or minimum levels of a good, that are necessary and prior to choices for other goods. Figure 1 depicts one possible case of modified lexicographic preferences between two goods, W and X. X_{min} may represent a subsistence level in consumption of X that ensures human survival. Any level of X below this threshold is unacceptable. However, once this minimum level is sustained, then a minimum level for W is invoked. Any point below W_{min} but above X_{min} is unacceptable based on a secondary threshold for W. Any point to the northeast of A is strictly preferred to A in that both goods are increasing.

Any point in the area ABCD is more preferred to point A, because more of the second level good (W) is obtained while not reducing the first level good (X) below its minimum acceptable level.

There are many factors, both internal and external to a decision or choice context, which can affect someone's value expressions (Ajzen and Peterson 1988; Brown and Slovic 1988; Lockwood 1999). Internal contexts can motivate individuals' values based on the strength of her beliefs, attitudes, or dispositions toward the object of valuation (Lockwood 1999). Various motivations for lexicographic preference expressions identified through stated preference economic valuation methods have been suggested. The most common of which is the holding of a deontological or rights-based ethical stance toward natural areas and species (Stevens et al. 1991; Hanley and Milne 1996; Spash 1997, 2000; Lockwood 1998). Other motivations for non-compensatory preference expressions may include dual, non-reducible utility functions (Sen 1977; Etzioni 1988; Sagoff 1988, 1998); amibivalence between hard-to-compare values (Opaluch and Segerson 1989); inability to commodify environmental goods (Vatn 2000); religious-cultural doctrines (Earl 1986); or the essentiality of a good (life support priorities) (Lockwood 1996; Schmidtz 2000). We must also accept the possibility that some people seemingly expressing lexicographic preferences are actually being inconsistent in their expressions.

This paper addresses two shortcomings of previous investigations of motivations for lexicographic preferences expressions. First, most investigations concerning the existence of lexicographic preferences employ follow-up attitudinal questions in stated preference surveys to locate respondents into different classifications. These studies are interested in identifying the

reasons behind why certain individuals respond the way they do. For example, Stevens et al. (1991) asked respondents about their ethical position toward species (animal rights vs. utilitarian). However, the options from which respondents may choose are often incomplete or force them into a position that they weakly hold given the context of the survey (Hanley and Milne 1996). A more complete attitudinal profile may provide insights into the motivations behind lexicographic preference expressions. Second, the bid levels or magnitudes of monetary tradeoffs offered are often within respondents' ability to pay. That is, respondents with seemingly lexicographic preferences for a good may be willing to pay an amount (or make sacrifices) significantly greater than what is involved in the exchange value scenario.

The results provided in this paper are part of a larger project that integrates psychometric and economic methods of preference measurement (Peterson and Brown 1998). The results are discussed in the context of defining and relating environmental dispositions (or psychometric personality scales) with potential lexicographic preferences (PLP) for environmental goods to monetary gains. Section 2 describes the psychometric method of paired comparisons used to identify individuals' stated preferences for the environmental goods included in the experiments. Respondents also completed the Environmental Response Inventory, a psychometric method of measuring environmental dispositions (McKechnie 1974). Section 3 describes this method and the environmental ethics scale that was added to it. Section 4 describes the experimental design. Section 5 provides association test results between preference rankings and disposition scores. Section 6 identifies PLPs for the two treatments. We then measure the marginal effects of the environmental disposition scores on respondent membership in one of four mutually exclusive

categories – low valuers, moderate valuers, high valuers, and potentially lexicographic valuers (Section 7).

2. The Method of Paired Comparisons

The method of paired comparisons (PC) is used to elicit binary choices or judgments for paired items in a choice set (Peterson and Brown 1998). Respondents choose the item in the pair that has a greater magnitude on a given dimension, whether it is for physical properties such as weight or psychological properties such as preferences. The individual simply chooses the preferred element in each pair. If there are no preference errors, and if preferences obey the axioms of utility theory (especially transitivity and comparability), the result will be a perfect rank ordering of the elements in the choice set. In our application of the method of paired comparisons, choices are from the chooser reference point (Kahneman and Tversky 1979). This simply means that each respondent is choosing from amongst alternative gains.

The paired comparison method yields a binary choice score for each pair and a preference score for each element. The preference score is the number of times the respondent prefers a given element to other elements in the choice set. A respondent's vector of preference scores, here called the preference profile, estimates her preference order among the elements in the choice set, with larger integers indicating more preferred elements. In this experiment with 20 elements in the choice set, an individual preference profile with no circular triads contains all 20 integers from 0 through 19. Circular triads cause some integers to appear more than once (ties) in the preference profile while others disappear. In this study, we assume that the respondent's preference profile estimates her stated preference utility function. Circular triads of the form

A>B>C>A are the result of inconsistent choices, the causes of which include (1) random inconsistency when items are very similar, (2) mistakes caused by chooser incompetence or carelessness, (3) systematic and repeatable intransitivity, and (4) non-compensatory behavior such as choices that cue on different attributes for different pairings.

