

THE COHERENCE OF PUBLIC CONCERN FOR THE ENVIRONMENT: A
CONCEPTUAL AND METHODOLOGICAL ANALYSIS

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A dissertation submitted in partial fulfillment of
the requirements of the degree of

DOCTOR OF PHILOSOPHY

WASHINGTON STATE UNIVERSITY
Department of Sociology

AUGUST 2004

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To the Faculty of Washington State University

The members of the Committee appointed to examine the dissertation of
CHENYANG XIAO find it satisfactory and recommend that it be accepted.

Chair

ACKNOWLEDGMENT

In completing this dissertation I received assistance from numerous people to whom I would like to give my appreciation. First, I want to thank Riley Dunlap for his invaluable and timely guidance throughout the entire dissertation project, and his detailed editorial suggestions on prior drafts that improved the dissertation and provided me a with valuable learning experience in terms of writing in English.. I also appreciate insightful assistance and ideas from Eugene Rosa and Thomas Rotolo. Finally, I would like to thank Aaron McCright for his assistance in revising early drafts of my dissertation.

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Abstract

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August 2004

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Despite a great number of published studies regarding public concern for environmental quality, our understanding of the nature of “environmental concern” is limited due to the lack of effective measurement of this construct. While there are systematic attempts at conceptualizing environmental concern, relatively less attention has been paid to problematic measurement approaches commonly utilized. I therefore attempt to contribute to advancing the measurement of environmental concern by systematically examining the commonly utilized measurement approaches and exploring the utility of confirmatory factor analysis (CFA) and structural equation modeling (SEM) techniques for measuring environmental concern.

To be more specific, I systematically examine several commonly utilized measurement approaches to environmental concern, including single-item measures, summation indexes with internal consistency tests, exploratory factor analysis, and CFA and SEM. Next, I utilize data from the 1992 Gallup Health of the Planet survey to explore the utility of CFA for examining the coherence of environmental concern and the utility of SEM for examining the interrelationships among key components of

environmental concern and six variables—five socio-demographic variables and political ideology—that are widely assumed to influence environmental concern.

The results of the CFA show that environmental concern among the general publics of the USA and Canada is characterized by considerable belief constraint, suggesting that it is reasonable to consider environmental concern as a coherent construct rather than inherently multidimensional, unstable, and idiosyncratic as some analysts have suggested. Comparisons between the USA and Canadian samples indicate that the two nations have similar levels of belief coherence regarding environmental concern, providing additional confidence in the findings.

The results of the SEM analysis generally suggest that environmental concern in both the USA and Canada is organized around a set of primitive beliefs reflected by the New Environmental Paradigm (NEP). However, the five socio-demographic variables and political ideology account limited variation in environmental concern in either sample. To conclude, CFA/SEM appears to be highly suitable and effective in dealing with the measurement of environmental concern, and thus a means of facilitating the development and testing of theoretical models of the nature and sources of such concern.

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Dedication

This dissertation is dedicated to my mother, father, wife, and two daughters Alison and Olivia, who created a lovely home that has been providing the motives and supports for me to finish this dissertation.

CHAPTER ONE

INTRODUCTION

Since the early 1970s, environmental issues have generated increased public attention, enhanced through prominent events such as the first Earth Day on April 22, 1970, the 1973-74 energy crisis, the Love Canal controversy, the Three Mile Island accident, the Exxon Valdez oil spill, and more recently through concerns over the ozone depletion, tropical deforestation, and global climate change. Correspondingly, examining public opinion on environmental issues, which is now commonly referred to as “concern for environmental quality” or simply “environmental concern,” became a major focus within environmental sociology and social science (Dunlap and Catton, 1979). Indeed, scholars at various times since then have noted how the number of such studies grew rapidly, with the most recent estimation by Dunlap and Jones (2002) being that there are more than one thousand published studies regarding environmental concern.

The rapid growth of empirical studies of environmental concern is not surprising. From a scholarly standpoint, the documentation, description and especially the analysis of public concern for environmental quality is an important intellectual issue worthy of theoretical and empirical analyses. From a practical standpoint, studies of environmental concern also can contribute valuable input into local, national and international policy-making processes since it is generally assumed that at least within democratic societies public opinion has significant influence on governmental decision-making (Dunlap, 1995)--an assumption supported by a growing body of evidence (Burstein, 2003).

Unfortunately, even though there is a weighty volume of published studies, the understanding of the nature of environmental concern remains rather limited. As noted by numerous scholars (e.g., Heberlein, 1981; Gray, 1985; Guber, 1996; and Dunlap and Jones, 2002), the environmental concern literature is highly fragmented and unorganized. Most studies are atheoretical and seldom build upon each other in a cumulative process, in part due to the wide range of disciplinary backgrounds of the researchers involved. Attempts to conceptualize and measure environmental concern are often ad hoc and subjective. Many measures of environmental concern are generated for use in only one specific study and, as Gray (1985: 21) put it, “never [again] see light of another day.” A direct consequence of this situation is the vast diversity apparent in the conceptualization and measurement of environmental concern.

Given that effective measurement of core variables is essential to all scientific research, the vastly diverse conceptualizations of environmental concern currently existing in the literature have become a fundamental barrier to achieving a better understanding of environmental concern. With different conceptualization schemes, researchers are not even certain whether they are referring to the same thing with the term “environmental concern.” Great differences in measurement approaches to environmental concern further complicate the situation. Comparisons of empirical studies are thus extremely difficult, and must be made with great caution. To address this situation, obviously both the conceptualization and measurement approaches to environmental concern require extensive attention.

The standard measurement process described in most research methods textbooks begins with the conceptualization of constructs. Ideally, the conceptualization of a

complex construct such as environmental concern should follow the existing consensual theoretical definition of that construct not only to provide the basis for evaluating measuring instruments but also to form the basis for meaningful theoretical comparisons among studies. This would facilitate the cumulative process of developing a shared body of knowledge (e.g., Singleton and Straits, 1999). One immediate difficulty confronting researchers of environmental concern is the absence of such a consensual theoretical definition. The conceptualization process therefore must take an alternate route, as demonstrated by several scholars that will be introduced in Chapter Two. This path follows an inductive strategy of summarizing existing empirical efforts at conceptualizing environmental concern, and integrating theoretical insights from relevant academic fields such as attitude theory from the social-psychological literature.

Due to the size and diversity of the environmental concern literature, this alternative strategy does not seem feasible in this dissertation. Fortunately, there have already been several efforts to clarify the conceptualization of environmental concern (e.g., Heberlein, 1981; Gray, 1985; and Dunlap and Jones, 2002) that provide a viable starting point. I thus draw upon theoretical insights from three prominent conceptualization schemes by Heberlein (1981), Gray (1985), and Dunlap and Jones (2002) to form a general agreement about the conceptualization of environmental concern. Such an agreement then serves as the theoretical basis for a selective review of the current literature focusing on the measurement of environmental concern.

Compared to discussions of the conceptualization of environmental concern, relatively less attention has been paid to problematic measurement approaches commonly utilized to measure this construct. For instance, Dunlap and Jones (2002) note that

common approaches to measuring environmental concern such as factor analysis or related techniques and single measurement techniques (e.g., summation indexes) are not capable of determining the dimensionality of environmental concern, a key issue that must be clarified if effective measures of the construct are to be developed. Dunlap and Jones thus call for increased use of more sophisticated approaches utilizing confirmatory factor analysis techniques, shown to have promise in a few recent studies such as Guber (1996) and Carman (1998).

In response to this call for more attention to measurement approaches, I seek to contribute to advancing the measurement of environmental concern in this dissertation by systematically examining the commonly utilized measurement approaches and then exploring the utility of confirmatory factor analysis and structural equation modeling techniques for the measurement of environmental concern. To be more specific, I systematically examine several measurement approaches to environmental concern, including single-item measures, summation indexes with internal consistency tests, exploratory factor analysis, confirmatory factor analysis, and structural equation modeling. Next, I utilize data from the 1992 Gallup Health of the Planet survey to explore the utility of confirmatory factor analysis in examining the dimensionality of environmental concern. I also explore the utility of structural equation modeling for examining the interrelationships among key components of environmental concern and several variables widely assumed to influence environmental concern.

The next chapter provides a brief summary and discussion of the three aforementioned conceptualization schemes of environmental concern offered by Heberlein (1981), Gray (1985), and Dunlap and Jones (2002), and then a detailed

examination and comparisons of commonly utilized measurement approaches to environmental concern. In Chapter Three, I describe the dataset utilized in this dissertation as well as data management issues. As the 1992 Gallup Health of the Planet survey is international and two national samples, the USA and Canada, are extracted for use in this dissertation, I also briefly compare the evolution of environmental issues in both nations and outline the comparative research strategy used in this dissertation. The remaining part of Chapter Three provides a detailed introduction and discussions of the two statistical techniques, confirmatory factor analysis and structural equation modeling to be employed for data analysis.

In Chapter Four I explore the utility of confirmatory factor analysis for examining the dimensionality of environmental concern, or addressing the question posed by Dunlap and Jones (2002: 511): “Is it appropriate to consider environmental concern as a single construct, or is it inherently multidimensional?” The dimensionality of environmental concern is a key issue of the conceptualization and measurement of environmental concern. However, as I mentioned above, many commonly utilized measurement approaches cannot adequately answer this question. On the other hand, confirmatory factor analysis has several unique features that make it particularly suitable for examining the dimensionality of environmental concern. Examining the dimensionality of environmental concern thus represents an excellent opportunity to illustrate the capability of confirmatory factor analysis.

In Chapter Five I examine the interrelationships among key components of environmental concern using structural equation modeling, a technique that is closely related to confirmatory factor analysis. Examining the interrelationships among key

components of environmental concern can facilitate developing better conceptualizations and more effective measurements of this construct. Structural equation modeling is an ideal technique for this task, and also allows for the investigation of a causal model incorporating several variables often found influencing environmental concern. Finally, Chapter Six presents a summary of research findings and discussion of suggestions for additional research to further improve our understanding of the nature and sources of environmental concern.

CHAPTER TWO

CONCEPTUALIZATION AND MEASUREMENT APPROACHES OF ENVIRONMENTAL CONCERN

In this chapter I first briefly summarize three efforts to conceptualize environmental concern offered by Heberlein (1981), Gray (1985), and Dunlap and Jones (2002), and then discuss the similarities and dissimilarities among these three works. I will use their general agreements to develop a theoretical basis for evaluating approaches to the measurement of environmental concern commonly utilized in the literature, as well as to develop the conceptualization of this construct that I will use in this dissertation. In the remaining part of this chapter I systematically examine and compare commonly utilized conceptual and measurement approaches to environmental concern in the empirical literature.

The Conceptualization of Environmental Concern

The Formation of the Environmental Attitudes: Heberlein's Conceptualization

Heberlein (1981) presents a conceptualization scheme that exemplifies a systematic effort to introduce social-psychological attitude theory into environmental concern research. To Heberlein, attitudes have at least two distinct components: (1) affect, or “an emotional dimension involving feelings” and (2) cognition, or “dispassionate facts and beliefs” (Heberlein, 1985: 244). Heberlein’s third concept—value—is also introduced, due to its central position within peoples’ belief systems and therefore is very important for understanding the formation of attitudes.

Next, Heberlein turns his attention to analyzing the richness and complexity of an illustrative “environmental attitude¹” by examining the relationships between affect, cognitions, and values and how these three function together to form an attitude. Therefore, Heberlein emphasizes the exploration of attitudinal structure. A basic understanding of the attitude formation process and of the attitudinal structure can facilitate developing a more effective measure of environmental attitudes. Because of this, Heberlein criticizes measures of environmental attitudes that use single indicators or several indicators focusing on only a specific issue such as pollution, population, and so on. He argues that such measures of single, specific beliefs are inadequate measures of environmental attitudes.

The focus on the formation of environmental attitudes also leads Heberlein to examine different attitudinal sources such as the media and personal experiences. Different attitudinal sources may create “cognitive inconsistency” because people tend to obtain different perceptions of environmental issues through their direct personal experience than through the media. Besides differing attitudinal sources, another identified source of inconsistency is between attitudes toward general environmental issues and more specific environmental issues—the notion of “specificity” of environmental attitudes. Heberlein argues that cognitive inconsistency tends to decrease over time as attitude theory suggests. It therefore makes theoretical sense to examine differences in the degree of consistency among different groups of people and/or changes in the degree of consistency within individuals or groups over time. Standardized measures of environmental attitudes are needed in the empirical research to facilitate the exploration of cognitive consistency.

The Structure of Ecological Attitudes: Gray's Conceptualization Model

Similar to Heberlein's work, Gray (1985) also argues for the need to integrate attitude theory into environmental concern research. As a result, Gray's conceptualization scheme shares with Heberlein's two common emphases. First, environmental concern is a multi-component construct². Second, there exists a structure of environmental concern—a map of the interrelationships among components—that is of great theoretical interest in and of itself. What distinguishes Gray's conceptualization scheme from Heberlein's is that Gray goes into much depth exploring the detail of the components and their interrelationships. Gray calls his conceptualization model the Ecological Attitude System (EAS).

Seven components, or as Gray calls them, “the dominant salient topics” (Gray, 1985:45), are identified in the EAS. Although there is little direct empirical evidence supporting his conceptualization, he argues (Gray, 1985: 45) that these seven proposed topics will “efficiently and comprehensively organize the total ecological belief domain.” The seven topics are organized into two general groups. One is the group of “primary beliefs,” including four topics: primitive beliefs, general environmental concern, locus of responsibility and control, and costs/benefits. The second is the group of “derived beliefs,” including three topics: conservation, pollution, and population.

In this model Gray does not attempt to differentiate between cognition and affect because he argues that cognition and affect cannot be empirically separated³. Rather, Gray argues for the necessity of distinguishing environmental attitudes by their content, or the object of such attitudes. Besides identifying seven major components of environmental attitudes, Gray takes a further step by hypothesizing the structure of the

interrelationships among these components. He hypothesizes that: (1) there is a positive correlation among all possible pairs of components, and (2) there is a hierarchical relationship between the group of primary beliefs and the group of derived beliefs. The four primary belief components form the core of environmental attitudes and are hypothesized to have the strongest intercorrelations among each other, while the cross-group intercorrelations will be moderate and the correlations among the derived beliefs the weakest.

The Dual Universes of Environmental Concern: Dunlap and Jones' Conceptualization

Dunlap and Jones (2002) provide the most comprehensive conceptualization scheme among the three works reviewed here. Utilizing Louis Guttman's facet theory as a conceptualization guide, Dunlap and Jones decompose environmental concern into two general components, the "environmental" and "concern" components. Each component can be seen as a content universe consisting of even more detailed and smaller key components or facets.

The "concern" component is a universe of forms of expression, such as cognitions, affects, behavioral intentions, and behaviors, as commonly identified in attitude theory (Dunlap and Jones, 2002). Dunlap and Jones identify two general approaches for mapping this concern universe. One is a "theoretical" approach, referring to the mapping strategy guided by various forms of attitude theory. Typical studies following a theoretical approach conceptualize the "concern" component as consisting of affective, cognitive, and conative facets—the classic tripartite conceptualization of attitude. The other is a "policy" approach referring to conceptualization efforts designed to capture

crucial policy-relevant facets of environmental concern. The policy oriented effort is often rather subjective. Identified facets employed in empirical studies using this approach include the perceived importance/seriousness of environmental problems, opinions about major causes of environmental problems, perceived responsibility for solving problems, individuals' willingness to pay higher prices and/or taxes for environmental protection, and support for governmental regulations. While these two mapping approaches are apparently different, Dunlap and Jones point out that the facets identified in the "policy" approach can, under closer inspection, often be classified as indicators of attitudes, beliefs, behavioral intentions, or actual behaviors—key facets identified by attitude theorists. Dunlap and Jones therefore believe it is possible to synthesize these two approaches into a more fruitful framework for conceptualizing the concern component.

The "environmental" component is a universe of substantive environmental issues (Dunlap and Jones, 2002). This component is not systematically addressed by Heberlein (1981) or Gray (1985). There are potentially many ways of differentiating substantive environmental issues according to their biophysical characteristics. For instance, Dunlap (1994) suggests identifying three basic functions of the environment: supply depot, waste repository, and living space. We could also distinguish among issues of conservation, pollution, and population (Van Liere and Dunlap, 1981; Gray, 1985). Beside this biophysical distinction, Dunlap and Jones (2002) also identify three additional important facets as revealed by past studies. One is a generality-specificity continuum, along which substantive environmental issues can be organized reflecting the level of specificity of the issues—for example, pollution, air pollution, and acid rain. Another is the spatial facet,

differentiating environmental issues based on their geographical scale such as local, regional, national, and global. And finally there is a temporal facet distinguishing past, current, and future environmental issues. Note that the generality-specificity continuum resembles Heberlein's (1981) notion of "specificity," a basis of cognitive inconsistency. Furthermore, as Heberlein (1981) points out, people tend to form attitudes toward national or global environmental issues based on information gained through media, while at local level, they often rely on direct personal experience. Thus, the spatial facet is connected to the other basis of cognitive inconsistency identified by Heberlein (1981), the source of environmental information.

Dunlap and Jones (2002) point out that the tremendous diversity found within the environmental concern literature reflects the vast range of potential conceptualizations stemming from the huge number of possible combinations of the various ways of conceptualizing both the "concern" and "environmental" components of environmental concern. Use of such diverse conceptualizations of environmental concern not only creates difficulties in assessing the validity of various measures of the construct but also limits the comparability across empirical studies, which "inhibits accumulation of knowledge" (Dunlap and Jones, 2002: 487).

Some Empirical Generalizations about the Characteristics of Environmental Concern

Based on these three conceptualization schemes, all grounded in extensive reviews of empirical studies in the field (especially Dunlap and Jones' [2002] article), some tentative empirical generalizations about the characteristics of environmental concern may be drawn. These generalizations will then form the basis of an assessment

of a variety of measurement efforts and the data analysis methods commonly used by empirical researchers of environmental concern.

An obvious agreement among the three schemes is that environmental concern is complex, as each of the two components—expressions of concern and substantive environmental issues—is multifaceted, to use the terminology of Dunlap and Jones (2002). Confronted with such a complex construct, researchers need to identify the key components of environmental concern that can sufficiently cover the conceptual universe in order to develop adequate measures. However, identification of key components is only the first step. As all three schemes agree, it is critical to explore the interrelationships among the identified components. *A key question often asked is whether it is appropriate to consider environmental concern as a single construct or whether it is inherently multidimensional* (Dunlap and Jones, 2002). *Given the agreement that environmental concern is multifaceted, this question is essentially asking about the nature of the interrelationships among the identified components, or the dimensionality issue of environmental concern.*

It is important to point out, however, that focusing on the dimensionality issue—whether the interrelationships among the identified components are strong enough to warrant the claim of unidimensionality of environmental concern—is only one of the issues to which we should pay attention. Heberlein's (1981) notion of “cognitive inconsistency” suggests that while it is possible to observe substantial inconsistency among key components of environmental concern (which would suggest that environmental concern is multidimensional), by and large most attitude theorists believe that cognitive inconsistency tends to decrease over time. In other words, the

interrelationships among components of environmental concern tend to change over time in the direction from multidimensionality (cognitive inconsistency) toward unidimensionality (cognitive consistency). It therefore makes theoretical sense to examine the *degree* of unidimensionality (or multidimensionality) in addition to examining whether environmental concern is multidimensional or unidimensional. In fact, besides the internal psychological driving force toward cognitive consistency described by Heberlein (1981), Dunlap and Jones (2002) summarize three general trends in the ever-changing set of environmental issues that can roughly be seen as external driving forces toward creating cognitive consistency in environmental concern.

These three trends are as follows: first, environmental problems are becoming more and more global and beyond individuals' immediate experiences, which makes awareness of them increasingly dependent on media coverage. Second, it is becoming clearer that environmental problems are interrelated in terms of their causes, consequences, and possible solutions. Third, the continuing emergence of new problems and evidence of continuing environmental deterioration make general notions such as "environmental deterioration" and "ecological vulnerability" more believable. As Heberlein (1981) points out, media and personal experience are two different information sources of cognition, and environmental attitudes formed through different information sources are likely to be inconsistent with one another. Therefore, the first trend seems to predict that differences in the cognition sources are likely to diminish as time goes by, thus leading to a higher degree of consistency within environmental concern. The latter two trends both suggest that people are more and more likely to become aware of the interconnectedness of various environmental problems, which should make the notion of

“environmental quality and deterioration” a more meaningful attitude object. Again, this should further increase the degree of cognitive consistency within peoples’ concern for the environment. In sum, we should not only pay more attention to the interrelationships among key components of environmental concern, but also examine trends of those interrelationships over time.

Besides agreements on these general characteristics of environmental concern, all three conceptualization schemes reviewed above overlap on more detailed aspects of environmental concern—namely, the key components and their interrelationships. With close inspection, one can see that Gray’s (1985) distinction between “primary beliefs” and “derived beliefs” more or less echoes the dual universes of Dunlap and Jones (2002). The “primary beliefs” have four topics (general environmental concern, primitive beliefs, locus of responsibility and control, and costs/benefits) which may be interpreted as a combination the two mapping approaches to the “concern” component of environmental concern identified by Dunlap and Jones (2002): the “policy” and “theoretical” approaches. Also, the “derived beliefs” include three topics (conservation, pollution, and population), which clearly represent one of many possible ways of mapping the universe of substantive environmental issues suggested by Dunlap and Jones (2002).

Furthermore, the proposed hierarchical relationship between the “primary beliefs” and “derived beliefs” offered by Gray (1985) agrees with Heberlein’s (1981) emphasis on values as a special type of attitude occupying the most central position in a person’s belief system and operating as the basis for evaluative beliefs. If we clarify terminological differences, it becomes clear that both Gray and Heberlein suggest that some components of environmental concern represent the fundamental part of a person’s

belief systems, which can in turn be seen as predictors of more specific beliefs. Dunlap and Jones (2002) agree with this assertion in their review of the New Environmental Paradigm (NEP) Scale, suggesting that the NEP can be seen as “a fundamental component (along with values) in theoretical models designed to predict more specific beliefs, attitudes, and behavior reflecting environmental concern” (Dunlap and Jones, 2002: 511).

There are disagreements, of course. The most apparent one is whether attitude includes actual behavior and/or behavioral intention. This disagreement, as Heberlein points out, reflects the uncertainty within attitude theory, not environmental concern *per se*. To Heberlein (1981), most attitude theorists agree that attitude consists of at least two distinctive components: affect and cognition. Dunlap and Jones (2002: 490) argue that the “concern” component of environmental concern should include four parts: “affect, cognition, behavioral intention, and actual behavior.” Gray (1985) also notes the same issue in the attitude theory literature and argues that while the term “attitude” mainly emphasizes affect, a full definition of attitude would also include cognition and behavioral intention. On the other hand, Gray examines in detail the correlations between affect and cognition reported in the empirical literature and tentatively concludes that affect and cognition belong to a single dimension and thus there is no need to distinguish them. Another apparent difference resides in the conceptualization of the “environmental” component of environmental concern. Dunlap and Jones provide a systematic discussion that leads to a comprehensive theoretical framework for conceptualizing the “environmental” component, while Heberlein and Gray only address

substantive environmental issues in their conceptualization schemes briefly and in general terms without careful attention.

Although comparing these three conceptualization schemes does not yield a clear theoretical definition of environmental concern that most researchers will agree upon, it nevertheless provides a starting point and theoretical guidance for further conceptualization efforts. The need for systematic efforts at exploring the conceptual universe of environmental concern and the interrelationships among its key components is clear. To facilitate this type of work, we need appropriate measures as well as data analysis methods. I will now turn to an assessment of commonly used measurement approaches in the environmental concern literature.

A Review of Measurement Approaches in the Environmental Concern Literature

Single-Item Measures

In the early days of environmental concern research and public opinion polls, researchers often used single-item measures, mostly aiming to detect possible changes in environmental concern over time (Heberlein, 1981; Keeter, 1984). For example, in one of the first longitudinal studies of environmental concern based on Washington State residents from 1970-1974, Dunlap and Dillman (1976) examined changes in public support for environmental protection by asking respondents their preferences for the allocation of tax funds among different governmental expenditure areas—including expenditure on pollution control and protection of forests and other natural areas for public enjoyment. Since Dunlap and Dillman did not attempt to form a single composite measure using these two items, each can be considered a single-item measure. Actually,

asking people's opinion about governmental expenditures on environmental protection programs remains one of the most popular measures of pro-environmental attitude in the literature (Klineberg *et al.*, 1998). Klineberg *et al.* explain that it is partially due to the fact that such an item has been included in the National Opinion Research Center (NORC)'s General Social Survey since 1973, providing important historical data for monitoring trends in environmental concern. Other early studies employing single-item measures includes Murch (1971), Buttel (1975), Honnold (1981), and more recently Jones and Dunlap (1992), for example (See Dunlap, 1991 for examples of single-item measures used to measure environmental concern).

While single-item measures might prove useful in trend studies, the validity problems of such measures are well known. A single-item measure is unlikely to fully capture the complex structure of environmental concern as an abstract construct. As noted in the previous section, it is generally agreed that environmental concern has multiple components. Single-item measures at best tap only single aspects of the construct. Because of this, Heberlein (1981) argues that single-item measures do not measure environmental concern *per se* but rather only an aspect of it or a specific environmental belief—for example, the concern over pollution (e.g., Murch, 1971). Furthermore, a single-item measure provides no opportunity for assessing measurement reliability, which by definition requires multiple indicators of the same construct. Thus, researchers using such items will either assume perfect measurement (zero measurement error) or assign fixed measurement reliability (Bollen, 1989), and neither approach is realistic.

The Concern for Internal Consistency and Unidimensionality of Composite Measures

Aware of the validity and reliability problems associated with single-item measures, a majority of analysts of environmental concern utilize multi-item measures. When constructing a multi-item measure of a construct a typical approach is to formulate a large pool of items with face validity and then select items based on careful validation procedures, often including expert judgment, pretesting, and data reduction via factor analyses. For example, in a now classic study on the measurement of ecological attitudes and knowledge, Maloney and Ward (1973) construct four multi-item measures of Verbal Commitment, Actual Commitment, Affect, and Knowledge. The final measures consist of 36, 36, 34, and 24 items, respectively, which are selected from a 500-item pool by utilizing expert (including psychology graduate students and Ph.D. psychologists) judgment of the face validity of the items.

Compared to single-item measures, multi-item measures have obvious advantages. First, due to the conceptual complexity of environmental concern, a multi-item measure has the potential to capture the meaning of the construct more adequately. Second, by summing the scores of several items, random measurement errors are supposedly reduced since such measurement errors for multiple items presumably cancel each other out (Singleton and Straits, 1999; Babbie, 2002). However, these desirable characteristics of multi-item measures are not automatically guaranteed. Several conditions need to be met first.

The first condition is that all items should indeed measure the same underlying construct, which presumably is the common source of variations for every item in the group. Statistically, the presence of such a common source of variations would lead to

strong correlations among items, which can then be interpreted as a sign of unidimensionality for the entire group of items. Another condition is that careful conceptualization is needed if the multi-item measure is to capture the full meaning of the construct being measured. Haphazardly constructing several survey items and forming a composite measure arbitrarily will not necessarily produce a better measure than single-item measures. Therefore, most studies utilizing composite measures typically report results of tests of internal consistency or unidimensionality of their measures—be the measures of specific aspects of environmental concern such as conservation, pollution, and overpopulation, or attitude, knowledge, and behavior (Tognacci *et al.*, 1972; Maloney and Ward, 1973; Buttel and Flinn, 1976; Dispoto, 1977; Smythe and Brook, 1980; Ester, 1981; Van Liere and Dunlap, 1981, 1983; Schahn and Holzer, 1990), or an overall measure of environmental concern dealing with concern for environmental quality or degradation in general (e.g., Weigel and Weigel, 1978; Dunlap and Van Liere, 1978).

The most commonly reported test for internal consistency in such studies mentioned above is Cronbach's Alpha, typically reported in conjunction with item-total correlations. Cronbach's Alpha is a numerical index of reliability, ranging from 0 to 1, calculated as a function of the number of items and the average inter-correlation among items, which is equal to the average value of all possible split-half reliability coefficients (Carmines and Zeller, 1979). Bollen (1989) demonstrates that technically Cronbach's Alpha measures the reliability of a simple (un-weighted) sum of equivalent measures of the same construct.

Reliability here means "the ratio of true scores' variance to the observed variables' variance" (Bollen, 1989: 208). In other words, it is a measure of how well the

observed variables measure the construct they are supposed to measure. The commonly used acceptable Alpha coefficient level of .70 can be interpreted as indicating that the variance of the underlying construct accounts for 70 percent of the combined variance of all items. If the coefficient is low it indicates that some of the items do not measure the underlying construct reliably; therefore, the constructed composite measure is unlikely unidimensional. Widely available statistical software packages such as SPSS also routinely reports corrected item-total correlations, which can be used to spot “unreliable” items, along with Alpha value. The Alpha coefficient can also be used to estimate the influence of random measurement errors. For example, an Alpha coefficient of .70 can be interpreted as 70 percent of the combined variance of all items in the composite measure being caused by the underlying construct while the remaining 30 percent of the variance is the result of random measurement errors (Bollen, 1989). However, studies utilizing such analyses to control for measurement error are rare in the environmental concern literature.

There are drawbacks to the use of Cronbach’s Alpha. First, when we have unequally weighted items (not a simple sum anymore, but a weighted sum), Alpha coefficient becomes an inaccurate measure of reliability (Bollen, 1989). Second, and more importantly, while a low Alpha coefficient indicates problems in the unidimensionality of the index, a high Alpha coefficient does not necessarily guarantee unidimensionality. Because Cronbach’s Alpha is calculated by an averaging procedure of the separate items, simply increasing the number of items (no matter how irrelevant they are) can sometimes lead to an increase in the magnitude of the coefficient (Carmines and Zeller, 1979). There is also empirical evidence that a group of items exhibiting high

internal consistency (high value for Alpha coefficient) actually have multiple dimensions (e.g., Horvat and Voelker, 1976).

