Research in Outdoor Education

Volume 16 Article 6

2018

Quantifying the Human-Nature Relationship: A User's Guide

Kelly S. Cartwright
College of Lake County

Denise Mitten
Prescott College

Research in Outdoor Education 2018, Vol. 16, pp. 42–70

Quantifying the Human-Nature Relationship

A User's Guide

Kelly S. Cartwright
Denise Mitten

Abstract

A growing trend in environmental research is the quantification of the human-nature relationship. This review of human-nature psychometric instruments should be used as a reference for individuals seeking to incorporate these tools into their outdoor and environmental education research. Extensive literature review and autoethnographic techniques were employed to identify and evaluate thirty-four instruments. Instruments were evaluated on structure, ease of use, and concepts represented. Diversity exists amongst the instruments in terms of length, concepts reflected, and structure. The majority of tools reflect environmental attitudes/views (16) or relationship/connection with nature (13). Fewer instruments reflect concern, identity, or environmental behavior. Twenty-eight instruments are deemed easy to use, based on time required to complete and ease of scoring. A timeline outlining the development of the instruments is presented and conclusions and recommendations from original and comparative studies are summarized.

Keywords: human-nature psychometric instrument, environmental education research, nature connection, environmental views, environmental behaviors

Kelly S. Cartwright, Professor, College of Lake County; **Denise Mitten**, Professor, Prescott College.

Address correspondence to Kelly S. Cartwright, Professor, College of Lake County, 19351 West Washington Street, Grayslake, Il 60030, Phone: 847-543-2792, Email: Kcartwright@clcillinois.edu

Introduction and study background

Multiple authors have identified a positive relationship to nature and our non-built environment as a key to sustainability, including healthy communities and people (see Clayton, 2012; Clayton & Opotow, 2003; Ewert, Mitten, & Overholt, 2014). A natural follow-up is how might we describe and quantify people's relationship with nature and how can we use these tools to help increase people's positive relationship with nature. Over the past few decades a number of psychometric instruments have been developed to quantify some aspect of the relationship between people and nature. These instruments have been referred to as conservation psychology indicators/measures/tools, connection to nature constructs/instruments, human-nature instruments/scales, environmental identity scales, or a combination of the terms. The terms *human-nature instruments/tools/scales* are used predominately throughout this paper to reduce confusion.

The development of numerous instruments has allowed for flexibility of choice in study design and the ability to evaluate different facets of the relationship between people and nature. This freedom, however, has introduced confusion as to which instrument/s may be best suited for a specific study. Although the instruments in general relate to the concept of people and nature, each tool has different facets and nuances that could be advantageous or limiting depending on the study objectives and parameters. For example, researchers seeking to understand participants' pre- and post-view of nature in conjunction with an outdoor education program might be best served by a certain instrument, whereas researchers seeking to understand the motivation for environmental behavior in varying demographic groups might be best served by a different instrument. Additionally, a study designed as a short poll may need to incorporate a different scale from one designed around lengthier interviews.

The growing interest in the human-nature connection has sparked several comparative papers examining the theoretical structure of the human-nature relationship (see Restall & Conrad, 2015; Ives, et al., 2017). Examining the structure of the human-nature relationship has merit and researchers should familiarize themselves with this body of knowledge; however, presenting the framework for the connection between people and nature is not the goal of this paper. The purpose of this paper is to present a summary of the instruments and highlight the different attributes of the instruments to aid fellow researchers in selection of the most appropriate tool. Our hope is that other researchers find this a useful reference should they consider the application of these instruments in a study.

History and evolution of human-nature constructs

Foundational work in environmental scales

Initial work in developing scales to quantify an aspect of environmental attitudes, knowledge, connection, or behaviors extends to the 1970s. A handful of instruments were produced in relative proximity to each other. The Ecology Scale (ES) developed by Maloney and Ward (1973) consists of 130 items spread across four subscales of Verbal Commitment, Actual Commitment, Affect (emotional connection to ecological issues), and Knowledge. The instrument includes statements worded in a true/false format, and the Knowledge section consists of multiple choice questions. Maloney and Ward determined that participants had strong interest in environmental issues (levels of Verbal Commitment and Affect), but did not take action related to those concerns (levels of Actual Commitment), and were not literate in ecological content (Knowledge). Maloney, Ward, and Braucht (1975) presented a streamlined version of their scale, which reduced the number of true/false statements to 10 in each category, and reduced the number of knowledge questions to 15. Weigel and Weigel (1978) added the idea of environmental concern to the field. They developed the Environmental Concern Scale (ECS), composed of 16 Likert-statements focusing on species conservation, pollution, pro-environmental views, and associated behavior changes.

While most of the early instruments fell into obscurity and are difficult to find reference to, the New Environmental Paradigm (NEP) scale developed by Dunlap and Van Liere (1978), rose to popularity and is still frequently employed in studies (Hawcroft & Milfon, 2010). This 12-item indicator measures the overall beliefs and views that people hold in respect to the environment. This indicator, a foundational contribution regarding how researchers measure pro-environmental beliefs, has been used in hundreds of studies (Dunlap, 2008). In 2000, Dunlap, Van Liere, Mertig, and Jones revised the NEP into the New Ecological Paradigm Scale (rNEP). The revisions to the NEP included modifying outdated or inappropriate terminology, expanding the ecological basis of the indicator, and using a more balanced pro- and anti-environment set of questions. The rNEP has 15 questions and is structured on five subscales: limits to growth, antianthropocentrism, balance of nature, antiexemptionism, and the possibility of an ecocrisis, in addition to a one-dimension overall score. The rNEP scale has been widely used to measure environmental concern, environmental values, and environmental beliefs (Dunlap, 2008). Amburgey and Thoman (2012) evaluated the dimensionality of the rNEP and concluded that a second-or-

der structure exists, which demonstrates the interrelated facets of the scale. Because of this, Amburgey and Thoman (2012) suggested that confirmatory factor analysis (CFA) be used on future research using the rNEP, and due to the interrelatedness of the facets of the scale, did not recommend the rNEP be used for a single one-dimensional value, but stated that the subscales can be used if CFA is not available.

The 1990s led to the development of numerous psychometric scales to gauge different facets of environmental or nature connection and views, or, to refine existing ideas or instruments. The Ecological World View Scale (EWVS) presented by Blaikie (1992) consists of 24 items, some of which were pulled from the original NEP. Blaikie tested the scale with college students and residents in Melbourne, Australia and determined differences in views in relation to gender and age. The Ecocentric and Anthropomorphic Attitudes Toward the Environment Scale (EAATE) developed by Thompson, and Barton (1994) added the concept of value to the human-nature relationship. The EAATE measures the distinction between valuing the environment for ecocentric attitudes compared to anthropocentric attitudes, in addition to the subscale of apathy. The Environmental Values Scale (EVS) developed by Zimmermann (1996) focuses on measuring the different subsets of preference for a pastoral setting, urban setting, and the view of human domination over the environment (environmental adaption). Zimmerman noted differences in views toward environmental adaption based on gender; males showed higher levels of support for human domination compared to females, gender differences were not documented in respect to pastoral or urban settings.