We focus on using PC to value a mix of goods. For example, we may be interested in ordering or measuring economic preferences for a variety of programs under resource constraints. Our application of PC begins with simple choice problems involving private goods, public goods, and sums of money. Our current use of the method is to investigate whether labile factors (attitudes, dispositions) affect people's expressions of preferences, as suggested by psychologists (Fischhoff 1991; Schkade and Payne 1994; Slovic 1995). PC may be one method that could be used to investigate these factors and how they affect individuals' values for public goods (Clarke et al. 1999; Lockwood 1999).

3. Measuring Environmental Dispositions

The Environmental Response Inventory (ERI) was developed in the field of environmental psychology by George McKechnie as a psychometric method for measuring enduring environmental dispositions. McKechnie (1974) defines environmental dispositions as "individual differences in the ways people think about and relate to the everyday physical environment" (pg. 1). In other words, the ERI is a broad personality assessment of human-environment interactions.

The ERI has been applied in different contexts. Domino (1984) used the ERI to investigate differences in peoples' willingness to live in a desert environment. Bunting and Cousins (1985) adapted the ERI to measure children's environmental dispositions. Zimmermann (1996) developed a shortened version of the ERI for use in testing environmental dispositions in children and adults.

The ERI consists of 184 statements that the respondent rates according to how well the statement describes or applies to her. A five-point Likert-type scale is used, ranging from 1 = strongly disagree to 5 = strongly agree, with 3 = neutral or don't know. The statements tap attitudes toward "a wide array of environmental themes, including conservation, recreation and leisure activities, architecture and geography, science and technology, urban life and culture, aesthetic preferences, privacy, and adaptation" (McKechnie 1974, 1). Attitudes are reinforced through affirmation of positive and negative statements.

Using exploratory and confirmatory factor analysis, eight environmental disposition categories were constructed (McKechnie 1974). Scores for each category are calculated by summing responses to each of the statements in a category and adding a constant.[2] The ERI has been tested and found to provide valid and reliable measures of environmental dispositions (McKechnie 1974). Table 1 provides a description of each disposition category and the number of statements and sign of the statements. Three categories – Pastoralism (PA), Urbanism (UR), and Environmental Adaptation (EA) – are most strongly related to attitudes toward conservation, pollution, and urban/natural environments (McKechnie 1974; Bunting and Cousins 1985; Zimmermann 1996). High scores on PA is positively correlated with membership in

environmental organizations, whereas high scores on EA is negatively correlated with membership in environmental organizations (McKechnie 1974).

The statements included in the original ERI may be a little outdated in that they do not account for advances in technology or newly emerged environmental problems (e.g., no statements regarding information technology or global environmental problems). However, subsequent tests have found the ERI to be robust (Domino 1984; Bunting and Cousins 1985). In order to capture attitudes related to ethical beliefs regarding human-environment interactions, we added 14 statements ranging from issues regarding future generations to animal and ecosystem rights (Table 2). We have named this category as Environmental Ethics (EE). The addition of this category is important given the empirical evidence that people do hold a variety of ethical beliefs that affect their values of the environment (Manning et al. 1998). Scores are calculated using the same rule as the ERI.

4. Experimental Design

The data are derived from an experiment consisting of two treatments designed to test the sensitivity of economic measures of value to the range of dollar magnitudes. The sample was drawn from students at a local university. Table 3 provides brief descriptions of the ten goods. Table 4 shows the dollar magnitudes used. In Treatment A, 125 respondents made choices among public goods, among private goods, between public goods and private goods, between public goods and sums of money, and between private goods and sums of money, with sums of money ranging from $10 to $700. In Treatment B, 126 respondents made similar choices, but

with dollar magnitudes ranging from $10 to $9,000. Respondents did not choose between sums of money, but did respond to the other 145 pairwise combinations among the items.

The private goods are familiar market goods. Two descriptions included suggested retail price; three did not, as indicated in Table 3. We included private goods to encourage respondents to consider a wide range of goods and trade-offs, to avoid inducing value by focusing too much attention on any one good, to examine economic measures for familiar private goods with and without suggested prices, and to detect apparently irrational choices such as rejecting $700 in favor of $25 worth of books.

The public goods are of a mixed type. Two are pure public environmental goods (wildlife habitat and clean environment); i.e., environmental goods that are non-rival and non-excludable in consumption. The other public goods are excludable by nature, but stated as non-excludable by policy. They are also non-rival until demand exceeds capacity. The pure public environmental goods benefit all people in the broader community, whereas the other public goods benefit only the group represented by respondents (college students). Respondents had Table 3 in front of them during the experiment and were free to refer to it at any time. The public and private goods used in the experiment were tested in pilot studies and selected to represent a substantial range of value. Respondents were asked to choose one or the other item from each pair under the assumption that either would be provided at no cost to the respondent. Each respondent also completed the ERI plus the environmental ethics addendum.

The experiment was administered by a computer program that presented pairs of items on the monitor in random order for each respondent. Short names for the goods and monetary magnitudes appeared side-by-side, with their position (right versus left) also randomized. The respondent recorded each choice by pressing the right or left arrow key and corrected mistakes by pressing the 'backspace' key. At the end of the paired comparisons, the ERI was immediately administered. Each statement appeared on the screen with the Likert-scale displayed beneath. The respondent expressed how the statement described or applied to her by pressing one of the number keys from 1 to 5 coinciding with the Likert-scale used. Following the ERI, the 14 environmental ethics statements were presented and evaluated using the same response mode as the ERI.