To overcome these limitations of relying on Alpha coefficient, researchers choose to employ more advanced techniques, typically various forms of factor analysis (Bollen, 1989). With only a few exceptions (e.g., Lounsbury and Tornatzky, 1977 use cluster analysis), most researchers utilize principal component analysis (PCA). Such techniques are now typically referred to as *exploratory* factor analysis (EFA), in contrast to *confirmatory* factor analysis (CFA) that will be discussed in detail later in this chapter. Due to its popularity, the use of EFA in the environmental concern literature deserves a closer examination.

The Use of Exploratory Factor Analysis in Measuring Environmental Concern

Factor analysis (both EFA and CFA) essentially involves analyses of the correlations among all items being used to measure a construct such as environmental concern. The basic idea is that the correlations among items are due to a smaller number of underlying factors serving as their common sources of variations. This is the reason that factor analysis is often referred to as a technique of data reduction and is used to avoid multicollinearity in a multivariate analysis (Hamilton, 1992). The extreme case is when there is only one such underlying factor responsible for all the correlations, it is interpreted as all items are measuring the same underlying construct—the definition of unidimensionality. Checking for unidimensionality of measures of environmental concern is the major goal of EFA in the environmental concern literature. Except for a few studies (e.g., Chanda, 1999), most works using EFA are mainly concerned with the

dimensionality of the proposed composite measures of either environmental concern *per se*, or some specific aspects of environmental concern such as concern over pollution or global warming (Dunlap and Jones, 2002).

Although generally EFA is performed to check the dimensionality of the proposed measures, its specific use varies among empirical studies. Three general types of usage can be identified among empirical studies of environmental concern. With the first type, a researcher typically begins with a pool of survey items selected on the basis of face validity, content validity and other subjective validity (e.g. expert judgment). This pool of items is then subjected to a form of EFA, most likely a PCA, which generally generates a small number of factors. By examining the factor loadings of each item on all extracted factors, survey items that heavily load onto the same factor are grouped together to form various composite measures whose interpretation depends on which items are included. Horvat and Voelker's (1976) effort at constructing measures of "environmental responsibility" provides an example of this type of usage. They start with 25 survey items, selected from a 37-item pool on the basis of both face validity and expert judgment. An EFA of these 25 items reveals 4 interpretable factors, containing 16 of the 25 items. Interestingly, Horvat and Voelker also create an overall index using all 25 items which has a respectable Alpha coefficient of .73. This provides empirical evidence for the assertion that high internal consistency does not prove unidimensionality. Other studies using EFA in a similar way include the aforementioned Lounsbury and Tornatzky (1977), Buttel and Johnson (1977), Smythe and Brook (1980), and Blocker and Eckberg (1989). The unidimensionality of the composite measures created through

this procedure is empirically verified and factor analysis is thus essentially a data reduction tool since unreliable items are excluded from the indexes.

In the second type of usage, EFA is strictly a tool for checking the unidimensionality of the proposed measure. Treatments of the widely used New Environmental Paradigm (NEP) Scale by Dunlap and Van Liere (1978) exemplify this type of usage. In fact, the dimensionality of the NEP Scale has attracted a lot of attention since its creation, stimulating an impressive series of studies by various scholars testing and retesting the validity of the NEP Scale utilizing different independent samples from different regions and even nations. In the original study, all NEP scale items are put through careful conceptualization and validation processes, which produce twelve items designed to tap crucial aspects of the NEP, essentially a set of basic beliefs about human-environment relations (Heberlein, 1981; Stern, Dietz, and Guagnano, 1995). To ensure that it is appropriate to combine all twelve items into a single scale, Dunlap and Van Liere (1978) conduct an extensive examination of their internal consistency, which included both Cronbach's Alpha and a PCA. The NEP Scale appears to have respectable Alpha coefficients (.813 for a general public sample and .758 for an environmental organization sample), while PCA results show that the NEP Scale is unidimensional (only one underlying factor is obtained).

The dimensionality of the NEP Scale has generated much discussion, which has not reached any general agreement yet (Dunlap *et al.*, 2000). Some empirical studies report evidence of unidimensionality with different samples (e.g., Edgell and Nowell, 1989; Noe and Snow, 1990). There are also studies demonstrating that the twelve NEP Scale items load onto two underlying factors (e.g., Noe and Snow, 1989-1990, 1990;

Gooch, 1995; Scott and Willits, 1994), three factors (e.g., Albrecht *et al.*, 1982; Geller and Lasley, 1985; Edgell and Nowell, 1989), and even four factors (e.g., Roberts and Bacon, 1997; Furman, 1998). Considerable sample-to-sample variation is found not only in the number of underlying factors obtained, but also in the factor loadings. Such apparent inconsistency in the empirical literature has led Dunlap *et al.* (2000) to argue that it is premature to conclude that the NEP Scale is multidimensional, and to stress the likelihood that its dimensionality will vary depending on the nature of the sample on which it is used.

There are also studies that couple EFA with careful theoretical conceptualization. With this third type of usage, scholars utilize EFA not to check the dimensionality of a single composite measure, but to confirm a pre-specified multidimensional structure of a composite measure. For example, to examine the relationship between the Dominant Social Paradigm (DSP) and concern for environmental quality, Dunlap and Van Liere (1984) construct 37 survey items to measure the DSP. Prior to data analysis, the researchers identify eight potential dimensions of the DSP via a careful literature review. They then perform a PCA with varimax rotation. The PCA results generally support the identified dimensions. Similarly, Ester (1981) constructs a multidimensional measure consisting of attitudes (including both cognition and affect), readiness to make environmental sacrifice, and readiness to engage in environmental actions based on insights from the environmental concern literature. Three dimensions are identified, together with their indicators. A PCA with varimax rotation on all selected items generally confirms the hypothesized dimensional structure. What is particularly interesting about Ester's (1981) study is that factor analysis is not only used as a tool for

confirming the pre-specified dimension structure, but is also used as an item analysis tool since Ester excludes from the list those indicators that do not load onto the corresponding dimensions or have weak loadings. A few other studies have followed more or less the same approach (e.g., Buttel and Johnson, 1977; Rohrschneider, 1988). It is important to point out that although a dimensional/factor structure is specified before the analysis in these studies, such specification has no impact on the actual EFA process because the specified factor structure is not inputted into the EFA estimation.

The case of the NEP Scale briefly described above provides an excellent example showing both the strengths and limitations of EFA. Compared to Cronbach's Alpha, EFA has the advantages of being more powerful in detecting multidimensionality and hence offers a more efficient tool for constructing composite measures. It is more efficient not only because the unidimensionality of individual composite measures is empirically verified, but also because the resulting factor loadings can be used as summation weights (Hamilton, 1992). Technically, EFA allows for measurement error on each indicator, as less-than-one factor loadings reveal that indicators are not perfect measurements (Bollen, 1989). When the extracted factors are entered into subsequent statistical analyses in the same study, measurement errors can at least be partially accounted for, although very few studies utilize this approach in the environmental concern literature.

The limitations of EFA are also very clear. The most obvious one is that great variation in results may occur among different samples even with the same set of survey items. This suggests that the results of EFA tend to be sample-specific, hence lacking generalizability or external validity. This is mainly due, according to some scholars (e.g.,

Gray, 1985; Bollen, 1989; Dunlap and Jones, 2002), to the fact that EFA does not specify a factor structure (the number of factors and the interrelationship pattern) before the actual data analysis. Typically, researchers utilizing EFA simply throw in all relevant items and then try to make sense of whatever factors obtained. This inductive approach lets the data speak for themselves, so to speak, and consequently the resultant dimensional/factor structure is very likely confounded by various methodological artifacts. This is particularly likely with opinion surveys for it is well known that surveys are very sensitive to differences in details such as question wording, question order, answer categories, and other methodological characteristics that often are unique to individual studies (Keeter, 1988; Dillman, 2000). For example, in their revision of the NEP Scale, Dunlap *et al.* (2000) notice that four of the twelve NEP Scale items generally form a distinct dimension in many samples in the relevant literature. A closer look reveals that these four items are the only four that are worded in an anti-NEP direction. A similar pattern appears in other empirical studies of environmental concern in which dimensions seem to reflect item wording direction (e.g., Blocker and Eckberg 1989; Ji, 2004). Without a careful conceptualization and factor structure specification, it is impossible to distinguish the effects of methodological artifacts from the true underlying factors. Since methodological artifacts tend to be random and sample-specific, empirical findings confounded by methodological artifacts also become inconsistent across samples.

Letting data speak for themselves may result not only in factors that simply reflect methodological artifacts, but also in factors that are difficult to interpret. For example, Smythe and Brook (1980) factor-analyze (via PCA) 30 items derived from the short version of the Ecological Attitude Scale developed by Maloney *et al.* (1975) and obtain

eight factors (with eigenvalues greater than 1). None of them is easily interpretable. This result forces the researchers to change their strategy. Instead of factor-analyzing all 30 items, Smythe and Brook (1980) divide the items into three individual groups, each supposedly forming a distinct dimension according to the conceptualization scheme used by Maloney *et al.* (1973, 1975). Then Smythe and Brook factor-analyze (PCA) each group separately. This new strategy yields ten new readily identifiable dimensions. This example is quite extreme in that all eight factors from the original factor analysis are not easily interpretable. More frequently, PCA may yield some uninterpretable factors or even single-item factors (factors that have only one item heavily loading onto them) along with readily interpretable ones (e.g., Horvat and Voelker, 1976; Berberoglu and Tosunoglu, 1995; Furman, 1998). Very often when this occurs, researchers have to remove the items loading onto hard-to-interpret factors or single-item factors from the pool to maintain the integrity of the composite measures; thus EFA is also used as an item analysis tool.

Even when the factors are interpretable, given that the interpretation of each factor in PCA occurs after the analysis, the interpretation becomes *ex post facto* and very likely equivocal (Gray, 1985). This limitation severely undermines the external validity of EFA. In fact, even though scholars seem to agree on the ability of EFA in checking the dimensionality of composite measures of environmental concern such as the NEP Scale (Gray, 1985; Dunlap and Jones, 2002), the case of the NEP Scale itself as described above reveals that using EFA to check for scale dimensionality only leads to inconclusive findings.

As for studies that couple theoretical conceptualization and EFA (i.e., the third type of usage described above), the analysis is more meaningful because the interpretation of factors is not solely *ex post facto* and the entire process is not completely inductive because EFA is used to verify the existence of a hypothesized dimensional structure. However, there is one additional limitation of EFA. Even though those studies mentioned above report that EFA results that generally support the pre-specified dimensional structures, there is no statistical significance test for the overall model (Hamilton, 1992). Therefore, it remains unclear whether such dimensional structure is a general pattern in the population, or just unique to the sample.

Furthermore, generally EFA is not capable of examining hypothesized inter-component relationships of environmental concern. In a typical EFA without rotations (or with only orthogonal rotation such as varimax), the correlations between factors are assumed to be zero. In EFA with oblique rotations such as promax, inter-factor correlations are allowed to be non-zero; however, such oblique rotations are often arbitrary in determining the degree of correlation to be allowed. The arbitrariness can lead to a fundamental uncertainty because different decisions can lead to very different analysis results (Hamilton, 1992). There are studies utilizing EFA to examine inter-factor correlations (e.g., Bogner and Wisemen, 1997). This is made possible by first utilizing oblique rotation and then calculating factor scores that can be further analyzed with simple correlation techniques such as Pearson's r . Thus it is not technically possible to examine inter-factor correlations with EFA alone. In sum, despite its advantages over simpler techniques such as Cronbach's Alpha as mentioned above, EFA has serious limitations that severely undermine its worth in exploring the nature and structure of

environmental concern. Confirmatory factor analysis (CFA), on the other hand, is increasingly recognized as a promising technique capable of overcoming the shortcomings of EFA (Guber, 1996; Carman, 1998; Dunlap and Jones 2002).

The Application of Confirmatory Factor Analysis and Structural Equation Modeling techniques to Measuring Environmental Concern

Confirmatory factor analysis (CFA) is another factor analysis technique that shares common characteristics with EFA. Both examine the correlations among observed variables to search for underlying common factors that are supposedly fewer than the number of observed variables. Therefore, CFA sometimes is also considered a data reduction technique (Long, 1983). Despite being yet another factor analysis technique, CFA differs from EFA in a number of crucial ways.

Unlike EFA, in which no factor structure is specified before data analysis and the strategy is to let the data speak for themselves, CFA requires a factor structure to be specified prior to the analysis. Such a factor structure must make clear exactly which underlying factor(s) is/are to be included in the model and which observed variables are expected to load onto which factor(s), along with other important details that will be discussed in the next chapter (Long, 1983; Bollen, 1989). Such an analytic strategy follows the hypothetico-deductive logic, which differs from the inductive logic of EFA. This strategy of CFA has two crucial advantages over EFA when applied to measuring environmental concern. First, as the first section of this chapter tentatively concludes, environmental concern is multi-faceted and theoretically it is very important to examine the interrelationships among the components of environmental concern. CFA provides

the ability to specify what components are included in the model, which indicators measure which components, and how those components are expected to correlate with one another. Statistical significance tests for all specified correlations and factor loadings are provided (Long, 1983). Second, as all hypothesis-testing techniques do, CFA provides a significance test for the entire model (Long, 1983; Bollen, 1989). This is crucial because it is then possible to falsify faulty models, and thus guard against sample-specific models that lack external validity. Although fewer in numbers, studies in the environmental concern literature utilizing CFA (or structural equation modeling [SEM], a more general statistical technique based on CFA that will be discussed in detail later) are beginning to emerge. In what follows, I will review the few existing empirical studies of environmental concern using CFA and/or SEM.

One of the earliest studies utilizing a CFA approach is Geller and Lasley's (1985) study, where they examine the dimensionality of the original NEP Scale. Many studies examining the dimensionality of the NEP Scale have reported the NEP Scale as having one-factor (e.g., Dunlap and Van Liere, 1978), two-factor (e.g., Noe and Snow, 1989), three-factor (e.g. Albrecht *et al.*, 1982), and even four and five-factor structure (e.g., Roberts and Bacon, 1997). Geller and Lasley (1985) tested these different specifications using data from two separate surveys and three independent samples. Geller and Lasley's CFA results reject the hypothesis that NEP Scale is unidimensional, and also the three-factor model specified by Albrecht *et al.* (1982) when all twelve NEP Scale items are included. Unable to fit either model, Geller and Lasley turn to EFA, which results in a trimmed down nine-item, three-factor model that seems to have adequate empirical support across all three samples. While the three-factor structure remains the same for all

three samples, the factor loadings of individual items onto corresponding factors vary considerably across samples. This makes the researchers to conclude that the nine-item, three-factor model only receives limited empirical support and more tests are needed to further clarify the issue.

As this example reveals, due to the lack of a commonly accepted or widely agreed conceptualization scheme, some researchers are forced to combine an exploratory process using EFA (not limited to PCA though) with CFA testing, either within the same study, or using the results of EFAs from previous studies. A few other studies follow a similar strategy (e.g., Berberoglu and Tosunoglu, 1995; Roberts and Bacon, 1997; Bechtel *et al.*, 1999; Kaiser *et al.*, 1999). A critical flaw of this approach is that the factor structure derived from an EFA has serious problems as I discussed above. Therefore, the subsequent CFA, although able to test such a factor structure against sample data, has only limited utility in terms of model testing due to the fundamental uncertainty about the validity of the factor structure derived with EFA.

Geller and Lasley's (1985) conclusion regarding the NEP Scale being multidimensional is based on the finding that a three-factor model fits significantly better than a single-factor model. Statistically, a single-factor model is equivalent to a three-factor model with the inter-factor correlations (a total of three) fixed at one (or perfect correlation). Therefore, Geller and Lasley's (1985) essentially reject the null hypothesis that the three inter-factor correlations are one. I believe, however, that such a statistical test does not necessarily reject the possibility of the NEP Scale being unidimensional, unless one is willing to accept the very restrictive criterion of judging unidimensionality: that is all non-redundant inter-factor correlations must not be significantly different from

one. Unfortunately, Geller and Lasley (1985) do not report the magnitude of inter-factor correlations in their three-factor model, which makes it difficult to examine this possibility.

More recently, Nooney *et al.* (2003) also examine the dimensionality of the NEP Scale, which is then used to construct an “environmental worldview” measure in their subsequent analyses. Nooney *et al.* (2003) first subject all twelve original NEP Scale items (for details about the original NEP Scale items, see Dunlap and Van Liere, 1978) to an EFA, which outputs two factors, one with four negatively worded “man over nature” items, and the other with the remaining eight items. Nooney *et al.* then proceed to estimate two CFA models, one specifying a single-factor structure and the other a two-factor structure. The results of their analysis show that the two-factor model has a significantly better fit, leading the analysts to reject the unidimensional model. However, Nooney *et al.* (2003) also point out that within the two-factor model, the estimated inter-factor correlation is very high at .71, indicating “substantial consistency” (Nooney *et al.*, 2003, pp. 772). Nooney *et al.* (2003) thus call into question the validity of distinguishing the two dimensions of the NEP Scale. This then provides empirical evidence for my previous assertion that the rejection of one-factor model does not necessarily deny the possibility of the NEP Scale being unidimensional.

Guber (1996; 2003) and Carmen (1998) focus on the dimensionality of environmental concern in general instead of the NEP Scale in particular. Compared to the other studies mentioned above, these two studies differ in a crucial way. In both studies a theoretical model is first constructed on the basis of insights from previous studies in lieu of an EFA. Such a strategy is preferable because the specified model is

more closely tied into theoretical discussions in the literature rather than some *ad hoc* model generated by EFA. Because of this, these two studies deserve a close examination.

Carman (1998) begins by explicitly pointing out the lack of a consensus regarding the latent factor structure of environmental concern in the literature. He thus proposes a latent structure of “environmental policy support” as consisting of three dimensions, an environmental-economic factor, support for environmental regulation, and environmental quality assessment. However, it is debatable whether “environmental concern” can be simply reduced to “environmental policy support.” This potential content validity issue aside, Carman’s methodology does exemplify the use of CFA in measuring environmental concern, or “environmental policy support” in this particular study.

After reviewing the literature on environmental policy support, Carman (1998) hypothesizes a three-dimensional latent structure for this construct. Each dimension is measured with a group of items (two measured with four items and one with six). All three dimensions, being (first-order) latent factors in the model themselves, are then specified as measuring one second-order latent factor, environmental policy support. Carman first utilizes a PCA to explore the three-dimensional structure using fourteen items. Three factors are extracted and used as observed indicators to conduct another PCA examining the possibility that these three extracted factors are measuring the same second-order latent factor, environmental policy support. This entire factor structure is then confirmed with a CFA, in which both individual coefficients and the goodness of fit of the entire model are examined, along with measurement errors and measurement error correlations being controlled. The results seem to suggest that all three first-order factors

indeed measure the single second-order latent variable, hence indicating a unidimensional structure.

While Carman's (1998) study demonstrates the capabilities of CFA testing, there are however serious measurement validity issues in it, as Dunlap and Jones (2002) point out. Theoretically, Carman's model fails to include any behavioral indicators that are critical indicators of environmental policy support. Methodologically, I see very little need for examining PCA models prior to the CFA. PCA might provide some additional empirical support for the overall latent structure; however, PCA results are ambiguous to interpret because there is no significance test for PCA. On the contrary, CFA can sufficiently test the hypothesized latent structure without any need for PCA, and also provide crucial statistical test for the entire model (Long, 1983).

Using a different approach from Carman, Guber's (1996) study directly utilizes CFA to examine the proposed latent structure of environmental concern, also drawing upon insights from existing literature on the dimensionality of environmental concern. More importantly, Guber is one of the very few scholars who explicitly address the issue of measurement errors and their correlations in the measurement of environmental concern (although Carman [1998] examines measurement errors and their correlations in his model, little discussion and justification is offered). Guber (1996) points out that correlations among measurement errors can cause serious distortion in the correlation estimation and hence lead to misleading interpretations of the results. CFA has the unique ability to account for measurement error correlations when compared to EFA (Long, 1983; Bollen, 1989).

Utilizing the 1991 national Gallup poll dataset, Guber (1996) estimates two measurement models (which are repeated using the 1989 and 1990 Gallup survey data as well but not reported in the study). In one model, environmental concern is hypothesized as consisting of two dimensions, perceived seriousness of environmental pollution and perceived seriousness of global environmental problems. Each dimension is measured with three items. Another model specifies environmental concern as a unidimensional construct measured by the same group of six items. Two CFA models are compared afterwards in term of goodness of fit for the entire models. Results show that these two models are not significantly different from each other and both exhibited adequate overall fit. Guber thus concludes that it is appropriate to consider environmental concern as a unidimensional construct. The examination of measurement error correlations also reveals that due to the use of similar question wording and identical format of answer categories, it is necessary to allow for measurement error correlations in order to control for potential distortions in the analysis caused by such methodological artifacts.

In addition to these two CFA models, Guber (1996) also tests an extended measurement model of environmental concern by including additional items. In the extended model, instead of using individual indicators, Guber constructs a series of additive indexes by summing scores for individual indicators and entering these additive indexes into the model as observed indicators. For example, those six indicators included in the first two CFA models mentioned above are summed into two additive indexes, perceived seriousness of environmental pollution and perceived seriousness of global environmental problems, and both are then treated as observed indicators measuring the latent factor “perceived seriousness of environmental problems.” In the extended model,

three latent factors are specified, perceived seriousness of environmental problems (measured by the two additive indexes), pro-environmental behavior (measured by three additive indexes), and self-identification as an environmentalist (a single-item factor). Results of Guber's (1996) analysis show that the correlations among them are quite high at .64, .73 and .80. The overall model fit is also quite good. Thus, Guber concludes that environmental concern may indeed be treated as one coherent construct.

Unfortunately, Guber's (1996) measurement models also suffer from measurement validity problems. Most obvious is that Guber's (1996) model only incorporate facets of what Dunlap and Jones (2002) would call the "concern" component, while failing to examine any facets of the "environmental" component or various substantive environmental issues other than the local/global distinction. Thus Guber's models lack content validity. Even within the "concern" component, there are many more facets besides those included by Guber, such as policy support and willingness to pay for environmental protection. Also, methodologically I do not see the need to use additive indexes in her extended model since CFA has the ability to use individual indicators directly. Obviously aware of this problem, with additional data (2001 Gallup Poll data) Guber (2003) subsequently retests the extended model without constructing additive indexes. She claims that the results still support her original conclusion even though correlations among the three latent factors are only .49, .51 and .67, much lower in magnitude than those of 1996. It is yet unknown whether the much lower correlations in Guber's (2003) latter test is because of the use of new data or the use of individual indicators instead of additive indexes, or a combination of both.

Both Carman (1998) and Guber's (1996; 2003) studies represent a more preferable approach to applying CFA than previous studies. They illustrate the ability of CFA to test a factor structure following an explicit theoretical framework without relying upon EFA results as input for an ad hoc structure for testing. However, both also suffer from questionable measurement validity that is associated more with their theoretical conceptualizations than their analytic methods.

In the literature, CFA is sometimes also used to help construct composite measures with multiple dimensions specified a priori, which is similar to the third type of usage of EFA described above. For instance, Tarrant and Cordell (1997) in a study investigating the relationship between general environmental attitude and pro-environmental behaviors construct a composite measure of pro-environmental behavior using CFA. They use 11 survey items grouped into two subscales, which are then subjected to a CFA test. Using factor loadings resulted from CFA as summation weights, Tarrant and Cordell (1997) then create a single additive environmental behavior index. Oddly, Tarrant and Cordell (1997) do not provide much theoretical justification for such specification, which makes their use of CFA somewhat atheoretical, although their CFA results do seem to support their specification with acceptable overall goodness-of-fit. More recently, Schultz (2001) also uses CFA to construct composite measures of environmental concern, which are then used in his subsequent regression analysis. Using 12 items all tapping perceived consequences of environmental problems in general, Schultz (2001) tests and finds a three-factor CFA model having the best fit. These three factors are perceived consequences of environmental problems for *self*, *other people*, and *the biosphere*. The inter-factor correlations are .41, .53, and .84, with the *concern for*

biosphere being the relatively distinct factor. Schultz's (2001) study illustrates that CFA provides the ability not only to help construct unidimensional composite measures, but also to statistically test the factor structure for overall fit. Such advantages of CFA over EFA give researchers the confidence that the created measures are less likely to be sample-specific.

More interestingly in the literature, there are studies that take a further step beyond dimensionality testing with CFA to begin examining "causal relationships" among components of environment concern and "causal effects" of exogenous variables such as demographic and political ideology variables. If the analyses go beyond the measurement stage, they are more appropriately called structural equation modeling (SEM) analysis (Bollen, 1989).

Three studies exemplify the use of SEM in the environmental concern literature. An early one by Samdahl and Robertson (1989) represents an effort to examine the social bases of environmental concern (see Van Liere and Dunlap, 1980; Buttel, 1987; Greenbaum, 1995; and Dunlap and Jones, 2002 for theoretical background). Based on previous studies, the researchers argue that environmental concern is not likely unidimensional and therefore should not be measured in a global fashion. Three commonly used measures are identified (perceptions of environmental problems, support for environmental regulations, and ecological behavior), each specified as a latent variable (underlying factor) measured by a group of observed indicators.

Unlike most other researchers using multi-item measures, Samdahl and Robertson (1989) do not attempt to form composite measures by summing item scores, but rather specify a general SEM that includes three measurement models for each measure

specified (there are five measurement models included in the overall model, three for environmental concern as mentioned, and two more including their independent variables). In each measurement model, every observed indicator (survey item) maintains its own entry (as a separate variable) instead of being summated into composite variables. A group of independent variables are specified as having direct effects (in contrast to an indirect effect that is mediated by a third variable) on all three measures of environmental concern. Moreover, the perception of environmental problems is hypothesized as having direct effects on both support for environmental regulations and environmental behavior, while the later two measures are assumed to be independent of each other after their common causes are controlled. The specified model is estimated with LISREL (LInear Structural RELationship), a statistical program developed by Jöreskog and Sörbom (1986). Several additional slightly modified models are also estimated and compared with each other to test more hypotheses concerning individual regression coefficients and correlations. Samdahl and Robertson's interpretation of results is focused on individual regression weights and R-squares.

This example generally presents the applicability of SEM in the study of environmental concern, in which the analysis is no longer only focused on the measurement of environmental concern but more on the “causal relationships”—directional relationships instead of correlations that do not specify direction of effects—among facets of environmental concern and between environmental concern and other theoretically relevant variables. What is unfortunately missing is the assessment of the entire SEM model. Samdahl and Robertson (1989) claim that it is meaningless to assess the goodness-of-fit of the entire model because such assessment generally proves fruitless

since it typically outputs unacceptable goodness-of-fit statistics (Samdahl and Robertson, 1989: 68). I do not agree with this claim at all because seeking a model that fits is always considered crucial in SEM. An unacceptable goodness-of-fit generally means the specified factor structure or causal model is not supported by the empirical data (Bollen, 1989), and this is exactly how other scholars (e.g., Geller and Lasley, 1985; Nooney *et al.*, 2003; Guber, 1996, 2003)) reviewed above are able to reject faulty models. Thus, Samdahl and Robertson's claim basically denies the utility of CFA or SEM in general for testing the pre-specified factor structure. Model comparison is only useful for testing individual coefficients and combinations of them (Bollen, 1989), while the assessment of the entire model is at least as important to our understanding of the nature of environmental concern as those individual coefficients. I will discuss the assessment of goodness-of-fit in detail in Chapter Three.

Another study, by Kaiser *et al.* (1999), provides an example of the assessment of an entire model along with the examination of individual coefficients. Building heavily on the theory of reasoned action by Ajzen and Fishbein, this study examines the relationship between environmental attitude and environmental behavior. If we adapt Dunlap and Jones' (2002) conceptualization of environmental concern, which includes all four attitudinal components (affect, cognition, behavior intention, and actual behavior), then this study examines the relationships among key components of the "theoretical" conceptualization of the "concern" component of environmental concern.

The theory of reasoned action suggests that actual behavior is heavily influenced by behavior intention, which in turn has two major sources of influences. One comes from the attitude (in a narrow sense) toward behavior, which itself is a result of factual

knowledge. The other is subjective norms that are influenced by general social and moral values. Following this theory, Kaiser *et al.* (1999) construct a general model including four latent variables: environmental knowledge (EK), environmental values (EV), environmental behavioral intention (EBI), and finally actual environmental behavior. In this model as suggested by the theory of reasoned action, EK and EV are hypothesized as having direct effects on EBI, which in turn directly affects actual environmental behavior.

To test this general model, Kaiser *et al.* perform a LISREL estimation. Unlike Samdahl and Robertson's (1989) study, Kaiser *et al.* do not enter individual survey items into the model as separate variables but rather utilize EFA to construct composite measures for all four latent variables as describe above. Actual environmental behavior is measured by a 28-item general environmental behavior (GEB) scale, which according to the authors' previous study is specifically designed as a unidimensional measure of environmental behavior (Kaiser, 1998). EK, EV, and EBI are each measured by several composite measures derived from a series of PCAs with very little theoretical justification. After the model estimation, the researchers not only examine individual coefficients but also assess the fitness of the entire model, which is acceptable. This enables the researchers to claim that their results have reasonable generalizability.

Unfortunately, there is a serious problem with the model estimation procedure used by Kaiser *et al.* (1999) that undermines the researchers' claim of generalizability of their model. The main problem is that construction of their composite measures for all latent variables is based on PCA models that are not statistically tested. As I mentioned earlier in the assessment of the use of EFA in environmental concern studies, the unidimensionality of a composite measure constructed with EFA is empirically verified;

but without a proper statistical test for the entire EFA model, there is no evidence for generalizability claim. When the composite measures constructed on the basis of EFA are entered into an SEM as observed variables in Kaiser *et al.*'s (1999) study, the statistical test for the general model's "goodness-of-fit" can yield misleading results because the model is not tested against the original raw sample dataset but against a modified dataset. As a result, the researchers' claim of generalizability for their general model is not as justifiable as they suggest.