The concept of culture in respect to environmental views was examined using the New Ecological Consciousness scale (NEC) developed by Ellis and Thompson (1997). The NEC is a 10-item instrument that evaluates general feelings about environmental degradation, anti-anthropocentrism, limits to growth (economic and population), and fragility of nature. Ellis and Thompson posited that environmental attitudes are enmeshed within a larger socioeconomic framework of culture and identity. Another early indicator, The Emotional Affinity Toward Nature scale (EATN) moved toward a more emotional and less cognitive measure of people's relationship with nature (Kals, Schumacher, & Montada, 1999). The EATN uses 16 items to address emotional attributes towards nature, including love for nature and a feeling of oneness. Kals et al. (1999) determined that affinity toward nature was influenced by times spent in nature (past and current) and by the meaningful people with whom that time was shared.

Environmental concern and motivation scales

The past two decades have led to an explosion of new instruments and expanded debate on the human-nature relationship. Schultz (2000) presented three values under which environmental concern can be classified: egoistic or self, altruistic or other, and biospheric or species based. The breakdown of environmental concern into egoistic, altruistic, and biospheric, outlined by Schultz, mirrored work by Stern and Dietz (1994), who differentiated three value orientations of environmental concern—egoistic, social altruistic, and biospheric—although the biospheric value was not found to be distinguishable from the social altruistic value in a sample of the general population. Stern (2000) presented a value-belief-norm theory of environmentalism that includes these values (egoistic, altruistic, biospheric) as dimensions underpinning a person's beliefs, pro-environmental personal norms, and behaviors. Schultz quantified these different value subsets using the Environmental Motives Scale (EMS), which identifies what values motivate an individual's environmental concern, using terms such as birds, plants, children, future generations, my health, and my lifestyle.

Schultz (2001) further explored the egoistic and biospheric values using the Implicit Association Test (IAT), a computerized test. The IAT was modified from Greenwald, McGhee, and Schwartz (1998) who tested implicit cognition (automatic association) using the concepts of plant names vs. insect names, and musical instruments vs. weapon names in conjunction to words related to the concepts of pleasant or unpleasant. Schultz used a combination of terms related to Nature Environments (animals, trees) vs. Built Environments (car, city) and the concepts of Me (I, mine, self) and Not Me (it, their, they) and a combination of the above categories, e.g. Car would relate to Built or Not Me. People who associated themselves with nature reflected a positive relationship with biospheric concerns. Conversely, a negative relationship was demonstrated between implicit connection to nature and egoistic concerns.

de Groot and Steg (2008) tested the construction of environmental value orientations of egoistic, biospheric, and altruistic, using the Environmental Value Orientations scale (EVO), which is a modification/reduction of items used by Stern et al. (1999) and Schwartz (1992). Participants ranked items related to the 3-dimensions on their importance as a guiding principle in their lives. Their findings supported the 3-dimensional structure of environmental values. Gatersleben, Murtagh, and Abrahamse (2014) employed the EVO and found that scores on the 3 dimensions were not related to age, gender, or income.

Environmental identity scales

Clayton (2003) described environmental identity as 'a sense of connection to some part of the nonhuman natural environment that affects the way humans perceive and act toward the world; a belief that the environment is important to us and an important part of who we are' (45-46). Clayton (2003) developed the 28-item Environmental Identity scale (EID) designed to measure the degree to which individuals identify with the environment or environmental issues. Clayton tested the EID in multiple studies with college students. She found that the EID scores were significantly positively correlated with environmental behavior, $r = .64$, pro-environmental choices in two conflict scenarios, $r = .27$ and .38, and principles such as 'responsibility to other species' and 'the rights of the environments', multivariate F [3,108] = 7.64 and 7.98, respectively. Winter and Chavez (2008) used a modified version of the EID for a survey of visitors to national forest lands, including wilderness areas and day-use sites, and found the EID scores to be significantly positively correlated with concepts of "managing for environmental purposes," $r = .24$, and "area needed for environmental protection," $r = .30$. The dimensional properties of the EID were assessed by Olivos and Aragonés (2011), who found four underlying dimensions: environmental identity, enjoyment of nature, appreciation of nature, and environmentalism. Clayton produced a modified form of the EID (EID-short form), which contains 11 items from the original scale; the EID-short form positively correlates to environmental concern (S. D. Clayton, personal communication, July 24, 2016).

The EID was used in respect to gardening by Kiesling and Manning (2010), who proposed that the different ways in which people relate to gardening could be measured in a gardening identity. The EGID, developed by Kiesling and Manning (2010), includes 29 statements targeting four constructs: self-identification with gardening/nature, adherence to an ideology, strength of identity, and positive emotional associations with gardening/nature. Kiesling and Manning (2010) found that five subscales existed in the scale: negative use of pesticides, connection to the wild, worldview, willingness to engage in natural process, and maintaining natural function. They found significant positive correlations between the overall results of the EID and the EGID, $r = .60$, and the subscales of the EGID and the EID, but did not feel the EGID accurately predicted an identifiable gardening identity.

Continuing with the concept of identity, Walton and Emmet Jones (2018) developed the Ecological Identity Scale (EIS), an 18-item instrument, which uses a social identity theory framework to examine environmental/ecologi-

cal identity. Their scale evaluates the sameness, difference, and centrality of environmental concepts within a socioecological setting.

Relationship with nature scales

A growing area of research is the concept of relationship to/with nature. The Connectedness to Nature Scale (CNS), developed by Mayer and Frantz (2004), explores the subjective connection people have with nature. The CNS, a 14-item survey, was demonstrated to be a good measure of ecological behavior, $r = .44$, and environmentalism, $r = .56$ (Mayer & Frantz, 2004) and has been widely used.

The CNS has been employed in studies seeking to understand human behavior and well-being. In a study focused on the influence of self-awareness on connection to nature, Frantz, Mayer, Norman, and Rock (2005) found that individuals with higher levels of self-awareness in conjunction with anti-environmental views or exploitative/entitlement views had a lower connection to nature; however, individuals with pro-environmental views had higher levels of connection to nature regardless of self-awareness level. Howell, Dopko, Passmore, and Buro (2011) employed the CNS and found people's connectedness to nature to be positively correlated with psychological well-being and social well-being, but found inconsistent results when compared to emotional well-being and mindfulness. Shaw, Miller, and Wescott (2013) compared the CNS scores of individuals in a wildlife gardening program to those not enrolled in a program and found that individuals participating in a wildlife gardening program had higher levels of nature connection. Frantz and Mayer (2014) and Geng, Xu, Ye, Zhou, and Zhou (2015), both concluded that connectedness to nature positively related to pro-environmental behavior and noted that this relationship should be addressed in programs seeking to study or influence environmental behavior.

In terms of theoretical applications, Tam, Lee, and Chao (2013) used the CNS to explore the relationship between tendency to anthropomorphize nature, CNS level, and conservation behavior. They concluded that anthropomorphism was positively correlated with connectedness to nature, which was related to conservation behavior. This is an important finding because it may influence how organizations or individuals communicate their conservation messages; anthropomorphizing environmental issues may bring about more concern or change in behavior than the facts alone.