The computer program recorded the respondent's choice for each pair in an ordered binary matrix and responses to the ERI, among other things such as response time for pairwise choices and sequence number of each pairing. The computer program administered paired comparisons enables a detailed mapping of an individual's preference profile in an efficient manner (Peterson and Brown 1998; Lockwood 1998). The average total time to complete the survey was about 30 minutes, not including the time required to become familiar with the goods and the computer program.

5. Associations between Preference Scores and Disposition Scores

Spearman's nonparametric correlations are calculated to test for associations between the preference scores and disposition scores. The null hypothesis is that the correlation coefficient (ρ) is equal to zero and the alternative hypothesis is that ρ is not equal to zero, thus providing a

two-tailed test of significance. Table 5 reports those correlations that reject the null hypothesis of no association at the 0.10 level or better. The magnitude of ρ indicates the strength of the association with higher values representing stronger association. ρ can range from 1 to –1 with either of these values showing two variables are perfectly correlated. The sign of ρ indicates the direction of the association.

Pastoralism (PA) disposition scores are positively correlated with preference scores for the two environmental goods (WLD and CLN). This association is expected since PA represents an individual's disposition toward land development and preservation. An Antiquarian (AN) disposition is also positively correlated with WLD and CLN, potentially meaning that in addition to the general disposition toward cultural aesthetics and history, people also include natural aesthetics and history (Thompson 2000). Environmental Ethics (EE) dispositions have the strongest associations, especially for preference scores regarding wildlife habitat (WLD). This disposition entails ethical sensitivities toward future generations, non-human life, and natural systems. This association is as expected.

Scores for Environmental Adaptation (EA) dispositions, which is the modification of natural environments, are negatively correlated with preference scores for the environmental goods. In addition, EA is positively correlated with the parking garages public good (PRK). This correlation is affirmed with the negative association of PRK values with EE in Treatment B. Scores for dispositions toward the Urban environment (UR) are negatively correlated with values for WLD in Treatment A and CLN in Treatment B. However, this evidence also suggests that

people may be able to appreciate the built environment and the natural environment if they are not in competition with one another (Thompson 2000).

In general, dispositions that are significantly correlated with both private and public goods showed associations of the opposite direction. This may mean that individual's who highly value private, consumable goods do not place high values on public goods. A test of association between the disposition scores and memberships in environmental organizations confirms McKechnie's (1974) findings. Positive correlations with PA (0.34; 0.27, respectively) and EE (0.32; 0.26, respectively) for Treatments A and B, and a negative correlation with EA (-0.31) for Treatment A were found in this experiment.

6. Identifying Potential Lexicographic Preferrers

Beginning with this section, we identify respondents who are potentially lexicographic preferrers of goods. The next section conducts regression analysis to test for significant covariate effects between disposition scores and membership in different value classes and to measure the marginal effects of dispositions on membership in the different value classes.

We identify potential lexicographic preferrers (PLP) using the following rule:

$$PLP = \begin{cases} 1 & if \quad PS_{good_i} >> PS_{Max\$} \\ 0 & if \quad PS_{good_i} \leq PS_{Max\$} \end{cases}. \qquad (1)$$

In other words, if a respondent's preference score for a good (PS_{good}) is strictly greater than her preference score for the largest dollar magnitude ($PS_{Max\$}$), then she prefers the good to all sums of money offered. We call this individual a potential lexicographic preferrer (PLP) because her exchange value for the good in terms of money may be greater than the largest dollar amount

offered. That is, the largest dollar amount offered in trade or compensation for the good may not be high enough (although $9,000 in Treatment B has a high opportunity cost). Arguably, our instrument does not differentiate between true lexicographic preferrers and those for whom a high enough price has not been reached. Nonetheless, the next section statistically tests whether these potential lexicographic preferrers differ on dimensions of environmental dispositions from people that place a high monetary value on environmental goods. Table 6 reports the number and proportion of respondents identified as PLP for all goods between both treatments.

The environmental public goods exhibit the largest proportions of PLP with 26 percent and 18 percent of Treatment A respondents and 16 percent and 9 percent of Treatment B respondents being PLP for WLD and CLN, respectively. The magnitude of the proportions of PLP for all public goods declines when the dollar magnitude increases from $700 to $9,000.[3] This supports Hanley and Milne's (1996) finding that self-proclaimed lexicographic preferrers become compensatory choosers when the stakes (opportunity costs) are raised. We also identified those individuals who preferred the goods to $700 in Treatment B (Table 6, 4th column). Although the distributions between the three proportions are not significantly different, their magnitudes differ with Treatment A most closely matching the $700 proportions of Treatment B.

As an anonymous reviewer noted, in Treatment B there is some fraction of people that hold compensatory values greater than $700 (33 percent for WLD). Some of these people may hold lexicographic values. As the opportunity cost is increased to $9,000, a larger proportion of people who hold compensatory values are identified (84 percent for WLD). It is possible that all of the respondents hold compensatory values; we just have not reached a high enough price. We

will address this issue when we compare the potentially lexicographic preferrers with the 'high valuers' identified in the next section.

