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Review

A literature review of connectedness to nature and its potential for environmental management

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ABSTRACT

Understanding how people's relationships with nature form, how they influence personal values and attitudes, and what behavioural implications they may have could provide more insight into how connectedness to nature (CNT) can effectively contribute to environmental management goals. This paper undertakes a review of literature published over the past decade (2002–2011) on SCOPUS; and describes the current state of knowledge regarding CNT, assesses any efforts towards the spatial mapping of CNT for environmental management, and identifies measures of CNT defined in the broader literature. This review suggests that there is quite some overlap in the literature on CNT concepts, and that more effort needs to be made towards multi-disciplinary research which explores how CNT can be useful to environmental planning and conservation research on the field. It also further corroborates the need and relevance of applying more social and affective strategies to promote conservation behaviour. The main progress in CNT theory seems to have been made in the development of measurement tools, and it is clear that there is a strong convergent validity amongst the different measures due to their similarity, and functional associations. Further efforts towards the exploration of multi-dimensional measures is recommended since they consistently stand out as showing better results. The geographic visualisation of CNT constructs is another area of research that deserves attention since it can provide a unique point of view towards guiding participatory protected area planning and management.

A substantial body of literature has been published in the social and behavioural sciences over the last three decades examining the human–nature relationship (e.g. Degenhardt, 2002; Schultz, 2001a,b, 2002; Mayer and Frantz, 2004; Orr, 2004; Nisbet et al., 2009). The study of connectedness to nature (CNT) is primarily concerned with understanding how people identify themselves with the natural environment and the relationships they form with nature. The literature devoted to people–nature relationships has made valuable contributions to environmental psychology; however the breadth and variety of CNT literature can also present challenges to a comprehensive understanding of the field. This is exemplified by the multiplicity of terms used for this construct, with CNT also referred to in the literature as nature connectedness (Schultz, 2002), nature relatedness (Nisbet et al., 2009), love and care for nature (Perkins, 2010), connectivity with nature (Dutcher et al., 2007), emotional affinity toward nature (Kals et al., 1999), dispositional empathy with nature (Tam, 2013a,b,c) or inclusion of nature in the self (Schultz, 2001a,b). Given this breadth of terms, there is substantial scope for literature reviews of existing academic research in the subject area, in order to highlight key elements and trends in the field.

CNT theory suggests that a relationship with the natural world directly affects people's physical, mental, and overall wellbeing due to benefits gained by increased exposure to nature and positive experiences in the natural world (Tauber, 2012). Direct experiences with natural settings seem to have very profound emotional effects on people (Louv, 2008), and a stronger commitment to nature could lead to higher human interest in environmental protection (Perkins, 2010). Consequently, understanding how people's relationships with nature form, how they influence personal values

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and attitudes, how they can be measured and what behavioural implications they may have, could provide more insight into how CNT has the potential to effectively help meet conservation goals. Better insight into people and their relationships with nature has the potential to enhance our ability to effectively meet conservation goals. Understanding how these relationships form, how they influence personal values and attitudes, and what behavioural implications they may have remains critical. The ability to link CNT concepts to geographically defined spaces could also potentially be useful for purposes of environmental management, and for conservation planning in particular.

Given the above, this paper provides a literature review of CNT academic literature over the past decade (2001–2011), with three main objectives: a) to describe the current state of knowledge regarding CNT; b) to assess any efforts towards the spatial mapping of CNT for environmental management and c) to identify measures of CNT defined in the literature.

1. Connectedness to nature and its relevance to environmental management

Various authors have suggested that humans were in the past more physically and psychologically connected to nature than people living in industrialised nations today (Melson, 2001; Shepard, 1993, 1996). This implies a potential disconnect from the natural environment (Axelrod and Suedfeld, 1995; Beck and Katcher, 1996, Katcher and Beck, 1987) primarily due to the displacement of people into cities which seems to insulate us from outdoor natural environmental stimuli (Stilgoe, 2001). Clearly human pressures in modern society, coupled with technological improvements and increased urbanisation, could also be affecting people's ability to connect with nature in their daily lives, potentially creating a nature-disconnect which is thought to have an impact on our empathy for other species and our desire to help conservation efforts (Louv, 2008; Kellert, 1997; Conn, 1998). This could also be leading to a decline in people's connectedness across generations and diminishing our experience in and with the natural world (Kahn et al., 2009). Some even argue that the relationship between people and the natural world is in fact broken, and that this is leading to a failure to value the very same systems that keep us alive (Monbiot, 2013). Consequently understanding how a sense of connection with nature can impact upon people's decisions to protect nature is important if we wish to protect biodiversity, and ultimately this same sense of connectedness to nature (Howard, 1997; Schultz, 2000).