The CNS has been employed by many authors, but is not without criticism. There is debate in the literature as to what the different instruments, both the CNS and others, measure (see Beery, 2013; Clayton, 2012; Nisbet, Zelenski, & Murphy, 2009; Perrin & Benassi, 2009; Tam, 2013; Kaieser,

Merten, & Wetzel, 2018). Perrin and Benassi (2009) conducted research to evaluate the idea that the CNS measures an emotional connection by recreating and reanalyzing data provided by the original 2004 Frantz and Mayer study. Perrin and Benassi (2009) concluded that the CNS measures a cognitive belief and not an emotional state; the researchers recognized that the CNS measured a relationship to nature but did not think it targeted the emotional state. Additional insight on how the CNS can be evaluated and what it measures can be gleaned from Beery (2013), whose findings supported the conclusions by Perrin and Benassi.

Pasca, Aragonés, and Coello (2017) analyzed the CNS using Item Response Theory and produced a short form of the scale, the CNS-7, which demonstrated good internal reliability and correlated positively with other human-nature indices. The production of the CNS-7 strengthened the dimension of connectedness and removed statements with inconsistent results (Pasca, Aragonés, & Coello, 2017).

Additional studies have been conducted exploring the idea of connection to nature. Dutcher, Finley, Luloff, and Buttolph Johnson (2007) developed the Connectivity With Nature (CWN) scale, and hypothesized that connectivity with nature stems from an inherent sameness and shared experience between the self, others, and the natural world. The CWN is composed of four Likert statements and a Venn diagram depicting the participant's relationship with nature. The creators of the CWN felt that connectivity explored a different facet of environmental values beyond that of cultural norms, postmaterialism, or altruism. Vining, Merrick, and Price (2008) used exploratory questions such as 'Do you consider yourself as part of or separate from nature?' and 'What words come to mind when you think of a natural environment?' to explore the concept of nature connectedness. The researchers coded the responses and found that many people considered themselves to be part of nature (compared to separate, both, or neither) with the rationale for the connection being interdependence, shared essence, shared resources, recreation, and care and enjoyment of nature. However, participants viewed natural environments as exclusive of humans or human involvement while unnatural environments were composed of primarily human-made entities.

Building on the facet of an emotional connection to nature is the Love and Care for Nature (LCN) scale, developed by Perkins (2010). The LCN is a 15-item scale developed to examine the altruistic care for nature that can be exhibited by people. The LCN was found to be a consistent measure of environmental beliefs or orientation when compared to the NEP, $r = .41$, and CNS, $r = .79$ (Perkins, 2010). In addition, Perkins (2010) found the LCN to be a better measure of altruistic or self-sacrificing behavior, will-

ingness to pay higher prices for environmentally friendly good and services, β = .46, and incur cuts in personal living standards to protect the environment, β = .46, than the CNS, based on multiple regression analysis.

Brügger, Kaiser, and Roczen (2011) developed the Disposition to Connect with Nature scale (DCN), which uses a scoring formula for each statement that combines the entities of disposition to connect with nature with the composite figurative costs of a behavior or view. Therefore, easier behaviors have a lower cost, and difficult behaviors have a higher cost and reflect a greater disposition to connect with nature. The use of the formula presents an interesting perspective of connection with nature but limits the ease of use for some situations. Brügger et al. (2011) determined that the DCN demonstrated a high correlation with existing instruments. They suggested that the DCN is an improvement over the other instruments because it is based on self-reflection pertaining to behaviors or events as opposed to self-reflection on value or belief statements.

Beery (2013) developed an additional indicator to gauge the connection between humans and the non-built environment. Beery's study focused on environmental connectedness in respect to nature-based recreation and the Scandinavian concept of friluftsliv, roughly translated as *free/open air life*. Using three questions from a larger survey, the Swedish Outdoor Recreation in Change, Beery compared the results of the three questions, now referred to as the Environmental Connectedness scale (EC), to other instruments. Beery found significant positive correlation between the established instruments, $r = .72$ (minimum) and between EC and the other instruments, $r = .52$ (minimum). Beery suggested that the EC provides a better measure of the emotional connection to nature because it is centered in the larger concept of friluftsliv, which contains an emotional component.

The Commitment to Nature (COM) scale is an 11-item instrument developed by Davis, Green, and Reed (2009) that explores the human-nature relationship from the side of interdependence, where the health of the environment influences the health of humans and vice versa, leading to a level of measurable commitment. The COM was demonstrated to reflect environmental behavior and intention to work for local environmental causes, $r = .60$ (Davis et al., 2009). The idea of relationship was further addressed by Nisbet, Zelenski, and Murphy (2009), who developed the Nature Relatedness (NR) scale to measure people's affective, cognitive, and physical relationship with nature. The NR consists of 21 statements that quantify the strength of a person's relationship to nature, and can be divided into three subscales (self, perspective, and experience). The NR and subscales demonstrated significantly positive relationships with environmental be-

haviors, time spent outside, and time in nature, and were comparable with other human-nature instruments.

Nisbet and Zelenski (2013) modified the original NR scale to the NR-6, which is a brief measure of nature relatedness. The NR-6 retains statements pertaining to the self and experience subscales of the original scale; statements pertaining to the perspective subscale have been removed. Nisbet and Zelenski found the modified scale to demonstrate good internal consistency, α = .86, .86, and .96, in three separate studies, and accurately predict happiness, environmental concern, and nature contact. The NR-6 was significantly positively correlated with results to the EM scale and the original NR. However, because of the removal of multiple statements the NR-6 provides only a single score; the two subscales of self and experience can no longer be calculated.

An extensive indicator, the 99-item Kellert-Shorb Biophilic Values Indicator (KSBVI), was developed by Shorb and Schnoeker-Shorb (2010) to evaluate the nine different dimensions of the biophilia hypothesis. The KSBVI, designed primarily for self-reflection and education in relation to the different biophilic values, has been used with many individuals and several community groups. Meltzer, Bobilya, Faircloth, Mitten, and Chandler (2018) used the KSBVI indicator as a pre- and post-test for individuals on the Prescott College New Student Orientation, an Outward Bound-style trip; the researchers found the KSBVI to be useful in describing the participants' relationships to the natural world and how this relationship changed as a result of the experience. Meltzer et al. (2018) concluded the KSBVI was a sensitive and powerful tool that was able to reflect change in participant's biophilic expressions, though not all nine dimensions were equally as sensitive.

Lumber, Richardson, and Sheffield (2017) applied biophilia values to nature connection. They developed three statements for each of the 9 biophilia values, referred to as Nature Indicators (NI). Respondents evaluated these statements on two aspects, engagement frequency and value. The researchers noted several significant relationships between the biophilia values and nature connection; they suggested that public engagement include activities related to contact, emotion, meaning, compassion, and natural beauty as these concepts were predictors of connection to nature, whereas knowledge-based activities did not have a significant relationship with nature connection.