7. Marginal Effects of Disposition Scores on Value Classifications

In this section, we report the effects of environmental dispositions on membership in four value classes using ordered probit regression analyses. We re-classify individuals as being members of a particular value class (M_j) using the following rule, where PS_{good} are preference scores as previously defined:

$$M_j = \begin{cases} 0 \quad if \quad PS_{good_i} < 11 \\ 1 \quad if \quad 11 \le PS_{good_i} \le 15 \\ 2 \quad if \quad PS_{good_i} > 15 (\& \sim M = 3) \\ 3 \quad if \quad PS_{good_i} >> PS_{Max\$} \end{cases}. \tag{2}$$

That is, membership in class j (M_j) is 0 if the respondents are low valuers of good i; 1 if they are moderate valuers of the good, 2 if they are high valuers of the good, and 3 if they are potential lexicographic valuers of the good. Each category is mutually exclusive in that if a respondent has membership in Class 3, then she cannot be a member in any of the other value classes. High valuers (Class 2) expressed a high value for the good, but still preferred some amount of money over the good.

The construction of the value classes follows the natural order of increasing expressed values for the goods. The appropriate regression method for polychotomous dependent variables of this sort is the ordered probit or ordered logit. There is no significant difference between the marginal effects derived from either method, so we choose the ordered probit since it is more

straightforward in interpretation of its covariate effects. The ordered probit model specifies an unobservable index of degree of value (M*) to be a function of certain explanatory variables:

$$M^* = \alpha + \beta x + \varepsilon, \quad (3)$$

where x will be the disposition scores, α is a constant, ε is an error term that is normally distributed, and β are the covariates to be estimated. The ordered probit calculates the probability of membership in Class 0 (M = 0) if $M^* \leq \delta_1$, Class 1 if $\delta_1 \leq M^* \leq \delta_2$, Class 2 if $\delta_2 \leq M^* \leq \delta_3$, and Class 3 if $\delta_3 \leq M^*$. The δ's are threshold parameters that are estimated along with α and the β's. δ_1 is normalized by setting it to zero when a constant term is included in the ordered probit model.

Table 7 reports the results of the ordered probit analyses for the wildlife habitat (WLD) good for both treatments. The threshold values (δ's) are significant in both models meaning there is a discernible difference between the value classes. PA, EA, and EE dispositions significantly affect membership in the different classes for Treatment A, and EA and EE significantly affect class membership for Treatment B. The signs of these effects are as expected, with higher scores for PA and EE increasing membership in the higher classes for the good, and higher scores for EA decreasing membership in the higher classes for the good.

Significant β's in the ordered probit models provide some information regarding the effects of the disposition scores on class membership, but this information is limited. A significant covariate such as βEE tells us that higher scores on EE definitely increases membership in Class 3 and definitely decreases membership in Class 0. However, the effect on membership in the intermediate classes is unknown. Therefore, a fuller picture of the effects of disposition scores is

provided through estimation of the marginal effects of the scores on class membership. Marginal effects are the change in the probability of membership in a specific class due to a change in the disposition score. Higher marginal effects mean larger changes in the probability of class membership.

Table 8 reports the marginal effects of the disposition scores on the probability of membership in each of the value classes. The general pattern across all marginal effects is that the greatest effects are for the polar extreme value classes (Class 0 and Class 3). For Class 1, the marginal effects are generally negligible. The marginal effects of EA and EE are strongest for determining membership in Class 0 (low valuers) for the environmental goods, although the effect is strong for membership in Class 3 (PLP). The sign of the marginal effects generally switches as we move out of Class 0 into Class 1. One may assume from the analysis that disposition scores may perform better at identifying low valuers than PLP. However, we caution against this interpretation given that our PLP class (Class 3) may contain high valuers (Class 2) if the range of dollar values was not high enough for some people. Which brings us back to the issue that arose at the end of the previous section. Are we really identifying people with lexicographic preferences, or is our price range still too low to elicit compensatory values?

One way to directly address this issue would be to have respondents self-report whether they are lexicographic preferrers or not. As the anonymous reviewer suggested, we could have asked close-ended questions such as ‘no monetary payment is sufficient’ when choosing between environmental goods and personal gain. Unfortunately, we did not ask such a question, although Hanley and Milne (1996) show that literal responses such as these may be dependent on the

magnitude of the tradeoff being offered. What we do have are our individual environmental ethics statements. Based on Mann-Whitney U tests of mean equality, PLP respondents differ significantly from high valuers on EE scores. In particular, this difference in EE scores is based, in part, on PLP respondents rating the following three individual statements significantly higher than the high valuers:

1. "Natural ecosystems have a right to exist for their own sake, regardless of human concerns and uses."
2. "We should try to get by with a little less so there will be more left for future generations."
3. "Unique environments should be protected at all costs."

Although this additional evidence does not definitively identify that there are lexicographic preferrers in our sample for the wildlife habitat good in Treatment B, the theme of two of the above statements is consistent with arguments that deontological ethical stances toward the environment may lead to lexicographic expressions of value for these kinds of goods (Stevens et al. 1991; Hanley and Milne 1996; Spash 1997, 2000; Lockwood 1998).