Wilson (1984) claims that humans have an innate kinship for nature which he terms biophilia. This understanding of our sense of inclusion in nature is referred to as our '*ecological identity or self*' (Naess, 1973); and attachment to nature and place are thought to affect human identity or self-definition (Clayton and Opotow, 2003; Mayer and Frantz, 2004; Schultz et al., 2004). Perkins (2010) defines the construct of love and care for nature as "a deep love and caring for nature which includes a clear recognition of nature's intrinsic value as well as a personal sense of responsibility to protect it from harm". Similarly Nisbet et al. (2009) proposed the term 'nature relatedness' (NR) to explain our connectedness with other living things in the natural world - even those that are not appealing to humans.

Klassen (2010) suggests a strong interrelatedness between ecological identity, sense of place and ecological literacy, and establishes that the degree to which these three concepts influence individuals varies from person to person. He also concludes that an individual's CNT is dependent on a variety of precursors, including 'prior knowledge', 'lived experiences', 'cultural background', as well as 'encountering and conversing with people who display their compassion, caring, and dedication for environmental concerns'. Schultz (2002) also suggests that '*values*' act as a bond between all these concepts and precursors mentioned by Klassens since they underpin the relationship with the natural world, and their affective psychological and physiological responses to natural settings (Crystal and Chuck, 1987). Wilson (1984) also suggests that another important determinant impinging on our deep and profound relationship with nature is spirituality, and suggests that an ecological self is experienced through '*a sense of belonging or spiritual oneness with nature*'. Similarly Kamitsis and Francis (2013) conclude that exposure to nature and CNT are indeed positively associated with psychological wellbeing and significantly mediated by spirituality. Schroeder (1990, 1991) defines spirituality as the experience of "*being related to or in touch with an 'other' that transcends one's individual sense of self and gives meaning to one's life*" at the deepest level of the human psyche (Crystal and Harris, 1987). Thus, the human values of natural areas can also include the sense of timelessness and feelings of community and connectedness to other people as well as to places and things in nature (e.g. landforms, natural features, other living things) (Daniel et al., 2007).

Schultz (2002, 2004) argues that the construct for CNT is composed of three dimensions of psychological inclusion in nature – i) a cognitive or mental representation of that self that creates an interdependence with nature; ii) an affective representation which refers to an individual's emotional bond with nature that creates a sense of intimacy and care for it; and iii) a behavioural component which refers to an individual's commitment to act in the best interest of the natural environment and protect it. However Ashmore et al. (2004) suggest that there are more dimensions to CNT and propose that '*collective identity*' also has a determinant role since one may interpret nature as a collective community which humans belong to (Clayton, 2003). Collective identity is defined by Tajfel (1978) as "*that part of an individual's self-concept which derives from his knowledge of his membership of a social group (or groups) together with the value and emotional significance attached to that membership*". Collective identity is also related to social capital theory which Perkins et al. (2002) define as "*the norms, networks, and mutual trust of 'civil society' that facilitate cooperative action among citizens and institutions*", and which results in direct benefits for those community members (Kawachi et al., 1997). In fact, social capital theory could also play an important role in the way humans adapt to environmental shocks (Mogues, 2006), or in certain cases even why they hamper adaptation (Bezabih et al., 2013). It would therefore be fair to conclude that the level of resilience of social-ecological systems is not only dependent on social factors such as people's ability to anticipate changes and adapt to future challenges (adaptive capacity), but is also influenced by human intervention, institutional policies and exposure to natural changes over time (Nelson et al., 2007). Consequently ecological resilience and social factors like CNT are intrinsically interconnected through changing forms of natural resource management demands over time (Ruiz-Mallén and Corbera, 2013).