Environmental attitude scales

Although environmental attitudes can be teased out or inferred from many of the instruments presented in this paper, one instrument, the Environmental Attitude Inventory (EAI) has been designed to evaluate a person's overall environmental attitude (Milfont & Duckitt, 2010). The EAI presents an approach to evaluating environmental attitude within a comprehensive multidimensional construct, as opposed to identifying single dimensions with multiple instruments. The EAI represents 12 distinct dimensions including enjoyment of nature, environmental movement activism, environmental fragility, and human dominance over nature. Milfont and Duckitt (2010) present the results of the instrument and modifications including a short form 72-item scale, and a 24-item scale. Sutton and Gyuris (2013) present research optimizing the EAI statements to evaluate the different dimensions using 37 items.

Focusing on attitude, Kaiser, Merten, and Wetzel, (2018) tried to address the ever-present concern of "how do we know what we are testing;" they used an empirical approach involving a set of five attitude measures, composed of evaluative and normative statements and behavioral items. Their approach differs in that they used specific objectivity to reduce the reliance of defining measures by their indicators, as is done with other instruments.

Action and behavior scales

A final attribute that can be measured is the frequency of behaviors or actions in which a person engages. The General Ecological Behavior scale (GEB) has been used to measure the level of ecological behaviors of respondents (Kaiser, Doka, Hofstetter, & Ranney, 2003). The original scale, developed by Kaiser (1998) was structured as a series of behavior pairs (one pro-environmental the other anti-environmental); pairs related to purchasing of items, energy efficiency, waste production, recycling, and related. Davis et al. (2009), and Davis, Le, and Coy (2011), modified the GEB statements to apply to college students, reduced the number of overall statements, and changed responses to participation frequency on a Likert scale, removing the need for the anti-environmental behavior statements.

Milfont and Duckitt (2004) developed an 8-item scale called the Ecological Behavior Scale (EBS), which has participants rate frequency of pro-environmental behaviors such as "Looked for ways to re-use things" and "Conserved gasoline by walking or bicycling" during the past year. Employing the EBS, Milfont (2009) noted that environmental attitude was positively correlated with ecological behavior. Similar in structure is the Recurring

Pro-Environmental Behavior Scale (REBS) developed by Brick, Sherman, and Kim (2017), which has participants evaluate their frequency of 21 pro-environmental behaviors such as reducing water use, using reusable bags, various dietary choice questions, travel choices, and energy usage. The researchers concluded that environmental identity had stronger predictive power for pro-environmental behavior compared to political party, especially for high-visibility behaviors.

An emerging avenue is the separation of civic engagement or activism from the umbrella of behavior. Alisat and Riemer (2015) developed the 18-item Environmental Action Scale (EAS) to measure level of engagement in civic actions intended to have an impact on environmental issues. The actions in the scale are tied to activism as opposed to pro-environmental behavior. The items are evaluated on frequency of participation and include such entities as took part in a protest/rally, organized a petition, and participated in nature conservation efforts.

Graphical instruments

The majority of instruments quantifying the human-nature relationship contain written statements. Two instruments are constructed in a graphical form. The Inclusion of Nature in Self (INS) scale, developed by Schultz (2001), is a visual representation of the inclusivity between a person and nature, using a series of Venn-style diagrams with overlapping circles representing "self" and "nature." The INS scale is a modified version of the Inclusion of Other in Self scale developed by Aron, Aron, and Smollan (1992). The INS has been used in multiple studies and has demonstrated convergence with other human-nature indices and pro-environmental behavior. The potential weakness of the INS is that it is a single value, and because of this has some statistical limitations. To address the potential limitation, Martin and Czellar (2016) expanded the INS and constructed the Extended Inclusion of Nature in Self (EINS) using three visual symbols that measure concepts representing the size of nature, distance between self and nature, and centrality of nature. The EINS retains the strengths of being quick to complete and visually based, while the addition of three additional concepts improves the power of the tool. The EINS was found to correlate positively with other human-nature psychometric scales and pro-environmental values.

Since the initial development of instruments designed to measure people's views and attitudes toward the environment a surprising number of scales have been employed. Some instruments have consistently been shown to reflect environmental behavior, and others evaluate how a person thinks

or feels about their environment. Instruments exist that provide a single one-dimensional score, while others delineate sub-themes.

Method

The literature on human-nature relationship instruments is far reaching and the terminology is not consistent, making it challenging to identify all published instruments in the related disciplines, though that was the intent of the research. The research method is best described as extensive literature review using a snowballing approach. Initial instruments were located in *Identity and the Natural Environment* (Clayton & Opotow, 2003) and *The Oxford Handbook of Environmental and Conservation Psychology* (Clayton, 2012). The website, conpsychmeasures.com provided many instruments in full form, with instructions for scoring and original citations; alas, the website became inactive circa 2014/2015. These initial resources provided for a wealth of publications, which each led to more publications. At the same time as these leads were being followed, a traditional literature review on the topic was conducted. Search terms included in varying combinations: conservation/environmental psychology measures/scales/indicators, connection/connectedness to nature, human-nature relationship, environmental identity, people and nature, pro-environmental behavior, plus searches on the names and acronyms for identified instruments. Literature review represents 2012 to February 2018. A prerequisite for inclusion in the study was that the instrument reflects a facet of the human-nature relationship; this included psychological relationships and behavior. Constructs that establish basic personality or psychological profiles were not evaluated. Our research focused on instruments that are intended for adult populations. Instruments designed for adolescents, such as the Two Major Environmental Values model (2-MEV) (Bogner & Wiseman, 2006), were not evaluated. Finally, instruments that require computer simulations or support were not evaluated.

We analyzed each instrument for structure (quantity and format of items in tool), results provided (overall scale or subscales), ease of use, and human-nature concepts addressed. These parameters were evaluated using autoethnographic approaches plus reference to initial studies and follow-up studies analyzing the properties of the instruments. Categorization of concept/s evaluated was based on the description from the initial study and subsequent studies. Concept categories included Attitudes/Views, Relationship (Connection, Relatedness, Inclusivity), Behavior/Action, Identity, and Concern. Instruments were assigned a category of Multiple Aspects if they evaluated more than one of the above categories, or additional sub-categories.

Results

Thirty-four instruments were identified. Table 1 outlines the instruments evaluated, Table 2 provides a summary of the instruments and their attributes, Table 3 displays the comparative analysis of the concepts measured, and Table 4 demonstrates structural differences of the instruments.

The majority of instruments are perceived to measure Attitudes/Views (16) or Relationship (13). Behavior/Action, Identity, and Concern made up a smaller proportion with 7, 4, and 3 tools, respectively. Ten instruments were categorized as gauging multiple aspects; many of these instruments contain subscales. The majority of tools (24) provide an overall score; 3 of those include subscales. Ten instruments provide subscales only. Twenty-eight instruments were deemed easy to use, based on time to complete and ease of scoring.