8. Conclusions

Attitudes, beliefs, and dispositions toward people, places and things can affect how people behave and respond to questions (Ajzen and Peterson 1988). This is true for economic surveys of people's values of environmental goods. This study combines psychology, economics and ethics through the use of the psychometric methods of paired comparisons to measure economic value and a slightly modified version of the Environmental Response Inventory to measure dispositions toward the environment. The main goal is to explain seemingly lexicographic

valuation behavior evident in economic surveys of environmental issues (Spash 2000). What this study shows is that, relative to the other elements in the choice set, environmental goods elicit more potentially lexicographic responses than other public goods. People who seemingly express their preferences lexicographically have stronger dispositions toward the environment, which is reflected in how, and not necessarily how much, they value the environment. If people are heterogeneous in how they express their preferences, then estimating values for the entire population of affected people with a single metric is problematic.

A method of paired comparisons is developed that elicits binary choices between the elements of a choice set composed of private goods, public goods, and sums of money. The result is a detailed map of each respondent's stated preferences for each element. Two treatments are employed that differ solely in the range of the dollar magnitudes (Treatment A ranges from $10 to $700 and Treatment B ranges from $10 to $9,000). For the two environmental public goods – wildlife habitat preserve and improved air and water quality arrangement – 26 percent and 18 percent of respondents (respectively) in Treatment A exhibited potentially lexicographic preferences, whereas 16 percent and 9 percent of Treatment B respondents (respectively) exhibited potentially lexicographic preferences for these goods. As the opportunity cost increases, we see a decline in the number of respondents self-reporting strict lexicographic preferences (Hanley and Milne 1996). These people may be operating from a modified lexicographic rule that constrains the lexicon within thresholds (Lockwood 1996).

The Environmental Response Inventory measures an individual's disposition toward the environment across eight categories (McKechnie 1974). We developed an additional category

that measured environmental ethics dispositions regarding future generations, non-human life, and ecosystem functioning. Pastoralism, antiquarianism, and environmental ethicism dispositions are positively associated with positive values for the environmental goods, whereas the environmental adaptation disposition is negatively associated with positive environmental values. This implies that people who tend to be pro-environment (want to preserve natural resources, find aesthetic beauty in natural surroundings, hold ethical commitments toward natural entities) may be more likely to use non-compensatory decision rules.

The marginal effects of dispositions on membership in four value classes – low valuers, moderate valuers, high valuers, and potentially lexicographic valuers – were most significant in defining the polar extremes. Low valuers tended to be low scorers for pastorialism, antiquarianism and environmental ethicism dispositions. Potential lexicographic valuers tended to be high scorers on these dispositions. Low valuers also tended to have high environmental adaptation disposition scores, while potential lexicographic valuers tended to score low on this disposition. The marginal effects for moderate and high valuers of the environmental goods tended to be miniscule for all dispositions.

There are several extensions for this research, some of which have been addressed throughout the paper. One of the more important extensions is overcoming the criticism that we have not identified lexicographic preferrers, but merely have not exceeded their value threshold for trading environmental goods for monetary gain. One method that could be used is to ask people to self-report whether they would choose any amount of money. Another method would be to increase the range of sums of money well beyond the $9,000 included in this experiment. Both

methods, however, are probably inadequate in that there are problems with self-reporting and how large the highest sum of money reasonably could be. A second extension is to apply the method to other populations beyond college students.

Acknowledgements

This project was supported by funds provided by the U.S. Department of Agriculture's Forest Service – Rocky Mountain Research Station, and the Natural Resource Conservation Service. We acknowledge helpful suggestions from reviewers of this *journal* and from participants at the 2001 Inaugural Conference of the United States Society for Ecological Economics held July 11-13 in Duluth, MN. Any errors are the sole responsibility of the authors.

References

Ajzen, I., Peterson, G.L., 1988. Contingent value measurement: the price of everything and the value of nothing? In: G.L. Peterson, B.L. Driver, and R. Gregory (Eds.), Amenity Resource Valuation: Integrating Economics with Other Disciplines. Venture: State College, PA, pp. 65-76.

Anderson, E., 1993. Value in Ethics and Economics. Harvard University Press: MA.

Brown, T.C., Slovic, P., 1988. Effects of context on economic measures of value. In: G.L. Peterson, B.L. Driver, and R. Gregory (Eds.), Amenity Resource Valuation: Integrating Economics with Other Disciplines. Venture: State College, PA, pp. 23-30.

Bunting, T.E., Cousins, L.R., 1985. Environmental dispositions among school-age children: a preliminary analysis. Environ. and Behav. 17 (6), 725-768.

Burney, J., 2000. Is valuing nature contributing to policy development? Environ. Values 9 (4), 511-520.

Clarke, A., Bell, P.A., Peterson, G.L., 1999. The influence of attitude priming and social responsibility on the valuation of environmental public goods using paired comparisons. Environ. and Behav. 31 (6), 838-857.

Domino, G., 1984. Measuring geographical environments through adjectives: the Environmental Check List. Psych. Reports 55 (1), 151-160.