A more recent study by Corral-Verdugo *et al.* (2003) takes a narrower vision of environmental concern by only looking at the NEP Scale as a measure of environmental concern instead of measuring environmental concern in a more general sense, based on a sample drawn from two northern Mexican cities. Twelve NEP Scale items are specified to form three dimensions, "man over nature", "balance of nature," and "limits to growth," which are consistent with the literature on the original NEP Scale (Van Liere and Dunlap, 1978; see also Dunlap *et al.*, 2000 for a review). In one model, these three NEP dimensions are hypothesized to influence observed water consumption, itself measured with six items. Results seem to suggest that "man over nature" is a distinct dimension while the remaining two dimensions have a correlation of .54. On the other hand, "man over nature" is the only dimension to have a small but significant influence on observed water consumption. Such a model has an acceptable model fit, according to Corral-Verdugo *et al.*'s (2003) criterion. Corral-Verdugo *et al.* then expand this model by adding in two mediating factors, a "utilitarian view of water" and an "ecological view of water," both seen as more specific environmental beliefs. The factor of "utilitarian view of water" is measured with six items, all dealing with water being seen as unlimited

resource, while the factor of “ecological view of water” is measured with two items, dealing with seeing water as a limited resource. These two factors are specified as being influenced by the three NEP Scale dimensions and then having direct impacts on observed water consumption. A second SEM test shows that the original NEP Scale is indeed multidimensional. “Man over nature” is the dimension that has the strongest influence on both mediating factors, which in turn have significant impacts on observed water consumption. The “balance of nature” dimension fails to influence either of the mediating factors, while the “limits to growth” dimension only has a moderate effect on the factor of “ecological view of water.”

Corral-Verdugo *et al.*' (2003) study is particular interesting in two senses. First, and theoretically, the NEP Scale is specified as predictor of both more specific environmental beliefs *and* concrete environmental behaviors, which is in line with the arguments of Dunlap and Jones (2002: 511) that the NEP is “a fundamental component (along with values) in theoretical models designed to predict more specific beliefs, attitudes, and behaviors reflecting environmental concern.” The Mexican study thus illustrates the superior capability of SEM over all factor analysis techniques in that it enables the examination of more elaborated “causal” relationships among components of environmental concern instead of merely looking at non-directional correlations. Second, and methodologically, Corral-Verdugo *et al.*' (2003) illustrates that with SEM, there is no need to form separate composite measures of latent variables as done in Kaiser *et al.*'s (1999) study. Individual survey items can be directly entered into SEM estimations, which is also more efficient since summing individual scores leads to loss of information.

Summary

In sum, the advantages of CFA/SEM over EFA are increasingly recognized by researchers as a tool for examining the nature of environmental concern, especially in recent years (all but two CFA/SEM studies reviewed here were published after 1995). Being a relatively new technique in the field, the application of CFA/SEM is not free of flaws. A common practice in the literature is to couple CFA/SEM with EFA as both Geller and Lasley's (1985) study and Kaiser *et al.*'s (1999) study exemplify. Such a strategy is seemingly capable of combining the strength of both methods and it does show some success in the literature as those studies examining the NEP Scale show. However, the factor structure generated by EFA can lead to factors confounded by methodological artifacts or factors that are not theoretically interpretable. A subsequent CFA can therefore do no better than testing a model that is flawed from the beginning. While this may be less of a problem with the NEP Scale, which is well established and has relatively few items, it can become quite problematic when testing a large number of items used to measure a more comprehensive set of components of environmental concern. In short, use of EFA in conjunction with CFA cannot replace careful theoretical conceptualization and model specification.

Most studies utilizing CFA/SEM reviewed here focus on the dimensionality of environmental concern (or the NEP as a crucial component of environmental concern), with only a few studies (e.g., Samdahl and Robertson 1989; Kaiser *et al.*, 1999; Corral-Verdugo *et al.*', 2003) seeking to go beyond the dimensionality issue. This is not to say that the dimensionality issue is unimportant; however, it should be only a beginning instead of the final goal. As the review of the three theoretical conceptualization schemes

shows, it is crucial to examine the interrelationships among key components of environmental concern if we are to achieve a fuller understanding of this construct. As Corral-Verdugo *et al.*'s (2003) study among others shows, SEM makes it possible to go beyond the dimensionality issue and examine causal relationships among key components of environmental concern, as well as the socio-demographic variables widely assumed to influence such construct.

It is therefore the general objective of this dissertation to contribute to advancing the application of CFA/SEM methods in the measurement of environmental concern. To be specific, in Chapter Four I plan to first utilize CFA/SEM to test some crucial conceptual distinctions regarding environmental concern as identified in the literature. Then I will test a well-thought-out measurement model based on the results of the first step. In Chapter Five, I will develop an SEM model that seeks to explore both the organization of environmental concern by examining possible causal relationships among components of environmental concern and the social bases of environmental concern by examining the influences of a set of socio-demographic variables as well as the political ideology. The primary goal of this dissertation is to demonstrate the utility of CFA/SEM in the measurement of environmental concern. Detailed statistical issues will be addressed, and the strengths and weaknesses of CFA/SEM will be discussed.

CHAPTER TWO ENDNOTES

1. Heberlein does not use the term “environmental concern” but rather “environmental attitude.” In the next section, Gray prefers “ecological attitude” over other terms. In this dissertation “environmental concern” (as a shorted version of “concern fro environmental quality”) preferred by Dunlap and Jones (2002) is used as the main term and all three terms are seen as interchangeable.

2. I am hesitant to use “multidimensional” here since multidimensionality is still a hypothesis to be tested.
3. It is unclear whether behavioral intention should be differentiated although it is according to Gray (1985) a component of attitude.

CHAPTER THREE

DATA, DATA MANAGEMENT, AND METHODS

Data and Samples

The main objective of this dissertation is to explore the use of the CFA/SEM techniques for measuring environmental concern. As discussed in Chapter Two, the construct of environmental concern is clearly multifaceted. To achieve satisfactory measurement validity a measure of environmental concern must use multiple indicators, which in turn necessitates the examination of the dimensionality of environmental concern. A dataset produced by the 1992 Gallup Health of the Planet (HOP) international survey is suitable for this study. The HOP survey was conducted in a total of 24 nations representing a diverse range both economically and geographically (Dunlap *et al.*, 1993). A long version of the HOP survey was used in six nations: USA, Canada, Mexico, Brazil, Portugal, and Russia, while a short version was used in the remaining 18 nations. The long version of the HOP survey used in six nations includes a set of survey items that cover a wide range of environmental issues varying not only in terms of content, but also in terms of generality, geographical scale, and different forms of expression (pro-environmental behaviors, environmental policy support, etc.), as well as a standard battery of demographic variables. Having such a wide range of survey items is essential when the conceptualization and measurement of environmental concern is the target of research.

In this dissertation I will focus on two of those six nations only, the USA and Canada, for several reasons. First, there is a methodological reason for choosing to concentrate on only the USA and Canadian samples. A close examination of the dataset reveals potential data problems in some of the other samples. The Mexican, Brazilian, and Portuguese samples have rather abnormal distributions on many relevant survey items. It appears that the proportions of respondents choosing extreme answers on ordinal scales (e.g., “strongly disagree” and “strongly agree”) are higher than the proportions choosing moderate answers (e.g., “disagree” and “agree”). Such abnormal distributions suggest the possibilities of strong primacy and recency¹ effects to which interviews are particularly vulnerable (Dillman, 2000). It is not the goal of this dissertation to determine whether such distributions reflect these methodological artifacts; therefore, I choose to avoid these potential problems by concentrating on the USA and Canadian samples. For the crucial survey items, neither the USA sample nor the Canadian sample has unusual distributions; that is, there are more people with moderate attitudes (e.g., choosing “agree” or “disagree”) than with extreme attitudes (e.g., “strongly agree” or “strongly disagree”) in these two samples.

Second, the main goal of this dissertation is to contribute to the measurement of environmental concern. At this stage of study, we still do not know whether it is appropriate to consider environmental concern as a coherent construct or whether it is inherently multidimensional. Major cross-cultural diversity would very likely add more complexity than is manageable in this dissertation. I therefore believe it is more efficient and fruitful for this dissertation to focus on the conceptualization and measurement issues described in Chapter Two without the complications of cross-cultural diversity.

Furthermore, a majority of existing studies in the literature of environmental concern are based on the USA. So it makes sense to restrict my focus on the USA and a socially and culturally similar nation, Canada, for comparative purposes (more on this shortly). By focusing on the USA and Canada, I can improve upon the typical study limited to a single (often sub-national) sample, while avoiding problems of major cross-cultural differences in environmental concern that would arise by including such diverse nations as Mexico, Brazil, Portugal and Russia.

Fortunately, every national sample in the HOP survey is an independent random sample; therefore, extracting only the USA and Canadian samples out of the complete multinational dataset will not affect the representativeness of either sample. Nationally representative samples were used in both nations, and respondents were surveyed via face-to-face in-home interviews (Dunlap *et al.*, 1993). The USA sample has a sample size of 1032, 50.5 percent female with a median age of 44 (years) and a median education level of some college. The size of the Canadian sample is 1011, 49.9 percent female, with a median age of 40 (years), and a median education level of high school completion. By and large, these two samples are very similar to each other in terms of demographic factors. Both sample sizes are sufficiently large to allow for generalizability of the results to the adult population of the USA and Canada.

The USA-Canada Comparison

The United States and Canada are two largely similar nations in terms of a variety of dimensions that are not limited to just geographical proximity. Both share a European cultural heritage, a common language, and colonial history, albeit with Canada having

stronger French influence. Both are two of the most developed post-industrial democratic nations in the world. On the other hand, there are widely assumed distinctions in the political culture between these two nations. According to Pierce and his colleagues (Pierce *et al.*, 1992), Canadian political culture is commonly thought to be collectivist, organic, and holistic in nature, while American political culture tends to be pluralistic, highly competitive, and individualistic. This distinction is believed to be reflected in differences in citizen commitment to postindustrial values such as Inglehart's postmaterial values, and more interestingly on environmental orientations as measured commonly with the NEP Scale. Pierce *et al.* (1992) argue that the Canadian collectivist and organic political culture is more compatible with postmaterialism as well as with the "spaceship earth" worldview reflected by the NEP Scale. The expectation that Canadians will have higher level of support for the NEP, and in general be more environmentally concerned than Americans, is somewhat supported by Pierce and his colleague's own empirical study (Pierce *et al.*, 1992).

While such a hypothesis regarding differences in public attitudes may have some empirical support, Canada has been playing catch-up relative to the USA in terms of environmental protection. Indeed, historically Canadians have had an even more utilitarian view of the environment than Americans, owing to the emphasis on natural resource extraction center during colonial times. During the 19th and early 20th century, Canadian environmental protection was following the American lead, mainly in the form of wildness conservation (Guay, 1995). In the second half of the 20th century both nations experienced rapid economic expansion after World War II, which led to a new set of environmental problems. Such problems gradually attracted societal attention. People

began to realize their interconnectedness and global nature. However, the two nations reacted differently in managing environmental issues, with the USA being the forerunner until early-1980s (VanNijnatten, 1999).

In the USA, widespread environmental concern among general public began to emerge in the mid-1960s, and reached a peak with the first Earth Day in 1970 (Dunlap, 1991). As a response to this growing public concern, the 1969 National Environmental Policy Act (NEPA) was also enacted, which along with the federal Environmental Protection Agency (EPA) founded in 1970 and a set of federal environmental acts initiated a new era in the American environmental policy-making (VanNijnatten, 1999). Meanwhile, in Canada the political system, except for establishing the Department of the Environment (Environment Canada), did not pay serious attention to environmental policy (Doern and Conway, 1994). The USA public then experienced a decade of declining environmental concern in 1970s, following the initial enthusiasm surrounding the first “Earth Day” in 1970, a trend that was reversed in the 1980s partially in response to the anti-environmental policies of the Reagan administration (Dunlap, 1991). In Canada, public environmental concern was also on the rise during 1980s and reached a peak in the late 1980s and early 1990s, as was true in the USA (Dunlap, 1995). As a response to public concern over rising environmental issues the Canadian political system seemed to catch up with the USA in terms of environmental policy-making. Two events illustrate such catching-up. In 1988, the Canadian Environmental Protection Act was passed by Parliament and in 1990, a \$3 billion “Green Plan” was announced that covers a wide range of environmental issues (Doern and Conway, 1994; Morrison, 1997; VanNijnatten, 1999).

Now I turn to 1990s, which is also the timeframe in which the dataset used in this dissertation was collected. Due to increased data availability, it is possible to look more specifically into the similarities and differences in environmental concern between the USA and Canada in the 1990s. Various international surveys consistently show that there are high levels of citizen concern and support for environmental protection in both nations (e.g., Dunlap *et al.*, 1993; Frizzell, 1997). According to the 1993 International Social Survey Programme (ISSP) environmental survey, the Canadian public seems to have a somewhat higher level of environmental concern than the American public (Frizzell, 1997). Out of eight relevant survey items for which frequencies are reported, Canadians showed higher levels of environmental concern than Americans in seven of them². This finding is consistent with the argument and empirical findings of Pierce *et al.* (1992) mentioned above.

The differences found, however, are not always substantively significant. Clarke and Steward (1997) using the same ISSP 1993 dataset, carefully compare perceived environmental hazards and pro-environmental activities between Canadian and American citizens. They conclude that although Canadians are more likely to perceive dangers posed by various hazards than are Americans, “the differences are small and modest” (Clarke and Steward, 1997: 82). In the case of pro-environmental activities, Canadians and Americans show similar levels of anticipated or actual activities. Clarke and Steward (1997) further examine the structures of perceived hazards and pro-environmental activities and find that Canadians and Americans have similar structures in both cases. Similarly and importantly for this dissertation, the HOP dataset also shows that levels of environmental concern are similar among Canadians and Americans. Dunlap *et al.* (1993)

report percentages of several HOP survey questions, similar levels of environmental concern are found for Canada and the USA on all of them.

Clarke and Stewart (1997) thus openly challenge Pierce *et al.*'s (1992) argument that Canadians are more “green” than Americans due to their stronger collectivist orientation by pointing out that recent national surveys tend to reveal that Canadians and Americans are more similar than different. They argue that “if social structural and demographic factors are important, one would again expect strong cross-national similarities” (Clarke and Stewart, 1997: 79) because Canada and the US are very similar to each other in terms of age, education, income, and urbanization. Such similarities are also revealed by the HOP dataset used in this study as noted above.

In sum, the USA and Canada are very similar to each other in terms of overall levels of citizens' environmental concern, despite obvious political and cultural differences between the two nations. By focusing on the USA and Canadian samples, I can therefore utilize a “similar systems” comparative design as this makes the finding of a similar structure of environmental concern more impressive. In the following section, I turn to methodological details of such a comparative approach.

A Comparative Approach and a Unique Feature of CFA

From a comparativist perspective, the logic of comparing two similar systems in a “most similar systems” design (Dogan and Kazancigil, 1994) resembles the logic of comparing the experimental and control groups in an experimental design. Ideally there needs to be two most similar systems that are almost identical to each other except for the key variable that is under investigation. Of course, in reality it is nearly impossible to

find two identical naturally formed systems such as nations. An example of this experimental design is Rosa *et al.*'s (2000) study examining the influences of culture on risk perception by comparing the USA and Japan. Similarly, by comparing two systems that are known to be very similar on a set of key variables, such as Canada and the USA, one can enhance the internal validity of empirical comparisons, albeit not as conclusively and powerfully as in a true experimental design.

In this dissertation, I focus not on the levels of environmental concern *per se*, but the “structure” of such concern, in the two nations. Confirmatory factor analysis has a unique feature called “comparing groups” (Bollen, 1989) that fits such a comparative design very well. Assuming the availability of two independent random samples (which I have, as noted above), CFA allows for the comparisons between two groups (national samples in this study) at two different but overlapping levels, the model form and the model parameters. The statistical significance test is provided by simultaneously estimating two models, one for each sample (for technical details, see Bollen, 1989). Such a strategy will output a set of model fit statistics on which a variety of comparisons can be based and a statistical significance test is available for each such comparison.

The lowest level of comparison is between the forms of models for the two samples. Specifically, I will specify the same structure of environmental concern—the same model form—for both the USA and Canadian samples and then proceed to estimating it. The null hypothesis at this level is that citizens in both nations share the same structure. If the estimation outputs show a poor model fit, then this null hypothesis is rejected, meaning that the USA and Canadian public are not likely to have the same structure of environmental concern. Otherwise, I can generally conclude that Americans

and Canadians do share a similar structure of environmental concern, which will also serve as the basis for higher level comparisons—comparing individual or sets of individual coefficients. For details about the application of such a strategy, see Chapter Four.

Data Management

The HOP was conducted via face-to-face in-home interviews, minimizing problems of illiteracy and widely seen as generating higher quality of data than do either telephone interviews or self-administrated questionnaires (Dillman, 2000). There are specific methodological issues associated with survey dataset that need to be addressed before applying the CFA/SEM techniques. In this section, I address two key issues: missing values and the categorical nature of survey items.

Missing values

As in virtually all large surveys, there are missing values in the dataset. In this study, I treat answers such as “don’t know” and “refuse” as missing values. One common practice of dealing with missing values is to exclude cases with missing values. Unfortunately in this dataset if all cases with any missing values are excluded, because of the very large number of variables it would lead to a total loss of about 20 percent of the sample in both nations. Therefore, I choose the alternative approach of recoding missing values.

One conventional means of recoding missing values, especially for attitudinal measures using Likert-type scales, is to recode them into a middle point or neutral option

(e.g., as “undecided,” or “neutral”). However, in the HOP dataset there is no middle point provided in the original scale for many relevant items. Most attitudinal items in the survey use a four-point scale such as “strongly agree,” “agree,” “disagree,” and “strongly disagree.” If the missing values, including answers indicating “don’t know” and “refuse,” are recoded to a neutral point it would create a bi-modal distribution for variables, with a dip in the middle due to the low frequency of the created neutral point. For descriptive analysis, such a dramatic change in the distribution of the variables may matter little; however, this is not the case with regression analysis and other more advanced statistical techniques such as CFA/SEM.

Regular regression models typically analyzed with Ordinary Least Square (OLS) and CFA/SEM with Maximum Likelihood (ML) both require that at least the dependent variables be approximately normally distributed. Distributions drastically different from normal distributions such as a bi-modal distribution can severely distort estimation results and sometimes even render estimation of parameters impossible (Bollen, 1989; Hamilton, 1992). It would therefore be foolish to create bi-modal distributions by recoding missing values to a middle point. To avoid this, I choose to recode missing values to a median point for all items lacking a middle point in their response categories. For those items that do have a middle point in their response categories, missing values are recoded to such middle point.

When replacing missing values with substantive data, an important issue is the pattern of missing values, or the “missingness” (Dillman *et al.*, 2002). The issue is whether missingness is correlated with some variables in the dataset or whether the missingness is random. Assuming that the original sample is a sound probability sample

of the target population, the resultant completed sample (with missing values) can generally be seen as a random subsample of the original sample if the pattern of missing values is completely random. In this case, the effects of missing values on the validity of the findings are rather minor and therefore it is relatively safe to replace these missing values with substantive values. Otherwise, there will be the risk of introducing extra biases into the dataset (Maxim, 1999; Little and Schenker, 1995; and Dillman *et al.*, 2002) by recoding significant proportions of the samples. I therefore performed a general check regarding missing values. First, for every individual survey item, the percentage of missing values rarely exceeds 5 percent, and only a couple are over 10 percent. Typically the missing values are only about 2-3 percent of the sample, thanks to the face-to-face interviews used. Second, missing values do not seem to overlap across items. That is, there are rarely instances when respondents consistently lack values across a series of items. Therefore, it seems reasonable to argue that missingness in this dataset is largely random.

Categorical nature of many survey items

The second problem I deal with in terms of data management is the categorical nature of many attitudinal variables using Likert-type questions and response formats. CFA/SEM is a linear model that requires at least the dependent variables in the model to be interval-level variables. Applying a linear model to non-interval dependent variables can produce misleading results (Long, 1997; Powers and Xie, 2000). Unfortunately, most attitudinal measures in the HOP survey to be used as dependent variables in this dissertation are ordinal, typically a four-point Likert-type scale such as “strongly

disagree,” “disagree,” “agree,” and “strongly agree.” The usual coding scheme assigns integral numbers, such as 1, 2, 3 and 4 to each of those four answer categories; however, this does not make the resulting variables interval.

To avoid the risky consequences of applying statistical techniques that require an interval-level dependent variable when we only have ordinal-level variables, scholars (e.g., Long 1997; Powers and Xie, 2000) recommend using appropriate techniques such as ordered logit regression and ordered probit regression that are specifically designed for ordinal data analysis. One disadvantage of these techniques is their inability to deal with multiple dependent variables in a single model; yet, this renders them inapplicable in this study because using multiple indicators is essential for measuring environmental concern due to the complexity of this construct.

An alternative provided by Powers and Xie (2000) is the Normal Score Transformation (NST) technique. NST assumes an underlying continuous variable representing, for example, peoples’ attitudes expressed on an environment-related issue. The technique also assumes that this underlying variable has a standard normal distribution and that the four observed categories (e.g., “strongly disagree,” “disagree,” “agree,” and “strongly agree”) are merely incomplete manifestations of this variable. In the context of a normal distribution, the relative frequency of each category is assumed to represent the probability of actually observing that category. If a distribution is normal, then the probability of a particular range—or distance between two points—can be calculated by finding the standard scores of the upper and lower limit points of the range. For example, the commonly used 95 percent confidence interval is the probability of the range between the two points that are two standard deviations below and above the

sample score. NST reverses the process, as we know the probability already and we need to figure out the standard scores. NST therefore converts the ordinal-level variable into an interval-level one that has a standard normal distribution by transforming the original integral values (1, 2, 3, and 4, for example) into standard scores—they are standard deviations corresponding to the probabilities of being observed for each answer category. Powers and Xie (2000) present examples of the application of NST and indeed obtain unequal distances between adjacent answer categories.

Someone might question the appropriateness of the distribution assumption of NST, which seems too restrictive to be completely justifiable. To assume a standard normal distribution for the dependent variables is indeed somewhat unusual since typically linear models only assume approximate non-standard normality of variables' distributions (e.g., Bollen, 1989; Hamilton, 1992). However, NST's additional assumption of the standardization of normal distribution is justifiable because the ambiguity of the measurement scale (as in for example, inches, dollars, etc.) of the variables involved necessitates the standardization technically to allow for statistical analysis (e.g., Bollen, 1989) and substantively to avoid confusion in the interpretation of analysis results. In addition, standardization does not affect the significance test of individual coefficients (Hamilton, 1992). I believe that NST is therefore justified.

On the other hand, in the analyses to follow NST is only used on survey items that are treated as dependent variables. The aforementioned risks of using non-interval variables with a technique such as CFA/SEM that requires interval-level variables are the most serious when such variables are used as dependent variables in the models. Using categorical independent variables is less problematic (for example, the use of dummy

variables in regression analysis) and linear models prove robust against estimation errors even with categorical independent variables (Bollen, 1989; Long, 1997; Powers and Xie, 2000). For survey items used in the analyses as independent variables, original coding is used to avoid unnecessary twist in the original data.

Methods

Use of CFA/SEM is relatively new in the environmental concern literature, which therefore necessitates a description of CFA/SEM in order to facilitate the interpretation and discussion of model specification and analysis results. However, it is not the objective of this dissertation to dwell on technical and statistical details of a CFA/SEM model. Thus, in what follows I present a general discussion of the CFA/SEM technique, mainly to introduce its unique features that might seem unusual in comparison to more commonly utilized techniques such as EFA and OLS regression.

The logic of latent variables

One unique feature of CFA/SEM is its ability to incorporate latent variables directly into the analysis (more on this shortly). This ability makes CFA/SEM particularly suitable in constructing models involving complex constructs such as environmental concern that are not directly observable. The use of latent variables therefore deserves a close examination. Indeed, one criticism of SEM is that latent variables are only imaginations of scholars that therefore have no scientific validity (Bollen, 1989). Bollen answers this criticism with much conviction by pointing out that such “imaginary” variables are actually very common in scientific research. As Bollen

points out, in physics for example, we cannot really observe quantum *per se*, but this does not stop physicists studying quantum. Nonetheless, an explanation of the logic of latent variables seems necessary.

It is fair to point out that an SEM analysis does not necessarily imply the inclusion of latent variables. As Bollen (1989) among many scholars notes, SEM analysis can be used with observed variables only. In fact, SEM with observed variables is the most common form of structural equation modeling, regular OLS linear regression being one special case of such technique. However, many key sociological constructs are not directly observable, and the focus of this dissertation—environmental concern—is one such example. The direct implication of this difficulty is that there will be no observed variable for environmental concern; thus, we assume it exists as a “latent” variable even though we cannot directly observe it. Such a latent variable is assumed to have its manifestations through influences on other observable variables, which are then considered its indicators—in other words, as the measures of the latent variable. Given this assumption, the latent variable is treated as the source of covariation among the observed indicators. Therefore, by studying the patterns of interrelationships among observed variables (covariation), it is possible for us to better understand the characteristics of the underlying latent variables (McCutcheon, 1987). Indeed, SEM is sometimes referred to as a technique made up of “measurement models and latent variable relationships” (Schumacker and Lomax, 1996: 2).

The notion of a latent variable is actually not unique to SEM. Even in a regular OLS regression equation, there is the residual term that is a latent variable. What differs is the role played by the latent variable in the model. In regular OLS regression, the

latent residual term never becomes a central part of analysis, while in EFA and CFA/SEM latent variables are the key foci of models.

As mentioned in Chapter Two, CFA and EFA share the critical assumption that the correlations (covariation) between observed variables are due to a smaller number of underlying factors. In SEM terminology, the underlying factors are latent variables. One major difference between CFA and EFA is the treatment of latent variables.

In EFA, there is no attempt to hypothesize the meaning of latent variables. The interpretation of latent variables depends solely on the outcomes of the analyses, which involves little effort more than labeling the resulting dimensions/factors. Also, there is no specific expectation about how observed indicators will load onto latent variables. Typically in an EFA, all indicators load onto all latent variables. The number of factors is also not predetermined, or is at least determined somewhat arbitrarily.³ When more than one factor emerges from the analysis, usually no correlations among latent factors are allowed if there is no rotation or if only orthogonal rotation is performed. With rotations other than orthogonal rotation, correlations among latent factors are allowed; however, all factors will correlate with one other and the magnitude of correlations are somehow arbitrarily pre-determined (Hamilton, 1992). Generally speaking, an EFA model poses no restrictions on the factor loadings and inter-factor correlations and therefore is referred to as “unrestricted” latent model (McCutcheon, 1987: 37). For this reason, Hamilton (1992: 278) points out that EFA is not a model-based technique and provides no systematic way of testing hypotheses about the number of factors, the factor loadings, or the inter-factor correlations.

With CFA, however, the meanings of latent variables are hypothesized beforehand based on a theoretical framework. Not all observed variables are expected to load onto every latent variable as is true in an EFA model; rather, observed variables are expected to load only onto relevant latent variables, in which the relevance is judged according to the hypothesized meaning of the latent variables. Besides the meanings of latent variables, the number of latent variables and the correlations among them are also hypothesized before the estimation. Thus, a CFA model can be called a “restricted” latent model (McCutcheon, 1987: 37). The focus of a CFA model is on whether the model specified according to a theoretical framework is confirmed by the sample data; hence, the name “confirmatory” factor analysis. Typically, a CFA model will be estimated with Maximum Likelihood method, which provides a systematic way of testing various hypotheses about the factor loadings, correlations among factors, and even the whole model (more on this later).

An SEM model goes one step further than a CFA model in that some latent variables can be hypothesized, also according to a theoretical framework, to have directional effects (as in contrast to non-directional correlations) on other latent variables; and latent variables can be affected by other observed variables with relatively standard measures such as income, education, gender, etc. Such a feature provides researchers with the ability to test a much wider range of models not limited to measurement of complicated constructs. The term “structural” in SEM according to Bollen (1989: 4) stands for “the assumption that the parameters are not just descriptive measures of association but rather that they reveal an invariant ‘causal’ relation.” We should of course be cautious when claiming a relation is “causal.” However, an SEM can test not

only the associations among variables but also the direction of effects, which then provides a fuller degree of understanding. Statistically, SEM is not much different from CFA; therefore these two techniques can be seen as belonging to the same category of methodological tools.

The evaluation of the entire model

A related aspect of this notion of “structural” is the test of the specified relationship structure, which statistically is a test of the entire model. Hypothesis testing is critical due to the use of sample data rather than population data. With a regular OLS regression, a researcher looks at statistical tests (*t*-tests) for individual coefficients such as regression weights and constant terms, and sometimes also a test for the entire regression model (typically an *F*-test). In the case of *t*-tests, the intention is to see whether individual coefficients are significantly different from zero (whether such effects exist or not); while *F*-tests examine whether the combined effect of all independent variables is significantly different from zero⁴. For hypothesis testing in a CFA/SEM, the researcher also tests whether individual coefficients are significantly different from zero. However, when the test of the entire model is involved, there is a change in orientation.

In a regular OLS regression model, we seek to minimize the difference between the observed values of individual cases (unit of analysis) and their corresponding predicted values that are calculated with the regression equation. Such a difference is presented as the residual term in the regression equation. Or, statistically speaking, we seek to minimize the variance of the residual term. The focus is on whether the independent variables combined can significantly improve our ability to predict variation

in the dependent variable. In a statistical test of the entire model, a significant probability value tells us that the model (or regression equation, in this case) does improve our ability to predict variance in the dependent variable.

A CFA/SEM, on the other hand, does not look at individual cases (unit of analysis) but rather focuses on the covariances⁵ among variables. CFA/SEM is therefore sometimes referred to as a technique of *analysis of covariance* while regular OLS regression and ANOVA, for example, are sometimes called *analysis of variance* techniques (Bollen, 1989). The model specified in accordance with a theoretical framework will present a hypothesized covariance matrix which will be compared to the observed covariance matrix obtained with the empirical data. In CFA/SEM, it is the difference between these two covariance matrices we seek to minimize, not the difference between predicted and observed individual values. Such a change in orientation leads to a change in focus when evaluating the entire model. In CFA/SEM, a model with desirable goodness-of-fit should present a hypothesized covariance matrix that is not statistically different from the observed covariance matrix—i.e., the statistical test of the entire model would yield a “non-significant” result. A significant result would lead to the rejection of the specified model, meaning that the data does not support the hypothesized model.