Implications for indicator selection

As demonstrated by the tables, diversity exists in terms of concepts evaluated and structure of the instruments. The subject and format of one's research project will influence which instruments are best suited. To aid in

Table 1. Overview of human-nature instruments in chronological order

Title	*Acronym**	*Initial Reference*
Ecology Scale	ES	Maloney & Ward, 1973
Ecology Scale – short	ES – short	Maloney, Ward, & Braucht, 1975
Environmental Concern Scale	ECS	Weigel & Weigel, 1978
New Environmental Paradigm	NEP	Dunlap & Van Liere, 1978
Ecological World View Scale	EWVS	Blaikie, 1992
Ecocentric and Anthropocentric Attitudes Toward the Environment	EAATW	Thomas & Barton, 1994
Environmental Values Scale	EVS	Zimmerman, 1996
New Ecological Consciousness	NEC	Ellis & Thompson, 1997
General Ecological Behavior	GEB	Kaiser, 1998
Emotional Affinity Towards Nature	EATN	Kals, Schumacher, & Montada, 1999
New Ecological Paradigm (revised NEP)	rNEP	Dunlap, Van Liere, Mertig, & Jones, 2000

(*continued*)

Table 1. Overview of human-nature instruments in chronological order

Title	*Acronym**	*Initial Reference*
Environmental Motives Scale	EMS	Schultz, 2000
Inclusion of Nature in Self	INS	Schultz, 2001
Environmental Identity	EID	Clayton, 2003
Connectedness to Nature	CNS	Mayer & Franz, 2004
Ecological Behavior Scale	EBS	Milfont & Duckitt, 2004
Connectivity with Nature	CWN	Dutcher, Finley, Luloff, & Buttolph Johnson, 2007
Environmental Value Orientations Scale	EVO	de Groot & Steg, 2008
Commitment to Nature	COM	Davis, Green, & Reed, 2009
Nature Relatedness	NR	Nisbet, Zelenski, &Murphy, 2009
Kellert-Shorb Biophilic Values Indicator	KSBVI	Shorb & Schnoeker-Shorb, 2010
Love and Care for Nature	LCN	Perkins, 2010
Environmental Gardening Identity	EGID	Kiesling & Manning, 2010
Environmental Attitudes Inventory	EAI	Milfont &Duckitt, 2010
Disposition to Connect with Nature	DCN	Brügger, Kaiser, & Roczen, 2011
NR-6	NR-6	Nisbet & Zelenski, 2013
Environmental Connectedness	EC	Beery, 2013
Environmental Action Scale	EAS	Alisat & Riemer, 2015
Extended Inclusion of Nature In Self	EINS	Martin & Czellar, 2016
Environmental Identity – short form	EID – 11	Clayton, 2016
Nature Indicators	NI	Lumber, Richardson, & Sheffield, 2017
Connectedness to Nature - 7	CNS-7	Pasca, Aragonés, & Coello, 2017
Recurring Pro-Environmental Behavior Scale	REBS	Brick, Sherman, & Kim, 2017
Ecological Identity Scale	EIS	Walton & Emmet Jones, 2018

Note: *Some authors use different acronyms for the connection to nature instruments; the acronyms listed here are consistent throughout this paper and represent the most frequently used acronyms in the relevant literature.

Table 2. Summary analysis of instruments in chronological order[A]

Instrument	*Structure*	*Scoring and Subscales*	*Concepts Measured*
ES	130 T/F and multiple choice items	Subscale scales: • Verbal Commitment 1–36 • Actual Commitment 1–36 • Affect 1–34 • Knowledge 1–24	Ecological attitudes and knowledge
ES – short	45 T/F and multiple choice items	Subscale scales: • Verbal Commitment 1–10 • Actual Commitment 1–10 • Affect 1–10 • Knowledge 1–15	Same as ES
ECS	16 Likert statements	Single score: 0–64	Concern towards conservation and pollution issues
NEP	12 Likert statements	Single score: 1–4	Beliefs and views towards environment
rNEP	15 Likert statements	Overall: 15–75 • Subscales: each 3–5 • Limits to Growth • Antianthropocentrism • Fragility • Reject • Exemptionalism • Possibility of Ecocrisis	General ecological beliefs and views, plus subscales related to global ecological principles.
EWVS	24 Likert statements	Single score: 1–5 Subscales: each 1–5 • Use/abuse of the natural environment • Precariousness of the natural environment • Conservation of the natural environment • Sacrifices for the environment • Confidence in science and technology • Problems of economic growth • Conservation of natural resources	View of non-western, worldview of natural environment

(*continued*)

Table 2. Summary analysis of instruments in chronological order[A]

Instrument	*Structure*	*Scoring and Subscales*	*Concepts Measured*
EAATW	33 Likert statements	Subscales: each 1–5 • Ecocentric attitude • Anthropocentric attitude • Apathy	Value of environment for human's benefit compared to an inherent ecological benefit, in addition to apathy towards environmental issues
EVS	31 Likert statements	Subscale scores variable: • Pastoral 6–59 • Urbanism ⁻14–26 • Human Domination ⁻6–42	Three subscales of pastoralism, urbanism, and ability for environmental adaptation or human domination of the environment
NEC	10 Likert statements	Single score: 1–7	Fragility of environment and need for transformation
GEB	40 or 65 yes/no or pro/anti-environment statements	Single score: variable range	General, non-specific environmentally friendly behaviors
EATN	16 Likert statements	Subscales: each 1–6 • Love of Nature • Feelings of Freedom • Feelings of Safety • Feelings of Oneness with Nature	Emotional aspects towards nature including love and feeling of oneness
EMS	15 entities (e.g., plants, me, birds, my health) to be valued by environmental concern	Subscales: each 1–7 • Egoistic • Altruistic • Biospheric	Three subscales of motivators for environmental concern, egoistic (my), altruistic (others), and biospheric (species)
INS	Series of 7 Venn style diagrams of separate, touching, and overlapping circles identified as 'self' and 'nature'	Single score: 1–7	Visual representation of view of self and nature

Table 2. Summary analysis of instruments in chronological order[A]

Instrument	*Structure*	*Scoring and Subscales*	*Concepts Measured*
EINS	4 sets of spatial metaphors	Single score: 1–7	Conceptual representation of self and nature in overlap, size, distance, and centrality
EID	28 Likert statements	Single score: 28–196	Identify with environment and environmental causes
EID - 11	11 Likert statements	Single score: 11–77	Same as EID
CNS	14 Likert statements	Single score: 1–5	Level of connection to nature
CNS - 7	7 Likert statements	Single score: 1–5	Same as CNS
EBS	8 pro-environmental behaviors	Single score: 1–5	Frequency of participation in pro-environmental behaviors
CWN	4 Likert statements and 3 choice Venn diagram of 'nature' and 'yourself'	Single score: 1–4.6	Perception of sameness between self, nature, and others.
EVO	13 items	Subscales: each –1–7 • Egoistic • Biospheric • Altruistic	Environmental values based on guiding principles
COM	11 Likert statements	Single score: 1–8	Perceived level of interdependence between people and nature
NR	21 Likert statements	Overall: 1–5 Subscales: each 1–5 Self Perspective Experience	Overall connection to nature plus three subscales of self, perspective, and experience
NR-6	6 Likert statements	Single score: 1–5	Single score reflecting connection to nature

(*continued*)

Table 2. Summary analysis of instruments in chronological order[A]