Earl, P., 1986. Lifestyle Economics: Consumer Behavior in a Turbulent World. St. Martin's Press: New York.

Etzioni, A., 1988. The Moral Dimension: Toward a New Economics. The Free Press: New York.

Fischhoff, B., 1991. Value elicitation: is there anything in there? Am. Psych. 46 (8), 835-847.

Georgescu-Roegen, N. 1954. Choices, expectations and measurability. The Quarterly J. of Econ. 68 (4), 503-534.

Hanley, N., Milne, J., 1996. Ethical beliefs and behaviour in contingent valuation surveys. J. of Environ. Plan. and Manage. 39 (2), 255-272.

Kahneman, D., Knetsch, J.L., 1979. Valuing public goods: The purchase of moral satisfaction. J. of Environ. Econ. and Manage. 22, 57-70.

Kahneman, D., Tversky, A., 1979. Prospect theory: An analysis of decision under risk. Econometrica 47 (2), 263-291.

Lockwood, M., 1996. Non-compensatory preference structures in non-market valuation of natural area policy. Austral. J. of Agri. Econ. 40 (2), 85-101.

Lockwood, M., 1998. Integrated value assessment using paired comparisons. Ecol. Econ. 25 (1), 73-87.

Lockwood, M., 1999. Humans valuing nature: synthesizing insights from philosophy, psychology and economics. Environ. Values 8 (3), 381-401.

Manning, R., Valliere, W., Minteer, B. 1998. Values, ethics, and attitudes toward National Forest Management: an empirical study. Soc. & Nat. Resources 12 (5), 421-436.

McKechnie, G.E., 1974. ERI Manual: Environmental Response Inventory. Consulting Psychologists Press: Palo Alto, CA.

Opaluch, J.J., Segerson, K., 1989. Rational roots of 'irrational' behavior: new theories of economic decision-making. NE. J. of Agri. and Resource Econ. 18 (2), 81-95.

Peterson, G.L., Brown, T.C., 1998. Economic valuation by the method of paired comparison, with emphasis on evaluation of the transitivity axiom. Land Econ. 74 (2), 240-261.

Rosenberger, R.S., Peterson, G.L., Loomis, J.B. 2002. Applying a method of paired comparisons to measure economic values for multiple goods sets. J. of Agri. and Applied Econ. 34 (1), forthcoming.

Sagoff, M., 1988. The Economy of the Earth: Philosophy, Law, and the Environment. Cambridge University Press, Cambridge.

Sagoff, M., 1998. Aggregation and deliberation in valuing environmental public goods: a look beyond contingent pricing. Ecol. Econ. 24 (2,3), 213-230.

Schmidtz, D. 2000. Natural enemies: An anatomy of environmental conflict. Environ. Ethics 22 (4), 397-408.

Sen, A.K., 1977. Rational fools: a critique of the behavioral foundations of economic theory. Phil. and Public Affairs 6 (4), 317-344.

Slovic, P., 1995. The construction of preference. Am. Psych. 50 (5), 364-371.

Spash, C.L., 1997. Ethics and environmental attitudes with implications for economic valuation. J. of Environ. Manag. 50 (4), 403-416.

Spash, C.L. 1998. Investigating individual motives for environmental action: Lexicographic preferences, beliefs and attitudes. In J. Lemons, L. Westra and R. Goodland (eds.), 1998, Ecological Sustainability and Integrity: Concepts and Approaches. Kluwer Academic Publishers: Netherlands. Pp. 46-62.

Spash, C.L., 2000. Ecosystems, contingent valuation and ethics: the case of wetland re-creation. Ecol. Econ. 34 (2), 195-215.

Stevens, T.H., Echeverria, J., Glass, R.J., Hager, T., More, T.A., 1991. Measuring the existence value of wildlife: what do CVM estimates really show? Land Econ. 67 (4), 390-400.

Thompson, J. 2000. Environment as cultural heritage. Environ. Ethics 22 (3), 241-258.

Vatn, A., 2000. The environment as a commodity. Environ. Values 9 (4), 493-509.

Zimmermann, L.K., 1996. The development of an environmental values short form. J. of Environ. Ed. 28 (1), 32-37.

Footnotes

[1] The definition of 'unreasonable' sacrifices is greatly dependent upon how you define rational choices. In the context of a neoclassical definition of instrumental rationality, unreasonableness may include willingness-to-pay expressions beyond an individual's ability to pay, reductions in standard-of-living below subsistence levels, or other sacrifices that involve large opportunity costs such as loss of human life.

[1] The constant for each category is six times the number of negative items in that category, ensuring there are no negative total raw scores.

[1] The increases in PLP for the private goods (CLO and BOK) between Treatment A and B is due to one individual in Treatment B preferring all private goods over money and public goods (except for the low valued MEA). This individual obviously was playing a different game in that he or she could have purchased large quantities of each private good by accepting the money.

Table 1. ERI Environmental Disposition Categories.