Technically, CFA/SEM with Maximum Likelihood estimation can utilize a Chi-square test to evaluate the entire model. There are doubts about the accuracy of the Chi-square test, however (Bollen, 1989; Corral-Verdugo, 2002), because it is fairly sensitive to non-normal variable distributions which are unfortunately more common than are normal distributions in the empirical world. Consequently, several alternative strategies

are suggested by various scholars such as Jöreskog and Sörbom's (1986) Goodness of Fit Index, and Bentler-Bonett's (1993) Normed Fit Index. In both cases, an index greater than .90 is generally considered as indicating an adequate model fit (Roberts and Bacon, 1997; Corral-Verdugo, 2002). Nonetheless, according to Bollen (1989), the Chi-square test provides the most amenable test of statistical significance because it is based on a known probability distribution (Chi-square distribution) while the other overall-fit indexes are mainly descriptive because their distributions are unknown.

Bollen (1989) does suggest using caution with the Chi-square test. First, the sample should be fairly large. Second, the covariance matrix, not the correlation matrix, should be used as input data. Third, observed variables should not have drastically non-normal distributions. In this dissertation, I take steps in data management to avoid excessive non-normality and also use covariance matrices. Combined with the fact that our sample sizes are sufficiently large, it seems that the Chi-square test is appropriate in this study. However, even Bollen (1989) admits that there is still much to discover and many uncertainties with regard to the evaluation of entire model. Thus, to follow Bollen's (1989) suggestion and the conventional practice in the literature, I will also report Jöreskog and Sörbom's (1986) Goodness of Fit Index (GFI) and Bentler-Bonett's (1993) Normed Fit Index (NFI) as additional measures of goodness-of-fit.

A non-significant Chi-square test (or GFI and NFI larger than .90) reveals good model-data consistency, which however does not necessarily imply model-reality consistency (Bollen, 1989). This idea is consistent with the well-known notion that one cannot empirically prove nomothetic causal relationships because there can be alternatives that have equally good model-data consistency. Replication is then critical.

In this dissertation, I can fortunately utilize two samples, the USA sample and the Canadian sample, to provide replications of one another and in the process improve upon the typical single-sample studies of environmental concern.

Measurement errors and measurement error correlations

Another advanced feature of CFA/SEM is its flexibility in incorporating measurement errors into the model. Such a feature is related to the logic of latent variables because measurement error technically is just another type of latent variable. I have already discussed the need for latent variables due to the fact that many sociological constructs, including environmental concern, are not directly observable. Therefore, on the basis of a theoretical framework, one can link a latent variable with directly observable variables used as the measurement indicators of the latent variable. It is virtually unrealistic to assume perfect measurement in most cases. Thus, we need to consider the possibility of both systematic and random measurement errors, the former associated with validity and the latter with reliability of measurement (Singleton and Straits, 1999). It is commonly understood that the assessment of validity is not directly possible and cannot be done solely with statistical tools (Kim and Mueller, 1978; Bollen, 1989; Singleton and Straits, 1997), so I turn to random measurement errors.⁶

In regular OLS regression, ANOVA, or even more advanced techniques such as logistic regression, measurement error is simply not included in the model. Most often, a researcher assumes the observed variable perfectly measures the construct it is supposed to measure, or that the construct is directly observable. Such an assumption is not realistic, especially in social science where we employ many very complex and abstract

constructs. By assuming perfect measurement, the variance of the measurement error becomes part of the total variance of the construct, which is thus clearly inflated. A direct consequence of inflated variances of variables is that the estimated correlations between variables are smaller than they should be (Bollen, 1989; Green *et al.*, 1993; Guber, 1996)—attenuation of correlation.

EFA somewhat improves the situation, as measurement errors can be allowed and included in the analysis. Less-than-one factor loadings reveal less than perfect correlations between latent variables and their indicators; therefore, those indicators are not perfect measures. However, there are two problems with EFA's accounting for measurement errors. First, there is no statistical test available for the factor loadings nor is there a test for the measurement errors. Second, and more importantly, no correlations between measurement errors are allowed in EFA.

There are many reasons why measurement errors may correlate with one another (Bollen, 1989). For example, a specific measuring approach or method can have distinct sources of measurement errors that may remain the same for each variable measured by that approach or method (McPherson and Tom, 1995). Possible sources of correlated measurement errors can thus include all sorts of methodological artifacts to which survey methods are particularly vulnerable (Keeter, 1988; Dillman, 2000; Guber, 1996; 2003). For example, one typical way of organizing survey questions is to use a matrix format, in which a set of survey items are grouped to share the same set of answer categories. With such a format, it is very likely that respondents develop an anchoring tendency that leads them to choose similar answers regardless of the items (Dillman, 2000). In terms of measurement error, this means the same factor that produces measurement error in one

indicator will also affect the entire set of indicators included in the matrix. Thus, the measurement errors for these survey questions will most likely correlate with one another. If no correlations among measurement errors are allowed in the analysis, such correlations become part of the correlations among latent variables and other related coefficients such as covariances, and potentially lead to distorted estimations. Depending on the strength and direction of the measurement error correlations, the final results may be inflated, attenuated, or even changed into the opposite direction (Guber, 1996; 2003).

An excellent example is one interesting finding noted by Dunlap *et al.* (2000). They find that the four of the twelve items in the original NEP Scale (Dunlap and Van Liere, 1978) that are often found to form a distinctive dimension in several EFA studies are the only four worded in an anti-NEP direction. Similar wording direction in this case has most likely led to measurement error correlations. Since EFA does not have the ability to take measurement error correlations into account, such correlations incidentally inflate the correlations between those four indicators so much in EFA results that these four often form a distinctive dimension. This distinctive dimension thus is at least partially the manifestation of a methodological artifact—wording direction (This problem was dealt with in the “Revised NEP Scale” reported in Dunlap *et al.*, 2000).

Both problems of EFA with regard to measurement error can be corrected by CFA/SEM. In CFA/SEM there are significance tests for not only the factor loadings and other coefficients, but also for the variance of each measurement error.⁷ Furthermore, correlations among measurement errors can be allowed. With the ability to allow for both measurement error and their correlations, CFA/SEM is potentially able to estimate

the coefficients more efficiently and the results are less confounded by methodological artifacts.

Summary

This chapter has briefly described the dataset to be used, several important data management issues, the comparative research strategy, and a general discussion of the statistical technique, CFA/SEM, to be employed. Details about variables such as question wording and coding schemes will be provided in the following chapters, in addition to model specification details. CFA/SEM differs from the more familiar OLS regression and EFA in many important ways and appears to offer the best way for testing the latent structure of environmental concern and its relationships to predictors. Thus, the application of CFA/SEM offers the possibility of improving upon the large majority of existing studies of environmental concern. Also note that in this chapter I chose to concentrate on explanations of the change of orientation and logic involved in the use of CFA/SEM relative to OLS and EFA, without devoting too much time to statistical details. These explanations provide the methodological basis for discussion and interpretation in later chapters.

CHAPTER THREE ENDNOTES

1. According to Dillman (2000), primacy effects refer to the tendency to choose the first answer category that respondents read or hear; while recency effects refer to the

tendency to choose the last answer category that is presented to respondents in a survey, regardless of the content of the answers in both cases.

2. Unfortunately, no statistical significance test is reported.
3. In an EFA, usually the number of factors is not predetermined but rather decided after the analysis is completed. For example, a researcher will look at the eigenvalues associated with every factor and decide to retain only those factors with eigenvalues greater or equal to one. Or, a researcher can also specify the number of factors to be retained prior to the analysis; however, an EFA will not provide a statistical test for such decision. Therefore both approaches are somewhat arbitrary.
4. Of course, we can test whether the coefficients are significantly different from a number other than zero, depending on the needs of a researcher. However, statistically there is not much difference in these approaches.
5. A covariance is statistically related to the more familiar term correlation in that a correlation is actually the standardized covariance. A variance can be seen as a special case of covariance in that it is the covariance between a variable and itself. The standardized variance is then the correlation of one variable to itself, which is one.
6. In a CFA/SEM model, all measurement errors are assumed to have a mean of zero, which is equivalent to assuming they are random measurement errors that tend to cancel out each other when summed together. Systematic measurement errors would add a constant to their means so that the means are no longer zero. Statistically, we do not have the ability to directly test this possibility (Kim and Mueller, 1978; Bollen, 1989; Singleton and Straits, 1999).
7. In a CFA/SEM, a measurement error is assumed to have the same measurement scale (as in for example, inches, dollars, etc.) as does the item to which it is attached, and it has a mean of zero (Bollen, 1989). Because of these assumptions, the variance of a measurement error can be determined by looking at the factor loading of the item. Squaring the factor loading of this item gives us the R-square showing how much the latent construct explains the observed item, while the remaining part of the variance unexplained is accounted for by the measurement error. Since the measurement error has the same measurement unit as the item, the remaining unexplained variance of the item is equal to the variance of the measurement error.

CHAPTER FOUR
THE KEY FACETS OF ENVIRONMENTAL CONCERN AND THEIR
INTERRELATIONSHIPS—LACK OF CONSTRAINT?

Introduction

In Chapter Two, three conceptualization schemes of environmental concern offered by Heberlein (1981), Gray (1985), and Dunlap and Jones (2002) were introduced and compared. One important agreement among these three schemes is that environmental concern is multifaceted. Conceptually environmental concern can be seen as consisting of two general components, “environmental” and “concern,” each of which is multifaceted, as Dunlap and Jones (2002) explain. To develop effective measures of environmental concern, it is necessary first to identify its key facets that can sufficiently cover the conceptual universe and utilize multiple indicators corresponding to the multifaceted nature of environmental concern. The second necessary step is to examine the dimensionality of environmental concern. Methodologically examining the dimensionality of environmental concern necessitates the development of multiple measures, each of which should be relatively independent of the others and therefore maintain its unique presence in the analysis process (Singleton and Straits, 1999).

Theoretically, the importance of dimensionality issue goes far beyond the mere methodological consideration, as it is closely tied with a fundamental question of the consistency or coherence of environmental concern. That is, as Dunlap and Jones (2002: 511) put it, “Is it appropriate to consider environmental concern as a single construct, or

is it inherently multidimensional?” There are two different perspectives on this issue in the literature, one leaning toward the “single construct” notion and the other toward the inherent multidimensionality view (more on this later). Interestingly, a common practice between the groups of scholars holding these two different voices is the adoption of the “belief systems” perspective originated from the discipline of political science for theoretical guidance on assessing the coherence of environmental concern (e.g., deHaven-Smith, 1991; Guber, 1996; 2003). From the belief systems perspective, dimensionality is a question of whether environmental concern as a set of environmental beliefs and attitudes has developed into a coherent belief system among the general public. Since environmental issues have remained on the public agenda for more than three decades, the latter seems a reasonable possibility (Dunlap *et al*, 2002). Before I look into the debates over the dimensionality of environmental concern in detail, let me first briefly introduce the belief systems perspective.

Conceptualization and Operationalization of Constraint—the Belief Systems Perspective

The belief systems perspective first originated in political science with Philip Converse’s classic article “The Nature of Belief Systems in Mass Publics” published in 1964 (Converse, 1964). It generated a great number of studies of belief systems, and a detailed review of this body of literature is obviously beyond the scope of this dissertation. In what follows, I will only briefly introduce some core notions of the belief systems perspective that are particularly relevant in this dissertation.

Converse (1964: 207) defines a belief system as “a configuration of ideas and attitudes in which the elements are bound together by some form of constraint or functional interdependence,” where constraint means “the success we would have in predicting, given initial knowledge that an individual holds a specified attitude, that he holds certain further ideas and attitudes.” It is therefore clear that the existence of some degree of constraint is the defining feature of a belief system. Constraint as it is loosely defined seems to refer to the interconnectedness among different beliefs within the same presumed belief system. It is in this sense that the dimensionality aspect of environmental concern can be re-defined within the belief systems framework, because dimensionality also concerns interrelations among different beliefs and attitudes.

One important property of constraint as pointed out by Converse (1964) is that it must be treated as a matter of degree. Equivalently, I argue against dichotomizing the dimensionality issue—i.e., seeing environmental concern as either unidimensional or multidimensional—but to conceptualize dimensionality as a continuum, with perfect unidimensionality at one end and complete multidimensionality at the other. Further, following Converse’s (1964) insight, I believe the dimensionality of environmental concern is more properly treated as dynamic instead of static. Or, more specifically, one needs to be concerned with the dynamic relationships among different environmental beliefs. This then leads to another important notion by Converse (1964: 208): the *centrality* of individual beliefs can be determined by “the role they play in the belief system as a whole”. The centrality of individual beliefs varies as some beliefs are harder to change, and if changed often cause less central beliefs to change along with them. This suggests the mechanism by which constraint functions, or how a belief system is

organized. In this chapter, I focus on the degree of constraint within environmental concern, while in Chapter Five I will explore the organization of environmental concern by identifying a set of core or central beliefs that appear to influence more specific sets of attitudes and beliefs.

The dimensionality aspect of environmental concern can be logically boiled down to the conceptualization and operationalization of the degree of constraint of the environmental belief system. While it is widely agreed that the degree of constraint of a belief system has something to do with the interconnectedness among different beliefs within the same system, there are controversies in the literature of belief systems on how to operationalize constraint. Such controversies also seem to return to the issue of the conceptualization of constraint (Mueller and Judd, 1981; Mueller and Dimieri, 1982; Martin, 2002).

An intuitive operationalization of constraint following the informal definition provided by Converse (1964) is to measure the inter-correlations among different beliefs with some type of correlation technique such as Pearson's correlation coefficient r (e.g., Pierce and Lovrich, 1980). Pearson's r (like other correlation coefficients) is a bivariate technique that measures the degree of interrelation between two variables (Ritchey, 2000). As the number of variables increases, the number of pairwise coefficients increases dramatically. For two variables, there is only one such coefficient. Three variables lead to three coefficients, and four variables generate six, and so on. To keep the results manageable, an average of all pairwise coefficients is usually calculated and used as input for subsequent analyses.

Such an operationalization, while intuitive, is not without limitations. Mueller and Judd (1981) utilize data generated from a survey of members of the Boston Chapter of the National Organization of Women (NOW) and members of the Massachusetts Federation of Republican Women (MFRW) to demonstrate one serious drawback of averaging correlations. Because correlations are positively related to the variances of the correlated variables, Mueller and Judd (1981) show that the higher degree of consensus (low variance) on issues of women's rights among NOW members leads to lower constraint (weaker correlations) measured with correlations when compared to MFRW members, which is clearly misleading. To avoid this pitfall, Mueller and Dimieri (1982: 658) propose to re-define constraint as "a property of individuals describing the degree to which one belief or preference can be predicted from another." Such a definition differs from Converse's original one in that it explicitly states that belief constraint is a property at the individual rather than group level. Additionally, Mueller and Dimieri (1982: 658) also define a belief consensus as "a group property that describes the average variability on a set of specific beliefs within a group." Corresponding to such a conceptualization, Mueller and colleagues (Mueller and Judd, 1981; Mueller and Dimieri, 1982) operationalize belief constraint by calculating response variance (row variance in a spreadsheet format) across questions (beliefs); while belief consensus is operationalized by calculating average response variance of each question across individuals. These operationalizations essentially treat belief constraint and consensus as independent of each other.

Martin (2002) in his recent article echoes the conceptualizations of Mueller and her colleagues (1981, 1982). Like Mueller *et al.*, Martin first points out the limitations of

the conventional operationalization of constraint (correlation based measures, to be specific) in comparing groups with different variances on some beliefs as well as in dealing with more complex interconnection than simple bivariate relations. Martin (2002) subsequently proposes to decompose constraint into two portions that are mutually exclusive of each other. One portion is named “consensus,” referring to “the level of overall agreement, or constraint at the level of the marginals” (group level), while the other is called “tightness” referring to “the degree of organization attributable to the interconnection of beliefs” at the individual level (Martin, 2002: 866).

Trivial difference in terminology aside, it appears that both conceptualizations reviewed above agree that constraint has two dimensions of variation. One dimension is at the group level indicating the degree of agreement/disagreement among members on specific beliefs, while the other dimension is at the individual level indicating the degree of tightness with which individuals’ beliefs are bound together. Such a conceptualization extends Converse’ (1964) definition of constraint by further considering the levels of constraint at the group level in addition to that at the individual level.

What is missing from this extended conceptualization, however, is the notion of tightness or interconnectedness among different beliefs at the group level that correlational measures of constraint try to tap. Strictly speaking, belief consensus at the group level cannot be seen as part of constraint because as shown above consensus concerns variation within single beliefs across sets of individuals, while constraint as used in Converse’ (1964) definition of “belief system” concerns variation across different beliefs. This becomes clearer when looking at how consensus is operationalized in detail. Mueller and Judd (1981) propose to measure belief consensus by averaging response

variance within each item across all items. Statistically, this means obtaining the variance of each relevant item first and then calculating a mean variance across all items. Such an approach does not consider at all the degree of interconnectedness across items. I thus propose to extend the conceptualization of constraint by additionally considering the variation of constraint at the group level, borrowing insights from the dimensionality research within the environmental concern literature.

The dimensionality issue arises when the necessity of utilizing multiple indicators to construct composite measure of environmental concern is made clear, as discussed in detail in Chapter Two. It is widely agreed that a necessary condition for justifying the construction of composite measure such as an additive index is that all items within the index reflect the same dimension; otherwise, the index will not be unidimensional. Thus, most studies utilizing composite measures typically report the results of testing for internal consistency and unidimensionality for their measures (see Chapter Two for details). In other words, we need to first ask the fundamental question of whether a group of different beliefs are indeed interconnected with each other, before we can start asking questions about the degree of such interconnectedness. However, the concept of constraint as it is defined either in the original Converse (1964) version or in the later versions by Mueller and colleagues (1982, 1982) and Martin (2002) seems to dismiss the necessity of such a question by only looking at interconnectedness at the individual level and thus committing the risk of mixing up levels of units of analysis. To illustrate such a risk, let me take a closer look at the operationalization of constraint proposed by Mueller and colleagues introduced above.

Mueller *et al.* (1981; 1982) propose to measure belief constraint by calculating response variance across items. In other words, they take every individual's responses to a set of items and calculate a variance of these responses for each individual. As we know, when calculating variance, it is necessary to calculate the mean of responses. The need for a mean of responses puts this measure of belief constraint in the same boat as an additive index—a composite measure typically used in the environmental concern literature. That is, examination of the potential unidimensionality of this composite measure is necessary. Another way to look at it is that variance by its nature is univariate and Mueller *et al.*'s procedure only makes sense when there is only one dimension of variation among scores on different items. Such a condition is automatically met when we have only one variable. However, to calculate response variance for each individual across items inevitably involves more than one variable, which brings up the question of potential dimensions of variation. Variance as a univariate statistic by itself is not capable of examining such dimensionality, just like an individual's mean score across items. Furthermore, variance is also very sensitive to extreme cases sometime called “outliers” (Hamilton, 1992). That is, if a few irrelevant questions (“bad” items using factor analysis terminology) that vary in a separate dimension were mistakenly included, the calculation of variances could become very misleading. A correlation measure such as Pearson's r , on the contrary, is based on covariance between a pair of variables and is thus capable of detecting “irrelevant” items.

One could argue that an individual's response variance does somehow measure the internal consistency among different beliefs within each individual, regardless the dimension of variation. A small variance would indicate that an individual is quite

organized in terms of beliefs, while a large variance would signal confusion. It is then necessary to make a distinction between individuals' "idiosyncratic belief systems" (Converse, 1964) and a common belief system shared by a large group of people such as the mass public (Barton and Parsons, 1977). Thus, I argue that we need to perceive levels of individual constraint and collective constraint corresponding to the individual belief system and the shared belief system, and that both types of constraint are fundamentally different from belief consensus, to follow the argument of Mueller and colleagues (1981; 1982). Let me now turn to the issue of operationalization of such collective constraint.

Constraint at the group level essentially concerns the interrelations among different beliefs and attitudes. Correlation measures (not limited to Pearson's r) are typically used, as introduced above. These correlational measures are most likely bivariate statistics that have limits when dealing with a large number of items because the number of correlation coefficients increases drastically as the number of variables increases. For example, in this dissertation I examine 55 items of environmental concern, which leads to 1,485 non-redundant pairwise correlations—creating a daunting task to determine if any pattern exists. One way to deal with this issue is to calculate an average correlation (e.g., Pierce and Lovrich, 1980). Such a method, while reducing a great number of correlations to a much more manageable level (one statistic to be exact) has some problems. First, the average (or arithmetic mean) is very sensitive to extreme cases. A few extremely low correlations could lead to a conclusion of low constraint, even when the majority of correlations are not very low. Second, averaging gives each correlation equal weight, which is not ideal for studying the organization of belief systems in which

different beliefs, or idea-elements to use Converse's (1964) term, can have different levels of centrality.

In the next section I will illustrate the use of a more sophisticated technique for examining collective constraint, namely confirmatory factor analysis (CFA). Details about this technique are described in Chapter Two and Three. Suffice it to say here that CFA is a covariance-based multivariate technique and is capable of overcoming the limits of correlation techniques. However, just like correlations, CFA is also affected by the range of variation of the variables involved, as Mueller and Judd (1981) convincingly illustrate. Therefore CFA should not be used when the variation of variables is truncated (high consensus) such as within groups of environmental activists. On the other hand, CFA is a strikingly suitable technique when analyzing mass publics where the range of variation is unlikely to be a problem.

Lack of Constraint?—Debates within the Environmental Concern Literature

There are relatively few studies of environmental concern explicitly conducted within the belief systems framework. However, if we can see the dimensionality issue as a collective constraint issue, then relevant studies, be them theoretical or empirical, are numerous. Indeed, although the main focus of Chapter Two is largely methodological, the dimensionality issue was persistent throughout the chapter. Without repeating myself all over again, in this section I will briefly lay out the debates over the existence of constraint in environmental concern, drawing heavily upon insights from Dunlap and Jones' (2002) discussion of the dimensionality of environmental concern.

It appears that in the environmental concern literature, scholars tend to hold different assumptions about the dimensionality of environmental concern. One group of scholars seems to believe that it is appropriate to consider environmental concern as a coherent construct. Reflected in their empirical practices is the use of either single-item measures (e.g., Murch, 1971; Buttel, 1975; Honnold, 1981) or the construction of single composite measures covering a wide range of different environmental topics (e.g., Weigel and Weigel, 1978; Dunlap and Van Liere, 1978). Single-item measures have obvious validity and reliability flaws as they are not capable of capturing the complexity of environmental concern. Single composite measures on the other hand are often questioned regarding their unidimensionality. The other group of scholars tends to construct multiple composite measures of environmental concern, typically utilizing a form of exploratory factor analysis (EFA). These scholars often find rather low correlations among different measures of environmental concern (e.g., Horvat and Voelker's, 1976; Ester, 1981; Stern, Dietz and Kalof, 1993), and therefore tend to conclude that environmental concern is multidimensional. Among the second group of scholars, the argument of deHaven-Smith (1991) deserves a closer examination because he explicitly utilizes the belief systems framework and presents a powerful challenge to the unidimensionality assumption.

deHaven-Smith (1991) starts with a recognition of the great complexity of contemporary environmental problems, which logically leads to the suspicion that the average citizen is unlikely to have any in-depth understanding of environmental issues. Subsequently deHaven-Smith (1991) contrasts two different perspectives with different assumptions on this very issue. One perspective is commonly shared among sociologists

and psychologists who seem to assume that average citizens have a reasonably sophisticated understanding of contemporary environmental problems, and therefore have environmental opinions akin to the views of elites and scientists that are likely to be relatively coherent and unidimensional. The other perspective is from political science—to be exact, Converse's (1964) belief systems perspective—and tends to assume the exact opposite. deHaven-Smith (1991) points out that Converse's (1964) own empirical analysis concludes that the mass public's belief system is far from being sophisticated and is mostly fragmented, localized, and issue-specific, although both Converse's methodology and conclusions have been widely challenged by subsequent researchers (e.g., Hagner and Pierce, 1982; 1984).

Utilizing a 1989 national telephone survey (N=635), deHaven-Smith (1991) concludes that among the general public, environmental problems are mainly conceived as local rather than national issues. In addition, a 1984 Florida statewide poll provides evidence that among general public in Florida there is little constraint across specific issues. deHaven-Smith (1991) thus concludes from both studies that respondents' belief systems are narrowly and locally focused and unsophisticated. These empirical findings enable deHaven-Smith (1991) to criticize the assumption that ordinary citizens have a sophisticated understanding of environmental problems. Thus, deHaven-Smith (1991) argues that Converse's (1964) conclusion that mass public's political belief system is largely fragmented, localized, and issue-specific is equally applicable to their environmental belief system. He also argues that researchers should stop looking for a "generalized" concern for the environment among the general public, and instead shift

their attention to the local conditions and factors that motivate specific environmental concerns (deHaven-Smith, 1991).

deHaven-Smith's challenge to the assumption of the unidimensionality of environmental concern among the general public, while strong, is by no means above challenge. Theoretically, both Heberlein (1981) and Dunlap and Jones (2002) provide reasons why we should look for a coherent environmental belief system among the general public. Heberlein (1981) points out while it is possible to observe substantial inconsistency (or lack of constraint) among key components of environmental concern, by and large most attitude theorists believe cognitive inconsistency among individuals tends to decrease over time (implying that degree of constraint increases). Furthermore, Dunlap and Jones (2002) summarize three general trends in the ever-changing set of environmental issues that could stimulate and enhance awareness of the interconnectedness of various environmental problems among the public (details of three general trends are described in Chapter Two). Thus, both Heberlein (1981) and Dunlap and Jones (2002) implicitly argue for an increasing trend in the public's degree of belief constraint regarding environmental concern over time.

Empirically and methodologically, Guber (1996; 2003) points out the possibility that low correlations among different measures of environmental concern observed in the empirical literature are in fact due to the use of faulty survey designs and improper analytic techniques. Utilizing a more advanced technique, confirmatory factor analysis, both Guber (1996, 2003) and Carman (1998) illustrate that after controlling for measurement errors and their correlations, different measures of environmental concern seem to tap the same underlying construct (for details, see Chapter Two). Unfortunately,

as noted in Chapter Two, both Guber (1996; 2003) and Carman's (1998) studies suffer from serious measurement invalidity as both of their conceptualizations ignore important facets of environmental concern. Logically, analyses examining relatively fewer facets of environmental concern are more likely to yield high constraint measures, exactly because of the elimination of potential sources of disagreement stemming from examination of a wider range of facets. Therefore, it is more proper to examine constraint of environmental concern using a comprehensive set of facets. In this chapter I will extend Guber (1996; 2003) and Carman's (1998) study by including more facets of environmental concern, and thus, try to achieve a higher level of content validity. The conceptualization scheme by Dunlap and Jones (2002) is adopted as the guiding theoretical framework.

Theoretical Framework

I have introduced details of Dunlap and Jones' (2002) conceptualization scheme in Chapter Two and general methodological considerations in Chapter Three. Thus, in the following discussion, I will not repeat those details but only focus on more specific issues that are directly relevant to model construction. According to Dunlap and Jones (2002), environmental concern has a dual-universe conceptual structure consisting of two general components—"environmental" and "concern"—both of which are multifaceted. The "environmental" component refers to the substantive content of environment concern, or the subject of the attitude; while the "concern" component is a universe of forms of expression, referring to ways by which environmental concern is expressed (Dunlap and Jones, 2002).

There are two broad approaches to conceptualize the “concern” component. First, a “policy” approach is commonly applied in public opinion (toward environmental issues) studies in which the “concern” component is conceptualized and operationalized by using survey items measuring crucial policy-relevant facets of environmental concern (Dunlap and Jones, 2002). Identified facets in the empirical studies include: perceived importance of environment issues, opinions about major causes of environmental problems, perceived degree of threat posed by environmental problems, perceived responsibility for solving problems, individuals’ willingness to pay for environmental protection, support for governmental policies and regulations, and various pro-environmental behaviors and activism (Dunlap and Scarce, 1991; Klineberg *et al.*, 1998; Carman, 1998; Dunlap and Jones, 2002; Guber, 1996 and 2003). Second, a theoretical approach conceptualizes and operationalizes the “concern” component according to various forms of attitude theory as consisting of affective, cognitive, conative, and behavioral expressions (Dunlap and Jones, 2002). These four forms of expression are therefore the identified facets within the “theoretical” approach. Unfortunately, the 1992 Gallup Health of the Planet (HOP) dataset does not provide adequate items to test these attitude-theory-based facets. Thus, I follow the “policy” approach and examine the “concern” component in the first part of the analysis in this chapter.

Dunlap and Jones (2002) also identify four (among many potential ways) ways of conceptualizing the “environmental” component. One way distinguishes environmental issues based on their biophysical characteristics such as Gray’s (1985) distinction among population, pollution and conservation issues, and Dunlap’s (1994) distinction among three basic functions of the environment: supply depot, waste repository, and living space.

Second, it is also possible to distinguish environmental issues along a generality-specificity continuum, e.g., pollution vs. air pollution vs. acid rain. A third way is to categorize environmental issues based on their geographical scales—e.g., global vs. national/regional vs. local. And finally, one can distinguish environmental issues according to their time frame—past vs. current vs. future environmental issues.

While each of these conceptual distinctions represents a specific way of conceptualizing the “environmental” component of environmental concern, they are not mutually exclusive of each other. For example, pollution issues can be classified into the three geographical scales of global, national, and local; then within each geographic level, we can further differentiate along the generality-specificity continuum between general pollution issues and specific pollution issues such as air pollution and water pollution; or vice versa. That is to say, all ways of distinguishing environmental issues could coexist and interact to potentially form a complex source of inconsistency within public’s environmental concern. In the second part of the analysis of this chapter, I will construct models to test two conceptual distinctions (limited data availability allows examining only these two), the distinction among the three basic functions of the environment by Dunlap (1994) and the geographical scale distinction.

Stepwise Strategy of Model Testing

With multiple conceptual distinctions and facets as mentioned above and 55 relevant survey items supposedly measuring environmental concern, it is very difficult to just jump right in and start building a comprehensive measurement model of environmental concern. I adopt a stepwise testing strategy. I will start with simpler

models specifically designed for testing individual conceptual distinctions. Upon finishing these simpler models, more complex models will be built utilizing the results of the analyses of the simpler models. Cumulatively, I plan on building models on top of one another and gradually reaching the final step of testing a comprehensive measurement model of environmental concern.