Instrument	*Structure*	*Scoring and Subscales*	*Concepts Measured*
KSBVI	99 Likert statements	Value ranges: each 11–44 Aesthetic Negativistic Humanistic Naturalistic Symbolic Scientific Utilitarian Dominionistic Moralistic	Nine biophilic values of affinity for nature
LCN	15 Likert statements	Single score: 1–7	Love and altruism in respect to nature
EGID	29 Likert statements	Single score: 1–7*	Reflection of the degree a person perceives nature in gardens/ gardening
EAI	120, 72, 37, or 24 Likert statements	Subscales: each 1–7 • Enjoyment of nature • Support for interventionist conservation policies • Environmental movement activism • Conservation motivated by anthropocentric concern • Confidence in science and technology • Environmental fragility • Altering nature • Personal conservation behavior • Human dominance over nature • Human utilization of nature • Eco-centric concern • Support for population growth policies	Individual belief regarding the management and quality of the natural environment
DCN	40 yes/no or behavior statements	Hand-computed score not available	Reflects a psychological bond with nature using self-reflection on past experiences and evaluative statements

Table 2. Summary analysis of instruments in chronological order[A]

Instrument	*Structure*	*Scoring and Subscales*	*Concepts Measured*
EC	3 Likert statements	Single score: 1–5	Measure of connectedness to nature
EAS	18 pro-environmental actions	Single score: 1–5	Assess level of engagement in environmental actions
NI	27 statements	2 subscales on nine biophilia values: Engagement: 1–6 Value: 1–5	Edgemont and Value related to biophilia entities
REBS	21 pro-environmental behaviors	Single score: 1–5	Level of participation in pro-environmental behaviors
EIS	18 Likert statements	Single score: 1–5	Social identify based view of self as part of an ecological system

Note: [A] Scales that are modifications to the original are placed below the original, and not in chronological order on this and subsequent tables. Unless stated, a higher score on the indicator represents a stronger connection/relationship to the specific attribute. *In this instrument, a lower score represents a stronger perception of nature in gardens/gardening.

selection of the most appropriate instrument/s, researchers should identify what aspect of the human-nature relationship they wish to explore; multiple tools can be employed to evaluate the different facets of the human-nature relationship. In addition, instruments with subscales can provide a multi-faceted picture within a single indicator. The structure of the instruments also influences the potential for use. In some studies, it may be appropriate to employ instruments that take a significant amount of time to complete, in other studies, a lengthier indicator could result in lack of participation, making a shorter instrument more appropriate.

Conclusions and recommendations

Numerous human-nature psychometric instruments exist, and a variety of information can be gleaned from these tools. As evident by the literature presented, the majority of studies have employed instruments to understand the human-nature relationship, establish correlations to demographic characteristics or behaviors, or validate the instruments. Few published studies represent the use of instruments in outdoor/environmental education

Table 3. Concept of human-nature relationship measured or indicated by evaluated instruments

Instrument	*Attitude/ View*	*Relationship*[A]	*Behavior/ Action*	*Identity*	*Concern*	*Multiple Aspects*
ES	•		•			
ES -short	•		•			
ECS					•	
NEP	•					
EWVS	•					•
EAATW	•					•
EVS						•
NEC	•					
GEB			•			
EATN	•	•				
rNEP	•					
EMS					•	•
INS		•				
EINS		•				•
EID	•			•		
EID - 11				•		
CNS		•				
CNS - 7		•				
EBS			•			
CWN		•				
EVO						•
COM	•	•				
NR	•	•				•
KSVBI						•
LCN	•	•				
EGID	•			•		
EAI	•	•	•		•	•
DCN	•	•				
NR-6		•				
EC		•				
EAS			•			
NI						•
REBS			•			
EIS				•		

Note: [A] Category includes connectedness, relatedness, and inclusivity.

Table 4. Usability features of evaluated instruments

	Values Produced		*Usability*	
Instrument	*Overall Score*	*Subscale Scores*	*Time to Complete*	*Ease of Scoring*
ES		•	3	3
ES - short		•	2	2
ECS	•		2	2
NEP	•		2	1
rNEP	•	•	2	2
EWVS	•	•	2	2
EAATW		•	2	2
EVS		•	2	3
NEC	•		2	1
GEB	•		3	2
EATN		•	1	2
EMS		•	1	1
INS	•		1	1
EINS	•		1	1
EID	•		2	2
EID - 11	•		2	1
CNS	•		2	1
CNS -7	•		2	1
EBS	•		2	1
CWN	•		1	1
EVO		•	2	1
COM	•		1	1
NR	•	•	2	2
NR-6	•		1	1
KSVBI		•	3	3
LCN	•		2	1
EGID	•		2	1
EAI		•	2–3	2–3
DCN	•		2	4
EC	•		1	1
EAS	•		2	2
NI		•	3	3
REBS	•		2	2
EIS	•		2	2

Note: Time to Complete: 1, approximately one minute or less; 2, between 2 and 5 minutes; and 3, over 10 minutes. Ease of Scoring: 1, very quick hand scoring; 2, simple by hand but requires a few minutes; 3, simple but requires additional time to hand score; and 4, requires use of statistical analysis for scoring.

and the impact that education can have on said relationship. The use of human-nature instruments in outdoor/environmental education can help researchers quantify the effects of their programs.

The majority of instruments reflect environmental attitudes/views and connection/relationship with nature. Most instruments are formatted using Likert or frequency statements and most are easy to use/score and require less than five minutes to complete. Some instruments, such as the CNS, EID, NEP, NR, and INS have been tested extensively across diverse demographic populations and variable research settings. Time will tell how more recent indices, such as the EAI, NI, and EIS perform. Some instruments have been used in initial studies with limited follow up application, whereas others rise in popularity and are applied in numerous comparative studies. Each indicator allows for examination of a different facet of the human-nature relationship or an evaluation of said relationship from a different theoretical perspective.

Although some instruments have a higher rate of use, we caution against selecting based upon citation frequency. There is enough diversity in structure of the instruments that, for specific studies, some will be more appropriate than others; factors to consider include concepts measured, appropriateness of subscales, comparison/redundancy to other instruments, and time/length/format. We recommend researchers start their selection process by identifying their main concept/s of interest. Once this is designated, researches can work with a reduced pool of potential instruments; keep in mind, selecting an indicator used in a similar study may provide opportunities for comparative evaluation. If time permits, we recommend using more than one instrument. Employing multiple tools allows for comparison of attributes, and provides a multi-faceted view of the study population. In addition, the use of multiple instruments for each study can help to further the understanding of how the instruments converge or diverge in their findings and enable researchers to identify the nuances that different instruments provide. For example, given the research question "What impact does interaction with the non-built environment have on a person's relationship with nature," a study that takes people on a week-long camping and service trip can employ substantial questionnaires to determine pre- and post-characteristics of people. A study of this type could be served well by the combination of the INS/EINS, the NR, and the CNS or LCN, which all reflect variables that might be influenced by a week in nature without being redundant. In comparison, a survey of people who attended an hour-long presentation on local wildlife may be better served by a shorter instrument or a combination of shorter instruments, such as the CNS-7, NR-6, or the EC.