Several authors (e.g. Bragg, 1996; Roszak, 1992) insist that a more connected sense of self to nature is conducive to environmentally responsible behaviour (ERB), and that less tangible social motivations like CNT or place attachment are in fact potential drivers of significant environmental action (Kals et al., 1999; Vaske and Kobrin, 2001; Dutcher et al., 2007). Indeed, as connectedness to nature or place increases so does one's empathy and willingness to

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protect it (Mayer and Frantz, 2004); and direct contact with nature has been shown to increase interconnectedness and love for nature (Kaplan and Kaplan, 1989; Rolston, 1993; Wilson, 1984). Meanwhile Schultz (2000) argues that the value people give to an object depends on the extent to which they include that object within their sense of self, and that pro-environmental behaviour is more likely with increased connectedness to nature or place (Gosling and Williams, 2010; Schultz, 2002).

The above '*eco-psychological*' arguments then suggest that there are significant disparities in the way individuals are attracted to nature, and disconnectedness from nature could indirectly contribute to environmental deterioration (Howard, 1997; Schultz et al., 2004). Schultz (2000) and Howard (1997) argue that if we start to value nature, we will feel a higher concern for it and commit towards its protection. However the relationship between nature and self is in many ways at conflict with people's perceptions of natural and unnatural environments – where most perceive natural areas as independent from human agency, potentially leading to cognitive dissonance (Elliot and Devine, 1994; Festinger, 1957). Cognitive dissonance occurs when people are torn between opposing thoughts or feelings about a particular concept (Vinning, 2008; Festinger et al., 1956). This dissonance typically leads people to rationalise their environmentally damaging behaviour in order to relieve this dissonance, and feel better about their contradictory perceptions and actions. Resolving this conflict in perceptions of CNT and actual behaviour could lead to more environmentally responsible behaviour (Vining et al., 2008).

2. Methods

2.1. Data collection protocol and search strategy

This paper presents two sets of literature reviews – the first dataset based on a review of the literature undertaken using principles of Systematic Literature Review (SLRs) protocols as a guide, and the second dataset based on a less restrictive but wider search for relevant literature related specifically to measures of CNT. The SLR protocol was identified a-priori and detailed the study inclusion criteria, established a series of review questions, identified relevant studies, appraised their quality and summarised the evidence to provide an overall picture of CNT literature. The aim was to synthesize findings from recent literature in order to understand the direction CNT research is taking, while reducing the effect of the reviewers' own bias, identifying gaps, and suggesting directions for further research (Khan, 2003; Higgins and Green 2011). Pullin and Knight (2001), Pullin et al. (2004), Fazey et al. (2004) and Sutherland et al. (2004) agree that SLRs are improved methods for the identification of academic evidence and for its application in environmental conservation and management. The study provides a concise and systematic synopsis of the somewhat fragmented literature on CNT for researchers to draw reliable conclusions on CNT's potential contribution to environmental management (Sackett et al., 2000).

The first step of the literature review involved systematically identifying data sources. The papers which formed our dataset were thus selected from peer reviewed literature on CNT published between January 2002 and December 2014 for the first dataset. Searches of web-based databases hosted by SciVerse (Scopus) were conducted, specifically under the categories for "Life sciences" (7200 journal titles) and "Social sciences and humanities" (5300 titles). Scopus was selected because it offers significant coverage of databases that deal with the environmental social sciences. The search terms used were "*connectedness to nature*" and "*nature relatedness*", with papers selected for further evaluation if they contained this term within the article title, abstract and/or keywords. Other related search terms were excluded since CNT is by now established as the leading term for this construct. The use of the Scopus database inevitably means that other relevant CNT literature may have been overlooked, since it only offers literature written in English, and excludes other works published in books, dissertations, and conference proceedings or online. Nonetheless peer-reviewed research communicated through the medium of established journals remains the most reliable source for a systematic literature review that can withstand academic scrutiny, despite the above limitations. For researchers trying to identify or build a CNT measure ideal for their needs, a more complete list of available measures is needed. Consequently, in order to provide a more comprehensive literature review of measures associated with CNT, the author also undertook a Scopus search beyond the reference years; and furthermore screened the first 100 returns of 'grey literature' from the Google search engine using the same keywords, but focussing specifically on measurement of CNT. This second dataset was used specifically to provide a more comprehensive collation of CNT measures beyond the first dataset. Only English language publications were assessed.