Part One: the Interrelationships among the Key Facets of the “Concern”

Component

There are many facets of the “concern” component of environmental concern identified in the literature as discussed above. Upon close inspection, some facets do not seem to have direct impacts on levels of environmental concern, which is defined as “the degree to which people are aware of problems regarding the environment and support efforts to solve them and/or indicate a willingness to contribute personally to their solution” (Dunlap and Jones, 2002: 485). These facets are opinions about major causes of environmental problems, and perceived responsibility for solving such problems. These two facets can be thus excluded from analysis. I am, however, able to include several crucial facets: perceived importance of environment issues, pro-environmental behaviors and activism, willingness to pay for environmental protection, and support for governmental policies and regulations.

Variable selection

Perceived importance of environmental problems (“Importance”) is often measured with items asking what respondents think are the most important problems

facing the nation today (open-ended question) or having them rate the seriousness of environmental problems (Dunlap and Scarce, 1991; Klineberg *et al.*, 1998). Although the 1992 HOP survey included both types of survey items, the open-ended items only yield qualitative data that are not suitable for CFA models. I thus select three items that yield ordinal level data and arguably also tap perceived importance of environmental problems in general. The first item is: *“I’m going to read a list of issues and problems currently facing many countries. For each, please tell me how serious a problem you consider it to be in our nation: (1) very serious, (2) somewhat serious, (3) not very serious, or (4) not at all serious.”* Included in the list is a question about environmental issues (Q3c). The second item asks: *“how concerned are you personally about environmental problems—would you say, (1) a great deal, (2) a fair amount, (3) not very much, or (4) not at all?”*(Q8) The third item asks: *“Which one of the following comes closest to your view, (1) the environment is one of the 2 or 3 most important problems facing our country; (2) the environment is an important problem, but there are several other problems that are more important; (3) the concern over the environment has been overblown and it is not as important as it has been made out to be.”* (Q9)

Pro-environmental behaviors and activism (“Behaviors & Activism”) is commonly measured by probing respondents’ involvement in the environmental movement and self-reported pro-environmental behaviors (Dunlap and Scarce, 1991; Guber, 1996 and 2003). One item reflecting involvement in the environmental movement was included in the 1992 HOP survey. The item asks: *“Thinking about this ‘environmental’ [or ‘ecological’] or ‘green’ movement, do you think of yourself as, (1) a very active participant in it, (2) a somewhat active participant in it, (3) sympathetic*

toward the movement, but not active in it, (4) neutral toward movement, or (5) not sympathetic toward the movement?” (Q10) For self-reported pro-environmental behaviors, the HOP survey has a diverse list of 13 various pro-environmental behaviors (see Table 4.1, page 95 for details on these 13 items) for respondents to identify which one(s) they have done in the past year. Each item therefore yields a dichotomous variable that is not directly suitable for CFA. I therefore construct two additive composite (Lifestyle and Political) indexes using two different sets of these dichotomous variables to provide two indicators of self-reported pro-environmental behaviors. I will provide details about the construction of these two composite indices below.

For willingness to pay for environmental protection (environment-economic tradeoffs, or “Env-Eco Tradeoffs”), there are four items. The first item is: “*With which of these statements about the environment and the economy do you most agree? (1) Protecting the environment should be given priority, even at the risk of slowing down economic growth; (2) economic growth should be given priority, even if the environment suffers to some extent; (3) (only if volunteer) should be given equal priority.*” (Q18) The second item is: “*Increased efforts by business and industry to improve environmental quality might lead to higher prices for the things you buy. Would you be willing to pay higher prices so that industry could better protect the environment, or not?*” (Q44)¹ The third one is: “*How willing would you be to pay somewhat higher taxes to the government if you knew the money would be spent to protect the environment? Would you be, (1) very willing, (2) somewhat willing, (3) not very willing, or (4) not at all willing?*” (Q46) The fourth item asks: “*How willing would you be to accept more unemployment if it*

improved environmental quality? Would you be, (1) very willing, (2) somewhat willing, (3) not very willing, or (4) not at all willing?” (Q47)

Finally, for support for governmental policies and regulations (“Policy Support”), I use five items. A question in the HOP asks: *“Here are some actions our government could take to help solve our nation’s environmental problems. Keep in mind that there are costs associated with these actions, please tell me—for each one I read—whether you would, (1) strongly favor, (2) somewhat favor, (3) somewhat oppose, or (4) strongly oppose?”* Five out of a total of six governmental actions are selected,² including: *“Make stronger environmental protection laws for business and industry;”* (Q25a) *“Make laws requiring that all citizens conserve resources and reduce pollution;”* (Q25b) *“Support scientific research to help find new ways to control pollution;”* (Q25d) *“Limits exports of our natural resources to other nations;”* (Q25e) and *“Ban the sale of products that are unsafe for the environment.”* (Q25f)

Construction of composite indices for self-reported pro-environmental behaviors

As mentioned above, the HOP questionnaire includes a list of thirteen self-reported pro-environmental behavior items, each of which yields a dichotomous variable that is not suitable for CFA. To avoid giving up these highly valuable items, I form composite indices by combining them. It is therefore logical to examine whether these 13 items converge onto one or more than one factor.

In the literature of environmental concern, except a few studies focusing on single specific pro-environmental actions (e.g., Heberlein and Black, 1976; Van Liere and Dunlap, 1978), most studies utilize multiple survey items aiming at measuring pro-

environmental behavior in a more general sense.³ Among studies utilizing multiple items, approaches to dealing with the factor structure of the items are fairly diverse, which is worth a closer look.

One group of studies simply assumes that all pro-environmental behavior items load onto a single factor and proceed to analysis without examining this assumption (e.g., Samdahl and Robertson, 1989) or with only a little effort at examining the appropriateness of such an assumption (e.g, Schahn and Holzer, 1990; Scott and Willits, 1994). A common approach is to use Cronbach's Alpha to measure the degree of internal consistency of the set of items, which as discussed in Chapter Two is not an adequate test for unidimensionality. Some studies, on the other hand, utilize more advanced techniques to establish the unidimensionality of multiple items before combining them to form a single index. For instance, Tarrant and Cordell (1997) subject 11 pro-environmental behavior items to a CFA. With the exception of one item, they seem to load onto a single factor as the CFA results show, which then justifies combining the ten into a single behavioral index. Kaiser (1998) examines 40 pro-environmental behavior items using a probabilistic measurement approach called "Rasch model" (Andrich, 1988). Such a probabilistic approach allows for some degree of inconsistency among specific environmental behaviors without concluding that the entire set of items is multidimensional. Kaiser (1998) finds out that except for three items, the remaining 37 items indeed form a unidimensional scale with quite reasonable reliability and internal consistency.

While these studies treat pro-environmental behaviors as unidimensional, many other empirical studies find the opposite. These studies typically utilize EFA to examine

dimensionality and report that pro-environmental behavior has three (e.g., Stern *et al.*, 1999), four (e.g., Smythe and Brook, 1980), five (e.g., Ester, 1981), or even six dimensions (e.g., Roberts and Bacon, 1997). A close look at the identified dimensions reveals considerable overlap as well as obvious disagreement across different studies.

Stern *et al.* (1999) identify three dimensions, one consisting of self-reported consumer behaviors, another including “willingness-to-sacrifice” items that are similar to the four indicators of willingness to pay for environmental protection in the HOP survey described above, and the third dimension consisting of a variety of so-called “environmental citizenship actions” such as participating in environmental organizations, signing petitions in support for environmental protection, voting for pro-environmental candidates, and protest activities. Similarly, Ester (1981) identifies a “collective environmental action” dimension, which overlaps with the third dimension of Stern *et al.* (1999). In addition to this collective action dimension, Ester (1981) also distinguishes four sub-dimensions among a group of individual environmental actions, consumer behavior being one of the sub-dimensions. Interestingly, the dimensions identified by Smythe and Brook (1980) are “active club membership,” “government contacts,” “purchases,” and “cleanup drive.” “Purchase” is clearly a consumer behavior dimension, while the remaining three dimensions identified by Smythe and Brook (1980) would otherwise be grouped into a single collective action dimension according to the schemes of both Ester (1981) and Stern *et al.* (1999). Therefore, it seems that on the one hand, there is some agreement on the general distinction between individual and collective actions; on the other hand, there are clear disagreements over whether we need to further distinguish within either group of individual or collective actions.

It is therefore reasonable to conclude that there is no clear agreement on the dimensionality of pro-environmental behaviors. This leads me to adopt a cautious approach in forming my own measures. The general strategy I adopt here is to first assume multiple dimensions and then to test such an assumption within the overall CFA model to be specified below. A detailed description of the 13 self-reported pro-environmental behaviors is provided in Table 4.1.

Item 13 is excluded from the list due to its inapplicability to those without children. The remaining 12 items are divided into two groups on the basis of their content validity and insights of previous studies reviewed above. Group one, labeled “green lifestyle,” consists of items 1, 9, 10, 11, and 12, which are mainly individual consumer actions. Group two is named “political actions” and composed of items 2, 3, 4, 5, 6, 7, and 8, which are more or less the type of actions Stern *et al.* (1999) would call the “environmental citizenship actions.” All 12 items are subjected to a principal component analysis, which yields two factors after varimax rotation with Kaiser Normalization. The results of the factor loading scheme confirms my initial division of these 12 items. For both sets of items the internal consistency is reasonable for dichotomous variables (Alpha=.67 for green lifestyle and .65 for political actions, respectively). Item 6 is however, excluded due to its low item-total correlation (below .30), raising the alpha for the political actions measure to .66. Each item is coded as yes=1 and no=0, with no missing values. I form two composite indices by summing up items in each of the two groups, which yields two summated rating scales of different pro-environmental behaviors. These two composite indices, named “Lifestyle” and “Political” respectively, are then entered into the CFA model to be specified below as indicators of individuals’

Table 4.1: Detailed Description of the 13 Self-reported Pro-environmental Behaviors

<i>Item</i>	<i>Description</i>
1	Avoided using certain products that harm the environment
2	Been active in a group or organization that works to protect the environment
3	Voted for or worked for candidates because of their position on environmental issues
4	Contributed money to an environmental, conservation or wildlife preservation group
5	Written letter(s) or tried to contact an official about some environmental problem
6	Participated in a public demonstration against a company or business because of its poor position or record on the environment
7	Signed a petition supporting an environmental group or some environmental protection effort
8	Attended a meeting concerning the environment
9	Tried to use less water in your household
10	Bought some product specifically because you thought it was better for the environment than competing products
11	Voluntarily recycled newspapers, glass, aluminum, motor oil or other items
12	Reduced your household's use of energy or fuel
13	If you are the parent of a school-age child, encouraged your child or children to be environmentally responsible

pro-environmental behaviors and activism.

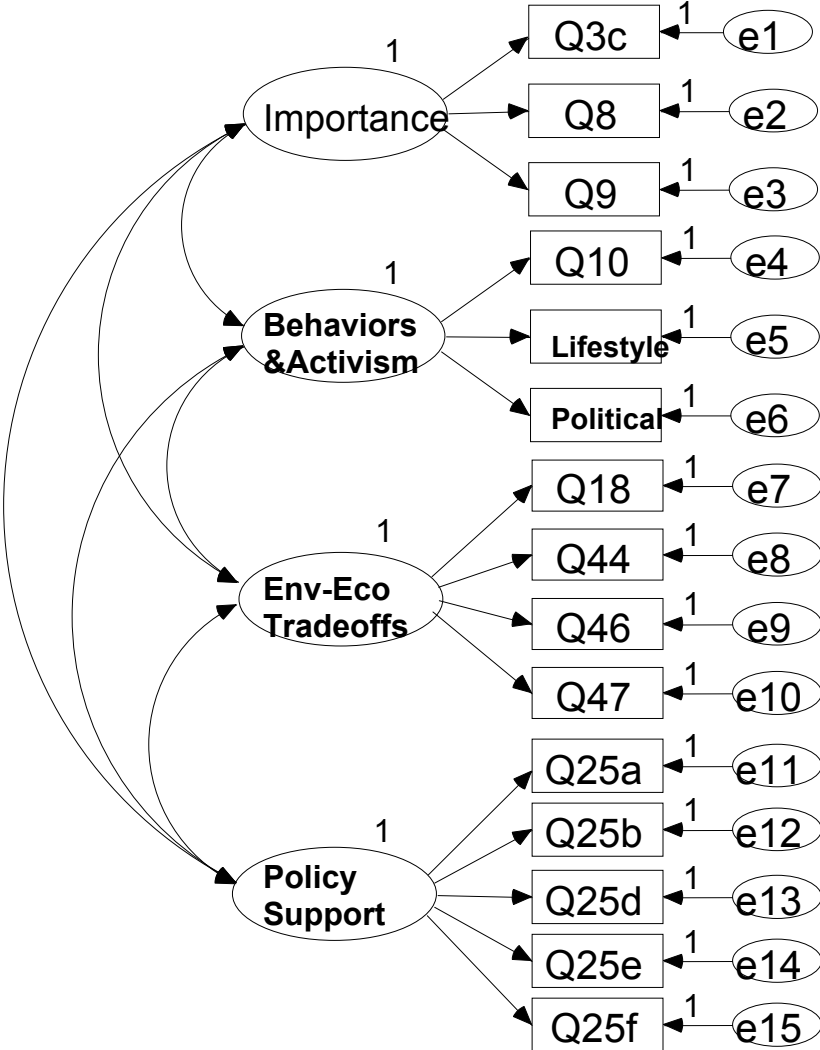
It should be noted that although the PCA results seem to suggest a two-dimensional structure for these eleven self-reported environmental actions, such a test is not conclusive as PCA has serious limitations in testing for dimensionality as noted in Chapter Two. In particular, varimax rotation used in this analysis is a form of orthogonal rotation that does not allow for inter-factor correlation. I will further examine the correlation between these two factors in the subsequent CFA model to reach a stronger conclusion about the dimensionality of self-reported environmental actions.

Model Specification

To examine the interrelationships among the four facets of the “concern” component of environmental concern described thus far, I specify a CFA model shown in Figure 4.1. As this path diagram shows, I hypothesize that there are four latent factors (in oval circles) within the “concern” component of environmental concern, each corresponding to one key facet as described above. Each latent factor is measured with multiple items (in rectangular boxes), also as described above. Each item has a measurement error term attached, designated as “e1” to “e15” (also in oval circles). Correlations between every pair of latent factors are also specified, designated by two-headed curve lines. The CFA model includes correlations among measurement error, but they are not shown in the path diagram for lack of space.

Figure 4.1: the Interrelationships among the Four Facets of the “Concern”

Component of Environmental Concern



Results

The CFA model estimation using AMOS 4.0 software returns over 100 coefficients and statistics. Table 4.2 reports those of primary interest. Please note that there are two samples in the model, the USA and Canadian samples. The goodness-of-fit statistics show very good model-data fit. This is also a test of similarity between the two national samples' overall factor structure. The non-significant result means I fail to reject the null hypothesis that the USA and Canada share the same factor structure, suggesting similar patterns of coherence in the “concern” component of environmental concern among the publics of both nations.

The first section of Table 4.2 reports the inter-correlations among the four facets of the “concern” component of environmental concern for both the USA and Canadian samples. Generally, all correlations are quite strong, near or above .50, except the correlation between “Policy Support” and “Env-Eco tradeoffs” for the Canadian sample at .46. All correlations are statistically significant at $\alpha=.05$ level. The correlations between “Importance” and “Behaviors & Activism” in both the USA and Canadian samples are particularly high at .88 and .85 respectively (with no statistically significant difference found between the two). Such high correlation coefficients translate into over 70 percent variance explained if one were to use one factor to predict the other in a linear regression model as the definition of belief constraint would suggest. This indicates that it is appropriate to consider that these two factors are measuring the same latent construct or that a high degree of constraint exists across these two factors. The remaining correlations are not as high, however, ranging for .46 to .73. This then raises the question of whether the whole set of latent factors can be considered unidimensional.

Table 4.2: CFA results of Model 4.1—the Interrelationships among the Four Facets of the “Concern” Component of Environmental Concern

<i>Correlations</i>	Importance		Behaviors & Activism		Env-Eco Tradeoffs		Policy Support	
	<i>USA</i>	<i>CAN</i>	<i>USA</i>	<i>CAN</i>	<i>USA</i>	<i>CAN</i>	<i>USA</i>	<i>CAN</i>
Behaviors & Activism	.88*	.85*	--	--	--	--	--	--
Env-Eco Tradeoffs	.65*	.54*	.73*	.65*	--	--	--	--
Policy Support	.62*	.53*	.52*	.51*	.60* ¹	.46* ¹	--	--
<i>Factor Loadings</i>								
Q3c	.44*	.48*	--	--	--	--	--	--
Q8	.68*	.73*	--	--	--	--	--	--
Q9	.57*	.50*	--	--	--	--	--	--
Q10	--	--	.64*	.60*	--	--	--	--
Lifestyle	--	--	.53*	.40*	--	--	--	--
Political	--	--	.55*	.50*	--	--	--	--
Q18	--	--	--	--	.49*	.53*	--	--
Q44	--	--	--	--	.67*	.70*	--	--
Q46	--	--	--	--	.62*	.68*	--	--
Q47	--	--	--	--	.43*	.43*	--	--
Q25a	--	--	--	--	--	--	.64*	.61*
Q25b	--	--	--	--	--	--	.60*	.48*
Q25d	--	--	--	--	--	--	.58*	.48*
Q25e	--	--	--	--	--	--	.40*	.36*
Q25f	--	--	--	--	--	--	.67*	.53*
<i>Goodness-of-Fit</i>								
Chi-square	133.78							
Degree-of-freedom	116							
P-Value	.12							
GFI	.99							
NFI	.98							

* P<.05

1. The USA and Canadian correlations are significant different from each other at $\alpha=.05$ level

As discussed in the second section of this chapter, correlation as a measure of constraint is not ideal when there are more than two variables. Unless there are clear patterns, such as all correlations are very high or very low, or some variables have very high or low correlations with all other variables, it is difficult to reach an unequivocal conclusion with a large number of correlation coefficients. There is an additional issue of interpretation concerning the magnitude of correlations. In the literature on environmental concern there are no widely agreed upon standards or cutting points with regard to how strong a correlation needs to be in order for a researcher to make an unequivocal interpretation about dimensionality. Judging by the pure mathematical magnitude of correlations, any correlation less than 1.00 reveals some difference between the pair of variables. It thus becomes a matter of degree about how small a difference one can safely discard.

A solution to the first issue can be accomplished by applying a technique called higher-order confirmatory factor analysis (see Bollen, 1989 for details). Higher-order CFA is based on general CFA, in which multiple first-order latent factors are subjected to a second-order factor analysis (the number of orders can be larger than two if needed). Such a higher-order CFA will yield a single second-order factor loading for each first-order latent factor, and therefore effectively reduces the number of coefficients to be interpreted.

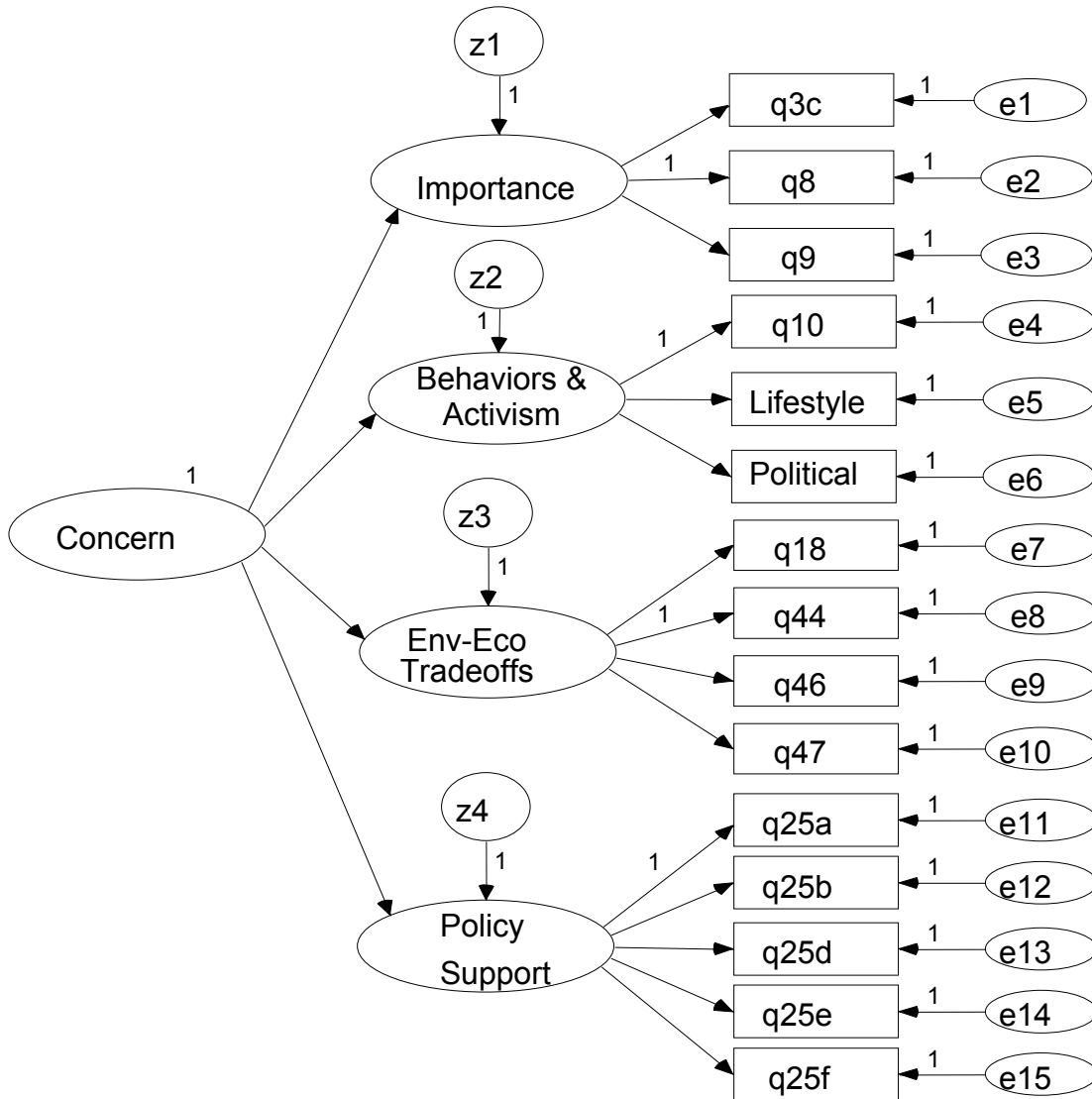
A solution to the issue of magnitude is provided by the adoption of Higher-order CFA. A criterion widely used in factor analysis noted by Kim and Mueller (1978) is that loadings below .30 signal that items are not measuring the same factor as are higher-loading items on the factor (e.g., Roberts and Bacon, 1997). I will therefore adopt the .30

criterion for the first-order factor loadings. For the second-order factor loading, I will adopt the more restrictive criterion of .50. This is because for second-order (or higher) factor analyses, additional measurement error is allowed for each first-order latent factor (see Figure 4.2 below for details) in addition to the measurement errors of the observed items. This more restrictive criterion is used to compensate for the accumulation of measurement errors. It is important to acknowledge that these criteria are subjective and therefore tentative.

The second section of Table 4.2 reports the factor loadings for all survey items and the two composite indexes of pro-environmental behaviors. Generally speaking, the factor loadings are quite strong, with only one below .40, and it is above .30. Such factor loadings indicate that a majority of the survey items have good measurement reliability, as even the one item with a loading below .40 (but larger than .30) has moderate and acceptable reliability. In terms of constraint, these factor loadings also suggest considerable constraint in the “concern” component of environmental concern across items of perceived importance of environmental problems, pro-environmental behaviors and activism, willingness to pay for environmental protection, and support for environmental policies and regulations.

In particular, the factor loadings of both composite indexes, “Lifestyle” and “Political,” are fairly strong at .53 and .55 for the USA sample and .40 and .50 for the Canadian sample. Strong factor loadings on the same latent factor suggest that these two indexes are quite consistent with each other. It is therefore reasonable to conclude that all 11 self-reported pro-environmental behavior items have a high degree of consistency or constraint, unlike what is reported by Stern *et al.* (1999) and others.

Figure 4.2: Higher-Order Confirmatory Factor Analysis with Four Facets of the “Concern” Component of Environmental Concern



Quite importantly, the inter-sample comparisons show that the USA and Canadian samples have very similar inter-factor correlations. Of the six pairs of correlations being compared, only one turns out to have significant difference (at $\alpha=.05$ level). That is the “Env-Eco Tradeoffs”-“Policy Support” correlation comparison, in which the USA sample has a stronger correlation than the Canadian sample.

Correlations among the four latent factors do not seem to yield a clear-cut answer about the dimensionality issue. However, since all correlations are substantial and significant, there is clearly a good deal of constraint across the four latent factors. In order to further examine the dimensionality issue, I construct a second model using the same set of items as Model 4.1. Figure 4.2 shows the path diagram.

As Figure 4.2 shows, I specify that all four first-order latent factors, “Importance,” “Behaviors & Activism,” “Env-Eco Tradeoffs,” and “Policy Support,” load onto one single second-order latent factor labeled simply as “Concern.” Note that there are four second-order measurement error terms named “z1” to “z4” attached to each first-order latent factor. Estimations of second-order factor loadings will help to clarify the dimensionality issue. Table 4.3 reports results of this higher-order CFA.

Comparing the results of Model 4.1 and 4.2, one can find virtually no difference in the first-order factor loadings. Most interestingly, all second-order factor loadings for the four first-order latent variables are strong to very strong in both nations, ranging from .62 to .90. Such strong factor loadings suggest that all four key facets of the “concern” component of environmental concern are indeed measuring the same underlying construct and thus exhibit high degree cross-factor constraint in both the USA

and Canadian samples. Model 4.2 also has adequate model fit, generally suggesting the same

Table 4.3: the Results of Higher-Order CFA with the Four Facets of the “Concern” Component of Environmental Concern

<i>Second-Order Factor Analysis</i>								
	Importance		Behaviors & Activism		Env-Eco Tradeoffs		Policy Support	
	USA	CAN	USA	CAN	USA	CAN	USA	CAN
Concern	.94*	.86*	.88*	.90*	.76*	.63*	.68*	.62*
<i>First-Order Factor Loadings</i>								
Q3c	.49*	.54*	--	--	--	--	--	--
Q8	.62*	.68*	--	--	--	--	--	--
Q9	.63*	.54*	--	--	--	--	--	--
Q10	--	--	.62*	.61*	--	--	--	--
Lifestyle	--	--	.55*	.40*	--	--	--	--
Political	--	--	.57*	.51*	--	--	--	--
Q18	--	--	--	--	.59*	.63*	--	--
Q44	--	--	--	--	.65*	.71*	--	--
Q46	--	--	--	--	.66*	.70*	--	--
Q47	--	--	--	--	.46*	.47*	--	--
Q25a	--	--	--	--	--	--	.65*	.63*
Q25b	--	--	--	--	--	--	.61*	.49*
Q25d	--	--	--	--	--	--	.57*	.47*
Q25e	--	--	--	--	--	--	.39*	.35*
Q25f	--	--	--	--	--	--	.67*	.52*
<i>Goodness-of-Fit</i>								
Chi-square	143.04							
Degree-of-freedom	123							
P-Value	.10							
GFI	.99							
NFI	.98							

*P<.05

factor structure for both the USA and Canadian samples. The fact that the results are similar for *both* the USA and Canadian samples provides even more basis for arguing that these findings demonstrate that the “concern” component of environmental concern is indeed a coherent construct in the minds of the general publics of both nations.

Part Two, a Combined Test of the Biophysical Property Distinction and the Geographical Scale Distinction

There are four conceptual distinctions identified within the “environmental” component of environmental concern as described above: biophysical property, generality-specificity continuum, geographical scale, and temporal distinctions. Unfortunately the 1992 HOP survey does not include enough items for a test of the temporal distinction and generality-specificity continuum, which are thus excluded. There is also only a modest list of substantive topics that allow for a limited test of the biophysical property distinction (operationalized to tap differing functions of the environment discussed by Dunlap, 1994). On the other hand, the 1992 HOP survey provides enough items at three geographical scales—community/local, national, and global—to allow for a comprehensive test of the geographical scale distinction. In the second part of the analysis, I will construct a model to test both the biophysical property distinction and the geographical scale distinction simultaneously.