In another example, a study looking for information about the people who adopt environmentally friendly landscape practices and incorporate native plants into their landscape used four human-nature instruments—CNS, NR, INS, and EMS—in their mail questionnaire (Cartwright & Mitten, 2017). Researchers were able to describe the participants' connection to nature and motivations for their conservation efforts across nine parameters while corroborating the instruments with each other.

We urge researchers to become familiar with the tools presented in this paper and incorporate them into projects where appropriate. Human-nature instruments are potentially powerful tools that can reveal useful information about people's relationship to nature. Increasing the appropriate use and visibility of these tools in outdoor educational settings can help us to better understand people as well as program efficacy.

References

Alisat, S., & Riemer, M. (2015). The environmental action scale: Development and psychometric evaluation. *Journal of Environmental Psychology*, *43*, 13–23.

Amburgey, J. W., & Thoman, D. B. (2012). Dimensionality of the new ecological paradigm: Issues of factor structure and measurement. *Environment and Behavior*, *44*(2), 235–256.

Aron, A., Aron E. N., & Smollan, D. (1992). Inclusion of other in the self scale and the structure of interpersonal closeness. *Journal of Personality and Social Psychology*, *63*, 596–612.

Beery, T. H. (2013). Establishing reliability and construct validity for an instrument to measure environmental connectedness. *Environmental Education Research*, *19*(1), 81–93.

Blaikie, N. W. (1992). The Nature and Origins of Ecological World Views: An Australian Study. *Social Science Quarterly*, *73*(1), 144–65.

Bogner, F. X., & Wiseman, M. (2006). Adolescents' attitudes towards nature and environment: Quantifying the 2-MEV model. *Environmentalist*, *26*(4), 247–254.

Brick, C., Sherman, D. K., & Kim, H. S. (2017). "Green to be seen" and "brown to keep down": Visibility moderates the effect of identity on pro-environmental behavior. *Journal of Environmental Psychology*, *51*, 226–238.

Brügger, A., Kaiser, F. G., & Roczen, N. (2011). One for all? Connectedness to nature, inclusion of nature, environmental identity, and implicit association with nature. *European Psychologist*, *16*(4), 324–333.

Cartwright, K. S., & Mitten, D. (2017). Exploring the human-nature relationship of conservation gardeners. *Native Plants*, *18*(3), 212–225.

Cervinka, R., Röderer, K., & Hefler, E. (2011). Are nature lovers happy? On various indicators of well-being and connectedness with nature. *Journal of Health Psychology*, *17*(3), 379–388.

Clayton, S., & Opotow, S. (2003). *Identity and the natural environment: The psychological significance of nature*. Cambridge, MA: The MIT Press.

Clayton, S. (2003). Environmental identity: A conceptual an operational definition. In Clayton, S. & S. Opotow (Eds.), *Identity and the natural environment: The psychological significance of nature* (pp. 45–65). Cambridge, MA: The MIT Press.

Clayton, S. D. (2012). Environment and identity. In Clayton, S. D. (Ed.), *The Oxford handbook of environmental and conservation psychology* (pp. 164–180). New York, NY: Oxford University Press.

Davis, J. L., Green, J. D., & Reed, A. (2009). Interdependence with the environment: Commitment, interconnectedness, and environmental behavior. *Journal of Environmental Psychology*, *29*, 173–180.

Davis, J. L., Le, B., & Coy, A. E. (2011). Building a model of commitment to the natural environment to predict ecological behavior and willingness to sacrifice. *Journal of Environmental Psychology*, *31*(3), 257–265.

Davis, N., & Gatersleben, B. (2013). Transcendent experiences in wild and manicured settings: The influence of the trait "Connectedness to Nature." *Ecopsychology*, *5*(2), 92–102. doi:10.1089/eco2013.0016

De Groot, J. I., & Steg, L. (2008). Value orientations to explain beliefs related to environmental significant behavior: How to measure egoistic, altruistic, and biospheric value orientations. *Environment and Behavior*, *40*(3), 330–354.

Dunlap, R. E. (2008). The new environmental paradigm scale: From marginality to worldwide use. *The Journal of Environmental Education*, *40*(1), 3–18.

Dunlap, R. E., & Van Liere, K. D. (1978). The "new environmental paradigm": A proposed measuring instrument and preliminary results. *Journal of Environmental Education*, *9*, 10–19.

Dunlap, R. E., & Van Liere, K. D., Mertig, A. G., & Jones, R. E. (2000). Measuring endorsement of the New Ecological Paradigm: A revised NEP scale. *Journal of Social Issues*, *56*, 425–442.

Dutcher, D. D., Finley, J. C., Luloff, A. E., & Buttolph Johnson, J. (2007). Connectivity with nature as a measure of environmental values. *Environment and Behavior*, *39*(4), 474–493.

Ellis, R. J., & Thompson, F. (1997). Culture and the environment in the Pacific Northwest. *American Political Science Review*, *91*(4), 885–897.

Ewert, A. W., Mitten, D. S., & Overholt, J. R. (2014). Adaptations and applications. In A. W. Ewert, D. S. Mitten, & J. R. Overholt (Eds.), *Natural environments and human health* (pp. 122–139). Wallingford, UK: Cabi Publishing.

Frantz, C. M., & Mayer, S. (2014). The importance of connection to nature in assessing environmental education programs. *Studies in Educational Evaluation*, *41*, 85–89.

Gatersleben, B., Murtagh, N., & Abrahamse, W. (2014). Values, identity and pro-environmental behaviour. *Contemporary Social Science*, *9*(4), 374–392.

Geng, L., Xu, J., Ye, L., Zhou, W., & Zhou, K. (2015). Connections with nature and environmental behaviors. *Plos One*. *10*(5), 1–11. doi:10.1317/journal.pone.0127247

Greenwald, A. G., McGhee, D. E., & Schwartz, J. K. L. (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality and Social Psychology*, *74*, 1464–1480.

Hawcroft, L. J., & Milfont, T. L. (2010). The use (and abuse) of the new environmental paradigm scale over the last 30 years: A meta-analysis. *Journal of Environmental Psychology*, *30*(2), 143–158.

Henderson, B. (2001). Lessons from Norway: Language and outdoor life. *Pathways: The Ontario Journal of Outdoor Education*, *13*(3), 31–32.

Howell, A. J., Dopko, R. L., Passmore, H., & Buro, K. (2011). Nature connectedness: Association with well-being and mindfulness. *Personality and Individual Differences*, *51*(2), 166–171.

Ives, C. D., Giusti, M., Fischer, J., Abson, D. J., Klaniecki, K., Dorninger, C., . . . & Raymond, C. M. (2017). Human–nature connection: a multidisciplinary review. *Current Opinion in Environmental Sustainability*, *26*, 106–113.

Johnson, B., & Manoli, C. C. (2010). The 2-MEV scale in the United States: a measure of children's environmental attitudes based on the theory of ecological attitude. *The Journal of Environmental Education*, *42*(2), 84–97.

Kals, E., Schumacher, D., & Montado, L. (1999). Emotional affinity toward nature as a motivational basis to protect nature. *Environment and Behavior*, 31, 178–202.