Category	Theme for High Scorers	# Variables (sign)
PA	**Patoralism**: Opposition to land development; concern about population growth; preservation of natural resources, including open space; acceptance of natural forces as shapers of human life; sensitivity to pure environmental experiences; self-sufficiency in the natural environment.	20 (+) 2 (-)
UR	**Urbanism**: Enjoyment of high density living; appreciation of unusual and varied stimulus patterns of the city; interest in cultural life; enjoyment of interpersonal richness and diversity.	11 (+) 9 (-)
EA	**Environmental Adaptation**: Modification of the environment to satisfy needs and desires, and to provide comfort and leisure; opposition to governmental control over private land use; preference for highly designed or adapted environments; use of technology to solve environmental problems; preference for stylized environmental details.	16 (+) 6 (-)
SS	**Stimulus Seeking**: Interest in travel and exploration of unusual places; enjoyment of complex and intense physical sensations; breadth of interests.	20 (+) 2 (-)
ET	**Environmental Trust**: General environmental openness, responsiveness, and trust; competence in finding one's way about the environment vs. fear of potentially dangerous environments; security of home; fear of being alone and unprotected.	20 (-)
AN	**Antiquarianism**: Enjoyment of antiques and historical places; preference for traditional vs. modern design; aesthetic sensitivity to man-made environments and to landscape; appreciation of cultural artifacts of earlier eras; tendency to collect objects for their emotional significance.	16 (+) 4 (-)
NP	**Need for Privacy**: Need for physical isolation from stimuli; enjoyment of solitude; dislike of neighboring; need for freedom from distraction.	15 (+) 4 (-)
MO	**Mechanical Orientation**: Interest in mechanics in its various forms; enjoyment in working with one's hands; interest in technological processes and basic principles of science; appreciation of the functional properties of objects.	17 (+) 3 (-)

Adapted from McKechnie (1974).

Table 2. Environmental Ethics Statements Supplementary to Environmental Response Inventory (Category EE).

Statement	Sign
1. It is not necessary to protect every endangered plant and animal.	-
2. Current generations should make sacrifices for future generations.	+
3. I am glad that there are wilderness areas, even if I never get to visit them.	+
4. Endangered wildlife species should be protected at any cost.	+
5. I would support the protection of an endangered bird species, even if I were never able to see one in the wild.	+
6. Future generations are not as important as the current one in decisions about natural resources.	-
7. Trapping of wild animals should be banned.	+
8. Natural ecosystems have a right to exist for their own sake, regardless of human concerns and uses.	+
9. Wild plants and animals have a right to live unmolested by humans.	+
10. Land should NOT be set aside for parks and wilderness areas if it will cost people their jobs.	-
11. I enjoy knowing that I can visit parks and wilderness areas if I want to.	+
12. We should try to get by with a little less so there will be more left for future generations.	+
13. Unique environments should be protected at all costs.	+
14. I think that we are doing an adequate job of protecting natural resources from being used up.	-

Likert scale: 1=most strongly disagree; 3=neutral; 5=most strongly agree.

Table 3. Description of Goods.

Public Good	Description
Video Library (VID)	A no-fee library service that provides videotapes of all course lectures so that students can watch tapes of lectures for classes they are not able to attend.
Parking Garages (PRK)	Parking garages to increase parking capacity on campus such that students are able to find a parking place at any time, without waiting, within a five-minute walk of any building at no increase in the existing parking permit fee.
Eating Area (EAT)	Expansion of the eating area in the Lory Student Center to ensure that any student can find a seat at any time.
Air-Water Quality (CLN)	A cooperative agreement between Colorado State University, local business groups, and the citizens of the community that would ensure the air and water quality of Fort Collins would be at least as clean as the cleanest 1% of the communities in the U.S.
Wildlife Habitat (WLD)	Purchase by Colorado State University of 2,000 acres of land in the mountains west of Fort Collins as a wildlife refuge for animals native to Colorado.
Private Goods	
Meal Ticket (MEA)	A meal at a Fort Collins restaurant of your choice.
Entertainment Ticket (ENT)	Two tickets and transportation to *one* of the following: • A concert of your choice in Denver (contemporary, rock, or classical), or • General admission to a sporting event (Broncos, Rockies, Avalanche, or Nuggets)
Clothing Certificate (CLO)	A nontransferable $200 certificate for clothing at a Fort Collins store of your choice.
Airline Certificate (AIR)	A nontransferable certificate for a round-trip flight to any major city in the contiguous 48 states on an airline of your choice.
Bookstore Certificate (BOK)	A $25 gift certificate for use at a bookstore of your choice.

Table 4. Dollar Magnitudes Used in the Experiment.

	Treatment	
Dollars	**A**	**B**
$10	X	X
$30	X	X
$50	X	X
$70	X	X
$100	X	X
$200	X	
$300	X	X
$400	X	
$500	X	
$700	X	X
$1,000		X
$3,000		X
$9,000		X

Table 5. Spearman's Nonparametric Correlation Tests of Association between Disposition Scores and Preference Scores.