Variable Selection

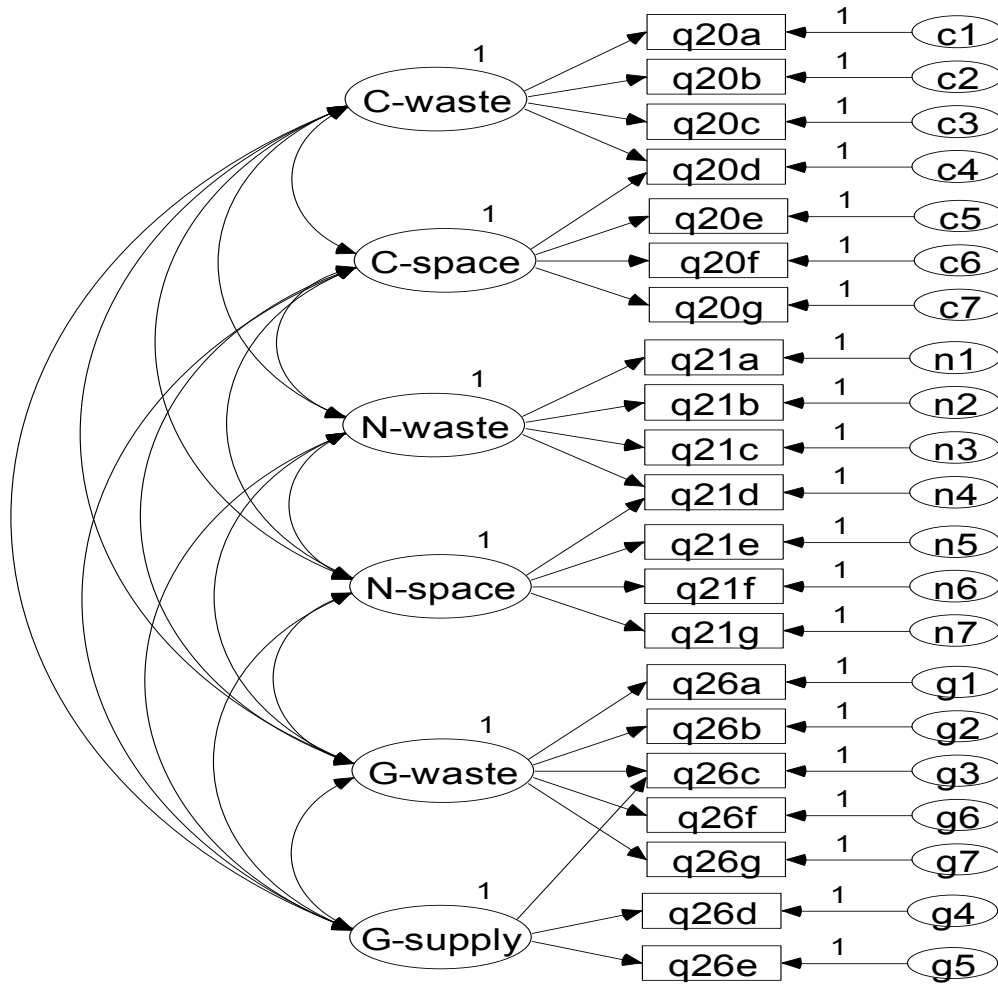
At both the community and national scales, items including *poor water quality* (Q20a and Q21a), *poor air quality* (Q20b and Q21b), *contaminated soil* (Q20c and Q21c),

and *inadequate sewage, sanitation, and garbage disposal* (Q20d and Q21d) can be seen as indicators of the waste repository function, while the other three items—including *too many people—overcrowding* (Q20e and Q21e), *too much noise* (Q20f and Q21f), and *not enough parks and open space* (Q20g and Q21g)—are more or less related to the living space function. Q20d and Q21d also can be seen as indicators of the living space function, so I will allow for their cross-loadings in the model as shown in Figure 4.3. At the global scale, three items including *air pollution and smog* (Q26a), *pollution of rivers, lakes, and oceans* (Q26b), and *soil erosion, polluted land, and loss of farmland* (Q26c) are indicators of various forms of pollution, and thus belong to the waste repository group. Q26c also involves loss of farmland, which clearly belongs to the supply depot function. So its cross-loading will be allowed to accommodate this issue. The next two items, *loss of animal and plant species* (Q26d) and *loss of the rain forests and jungles* (Q26e), are both indicators of the supply depot function because they are related to loss of nature resources. The last two global environmental issues, *global warming or the ‘greenhouse’ effect* (Q26f) and *loss of ozone in the earth’s atmosphere* (Q26g), are in fact two specific forms of air pollution as they are both due to the emission of some specific pollutants (greenhouse gases for the former and CFCs for the latter) into the atmosphere (e.g., Dunlap, 1994). Thus they belong to the waste repository set of indicators.

Model Specification

In Model 4.3, there are six latent variables, “supply depot” at the global scale named as “G-supply;” “waste repository” at the community, national, and global scale that are named as “C-waste,” “N-waste,” and “G-waste” respectively; and “living space”

**Figure 4.3: the Interrelationships between the Six Facets of the “Environmental”
Component of Environmental Concern**



at the community and national scale named as “C-space” and “N-space.” There is no indicator for the supply depot function at either the community or national scales, nor one for the living space function at the global scale. Twenty-one observed variables are hypothesized to measure their respective latent variables, with a measurement error term attached to each of them. Through estimation of correlations between the six latent variables, Model 4.3 enables a simultaneous examination of both conceptual distinctions among the three basic functions of the environment *and* geographical scales. It is also possible to examine the relative effects of each distinction by comparing two types of correlations, correlations between the latent variables belonging to the same basic function and correlations between the latent variables sharing the same geographical scale.

Results

Due to the large number of coefficients, I divide the results into two tables. The first table (Table 4.4) reports the correlations among the latent factors as well as the model evaluation statistics. The second table (Table 4.5) reports factor loadings for the twenty-one survey items. Table 4.4 presents a complicated picture. Although all correlations reported are significant at $\alpha=.05$ level, some correlations are very strong, while some others are fairly weak. The strongest correlations are those between the factors that belong to the same geographical scale. For example, the “G-waste”-“G-supply” correlation is very strong at .86 (USA) and .80 (Canada), the “N-waste”-“N-space” correlation is also strong at .65 (USA) and .63 (Canada), and so is the “C-waste”-“C-space” correlation at .72 (USA) and .64 (Canada). The weakest correlations are those

Table 4.4: CFA Results of Model 4.3—the Interrelationships between the Six Facets of the “Environment” Component of Environmental Concern

Correlations		C-waste	C-space	N-waste	N-space	G-waste
C-space	<i>USA</i>	.72*				
	<i>CAN</i>	.64*				
N-waste	<i>USA</i>	.47*	.31*			
	<i>CAN</i>	.59*	.28*			
N-space	<i>USA</i>	.30*	.36*	.65*		
	<i>CAN</i>	.34*	.44*	.63*		
G-waste	<i>USA</i>	.29*	.20*	.56*	.42*	
	<i>CAN</i>	.26*	.15*	.47*	.29*	
G-supply	<i>USA</i>	.26*	.21*	.47*	.38*	.86*
	<i>CAN</i>	.22*	.15*	.38*	.17*	.80*
Goodness-of-fit						
Chi-square		287.77				
Degree of freedom		252				
P-value		.06				
GFI		.99				
NFI		.99				

*P<.05

between the community factors and the global factors. For instance, the “C-space”-“G-waste” correlations are only .20 (USA) and .15 (Canada) while the “C-space”-“G-supply” correlations are also very weak at .21 (USA) and .15 (Canada).

Based on these correlations, it appears that respondents in both nations tend to make a clear distinction among specific environmental issues reflecting the three geographical scales. On the other hand, correlations between the latent factors reflecting the same basic function of the environment tell a different story. For the waste repository function, the correlations between “C-waste” and “N-waste” and between “N-waste” and “G-waste” are moderate at near .50 level, while the correlations between “C-waste” and “G-waste” are quite weak at only .29 (USA) and .26 (Canada). For the living space function, the correlations between “C-space” and “N-space” are also not strong at .36 (USA) and .44 (Canada). Thus, a logical interpretation is that distinctions among environmental problems reflecting the waste repository and living space functions are not that salient to respondents. Such a finding, however, is somewhat inconclusive due to lack of data to cover the entire range, since there are no indicators of the supply function at both the community and national scales and only correlations involving waste repository function for all three geographical scales. Let me now turn to factor loadings.

According to Table 4.5, all factor loadings are both statistically significant (at $\alpha=.05$) and substantively strong, ranging from .54 to .86, except the three cross-loadings described above. Strong factor loadings show that these items are reliable indicators of their corresponding latent factors, and also reflect strong cross-item constraint within each of the six groups of items corresponding to the six latent factors. On the other hand, the three cross-loadings for Q20d, Q21d, and Q26c are not significant, indicating that

Table 4.5: CFA Results of Model 4.3, Factor Loadings

Factor Loadings	USA	CAN
Q20a (on C-waste)	.73*	.76*
Q20b (on C-waste)	.79*	.86*
Q20c (on C-waste)	.71*	.71*
Q20d (on C-waste)	.72*	.60*
Q20e (on C-space)	.81*	.79*
Q20f (on C-space)	.80*	.84*
Q20g (on C-space)	.69*	.70*
Q21a (on N-waste)	.67*	.75*
Q21b (on N-waste)	.69*	.82*
Q21c (on N-waste)	.75*	.81*
Q21d (on N-waste)	.60*	.67*
Q21e (on N-space)	.77*	.78*
Q21f (on N-space)	.75*	.82*
Q21g (on N-space)	.73*	.71*
Q26a (on G-waste)	.68*	.68*
Q26b (on G-waste)	.63*	.71*
Q26c (on G-waste)	.59*	.58*
Q26d (on G-supply)	.88*	.79*
Q26e (on G-supply)	.68*	.72*
Q26f (on G-waste)	.60*	.54*
Q26g (on G-waste)	.67*	.57*
Cross Loadings		
Q20d (on C-space)	.01	.06
Q21d (on N-space)	.08	.01
Q26c (on-G-supply)	.10	.14

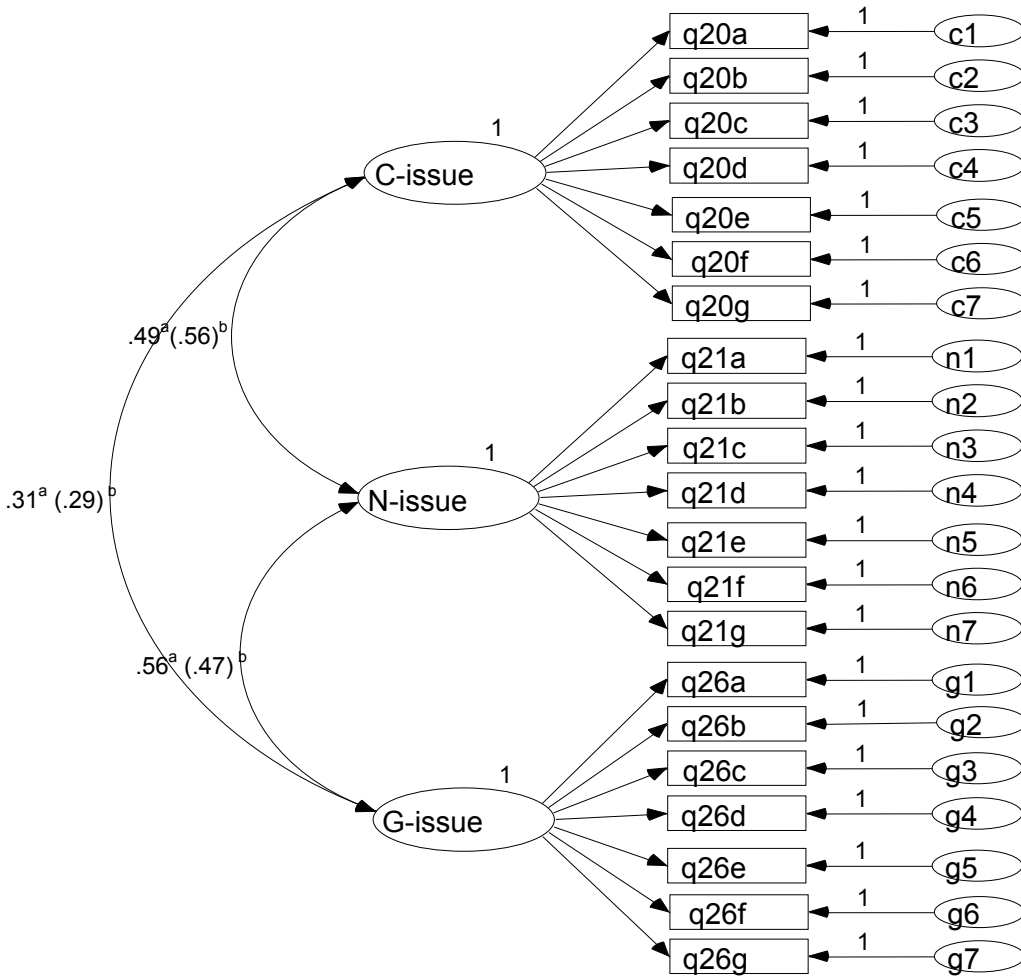
* P<.05

there is no need for such cross-loadings. Indeed, as will shown in the following Model 4.4, the three pairs of latent factors that share the same geographical scale are in fact measuring the same underlying construct. Therefore, the cross-loadings specified in Model 4.3 are redundant.

The empirical evidence shows that the geographical scale distinction is strong and prominent, while the effect of the distinction among the three basic functions of the environment is not very significant. These twenty-one specific environmental issues thus appear to form three latent factors: community issues, national issues, and global issues. To further test this factor structure, I specify another CFA model with these twenty-one items, as shown in Figure 4.4.

Figure 4.4 also reports the correlations between latent factors, while all factor loadings are essentially the same as reported in Table 4.5. The correlations between “C-issue” and “N-issue” and between “N-issue” and “G-issue” are around .50, which is fairly strong, while the correlations between “C-issue” and “G-issue” are at best moderate at about .30. Based on these correlations, there is no clear answer as to whether this CFA model supports the hypothesized three-factor structure. Correlations at the .50 level provide moderate evidence for unidimensionality, while correlations of .30 level seem too weak to support unidimensionality. On the other hand, it is reasonable to conclude that these correlations do indicate considerable constraint among substantive aspects of environmental problems. The cross-issue constraint is especially high within each of the three geographical groups as the factor loadings reported in Table 4.5 show.

Figure 4.4: the Three-factor Structure of the “Environmental” Component of Environmental Concern



Note:

1. Model 4.4 has adequate model fit, (Chi-square=299.9, degree of freedom=265, P=.07, GFI=.99, NFI=.99).
2. All correlation coefficients reported are significant at $\alpha=.05$.
 - a. USA Sample
 - b. Canadian Sample

The above results enable me to question deHaven-Smith's (1991) argument to a certain extent. One aspect of the empirical evidence deHaven-Smith (1991) uses to support his conclusion that there is no "generalized" concern about the environment is the finding that among the general public in Florida there is not much constraint across specific issues. The results of Models 4.3 and 4.4, however, show considerable cross-issue constraint within geographical scales and even moderate constraint across geographical scales. To be cautious, I will tentatively treat these three geographical factors as relatively distinct from one another for now. In later models, these three factors will be entered into analysis separately and subjected to further testing.

Inter-sample comparisons reveal that the correlation between "N-issue" and "G-issue" is significantly stronger in USA than Canada ($p=.03$). Comparisons of the remaining two pairs of correlations are not significant. Overall, Model 4.4 has adequate goodness-of-fit, suggesting that the USA and Canada, *again*, share similar factor structure, this time when the "environmental" component is considered. This reinforces the earlier findings of the analyses in Part One where I reported that the USA and Canadian samples have a very similar factor structure and inter-factor consistency on the "concern" component. It is therefore reasonable to hypothesize that citizens in these two nations have similar levels of belief constraint and a relatively coherent structure of environmental concern. This hypothesis will be examined in the final step of analysis.

Part Three: Incorporating the NEP

The analyses reported in Part One examined the interrelationships among the key facets of the "concern" component of environmental concern, employing a broad range of

indicators tapping different policy-relevant expressions of concern. In Part Two I examined two conceptual distinctions, the three basic functions of the environment and varying geographical scales, among specific environmental issues to examine the substantive component of environmental concern. The next logical step is to put both Part One and Two together to form a comprehensive measurement model of environmental concern. In addition to variables examined in the analyses reported in Part One and Two, the 1992 HOP dataset provides additional variables enabling me develop an even more comprehensive measurement model. These additional variables are eight items measuring the New Environmental Paradigm.

The New Environmental Paradigm (NEP) Scale was originally developed by Dunlap and Van Liere in 1978 and revised by Dunlap *et al.* in 2000 (see Chapter Two for more detail). The 1992 HOP survey included eight items that are only slightly different from those in the original NEP Scale. It is widely agreed that the NEP Scale measures a set of basic environmental values and beliefs or a “worldview” (e.g., Heberlein, 1981; Gray, 1985; Stern *et al.*, 1995; Dunlap and Jones, 2002). According to Gray (1985: 32), the NEP can be classified as a measure of “primitive beliefs,” which constitute one important component of the primary beliefs in Gray’s Ecological Attitude System (again, see Chapter Two for more detail). Therefore, by including the NEP items, I can further enhance the content validity of the final measurement model.

There is, however, a complication that first requires attention. There are debates in the literature on environmental concern about whether it is appropriate to consider the NEP Scale as unidimensional (see Chapter Two for detail). Among the eight NEP items included in the 1992 HOP survey, there could be three latent factors identified by

previous empirical studies (Albrecht *et al.*, 1982; Geller and Lasley, 1985): “balance of nature,” “limits to growth,” and “(anti-) anthropocentrism.” Let me describe the eight NEP items.

Variable Selection and Model Specification

In the early middle of the HOP survey, respondents are asked a set of 12 questions about humans’ relationship to the natural environment and science and technology.

These include eight NEP items.

- 1: *The balance of nature is very delicate and easily upset by human activities.*
- 2: *There are no limits to growth for advanced industrialized nations.*
- 3: *Humans were created to rule over the rest of nature.*
- 4: *Modifying the environment for human use seldom causes serious problems.*
- 5: *The earth is like a spaceship with only limited room and resources.*
- 6: *Plants and animals do not exist primarily to be used by humans.*
- 7: *The so-called “ecological crisis” facing mankind has been greatly exaggerated.*
- 8: *The earth can support a much larger world population than exists today.*

For each item, respondents are asked to indicate whether they “(1) *strongly agree with it*, (2) *agree with it*, (3) *disagree with it*, or (4) *strongly disagree with it*.” Table 4.6 shows coding information for these items.

Table 4.6 also shows the hypothesized item loading scheme. The eight NEP items are hypothesized to load onto the three latent factors mentioned above. Item 7, which is only indirectly about balance of nature, is grouped into the “balance of nature” factor. The justification for this specification is based on a recent study by Dunlap and his colleagues (Dunlap *et al.*, 2000). The results of their study show that this item heavily loads onto the same factor with item 1 and other “balance of nature” items not included in the 1992 HOP survey. I therefore hypothesize Model 4.5, as shown in Figure 4.5, to capture the structure of the NEP.

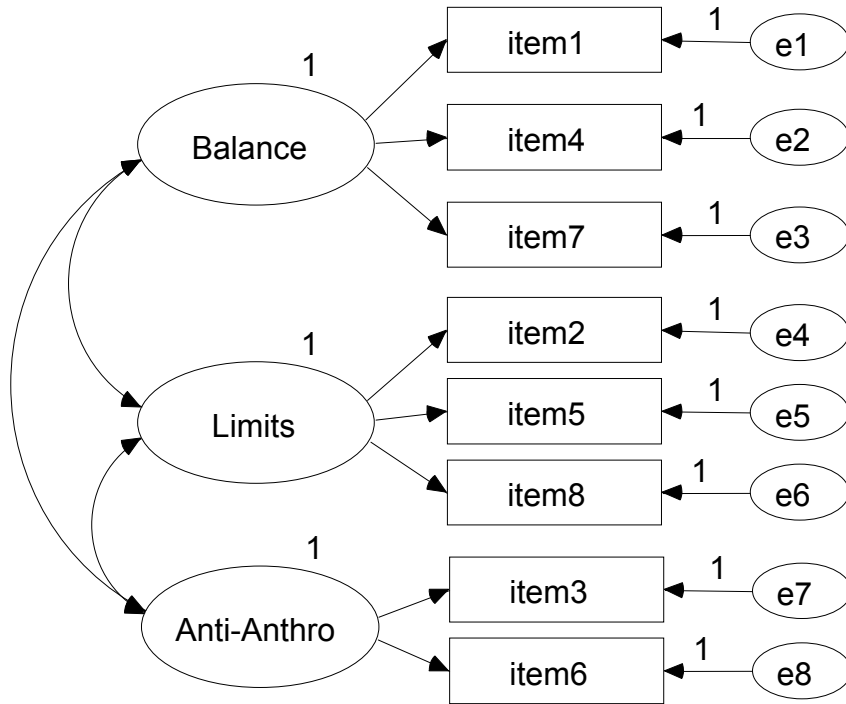
Table 4.6: Variable Names and Coding Information of the Eight NEP Items

<u>Item</u>	<u>Loading onto Factor</u>	<u>Coding</u>
Item 1	Balance	4 (strongly agree) to 1 (strongly disagree)
Item 2	Limits	1 (strongly agree) to 4 (strongly disagree)
Item 3	Anti-Anthro	1 (strongly agree) to 4 (strongly disagree)
Item 4	Balance	1 (strongly agree) to 4 (strongly disagree)
Item 5	Limits	4 (strongly agree) to 1 (strongly disagree)
Item 6	Anti-Anthro	4 (strongly agree) to 1 (strongly disagree)
Item 7	Balance	1 (strongly agree) to 4 (strongly disagree)
Item 8	Limits	4 (strongly agree) to 1 (strongly disagree)

Note:

1. “Anthro” is the short for anthropocentrism.
2. All indicators are recoded so that high scores represent pro-NEP beliefs prior to analysis.

Figure 4.5: the Three-factor Structure of the Eight-Item NEP Scale



As this path diagram shows, I hypothesize that the eight NEP items load onto three latent factors, “Balance” for balance of nature, “Limits” for limits to growth, and “Anti-Anthro” for anti-anthropocentrism. Since all indicators share exactly the same answering categories in a matrix format, measurement error correlations are expected and controlled (but not shown in the path diagram as always). All indicators are recoded so that high scores represent pro-NEP beliefs and NST is applied to each of them.

Results

Table 4.7 reports the results of Model 4.5. One prominent pattern standing out is that all correlations among latent factors are strong to very strong for both the USA and Canadian samples, with no significant differences found between them. These correlations suggest that the three latent factors are indeed measuring the same underlying construct, the NEP. Table 4.7 also reveals that generally the factor loadings are moderate to strong, ranging from .37 to .73, and none of the loadings is below .30. This indicates acceptable to good measurement reliability for each item as well as considerable cross-item constraint. Finally, the goodness-of-fit statistics show that this model has a good model fit, indicating that the USA and Canadian samples share a similar factor structure for the NEP, and that the eight-item NEP Scale in the HOP can be treated as unidimensional.

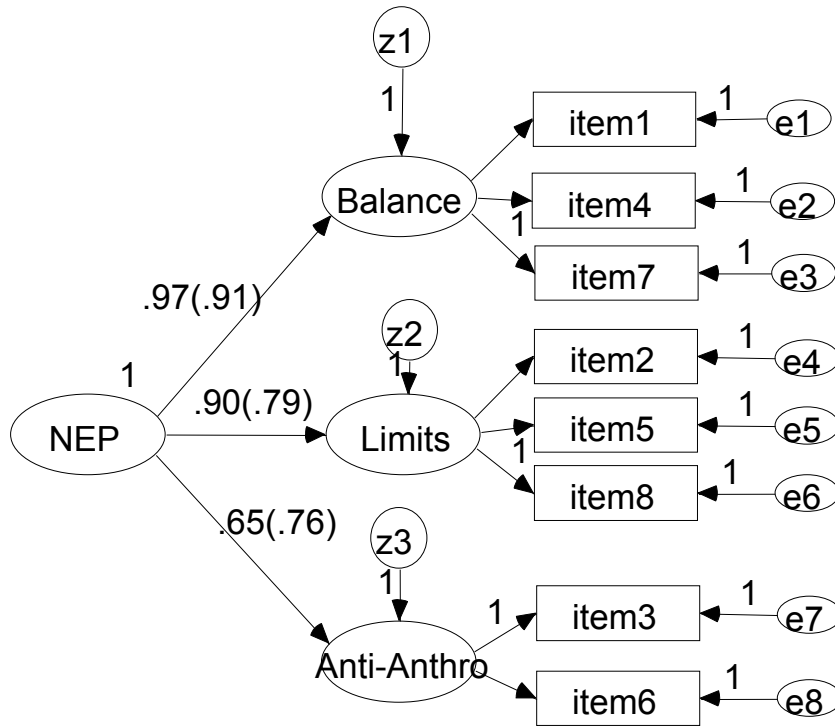
The high inter-factor correlations suggest unidimensionality, which is also confirmed by a higher-order CFA model as specified in Figure 4.6. As one can see, all of the second-order factor loadings are very high for both the USA and Canadian samples, ranging from .65 to .97, indicating a high degree of belief constraint. Therefore, it is appropriate to conclude that this eight-item NEP Scale is essentially unidimensional.

Table 4.7: Analysis Results of Model 4.5—the Three-Factor Structure of the Eight-Item NEP Scale

Correlations	Balance		Limits		Anti-Anthro	
	<i>USA</i>	<i>CAN</i>	<i>USA</i>	<i>CAN</i>	<i>USA</i>	<i>CAN</i>
Limits	.89*	.75*	--	--	--	--
Anti-Anthro	.60*	.75*	.66*	.69*	--	--
Factor Loadings						
Item1	.39*	.37*	--	--	--	--
Item4	.45*	.54*	--	--	--	--
Item7	.73*	.55*	--	--	--	--
Item2	--	--	.38*	.39*	--	--
Item5	--	--	.42*	.38*	--	--
Item8	--	--	.53*	.53*	--	--
Item3	--	--	--	--	.52*	.56*
Item6	--	--	--	--	.46*	.51*
Goodness-of-fit						
Chi-Square	25.70					
Degree of Freedom	21					
P-Value	.22					
GFI	1.00					
NFI	.99					

*P<.05

Figure 4.6: Higher-order CFA of the Eight-Item NEP Scale



Note:

1. Model 4.6 has excellent goodness-of-fit (Chi-square=23.43, degree of freedom=21, $p=.32$, GFI=1.00, NFI=.99).
2. Factor loadings in parentheses are the ones for the Canadian sample.

Part Four: A Comprehensive Measurement Model of Environmental Concern

In this part of analysis, I put the previous three parts of the analysis together to form a comprehensive measurement model of environmental concern. Based on the results of the analyses in Parts One, Two, and Three, I specify the final model as shown in Figure 4.7.

Combining all of the previous models together, I specify that environmental concern has a total of eight facets. Note that although in the analyses in Part One, “Importance,” “Behaviors & Activism,” “Env-Eco Tradeoffs,” and “Policy Support” were found to be measuring the same underlying construct, it still makes conceptual sense to keep them separate in this final model since they are widely treated as distinct aspects of environmental concern. Finally, since the eight-item NEP Scale is found to be essentially unidimensional in Part Three, I specify all eight items as loading onto one single latent factor, “NEP”. Table 4.8 reports the correlations among the eight key facets as well as the overall model evaluation statistics.

With eight latent factors and two samples, Table 4.8 reports a total of 56 correlations. I will concentrate on the correlations that are not already examined in the previous models. The first set of new correlations are those among the NEP and all other facets. It appears that the NEP strongly correlates with a majority of them, except “N-issue” and “C-issue.” What is striking is the “NEP”-“G-issue” correlation, which is fairly strong at about .60 for both the USA and Canadian samples. In fact, like the NEP, “G-issue” has strong correlations with all other key facets except “N-issue” and “C-issue.” This model thus reveals substantial belief consistency or coherence among the general public, encompassing a broad measure of perceived seriousness of