2.2. Study inclusion criteria

Each article returned by the database search had its full text reviewed if the title and/or abstract were deemed to meet any three of the following study inclusion criteria, namely: a) articles specifically dealing with the topic of connectedness to nature; b) articles containing a measure quantifying the connection to the natural world; and c) articles that attempt to map CNT. Publications were scored for the extent to which they discussed each of the three inclusion criteria listed above in the title or abstract, and when necessary in the introduction and discussion sections. Thus, whether a published article was deemed relevant was dependent on the context of the study, and its direct relevance to CNT. Consequently papers that simply mentioned CNT or simply discussed fringe aspects of underlying CNT concepts were deemed to be irrelevant to this review. All papers were assessed by the primary author to ensure consistency, with key findings then reviewed by the second author. After searching the Scopus database, the selection was narrowed down to 260 papers published between 2002 and 2014. Of these 260 sources, 170 were rejected because they did not match the study inclusion criteria mentioned above. Our final sample was comprised of 90 peer reviewed papers from forty different journals and are listed in Annex I.

2.3. Coding protocol

The selected 90 papers were each reviewed carefully to assess their relevance against an a-priori protocol derived following a preliminary review of all papers. We identified the following ten review variables in order to describe the papers' context and methods for measuring CNT, and these variables were subsequently used to score each relevant paper accordingly.

2.4. Limitations

Bibliographic and academic research databases available

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electronically are typically the primary source for systematic reviews; however, the social sciences and humanities literature is more fragmented than the natural sciences and engineering field (Boaz et al., 2002). The social sciences also seem to lack the large scale databases typically found in medicine, chemistry and other scientific disciplines; and are spread across niche journal repositories available via commercial subscription. Similarly undertaking systematic search protocols tends to be more difficult than in scientific disciplines like medicine because of the variability of social science terminology and indexing in established repositories (Fazey, 2005a,b). Since we only assessed literature from Scopus journals, and general Google searches specifically for the measures section, some caution is necessary when deriving conclusions from this work since other relevant CNT literature may have been excluded. This is especially relevant in view of recent open-access repositories like PlosOne and the acceleration of scientific output which is estimated to double every 9 years (Bornmann and Mutz, 2014). In fact, circa 60 of the 90 papers selected here where published in 2013 and 2014 alone.

3. Results and discussion

3.1. CNT papers published and their wider research contexts

Ninety papers were found to be of direct relevance to CNT within the 13 years analysed on the Scopus database. A comparison against the coverage of other similar psychological constructs like place attachment (in the same database and over the same period) suggests that CNT is still somewhat under-represented in the Scopus literature. For instance a similar search for the term "*place attachment*" (PA) revealed 1064 potential sources which are of direct relevance to the PA literature.

Out of the 90 papers reviewed, 76 papers (84%) undertook empirical research which applies CNT within specific contexts, while only 12 published papers (13%) comprised literature reviews, and only two papers were general format papers in the form of essays, reports or discussion papers. While the benefits of widespread empirical research are clear, this result also confirms there is scope for reviews of this nature. The majority of papers were standalone studies (78%) and the remaining 22% of the studies formed part of wider programmes of research – primarily looking at related health issues in connection with CNT, or else exploring the interplay between teaching and CNT. 54% of the studies received no reported funding whatsoever, and only 31% of papers received state funding, with only 4% receiving academic funding and 7% receiving NGO funding.

3.2. Journals publishing about CNT

Between 2002 and 2014, 17 journals published papers specifically dealing with CNT; however, 15 of these journals only published one paper on the subject over this time span. The 'Journal of Environmental Psychology' (JEP) published 30% of all papers (27 papers), followed by Landscape and Urban Planning (LUP) at 56% and Health & Place, Ecological Economics, Journal of Environmental Management, Procedia – Social and Behavioral Sciences, and Environment and Behavior which published 3% of the papers. This result comes as no surprise since the *JEP* is a leading journal for academics who have a specific interest in the interrelationships between people and their physical surroundings. This implies that CNT is somewhat relegated to the psychology literature base and has limited exposure or application in other multi-disciplinary publications or academic literature, which can be a limiting factor towards the potential influence of CNT concepts in environmental policy or management decisions.