Kaiser, F. G. (1998). A general measure of ecological behavior. *Journal of Applied Social Psychology*, *28*(5), 395–422.

Kaiser, F. G., Doka, G., Hofstetter, P., & Ranney, M. A. (2003). Ecological

behavior and its environmental consequences: A life cycle assessment of a self-report measure. *Journal of Environmental Psychology*, *23*(1), 11–20.

Kaiser, F. G., Merten, M., & Wetzel, E. (2018). How do we know we are measuring environmental attitude? Specific objectivity as the formal validation criterion for measures of latent attributes, *Journal of Environmental Psychology*.

Kiesling, F. M., & Manning, M. (2010). How green is your thumb? Environmental gardening identity and ecological gardening practices. *Journal of Environmental Psychology*, *30*, 315–327.

Lumber, R., Richardson, M., & Sheffield, D. (2017). Beyond knowing nature: Contact, emotion, compassion, meaning, and beauty are pathways to nature connection. *PloS One*, *12*(5), e0177186.

Maloney, M. P., & Ward, M. P. (1973). Ecology: Let's hear from the people: An objective scale for the measurement of ecological attitudes and knowledge. *American Psychologist*, *28*(7), 583.

Maloney, M. P., Ward, M. P., & Braucht, G. N. (1975). A revised scale for the measurement of ecological attitudes and knowledge. *American Psychologist*, *30*(7), 787.

Martin, C., & Czellar, S. (2016). The extended Inclusion of Nature in Self scale. *Journal of Environmental Psychology*, *47*, 181–194.

Mayer, F. S., & Frantz, C. M. (2004). The connectedness to nature scale: A measure of individuals' feeling in community with nature. *Journal of Environmental Psychology*, *24*, 503–515.

Mayer, F. S., Frantz, C. M., Bruehlman-Senecal, E., & Doliver, K. (2008). Why is nature beneficial? The role of connectedness to nature. *Environment and Behavior*, *41*(5), 607–642.

Meltzer, N. W., Bobilya, A. J., Faircloth, W. B., Mitten, D., & Chandler, R. M. (2018). The effect of an outdoor orientation program on participants' biophilic expression. *Journal of Outdoor and Environmental Education*, 1–19.

Milfont, T. L. (2009). The effects of social desirability on self-reported environmental attitudes and ecological behaviour. *The Environmentalist*, *29*(3), 263–269.

Milfont, T. L., & Duckitt, J. (2004). The structure of environmental attitudes: A first-and second-order confirmatory factor analysis. *Journal of Environmental Psychology*, *24*(3), 289–303.

Milfont, T. L., & Duckitt, J. (2010). The environmental attitudes inventory: A valid and reliable measure to assess the structure of environmental attitudes. *Journal of Environmental Psychology*, *30*(1), 80–94.

Nisbet, E. K., Zelenski, J. M., & Murphy, S. A. (2009). The nature related-

ness scale: Linking individuals' connection with nature to environmental concern and behavior. *Environment and Behavior*, *41*(5), 715–740.

Nisbet, E. K., Zelenski, J. M. (2013). The NR-6: A new brief measure of nature relatedness. *Frontiers in Psychology*, *4*. doi:10.3389/fpsyg .2013.00813

Olivos, P., & Aragonés, J. I. (2011). Psychometric properties of the Environmental Identity Scale (EID). *Psyecology*, *2*(1), 65–74.

Pasca, L., Aragonés, J. I., & Coello, M. T. (2017). An analysis of the connectedness to nature scale based on item response theory. *Frontiers in Psychology*, *8*, 1330.

Perkins, H. E. (2010). Measuring love and care for nature. *Journal of Environmental Psychology*, *30*(4), 455–463.

Perrin, J. L., & Benassi, V. A. (2009). The connectedness to nature scale: A measure of emotional connection to nature? *Journal of Environmental Psychology*, *29*, 434–440.

Restall, B., & Conrad, E. (2015). A literature review of connectedness to nature and its potential for environmental management. *Journal of Environmental Management*, *159*, 264–278.

Schultz, P. W. (2000). Empathizing with nature: The effects of perspective taking on concern for environmental issues. *Journal of Social Issues*, *56*(3), 391–406.

Schultz, P. W. (2001). The structure of environmental concern: Concern for the self, other people, and the biosphere. *Journal of Environmental Psychology*, *21*, 327–339.

Schultz, P. W., Shriver, C., Tabanico, J., & Khazian, A. (2004). Implicit connections with nature. *Journal of Environmental Psychology*, *24*, 31–42.

Schwartz, S. H. (1992). Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. In *Advances in Experimental Social Psychology* (Vol. 25, pp. 1–65). Academic Press.

Shaw, A., Miller, K., & Wescott, G. (2013). Wildlife gardening and connectedness to nature: Engaging the unengaged. *Environmental Values*, *22*, 483–502.

Shorb, T. L. & Schnoeker-Shorb, Y. A. (2010). *The Kellert-Shorb Biophilic Values Indicator: A workbook*. Prescott, AZ: Native West Press.

Stern, P. C. (2000). Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues*, *56*(3), 407–424.

Stern, P. C., & Dietz, T. (1994). The value basis of environmental concern. *Journal of Social Issues*, *50*(3), 65–84.

Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. *Human Ecology Review*, 81–97.

Sutton, S. G., & Gyuris, E. (2015). Optimizing the environmental attitudes inventory: Establishing a baseline of change in students' attitudes. *International Journal of Sustainability in Higher Education*, *16*(1), 16–33.

Tam, K.-P. (2013). Concepts and measures related to connection to nature: Similarities and differences. *Journal of Environmental Psychology*, *34*, 64–78.

Tam, K.-P., Lee, S.-L., & Chao, M. M. (2013). Saving Mr. Nature: Anthropomorphism enhances connectedness to and protectiveness toward nature. *Journal of Experimental Social Psychology*, *49*, 514–521.

Thompson, S. C. G., & Barton, M. A. (1994). Ecocentric and anthropocentric attitudes toward the environment. *Journal of Environmental Psychology*, *14*(2), 149–157.

Vining, J., Merrick, M. S., & Prices, E. A. (2008). The distinction between humans and nature: Human perception of connectedness to nature and elements of the natural and unnatural. *Research in Human Ecology*, *15*(1), 1–11.

Walton, T. N., & Jones, R. E. (2018). Ecological Identity: The Development and Assessment of a Measurement Scale. *Environment and Behavior*, *50*(6), 657–689.

Weigel, R., & Weigel, J. (1978). Environmental concern: The development of a measure. *Environment and Behavior*, *10*(1), 3–15.

Winter, P. L., & Chavez, D. J. (2008). Wildland recreationists' natural resource management purposes and preferences: a connection to environmental identity. In Chavez, D. J., Winter, P. L., & Absher, J. D. (Eds.), *Recreation visitor research: studies of diversity* (163-174). General Technical Report. PSW-GTR-210. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station.

Zimmermann, L. K. (1996). The development of an environmental values short form. *Journal of Environmental Education*, *28*(1), 32–37.