Figure 4.7: A Comprehensive Measurement Model of Environmental Concern

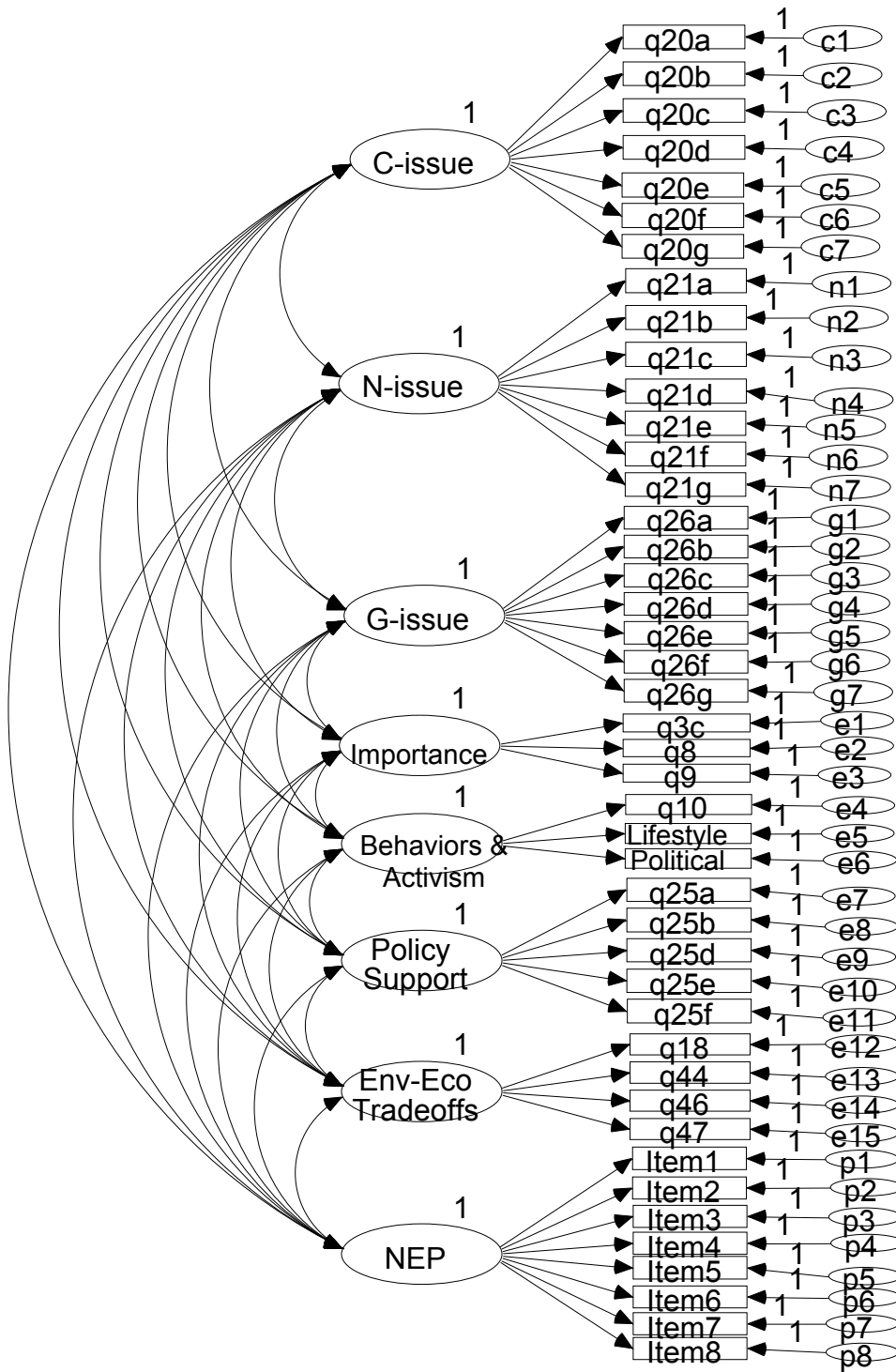


Table 4.8: Correlations among the Eight Key Facets of Environmental Concern

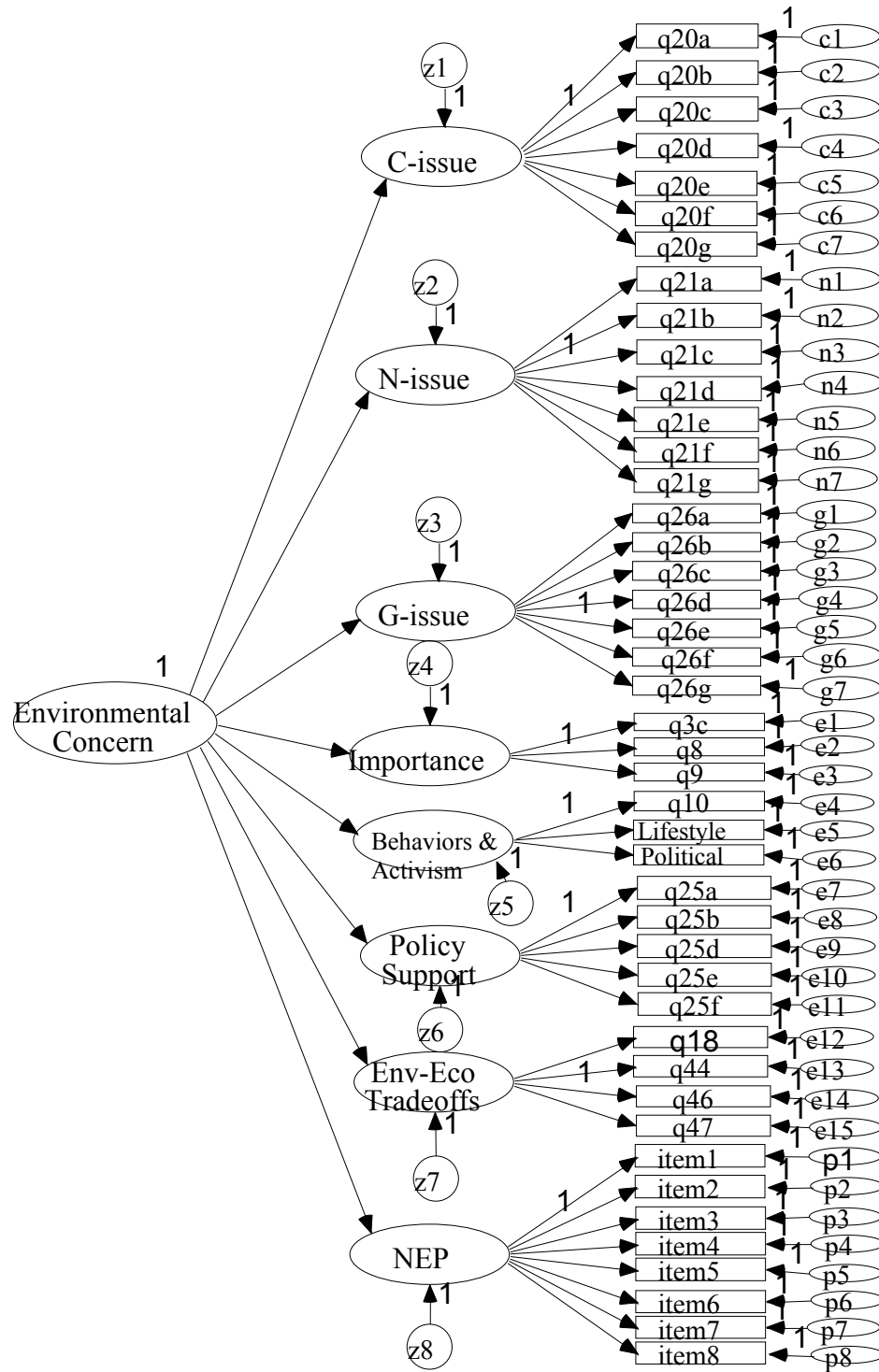
Correlation		Behaviors & Activism	Policy Support	Env-Eco Tradeoffs	NEP	C- issue	N- issue	G- issue
Importance	<i>USA</i>	.80*	.73*	.65*	.78*	.31*	.47*	.81*
	<i>CAN</i>	.85*	.63*	.54*	.69*	.36*	.46*	.72*
Behaviors & Activism	<i>USA</i>		.57*	.68*	.69*	.24*	.34*	.63*
	<i>CAN</i>		.55*	.62*	.68*	.23*	.32*	.50*
Policy Support	<i>USA</i>			.51*	.52*	.23*	.45*	.71*
	<i>CAN</i>			.37*	.57*	.20*	.34*	.62*
Env-Eco Tradeoffs	<i>USA</i>				.52*	.14*	.29*	.46*
	<i>CAN</i>				.47*	.12*	.10*	.29*
NEP	<i>USA</i>					.09*	.32*	.60*
	<i>CAN</i>					.20*	.32*	.58*
C-issue	<i>USA</i>						.48*	.28*
	<i>CAN</i>						.55*	.29*
N- issue	<i>USA</i>							.55*
	<i>CAN</i>							.46*
Goodness-of-fit								
Chi-square		1495.21						
Degree of freedom		1411						
P-value		.06						
GFI		.97						
NFI		.95						

*P<.05

environmental problems (at the global scale), basic environmental beliefs (the NEP), support for environmental policies and regulations, and so on. The second set of new correlations are those among the facets of the “environmental” component (the three geographical scale factors) and the facets of the “concern” component. “C-issue” has only moderate correlations (about .30) with “Importance” and modest ones (about .20) with “Behaviors & Activism” and “Policy Support,” but only weak correlations (about .10) with “Env-Eco Tradeoffs.” “N-issue” has stronger correlations with the key facets of the “concern” component than “C-issue,” with most of them near or stronger than .30 except the one with “Env-Eco Tradeoffs” in the Canadian Sample (at .10). Again, the overall pattern of consistency among this diverse range of measures is considerable. However, several low correlations also reveal that some facets of environmental concern are fairly distinct as will be discussed in more detail shortly.

The inter-sample comparisons have two parts. First is the overall structure comparison, which turns out to be not significant as the goodness-of-fit statistics show. Second is the comparison of individual inter-factor correlations, consisting of 28 tests, among which only seven are significant at $\alpha=.05$ level: “C-issue”-“NEP” (.09 vs. .20), “N-issue”-“G-issue” (.55 vs. .46), “N-issue”-“Policy Support” (.45 vs. .34), “G-issue”-“Importance” (.81 vs. .72), “G-issue”-“Env-Eco Tradeoffs” (.46 vs. .29), and “Policy Support”-“Env-Eco Tradeoffs (.51 vs. .37).” If I exclude “C-issue” and “N-issue” as they seem to be distinct from all other facets, then there are only three significant differences between the USA and Canadian samples out of 15 total comparisons. Thus, the evidence seems to support the hypothesis that in both nations environmental concern among the general public has a very similar degree of coherence, with Americans having somewhat

Figure 4.8: Higher-order CFA of the Eight Facets of Environmental Concern



higher levels of coherence than Canadians.

In order to investigate the coherence of environmental concern more clearly, I also specify a higher-order CFA with the same set of key facets. Figure 4.8 shows the path diagram while Table 4.9 reports the results of the analysis. Generally speaking, all of the facets have substantial and positive loadings, which suggest that this comprehensive model of environmental concern has a high degree of constraint. Two facets—“C-issue” and “N-issue”—are relatively distinct from the others. In particular, “C-issue” has only a factor loading of .31 in both the USA and Canadian samples, barely edging out the .30 cut-off point for first-order factor loadings, well below the .50 criterion for second-order factor loadings. “N-issue” has a loading that is quite close to the .50 level, suggesting that it is somewhat distinct from the other facets but not as distinct as is “C-issue.” These results thus show that respondents do perceive environmental problems differently according to their geographical scale, as several previous studies suggest (e.g., deHaven-Smith, 1991; Dunlap *et al.*, 1993). As both deHaven-Smith (1991) and Dunlap *et al.* (1993) studies reveal, respondents tend to perceive the global problems as more serious than national and local problems.

Discussion

A possible explanation for the inconsistency found among “C-issue,” “N-issue,” and “G-issue” stems from the fact, as Heberlein (1981) and Rohrschneider (1988) both point out, that people form their environmental attitudes and beliefs partially on the basis of information gained from two distinctive sources—direct personal experience and media. Such a difference in key sources of information about environmental issues is

Table 4.9: Second-order Factor Loadings of the Eight Facets of Environmental Concern and Overall Model Evaluation of Model 4.8

<i>Facets</i>		<i>Environmental Concern</i>
Importance	<i>USA</i>	.95*
	<i>CAN</i>	.93*
Behaviors & Activism	<i>USA</i>	.78*
	<i>CAN</i>	.79*
Policy Support	<i>USA</i>	.73*
	<i>CAN</i>	.69*
Env-Eco Tradeoffs	<i>USA</i>	.65*
	<i>CAN</i>	.59*
NEP	<i>USA</i>	.76*
	<i>CAN</i>	.77*
C-issue	<i>USA</i>	.31*
	<i>CAN</i>	.31*
N- issue	<i>USA</i>	.45*
	<i>CAN</i>	.46*
G-issue	<i>USA</i>	.81*
	<i>CAN</i>	.75*
<i>Goodness-of-fit</i>		
Chi-square		1531.85
Degree of freedom		1449
P-value		0.06
GFI		.97
NFI		.95

*P<.05

potentially a source of cognitive inconsistency, to use Heberlein's (1981) term. "C-issue" thus likely reflects awareness of local environmental conditions and personal experiences, not a general concern as is true of awareness of global problems or "G-issue." "N-issue" is likely shaped by both personal experience and media information, and therefore positions itself somewhere in the middle—i.e., it correlates more strongly with the remaining facets of environmental concern than does "C-issue," but not as strongly as does "G-issue." Unfortunately, the 1992 HOP survey does not include questions dealing with sources of information, so this remains an untested hypothesis for future studies.

Following Heberlein (1981) and Rohrschneider's (1988) arguments, I propose that peoples' general environmental concern strongly corresponds to their awareness of global environmental problems, to a lesser extent to their awareness of national problems, but only a little to their personal experiences with local environmental conditions. Such an interpretation directly contradicts deHaven-Smith's (1991) conclusion that the average citizens' environmental concern is largely localized and isolated and narrowly focused. Furthermore, within each geographical level, the analyses in this chapter show strong consistency across different environmental problems. That is, if we know a person's levels of worry about a certain environmental problem, we can predict the same person's level of worry about other environmental problems at the same geographical level with high accuracy. Thus, it is reasonable to conclude that the general public does not seem to have a highly fragmented concern about environmental issues as deHaven-Smith (1991) suggests. In sum, the empirical evidence generated from the analyses reported in this

chapter seems to support the argument that there indeed is a *coherent* “generalized” environmental concern among the general public, in both the USA and Canada.

What does the evidence reported in this chapter have to say about the dimensionality of environmental concern? On the one hand, as discussed above, all eight key facets of environmental concern seem to load significantly onto one single underlying construct, which is certainly a resounding rejection of the idea that the general public lacks a coherent belief system regarding the environment. On the other hand, the distinctiveness of the perceived seriousness of local environmental problems is too apparent to be overlooked. Thus, the evidence does not fully support the notion that environmental concern is unidimensional, at least at this point. If this sounds confusing, I believe it is largely because of the use of the term “dimensionality”.

The term “dimensionality” implicitly suggests a dichotomization of the issue—unidimensional or multidimensional, which essentially represents a static view of the coherence of environmental concern. As I discussed in the section on conceptualization and operationalization, Converse (1964), Heberlein (1981), and Dunlap and Jones (2002) all seem to agree that constraint (or coherence) of a belief system is a matter of degree, and its status is dynamic and likely ever-changing. For instance, Heberlein (1981) argues that cognitive consistency tends to increase over time even though it is possible to observe substantial cognitive inconsistency at any time. Dunlap and Jones (2002) similarly suggest the likelihood of a trend toward people becoming more and more aware of the interconnectedness among various environmental problems. I thus argue that the term “dimensionality” is incapable of tapping such a dynamic continuous process, while

the concept of “constraint” is potentially more useful, with a stress on the degree of constraint or coherence.

There is also a need for a shift in focus of research on environmental concern. Instead of limiting attention to static statuses depicted as “unidimensional” or “multidimensional,” I suggest we first conceptualize the interconnectedness among environmental beliefs and attitudes depicted as “constraint” as a dynamic process and then examine: (1) the structure of the constraint or organization of environmental concern; (2) the forces that enhance or reduce the degree of constraint; and (3) comparisons between nations, regions, different segments of population, etc. in terms of the previous aspects of environmental concern.

Summary

In this chapter I have presented an effort to address a key question, whether environmental concern among the general public lacks constraint and therefore is inherently multidimensional or whether it is unidimensional and thus represents a coherent belief system. In the literature of environmental concern there are two types of answers to this question. One type either implicitly assumes or explicitly examines the unidimensionality and operationalizes environmental concern as single construct; while the other type suggests the opposite. Applying the belief systems framework to environmental concern, I argued that the dimensionality issue is essentially a question about *collective constraint* across different environmental beliefs and attitudes among the public. Such a conceptualization implies that to examine the dimensionality of

environmental concern one needs to examine the interconnectedness among different environmental beliefs and attitudes.

Adopting Dunlap and Jones' (2002) conceptualization scheme to maximize content validity, I followed the examples of Guber (1996; 2003) and Carman (1998), among others, in applying confirmatory factor analysis to avoid the methodological pitfalls of other commonly utilized techniques. The results of my analyses suggested that although environmental concern conceptualized via the eight key facets is not completely unidimensional, the belief constraint or internal consistency among these facets is substantial. In fact, six out of eight key facets are so closely bound together that it is reasonable to conclude that they are measuring the same underlying construct—namely, a “generalized” environmental concern among the general public. This model of environmental concern is more comprehensive in terms of covering the key facets of environmental concern than those developed by Guber (1996; 2003) and Carman (1998), and thus represents an advance over these cutting-edge efforts.

Comparisons between the USA and Canadian samples were given attention throughout this chapter. The comparisons were carried out at two levels. At one level, I compared the overall factor structure between the two national samples. The results show that generally the USA and Canadian samples share a similar overall structure of environmental concern. At the other level, I compared individual coefficients, mostly correlation coefficients. The results indicate that while the USA sample exhibits a somewhat higher degree coherence in environmental concern than does the Canadian sample, the difference is rather small. It is thus reasonable to conclude that both the USA

and Canadian samples have similar levels of belief coherence or constraint regarding environmental concern.

CHAPTER FOUR ENDNOTES

1. Such an item yields a dichotomous variable that is not directly suitable for CFA models. However, due to its high face and content validity, I decided to recode all “*don’t know*”/”*refuse*” and missing values as a middle point, thus creating a three-value-point ordinal variable. The potential risks of this decision are discussed in Chapter Three.
2. The deleted item is: “*Provide family planning information and free birth control to all citizens who want it to help reduce birth rates.*” This item is dropped due to its low factor loading and item-total correlation found in preliminary analyses.
3. It is important to clarify that most studies only examine self-reported pro-environmental behaviors, which should not be confused as actual behaviors as several scholars point out (e.g, Heberlein, 1981; Tarrant and Cordell, 1997).

CHAPTER FIVE

THE ORGANIZATION OF ENVIRONMENTAL CONCERN

Introduction

In Chapter Four, the coherence or belief constraint of environmental concern among the general publics of both the USA and Canada was examined. Generally speaking I found considerable belief constraint within the public's environmental concern in both nations' samples. In particular, I found six key facets of environmental concern, perceived importance of environmental problems, pro-environmental behaviors and activism, support for environmental regulations and policies, willingness to pay for environmental protection, the NEP, and the perceived seriousness of global environmental issues, to be tightly interrelated and thus forming a largely unidimensional construct of environmental concern. It is therefore logical to examine what exactly is the underlying dimension that organizes all these various facets together, or what constitutes the key source of belief constraint (Converse, 1964).

While there are several approaches one can take to address this question, Converse (1964) provides a suggestion that I can use to form hypotheses for testing. The starting point is Converse's notion of the *centrality* of idea-elements within a belief system, which refers to the "role that they play in the belief system as a whole" (Converse, 1964: 208). According to Converse (1964), some idea-elements, or components of a belief system, are more central than others in that they are less likely to change with new information—but if they do change, this is likely to create changes in

less central idea-elements as well. These more central idea-elements thus become the anchors of a belief system in that they can organize a wide range of less central but more specific idea-elements into a tightly constrained or coherent whole. The example of such a central idea-element Converse (1964) gives is the liberal-conservative continuum within a political belief system, as he argues that liberalism versus conservatism influences a range of political beliefs. An interesting question becomes whether one can find such a central dimension within environmental belief systems. One approach to identifying such a central component (or components) is to examine whether a change in the hypothesized central component(s) leads other components of environmental concern to change.

Converse's notion of the centrality of idea-elements is echoed in the literature of environmental concern. For example, Pierce and Lovrich (1980) first note that their empirical study of environmental belief system leads to the conclusion that "beliefs about specific environmental issues seem to fit together on a single dimension, thus suggesting some underlying concept or fundamental orientation to which these beliefs are mutually connected" (Pierce and Lovrich, 1980: 261)¹. Then Pierce and Lovrich (1980) continue by arguing that environmental beliefs vary in their generality. Beliefs at the most general level reflect an overall orientation that may tie together more specific beliefs into a coherent system. Thus, according to Pierce and Lovrich (1980), one possible way of identifying the beliefs that play the anchoring role for the whole belief system is to examine the level of generality of various environmental beliefs.

Similarly, but more systematically, Heberlein (1981) presents a general conceptualization scheme of environmental concern that addresses the organization of environmental concern (for details, see Chapter Two). Borrowing insights from social-

psychological attitude theory, Heberlein (1981) points out that several specific beliefs can originate from one single general belief. The specific beliefs along with the more general one can be tied together to form a so-called “cognitive structure” (Heberlein, 1981: 245). A value (or a set of values) is a special type of belief in that first of all, it is general—that is a value tends to transcend attitudinal objects, and second, “values are most central in a Person’s belief system” (Heberlein, 1981: 245). Because of these two characteristics, Heberlein (1981: 245) emphasizes that values are “very difficult to change, and if they were to be changed, we would expect to see major cognitive reorganization.” Heberlein thus provides insight into the connection between centrality and generality, and a value exhibits both characteristics.

Also borrowing insights from attitude theory, Gray (1985) in his conceptualization scheme termed Ecological Attitude System (reviewed in Chapter Two) describes a detailed organization of seven identified components of environmental concern. These components are organized into two general groups according to their relative generality. One group consists of primary beliefs, including four components: primitive beliefs, general environmental concern, locus of responsibility and control, and costs/benefits. The second group consists of derived beliefs, including three topics: conservation, pollution, and population. As the name “derived beliefs” suggests, these three components are subject to the influences of the four primary belief components, which form the core of environmental attitudes that organizes the whole Ecological Attitude System. Of particular interest is the component of primitive beliefs. According to Gray (1985: 47), two examples of such primitive beliefs are (1) that “humankind is above and apart from nature; and (2) that “progress and growth are natural, inevitable,

and good.” I believe such primitive beliefs resemble what Heberlein would call values for these primitive beliefs are both very general and reside in the core of Gray’s Ecological Attitude System. Of course, Heberlein focuses on values in general that may influence environmental attitudes and beliefs, while Gray’s primitive beliefs are more specific and narrowly focused on human-environment relations.

Such a difference in the levels of generality between values and primitive beliefs is assumed by Stern *et al.* (1995) when they propose a schematic causal model of environmental concern. Their causal model presents a long causal train, beginning with an individual’s position in social structure, institutional constraints, and the incentive structure—variables that are immutable for individuals. The next element on this causal chain is basic values, which Stern *et al.* (1995) see as shaping so-called “folk ecological theory” or environmental worldview that consists of what Gray (1985) calls primitive environmental beliefs. Next down the causal chain are specific environmental beliefs and attitudes, which are seen as influencing on behavioral intentions that in turn influences actual environmental behaviors. In this causal model, values are seen as more general than are primitive beliefs or worldview, and also as causally antecedent to worldview. However, Stern *et al.* (1995) admit that theoretically it is difficult to establish a causal relationship between these two elements, and therefore it may be more appropriate to consider values and worldview as merely correlated. Lacking a measure of basic values like that developed by Stern *et al.* (1998), in this dissertation I focus on primitive beliefs about the environment as the potential central organizing factor in the model of environmental concern.

Thus, theoretical insights introduced above seem to agree that some components of environmental concern are more central or important than others, and can therefore be seen as predictors of more specific environmental attitudes and beliefs. This implies that one can hypothesize a causal link between a set of primitive beliefs and more specific environmental attitudes and beliefs. In this chapter, I will test such a model by utilizing a measure of environmental worldview, the limited version of the NEP Scale established in the previous chapter, and examining its relationship to the more specific components in the comprehensive measure of environmental concern tested in Chapter Four. I will first review relevant results from a few previous studies in the next section. Then I will introduce a group of control variables, describe the detailed model construction, and finally report analysis results of the test of the model.

Previous Studies

The New Environmental Paradigm Scale has become the most widely used measure of environmental concern in the literature (Stern *et al.*, 1999; Dunlap and Jones, 2002). It is widely agreed (e.g., Heberlein, 1981; Gray, 1985; Stern *et al.*, 1995; Dunlap *et al.*, 2000) that the NEP Scale forms a measure of a set of basic environmental beliefs, “a worldview” or set of “primitive beliefs” as Gray (1985) calls them, which can be seen as “a fundamental component (along with values) in theoretical models designed to predict more specific beliefs, attitudes, and behaviors reflecting environmental concern” (Dunlap and Jones, 2002: 511). Since its creation in 1978 by Dunlap and Van Liere (1978), the NEP Scale and its recent revision (Dunlap *et al.*, 2000) has stimulated a large and rapidly growing number of empirical studies. I reviewed many of them in Chapter

Two, with a focus on the dimensionality of the NEP Scale. In this section, I choose to review a select group of studies focusing on the role of the NEP Scale as a predictor of more specific environmental attitudes and beliefs.

Studies employing the NEP Scale as a predictor variable began to emerge rather late (since the second half of 1990s) in the literature of environmental concern, with a common goal of explaining variation in pro-environmental behaviors. For example, Roberts and Bacon (1997) examine the relationship between the NEP Scale and a set of ecologically conscious consumer behaviors (ECCB). Both the NEP Scale and the set of 30 ECCB items are subjected to confirmatory factor analyses and both are found to be multidimensional. Consequently, Roberts and Bacon (1997) form four subscales out of the 12 NEP Scale items and six behavior subscales out of the set of 30 ECCB items and their inter-correlations are examined. Their analyses generate 24 correlations, presenting a very complex picture. Some correlations are moderate at around .40, some are weak at or below .30, and some are not even statistically significant. Roberts and Bacon (1997) subsequently do not comment on the NEP-ECCB relationship in general but focus on comparing these correlations among one another and discuss implications of the comparisons. It is rather odd that Roberts and Bacon (1997) utilize only correlation coefficients that do not empirically establish the direction of effect for a test of causal model, even though the set of ECCB items are intended to be the “dependent measure.” However, judging by the signs and significance of those 24 correlations, it appears that the four NEP subscales do have mainly significant positive influence on the six ECCB subscales, with only one NEP subscale having insignificant correlations with three ECCB subscales.

Tarrant and Cordell (1997) take a different approach. First, Tarrant and Cordell (1997) employ five environmental attitude scales including the NEP Scale, all treated as unidimensional. Second, Tarrant and Cordell (1997) construct a single behavior index using confirmatory factor analysis without commenting on the dimensionality of this index. Finally, each of the environmental attitude scales is separately analyzed as predicting this behavior index, with six socio-political variables also included as control variables. Their results show that the NEP Scale has a significant influence on the behavior index and can explain about 20 percent the variance in this variable.

Both of the above studies use self-reported behavior items, similar to the indicators of pro-environmental behaviors and activism used in this dissertation. Thus, both studies can be seen as examining the relationship between the NEP and less general components of environmental concern. Both also show supportive evidence that the NEP as a measure of primitive beliefs has significant impacts on self-reported behaviors, although neither study finds the NEP accounts for a lot of the variance in the behaviors. The use of correlation and OLS regression may contribute to this, because as discussed in Chapter Two and Three, measurement errors, which can attenuate the actual correlations, are ignored in both techniques (Bollen, 1989). Furthermore, in both studies only pro-environmental behaviors are examined, while as shown in Chapter Four, environmental concern is far more complex. Similar narrowly focused studies also include Pierce *et al.*'s (1999) study targeting public support for environmental actions, Corral-Verdugo's (2002; *et al.*, 2003) study of conservation motives, and Clark *et al.*'s (2003) study of green electricity participation decision (dichotomous), all using the NEP Scale as a predictor.

In contrast to the narrow focus of the studies just reviewed, Hawthorne and Alabaster (1999) make a bold attempt to test perhaps the most complex causal model ever developed to determine the level of citizen participation in the environmental debate, named “environmental citizenship.” Besides a wide range of exogenous variables such as socio-demographic variables, political affiliation, and personality variables, this model contains many components of environmental concern including: the NEP, environmental awareness, pro-environmental attitude, and environmental responsibility. According to their model, both the NEP and environmental awareness are causally antecedent to pro-environmental attitudes, which in turn shape environmental responsibility. Due to the complexity of such a model, Hawthorne and Alabaster (1999) report a great number of results from correlation and multiple regression analyses. Of particular interest here is that the endorsement of the NEP is highly correlated with willingness to sacrifice for environmental protection (part of responsibility) and that the NEP in general and its “limits to growth” subscale in particular strongly influence pro-environmental attitudes (support for environmental protection), which in turn strongly influence environmental responsibility, even after controlling for all other relevant variables. This study, although not examining the central role of the NEP within the environmental belief system directly, provides ample empirical evidence that the NEP is a strong predictor of other more specific environmental attitudes and beliefs.

Stern and colleagues (1999) update their causal model described earlier (Stern *et al.*, 1995) and propose a Value-Belief-Norm theory for explaining support for environmentalism. Based on this theory, a set of general values such as altruistic and egoistic values are hypothesized to directly influence the NEP. In turn, the NEP is

hypothesized to have both direct and indirect effects on a set of environmental attitudes and beliefs including awareness of consequences of environmental problems, ascription of responsibility for environmental problems, pro-environmental personal norms, environmental activism, environmental citizenship, policy support, and consumer behaviors. It is clear that many of these components tap the key facets of environmental concern identified and examined in Chapter Four. Stern *et al.*'s (1999) results show that the NEP is a significant predictor of policy support, awareness of consequences, environmental citizenship, and pro-environmental personal norms, while having little effect on consumer behavior or environmental activism as measured by one item asking about participation in demonstrations and protest.

These two studies examine the causal relationship between the NEP and other more specific environmental attitudes and beliefs in a fuller sense. However, both studies utilize OLS regression that is incapable of controlling for measurement errors and their correlations. In fact, very few studies in the literature of environmental concern utilize the more advanced Structural Equation Modeling (SEM) technique to test for causal relationships. Among studies reviewed here, only Corral-Verdugo and colleagues (2002; *et al.*, 2003) utilize SEM and thus illustrate the advantages of such technique (See Chapter Two for more studies using SEM and Chapter Three for details about SEM and its advantages over correlation and OLS regression). In this chapter, I will utilize SEM to test a causal model with both the NEP and the comprehensive measure of environmental concern tested in Chapter Four included, and thus extend the previous studies just reviewed both theoretically and methodologically.

Control Variables

To increase the internal validity of the causal model, I include a set of exogenous variables to be controlled for as potential causes of environmental concern. These variables are age, educational attainment, gender, residence, social class, and political ideology. In this section, I provide justification for my selection and details about these variables.

In the literature on environmental concern, a persistent research interest has been to answer the question, “whether there are differences in the environmental attitudes and beliefs of different segments of the public” (Buttel, 1987: 472) and thus to examine the social bases of environmental concern (Van Liere and Dunlap, 1980; Jones and Dunlap, 1992; Greenbaum, 1995). To date, scholars have consistently found three factors to have robust effects on environmental concern across different surveys and samples: age, educational attainment, and political ideology with younger, better educated, and politically liberal segments of the public expressing higher levels of concern than their counterparts (Van Liere and Dunlap 1980; Greenbaum 1995). Since environmental concern is measured in a variety of ways in the literature, including via the NEP Scale, it is logical to consider age, educational attainment, and political ideology as potential causes of both the NEP and other more specific environmental attitudes and beliefs. These three variables are therefore selected as control variables. Three additional variables are also selected based on empirical evidence that they sometimes influence environmental concern, although not with the consistency of the three just discussed.

Gender as a basic demographic variable has long been included in efforts to explain levels of environmental concern (e.g, McStay and Dunlap, 1983; Blocker and

Eckberg, 1989; Schahn and Holzer, 1990; Jones and Dunlap, 1992; Stern *et al.*, 1993; Furman, 1998; Fransson and Gärling, 1999). Both theorizing and empirical findings about gender's effect are inconsistent and thus inconclusive (Van Liere and Dunlap 1980; Greenbaum 1995). Some studies find little if any gender differences (McStay and Dunlap, 1983; Blocker and Eckberg, 1989; Jones and Dunlap, 1992); some find that females are more pro-environment (Stern *et al.*, 1993; Furman, 1998); and some find a mixed picture, depending on the measures of environmental concern (Schahn and Holzer, 1990). However, Davidson and Freudenburg (1996) via their review of 75 quantitative studies involving environmental and technological risk concern in the USA conclude that there are consistent but modest generic gender differences between women and men in terms of overall orientation, while gender differences are more salient in terms of concerns over more specific issues, particularly nuclear power and/or nuclear waste. Gender is then included as a control variable in my analysis.

Current residence is another demographic factor frequently examined in the environmental concern literature (e.g., Mohai and Twight, 1987; Jones and Dunlap, 1992; Fransson and Gärling, 1999). Community size tends to be hypothesized as positively correlated with levels of environmental concern (Van Liere and Dunlap, 1980; Greenbaum 1995). Earlier studies reviewed by Van Liere and Dunlap (1980) do not seem to yield consistent findings, while more recent studies reviewed by Greenbaum (1995) seem to support the hypothesis that residents of larger communities are more environmentally concerned. Thus, residence is included as a control variable in the SEM analysis.