Disposition	Significantly Correlated with Good (ρ)			
	Treatment A			
PA	WLD (0.43)	CLN (0.31)	CLO (-0.29)	VID (0.18)
UR	WLD (-0.19)	MEA (0.18)		
EA	WLD (-0.51)	CLN (-0.36)	CLO (0.29)	PRK (0.26)
AN	WLD (0.29)	BOK (0.24)	CLN (0.18)	
NP	ENT (-0.20)			
MO	BOK (0.24)			
EE	WLD (0.50)	CLN (0.41)	CLO (-0.34)	
	Treatment B			
PA	WLD (0.39)	CLN (0.26)	MEA (-0.19)	
UR	MEA (0.22)	CLN (-0.21)	AIR (0.20)	
EA	WLD (-0.35)	CLN (-0.30)	CLO (0.28)	
AN	WLD (0.39)	CLN (0.31)	CLO (-0.25)	MEA (-0.23)
NP	CLO (-0.21)	PRK (-0.19)		
EE	WLD (0.44)	PRK (-0.21)	CLN (0.20)	

The null hypothesis that $\rho=0$ is rejected at a significance level of 0.05 or better based on two-tailed tests of significance. The size of ρ tells the magnitude of the association and the sign of ρ tells the direction of this association. ρ can range from -1 to 1.

Table 6. Proportion of Respondents Potentially Expressing Lexicographic Preferences.

	Treatment A (n=124)	Treatment B (n=124)	
Dollar Amount	**$700**	**$9000**	**$700**
Public Good	**Number (%)**	**Number (%)**	**Number (%)**
WLD	32 (26%)	20 (16%)	41 (33%)
CLN	23 (18%)	11 (9%)	28 (22%)
EAT	1 (1%)	0 (0%)	5 (4%)
PRK	11 (9%)	4 (3%)	12 (10%)
VID	7 (6%)	2 (2%)	7 (6%)
Private Good			
AIR	4 (3%)	1 (1%)	21 (17%)
CLO	0 (0%)	1 (1%)	2 (2%)
MEA	0 (0%)	0 (0%)	1 (1%)
ENT	2 (2%)	2 (2%)	11 (9%)
BOK	0 (0%)	1 (1%)	1 (1%)

Identification Rule: Potential Lexical Preference if and only if preference score for $good_x$ > preference score for $dollar\ amount_y$.

Table 7. Ordered Probit Analysis of Environmental Disposition Scores – Wildlife Habitat.

	Treatment A (n=124)		Treatment B (n=124)	
Variable	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**
PA	0.0270*	0.0168	0.0257	0.0212
UR	0.0050	0.0130	0.0123	0.0106
EA	-0.0390*	0.0137	-0.0400*	0.0135
SS	0.0014	0.0142	-0.0144	0.0147
ET	0.0098	0.0169	0.0073	0.0151
AN	-0.0034	0.0132	0.0160	0.0127
NP	0.0171	0.0150	0.0002	0.0134
MO	-0.0118	0.0104	0.0135	0.0102
CO	0.0007	0.0189	-0.0228	0.0201
EE	0.0386*	0.0168	0.0584*	0.0202
Constant	-2.1368	2.1408	-2.1508	1.8998
δ_2	0.7359*	0.1280	1.4067*	0.1815
δ_3	1.1805*	0.1677	1.9635*	0.2057
Log likelihood	-141.23		-133.59	
Chi-square	44.20*		52.03*	

* Significant at the 0.10 level or better based on asymptotic t-statistics.

Note: The dependent variable is based on membership in one of four mutually exclusive classifications defined as 0 = ratings < 11; 1 = rating of 11 to 15; 2 = rating > 15; 3 = WLD > MaxDollar (potential lexicographic preference identifier rule). Membership per class is: Treatment A (48, 28, 16, 32); and Treatment B (38, 50, 16, 20), respectively.

Table 8. Marginal Effects of Environmental Disposition Scores on Class Membership – Treatments A and B Ordered Probit Analyses for Wildlife Habitat.

	Class 0		Class 1		Class 2		Class 3	
Variable	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**
PA	-0.0101	-0.0082	0.0001	0.0004	0.0023	0.0034	0.0077	0.0044
UR	-0.0019	-0.0039	0.0000	0.0002	0.0004	0.0016	0.0014	0.0021
EA	0.0146	0.0128	-0.0001	-0.0006	-0.0034	-0.0052	-0.0111	-0.0069
SS	-0.0005	0.0046	0.0000	-0.0002	0.0001	-0.0019	0.0004	-0.0025
ET	-0.0037	-0.0023	0.0000	0.0001	0.0009	0.0010	0.0028	0.0013
AN	0.0013	-0.0051	0.0000	0.0003	-0.0003	0.0021	-0.0010	0.0028
NP	-0.0064	-0.0001	0.0000	0.0000	0.0015	0.0000	0.0049	0.0000
MO	0.0044	-0.0043	0.0000	0.0002	-0.0010	0.0018	-0.0034	0.0023
CO	-0.0003	0.0073	0.0000	-0.0004	0.0001	-0.0030	0.0002	-0.0039
EE	-0.0144	-0.0187	0.0001	0.0009	0.0034	0.0077	0.0110	0.0100

The value classifications are based on membership in one of four mutually exclusive classifications defined as 0 = ratings < 11; 1 = rating of 11 to 15; 2 = rating > 15; 3 = WLD > MaxDollar (potential lexicographic preference identifier rule).

Figure 1. Strict and Modified Lexicographic Preferences (adapted from Spash 1998).