Finally, social class or socio-economic status (SES) measured in terms of income and/or occupational prestige, is sometimes hypothesized to be positively related to levels of environmental concern in the literature (e.g., Mohai and Twight, 1985; Schahn and Holzer, 1990). Van Liere and Dunlap (1980) find inconsistent empirical evidence regarding this hypothesis in the literature; however, Greenbaum (1995) suggest that in the more recent literature SES is positively related to environmental concern. Social class is thus also controlled in the model to be tested in this chapter.

Thanks to the use of face-to-face interviews in the Health of the Planet survey, missing values regarding these control variables are rare and do not appear to be systematic. Age is recorded in actual number of years, with missing values recoded to the sample median. Educational attainment is measured by a question asking: “*The last year of school or university you completed*” Seven options are provided, 1 “*none*,” 2 “*8th grade or less*,” 3 “*high school incomplete*,” 4 “*high school completed*,” 5 “*some technical training or university incomplete*,” 6 “*university completed*,” and 7 “*post-graduate work*.” Missing values are recoded to the sample median. Political ideology is measured with a 7-point scale, 1 “*far left*” to 7 “*far right*.” This variable is reversely recoded to 1 for “*far right*” to 7 for “*far left*” and missing values are recoded as 4 for “*center*.” Gender is interviewer-recorded, 1 “*male*” and 2 “*female*,” with no missing value. “*Female*” is recoded to 0 in the analysis. Two items provide information about residence, *number of inhabitants* and *type of area*. *Number of inhabitants* would have provided the better measure of residence type but the data was miscoded in the USA sample. Thus, *type of area* is used in the analysis. Seven options are provided, 1 “*large city*,” 2 “*medium-sized city*,” 3 “*suburban area*,” 4 “*small town*,” 5 “*village*,” 6 “*Rural area*,” 7

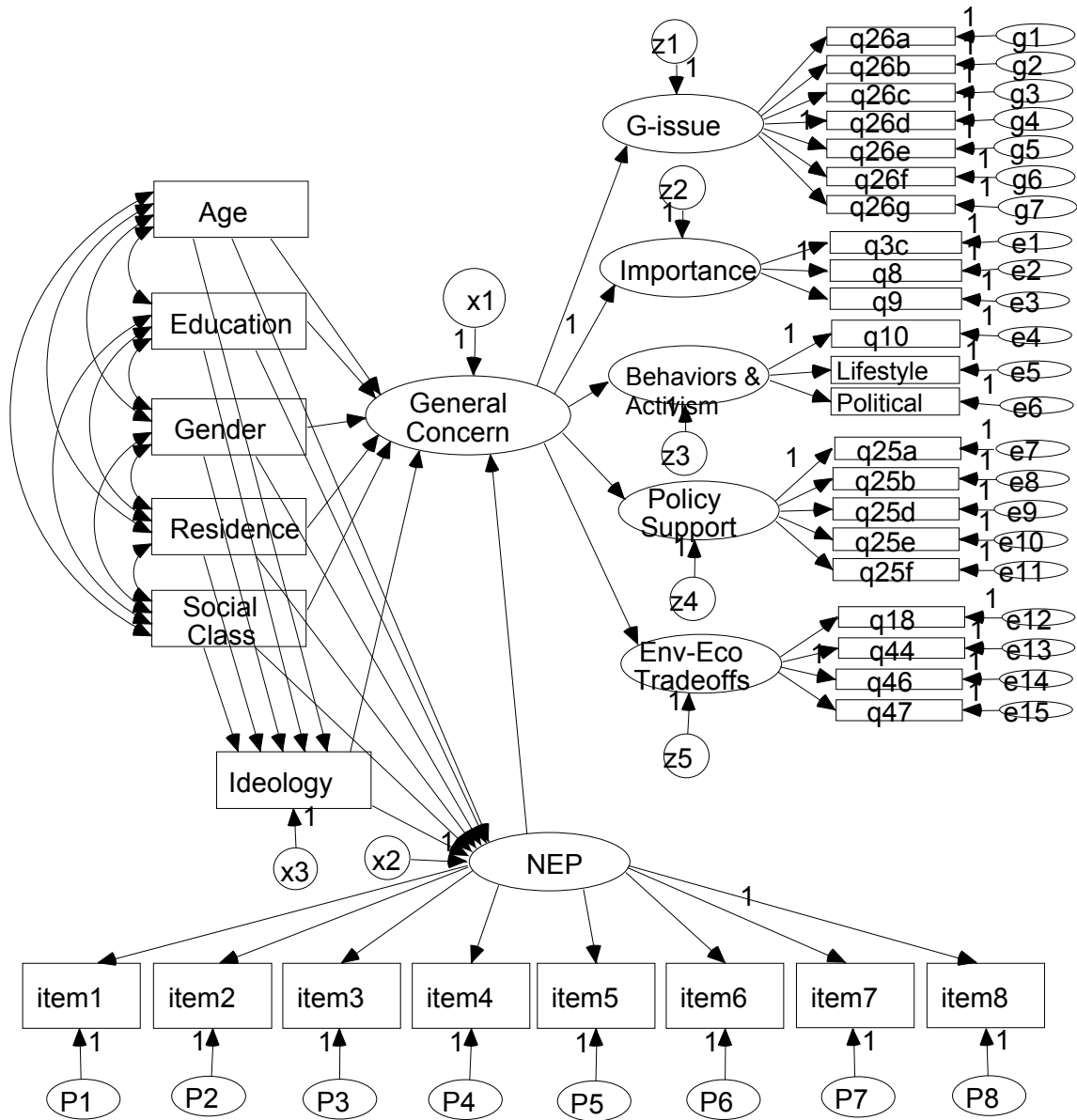
farm.” This variable is reverse coded, *“suburban area”* and *“small town”* are combined prior to the recoding, and missing values are recoded to the sample median. Finally, the HOP uses a self-classification measure of social class with a 5-point scale, 1 *“working class,”* 2 *“lower middle class,”* 3 *“middle class,”* 4 *“upper middle class,”* and 5 *“upper class.”* Missing values are recoded to 3.

Structural Equation Modeling Analysis

Model Specification

Figure 5.1 shows the path diagram for hypothesized model to be tested. In Model 5.1, general environmental concern (GEC), termed “General Concern” in the path diagram, is measured with five first-order latent factors, “G-issue,” “Importance,” “Behaviors & Activism,” “Env-Eco Tradeoffs,” and “Policy Support.” Each of these five first-order latent factors is measured by multiple items as described in Chapter Four. The NEP is measured with the eight NEP items also described in Chapter Four. For every item, there is a measurement error term attached and although not shown in the path diagram for the sake of readability, measurement error correlations are allowed. There are five exogenous variables, “Age,” “Education,” “Gender,” “Social Class,” and “Residence.” For these five exogenous variables, perfect measurement is assumed and no further recoding or transformations were performed. As discussed in details in Chapter Three, it is relatively safe to use categorical variables as independent variables in linear models. Since these are standard measures of socio-demographic factors, it is also relatively safe to assume little measurement error. Finally, political ideology is a basic

Figure 5.1: The Organization and Social Bases of Environmental Concern



social-psychological variable and is thus assumed to intervene between the five socio-demographic variables and both the NEP and GEC (e.g., Mohai and Twight, 1985; Hawthorne and Alabaster, 1999; Fransson and Gärling, 1999). Thus, in the path diagram, the five socio-demographic variables are hypothesized to have direct impacts (the straight one-way arrow lines) on political ideology, the NEP, and then GEC, while political ideology is hypothesized to have direct impacts on the NEP and GEC. Finally, the NEP is hypothesized to have direct impacts on GEC. For political ideology, the NEP, and GEC there is a regression residual term attached to each, designated “x1,” “x2,” and “x3” to statistically complete the model (Bollen, 1989).

The main purpose of this model is to test whether the strong correlation between the NEP and GEC as tested in Chapter Four is the result of their sharing causes. If after controlling six potential causes of both the NEP and GEC as specified in the path diagram the effect of the NEP on GEC still largely exists, it will enhance the internal validity of this causal model. In addition, this model places the NEP in a mediating position. Thus this causal model can be interpreted as a test of the *centrality* of the NEP within environmental belief systems. If the NEP does serve as an anchor of environmental belief systems, it is reasonable to hypothesize that any observed effects of external forces such as socio-demographic factors and political ideology on environmental concern will occur through the NEP or be mediated by the NEP. Finally, this model can also be interpreted as a model of the social bases of environmental concern.

Table 5.1: Selective Results of Model 5.1—Standardized Regression Weights, Squared Multiple Correlations, and Model Evaluation Statistics

<i>Predictor</i>	Ideology		NEP		GEC	
	<i>USA</i>	<i>CAN</i>	<i>USA</i>	<i>CAN</i>	<i>USA</i>	<i>CAN</i>
Age	-.05	-.08*	-.09*	-.22*	.00	.05
Education	.05	.00	.34*	.30*	-.03	.04
Gender	-.02	-.03	-.02	-.02	-.07*	-.09*
Residence	.01	-.02	-.01	-.02	-.02	.12*
Social Class	.00	-.05	.00	-.04	-.01	.02
Ideology	--	--	.17*	.05	-.04	.01
NEP	--	--	--	--	.83*	.81*
<i>R</i>²	.01	.01	.16	.18	.70	.69
<i>Model Evaluation</i>						
Chi-square			1603.25			
degree of freedom			981			
P-value			.00			
GFI			.96			
NFI			.91			

Note:

1. GEC—general environmental concern, “General Concern” in Figure 5.1
2. *R*²—squared multiple correlation coefficient, or R-square
3. *P<.05

Results

Estimation of Model 5.1 yields a great number of coefficients and statistics. In Table 5.1, I report those of the most important, standardized regression weights, squared multiple correlation coefficients, and model evaluation statistics.

Note that there is some inconsistency among the goodness-of-fit statistics. The Chi-square is significant at $\alpha=.05$ level, even after all sizable (statistically significant at $\alpha=.05$) measurement error correlations are controlled, which would suggest an inadequate model fit. On the other hand, both GFI and NFI (for details about these two indexes, see Chapter Three) are above .90, showing that this model has adequate fit. In the literature, such a model is conventionally considered to have adequate fit (e.g., Roberts and Bacon, 1997; Corral-Verdugo, 2002). I then choose to proceed as having a fitting model, with considerable cautions of course. There are a couple of reasons that could contribute to a significant Chi-square. First, as noted in Chapter Three, the Chi-square test is also a test of comparison between two national samples' overall model structure. As I will soon report in the following text, there are obvious differences in how socio-demographic factors and political ideology influence both the NEP and GEC between the USA and Canadian samples. Therefore it falsifies the null hypothesis that the USA and Canadian samples share similar causal model of environmental concern. Second, in both the USA and Canadian samples, all five socio-demographic variables plus political ideology do not seem to explain much of the variance in either the NEP or GEC. In other words, these are not very strong predictors and there is still much variance in environmental concern to be explained.

Due to the differing and ambiguous measuring units of all variables involved, I report standardized coefficients that allow for comparing the magnitude of the various regression weights. There are three endogenous variables and two samples (the USA and Canada) in Model 5.1, and therefore three pairs of columns of standardized regression weights are reported. The first pair of columns reports standardized regression weights of the five socio-demographic variables on political ideology. Generally speaking, the socio-demographic variables have virtually no impact on political ideology. Only age in the Canadian sample shows a significant but weak impact ($\beta = -.08$, explaining only 6.4 percent of the variance).

Turning to the second pair of columns, three variables have significant impacts on the NEP in the USA, age, educational attainment, and political ideology. The signs of all three regression weights are in the expected direction, as younger adults, the better educated, and political liberals have higher levels of endorsement of the NEP than their counterparts. This finding is consistent with previous studies. Judging by the magnitude of standardized regression weights, educational attainment has the strongest effect. With a $\beta = .34$, educational attainment alone can explain 11.6 percent of the variance of the NEP, while in combination all six independent variables explain 16 percent of the variance of the NEP. The second strongest predictor is political ideology, explaining about 3 percent of the variance, and finally age, which is considerably weaker, contributing just under 1 percent. For the Canadian sample, educational attainment is also the strongest predictor, contributing 9 percent of the explained variance, precisely half of the total explained variance (18 percent) of the NEP. Age is the second strongest predictor, contributing

about 5 percent. Political ideology's influence is not even statistically significant, although the direction is as expected.

Lastly, the final pair of columns report standardized regression weights for GEC. The general pattern suggested by these regression weights is that in both the USA and Canadian samples, the socio-demographic variables plus political ideology do not have much influence on GEC. Although the explained variances in both samples are very impressive at .70 (USA) and .69 (Canada), almost all of the variances in both countries can be attributed to the NEP's influence. In both the USA and Canadian samples, gender shows a weak but significant negative effect, indicating that females (coded as 0) in both samples are more environmentally concerned than are males (coded as 1). In addition, residence in the Canadian sample shows a significant positive effect on general environmental concern, indicating that respondents living in larger cities and towns are more environmentally concerned than are respondents living in smaller towns and rural areas. These effects of gender and residence are consistent with the literature as reviewed earlier in this chapter; however both effects are quite weak, although statistically significant. Social class and ideology have no significant direct effects on GEC in both nations.

In sum, the results reported in Table 5.1 indicate that the relationship between the NEP and GEC does not appear to be a result of both being caused by other factors. The NEP is clearly the single most powerful predictor of the more specific environmental attitudes and beliefs measured by the five latent variables shown in Figure 5.1. This is a strong evidence that the NEP is an organizing core of environmental belief system

hypothesized in Model 5.1. Additional evidence regarding to the centrality of the NEP is reported in Table 5.2.

Table 5.2 is organized to report three different effects. The direct effect is the standardized regression weight reported in Table 5.1. The indirect effect is that part of the effect that is mediated by a third or fourth variable. For example, in Model 5.1, “Age” has a direct effect on all three endogenous variables, while there is also a chain of effects linking these three endogenous variables, from political ideology to the NEP and finally to GEC. Therefore, besides the direct effect of age on GEC, age can also influence GEC through this chain of effects. This part of the effect of age is mediated by political ideology and the NEP, thus it is an indirect effect. Finally, adding the direct and the indirect effects together produces the total effect one variable has on a given endogenous variable. If an exogenous variable has a significant effect on a mediating variable, which in turn has a significant effect on an endogenous variable, then this exogenous variable has a significant *indirect* effect on the endogenous variable. If a variable is found to have either a significant direct effect or a significant indirect effect, or both, on an endogenous variable, it thus has a significant total effect on the endogenous variable.

From Table 5.2 one can clearly see that in both the USA and Canadian samples, age, educational attainment, gender, and endorsement of the NEP have significant total effects on GEC; while in the USA sample only, political ideology has a significant total effect and in the Canadian sample only, respondents’ residence has significant total effect on GEC. Comparing total effects to direct/indirect effects, one can determine how much

**Table 5.2, Standardized Direct, Indirect, and Total Effects on General
Environmental Concern**

<i>Predictor</i>	Direct Effect		Indirect Effect		Total Effect	
	<i>USA</i>	<i>CAN</i>	<i>USA</i>	<i>CAN</i>	<i>USA</i>	<i>CAN</i>
Age	.00	.05	-.08*	-.18*	-.08*	-.13*
Education	-.03	.04	.28*	.24*	.25*	.28*
Gender	-.07*	-.09*	-.02	-.02	-.09*	-.10*
Residence	-.02	.12*	-.01	-.01	-.03	.10*
Social Class	-.01	.02	.00	-.03	-.01	-.02
Ideology	-.04	.01	.14*	.04	.10*	.05
NEP	.83*	.81*	--	--	.83*	.81*

Note:

1. *Statistically significant.
2. The significance of indirect effect is determined by the significance of all direct effects on the chain of effect. For example, “age” has a significant direct effect on the NEP that in turn has a significant direct effect on GEC, the indirect effect of “age” on GEC is thus determined significant. The significance of the total effect is established as long as either the direct or indirect effect is significant or both.

of the total effect of all five socio-demographic variables and political ideology is mediated by the NEP, which itself has only a direct effect on GEC. It appears that in both the USA and Canadian samples, a majority of the total effects of age and educational attainment is mediated by the NEP, as both age and educational attainment have insignificant direct effects on GEC. The same can be said for political ideology in the USA sample. In both the USA and Canadian samples, a majority of gender's total effect is from the direct effect, thus it is not mediated by the NEP. Finally, in the Canadian sample only, the total effect of residence is not mediated by the NEP either. However, since education and political ideology in the USA sample and education and age in the Canadian sample are responsible for the majority of effect of these six external variables combined (treating the NEP as the internal variable), Table 5.2 suggests that that the NEP is not only the single most power predictor of GEC, but it also functions as a mediating factor that channels the effects of the socio-demographic variables and political ideology toward GEC.

Table 5.2 also shows several differences between the USA and Canada. First of all, it is quite surprising to find that within the Canadian sample, political ideology does not have any effects on either the NEP or GEC; while within the USA sample, the effect of political ideology is the second strongest among all six external predictors (with the NEP considered an internal predictor). Second, in Canada residence has a significant effect on GEC, which is not mediated through the NEP, while in the USA residence has no effect. Third, although age has a significant total effect but insignificant direct effect in both samples, age's effect in the Canadian sample is significantly larger than in the USA sample (test of comparison, $P < .05$). Thus, it appears the social bases of

environmental concern are different between these two samples, but overall are relatively weak in both.

Discussions

Model 5.1 is designed to explore details about the organization of environmental concern (after it is found to be a quite coherent belief system in Chapter Four) as well as its causal antecedents. When strong inter-correlations are found among different variables, logically there can be two possible explanations. One explanation would attribute the high correlations to a common external factor. Another possible explanation as suggested by the literature would look into the internal organizing mechanism. That is, within the environmental belief system, some beliefs are more basic or fundamental and become the core of the entire belief system and function as an organizing anchor. Model 5.1 tests both possibilities, with the NEP Scale to measure such a set of basic environmental beliefs.

The results confirm the centrality of the NEP within the environmental belief system, as measured by the diverse set of variables used to measure the construct of general environmental concern. First the NEP is the single most powerful influencer that can explain about 69 percent (USA) and 66 percent (Canada) of the variance in GEC, even after five socio-demographic variables and political ideology are controlled. Second, it also appears that when considering environmental concern as a whole, the effects of the socio-demographic variables and political ideology are largely channeled through the NEP, indicating that the NEP is indeed the anchor of the whole belief system. Therefore, I believe it is reasonable to conclude that general environmental concern (albeit not

including perceptions of local and national environmental problems) as a coherent belief system is organized around the NEP. In other words, the NEP represents the fundamental orientation to which different environmental beliefs are mutually connected, to use Pierce and Lovrich's terms (1980).

Thus, environmental concern appears to be a coherent construct and a constrained belief system, while the NEP, which itself is unidimensional, represents the source of coherence/belief constraint. Political ideology is another fundamental socio-psychological orientation, which is often found to have significant impacts on environmental concern in the literature (see above for references). According to the results of Model 5.1, however, the impact of political ideology is weak, even though statistically significant in the USA sample. Therefore, I argue that the NEP is largely independent of political ideology and consequently that environmental concern is an independent belief system that is not reducible to liberal-conservative (left-right) political orientation.

In terms of the social bases of environmental concern, the analysis in this chapter more or less confirms the findings of the literature briefly summarized in the section on control variables. Combined together, the political ideology and the five socio-demographic variables explain only a limited amount of variation of environmental concern. Table 5.1 reports that only 16 percent (USA) and 18 percent (Canada) of the variance of the NEP is explained by these six variables. Although about 70 percent of the variance in GEC is explained in both samples, an overwhelming majority of the explained variance can be attributed to the NEP judging by the magnitude of its standardized regression weights (.83 and .81 for the USA and Canada respectively).

Thus, the results largely confirm prior summaries from literature on environmental concern suggesting that political ideology and socio-demographic variables rarely account for more than 15 percent of the variance in such concern (e.g., Van Liere and Dunlap, 1980; Jones and Dunlap, 1992; Greenbaum, 1995). It is clear that environmental concern is not a unique property of some specific segments of the public, but a set of broad-based set of attitudes and beliefs (e.g., Jones and Dunlap, 1992; Klineberg *et al.*, 1998).

Summary

In this chapter I utilize Structure Equation Modeling to examine the organization of environmental concern and its social bases. The results generally suggest that environmental concern in both nations is organized around the set of primitive beliefs or worldviews reflected by the NEP, which appears largely independent of the left-right dimension of political ideology. This contributes to a deeper understanding of the organization of environmental concern in that it sheds lights on the internal mechanism by which components of environmental concern are causally interrelated, a step above merely examining levels of belief constraint. The inter-sample comparison shows that environmental concern is organized similarly among the USA and Canadian publics, in addition to the finding that the two countries also share similar levels of coherence found in Chapter Four.

On the other hand, the five socio-demographic variables and political ideology do not account for much of the variation in environmental concern in either sample. There are, however, apparent differences in their social bases of environmental concern. Most

striking is that among the Canadian respondents, political ideology does not seem to matter at all, while respondents' residence shows no effect among the USA respondents. The effect of age is found significantly stronger among Canadian respondents than their American counterparts. Possible reasons for these differences are beyond the scope of this dissertation, but are nonetheless worth exploring in future studies.

CHAPTER FIVE ENDNOTES

1. Note that analysis results of Chapter Four more or less confirm this conclusion.

CHAPTER SIX

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

This dissertation is mainly inspired by a rather unfortunate situation in the literature on environmental concern. Despite a great number of published studies that more or less address environmental concern, more than one thousand estimated by Dunlap and Jones (2002), our understanding of the nature of environmental concern is rather limited. One major reason for this situation, as noted by numerous scholars (e.g., Heberlein, 1981; Gray, 1985; Guber, 1996; and Dunlap and Jones, 2002), is the lack of effective measurement of environmental concern in the literature. Analytically, the measurement of environmental concern can be seen as having two separate processes: first is the conceptualization of environmental concern, a mainly theoretical endeavor; second is the operationalization of environmental concern, a largely methodological task. In the literature on environmental concern, there are already systematic attempts at conceptualizing environmental concern. The conceptualization schemes of Heberlein (1981), Gray (1985), and Dunlap and Jones' (2002) were reviewed in Chapter Two. Still, relatively rare are systematic attempts to operationalize environmental concern. This dissertation has sought to contribute to one aspect of the operationalization process, the use of sophisticated statistical techniques to test a detailed theoretical conceptualization of environmental concern.

The main thesis of this dissertation is that confirmatory factor analysis (CFA) and the more general technique of structural equation modeling (SEM) are more effective

than the commonly utilized statistical techniques in dealing with the measurement of environmental concern. Much of the Chapter Two is devoted to a review of the existing literature with a focus on the commonly utilized statistical techniques and their shortcomings. Since CFA/SEM is relatively new to this literature, I presented a detailed discussion of this technique in Chapter Three. In Chapters Four and Five I explored the use of CFA and SEM with a unique, two-nation dataset, with Chapter Four focused on the dimensionality of environmental concern and Chapter Five on the organization of environmental concern.

The dimensionality issue arises due to the necessity of utilizing multiple items to achieve effective measure of environmental concern. Combining items that vary along different dimensions can lead to misleading findings because multiple dimensions of variation are likely to confound the examination of relationships between environmental concern and other variables. However, the dimensionality of environmental concern is directly connected to the critical question, as Dunlap and Jones (2002: 511) put it, “Is it appropriate to consider environmental concern as a single construct, or is it inherently multidimensional?” Thus, although it may seem that the issue of dimensionality is a purely methodological one to begin with, it is now clear that the issue of dimensionality is a theoretical as well as methodological issue.

In Chapter Four I reviewed existing efforts to theorize the dimensionality of environmental concern, which brings this seemingly methodological issue back into theoretical context—i.e., the conceptualization of environmental concern. I borrowed theoretical insights from the belief systems perspective of political science, particularly the notion of belief constraint. Within the literature on environmental concern, there

seems to have two more or less opposite perspectives. One assumes that environmental beliefs are largely localized and fragmented and thus that a “generalized” environmental concern does not exist, at least among the general public, in any meaningful sense (deHaven-Smith, 1991). The other perspective, while it does not deny the possibility of observing substantial inconsistency among some environmental beliefs attitudes, assumes that general environmental concern is a meaningful construct and indeed that it may become more and more coherent among the general public over time (Heberlein, 1981; Dunlap and Jones, 2002).

Utilizing the technique of CFA, I employed a stepwise cumulative model testing strategy and developed and tested a measurement model of environmental concern encompassing eight key facets identified in the literature. The results of CFA provide considerable supportive evidence that environmental concern as a whole has substantial internal consistency, although two facets (perception of the seriousness of local and national environmental problems) are so distinct that it would be inappropriate to conclude that environmental concern is fully unidimensional. I thus called into question the adequacy of the notion of dimensionality for dealing with a dynamic environmental belief system and proposed belief constraint as a more appropriate tool for judging the coherence of environmental concern.

Chapter Four presents a case in which the operationalization of environmental concern is closely tied into its theoretical conceptualization. Indeed, the measurement of highly complex constructs in social science such as environmental concern inevitably involves both essential processes of conceptualization and operationalization. This is especially important for environmental concern, as there are controversies in the literature

about its conceptualization. Without a consensus on conceptualization, we would not be able to tell whether inconsistent empirical findings are due to the “true” differences in environmental concern or to how environmental concern is conceptualized and measured that “makes the difference”—as Van Liere and Dunlap (1981) once suggested. In other words, constructing a measure of environmental concern is inherently intertwined with theoretical issues regarding the conceptualization of environmental concern, as suggested long ago by Hubert Blalock (1968).

For Blalock (1968) measurement needs to bridge the gap between an abstract construct and tangible observable indicators, and such linkage between the abstract and the observable must follow an explicit theory so that it yields theoretically informed research. In this sense, all three conceptualization schemes of environmental concern by Heberlein (1981), Gray (1985), and Dunlap and Jones (2002) reviewed in Chapter Two are in fact theories about the relationships between the general notion of environmental concern and more specific and tangible beliefs and attitudes such as worries about pollution. The models tested in Chapter Four are therefore not only measurement models but also theoretical models. The implication is that CFA appears to be a particularly suitable technique for measuring environmental concern. As discussed in detail in Chapter Three, the use of CFA requires the specification of a model according to an explicit theory or theoretical framework prior to actual testing. Thus, CFA provides a researcher with the ability to empirically test the conceptualization scheme used when constructing the measurement model.

Similarly, the model tested in Chapter Five can also be seen as a measurement model, even though it was intended to test the hypothesized causal relationship between

the New Environmental Paradigm (NEP), a presumed core component of the environmental belief system, and other more specific environmental beliefs and attitudes (designated as GEC) as a whole. From a measurement perspective, examining the significance, magnitude, and directions of the effects of political ideology and five demographic variables on the NEP and GEC provide a test of construct validity (Bollen, 1989; Singleton and Straits, 1999) of the proposed measurement model of environmental concern. It is especially the case when age, educational attainment, and political ideology are considered because in the literature on environmental concern these three variables are often found to have significant influences on levels of environmental concern. In the case of the USA sample, all three aforementioned variables have significant influences in the expected direction, suggesting that the measures of the NEP and GEC have considerable construct validity. In the case of the Canadian sample, both age and educational attainment have significant influences in the expected direction but this is not the case for political ideology. This suggests that the measures of the NEP and GEC within the Canadian sample may not have construct validity quite as strong as within the USA sample. However, the insignificant effect of political ideology within the Canadian sample could also be interpreted as suggesting that among the Canadian public, political ideology has little effect on peoples' levels of environmental concern. Once again, a methodological question is intertwined with a theoretical question.

An implication for future study would be that we need not only to keep an eye on improving the measurement of environmental concern, but we should also pay attention to potential international differences that are not due to measurement quality issues. Indeed, there is evidence of international differences in environmental concern. For

example, Dalton *et al.* (1999) compare a Russian sample to an American sample in terms of the NEP. They found via factor analyses that among American respondents there is a single NEP framework; while Russian respondents seem to possess a less coherent NEP framework that has three distinct dimensions.

On the other hand, within both the USA and Canadian samples, I found very high standardized regression weights of the NEP on GEC. Thus, combining the results of the analyses in Chapter Four and Five, in general I found little difference between the USA and Canadian samples in terms of both the coherence and organization of environmental concern. My findings thus extend Clarke and Stewart's (1997) conclusion that recent national surveys suggest that Canadians and Americans are more similar than different regarding their levels of environmental concern. Importantly, my findings show that the similarities between environmental concern among the publics of these two nations does not end at the levels of environmental concern but extends to the more fundamental issue of the coherence of such concern.

A further implication of this strong standardized regression weight of the NEP on GEC in both samples is that the NEP Scale can be used as an economical alternative measure of GEC with only up to fifteen items as used in the new version of the NEP Scale (Dunlap *et al.*, 2000) without losing much measurement power. I must clarify however, that the NEP does not correlate strongly with perceptions of the seriousness of both local and national environmental problems as found in Chapter Four. So the NEP cannot necessarily substitute for all possible facets of environmental concern, and should be treated as reflecting general environmental concern. Future research focused on

specific environmental issues should remain sensitive to the possibility that they may be viewed as somewhat distinct from environmental concern in general.

To conclude, I explored and illustrated in this dissertation the use of the confirmatory factor analysis (CFA) and structural equation modeling (SEM) techniques in dealing with the measurement of the highly complex construct, environmental concern. CFA/SEM appears to be highly suitable and effective for this purpose, as they provide the ability to integrate a theoretically informed conceptual model and a measurement model for simultaneous testing. Very recent literature on environmental concern shows a growing use of CFA/SEM (e.g., Schultz, 2001; Corral-Verdugo, 2002; Nooney *et al.*, 2003; Guber, 2003; Corral-Verdugo *et al.*, 2003), and it is therefore reasonable to predict that the power of CFA/SEM is going to be harnessed increasingly in future studies of environmental concern. I trust that the results of this dissertation will help to strengthen this trend. Of course, appropriate statistical technique is only one aspect of the whole measurement process of environmental concern that needs attention. Future study should also seek to improve the validity and reliability of measures of environmental concern via for example, utilizing multiple methods to measure the same construct with a Multitrait-Multimethod (MTMM) approach (Bollen, 1989; McPherson and Tom, 1995).

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