3.3. Country interest in CNT

For each paper we noted the institution and country where authors were based in order to give an idea of the spread of CNT research and to identify any cultural biases which may be present. All papers originated only from 25 countries, and the largest numbers of publications (27%) were written from USA institutes, followed by 17% in Australia and 8% in the UK, 7% in the Netherlands, 6% in Canada, while Germany made a modest contribution (4%).

The only lower income country represented, based on the gross national income per capita and a classification of economies by the World Bank (2010–2014), was Iran; however the paper in question was written by academics in India. Overall this suggests that studies in CNT are undertaken in high-income countries, and that low-income countries are poorly represented in CNT literature. Unfortunately this bias towards high-income countries is not specific to CNT literature alone and remains prevalent in most fields of research (Pablos-Mendez and Shademani, 2006). The main probable reason for such a significant discrepancy between high and low-income countries is likely due to the lack of environmental research funding allocated in these countries, and is further compounded by the Environmental Kuznets Curve hypothesis (Kuznet, 1955; Grossman and Krueger's 1991; Stern 2004). Kuznet's hypothesis suggests that there is a relationship between environmental deterioration and a country's development especially during the initial phases of industrialisation. He posits that when certain levels of per-capita income are reached the degradation is reversed since economic growth helps create better regulatory conditions for environmental improvement and more demand for better environmental quality (Yandle et al., 2002). Understanding CNT in low-income countries could expose some interesting comparisons in connectedness between people from different social and economic realities, and the potential effects of technology embeddedness and globalisation on CNT perceptions. Consequently one can assume that such discrepancies are also attributable to a country's capability to invest in research, and the significant differences in the scientific spending of nations (Fazey, 2005a,b; May, 1998; Tilman, 2000). This limitation is indeed significant because ultimately we may be generalizing about the way people connect to nature on the basis of very few cultural frameworks, and limits a true understanding of CNT as a universally-applicable concept.

3.4. Academic domains pursuing CNT, and their spatial focus

As can be expected, the greatest proportion of papers (66%) analysed CNT purely from the psychological point of view, or looked at its application within the environmental and social psychology domain. Only 13% of papers focused on the implications of CNT on conservation, 6% on human geography, 3% on sociology along with a similar 3% on the medical sciences. Other varied disciplines like education only garnered a share of 7%of the literature. This suggests that CNT is somewhat grounded in the psychological sciences but still garners interest from various domains (Oberkircher et al., 2011) including environmental policy and planning, and more needs to be done to ensure more interdisciplinary approaches for its application on the field.

Our review indicates that there is a moderately varied distribution of studies across the identified spatial scales. Papers

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considering the relevance of CNT for '*Nature in general*' dominated the literature (29%); followed by a specific focus on '*Natural areas (not directly modified for human purposes)*' at 13%. '*Urban areas*' (12%) and '*Agricultural areas*' (11%) also were the subject of study; while '*Rural areas*', (7%), '*Outdoor areas or urban parks*' (6%), '*Touristic areas*' (2%), and '*Contaminated/polluted environments*' (1%) garnered modest interest. '*Office environments*' received no direct CNT attention in the period reviewed and 16% of the papers had no particular spatial focus. These results indicate that research is mostly focused on understanding CNT within a generic appreciation of nature, or simply focused on the psychological implications of CNT on people, rather than being framed within specific environments. However, natural and urban areas do seem to be of direct interest in CNT, while fewer studies where applied to agricultural areas, rural areas, outdoor areas or urban parks, and touristic areas. This is possibly the result of people moving out of rural areas and relocating to coastal and urban settlements (Daily, 2001; Fischer et al., 2005), which further decreases our exposure to nature and natural places and creates an implicit demand towards understanding people's affinity to modified urban areas or their peri-urban fringes. As mentioned earlier human contact with nature is important for human well-being, both physically and psychologically, and applies not only within natural environments but also within urban environments (e.g. importance of urban green space). In fact, a recent literature review by Haluza et al. (2014) that investigated physiological outcomes of experiencing nature confirms that natural environments offer a high potential for human well-being, restoration and stress recovery. The benefits of being connected with nature seem to reach beyond helping people to recover from stress or attention fatigue, and Mayer et al. (2009) suggest that a sense of belonging in the natural world can also help people gain purpose and meaning in life. Many (Wilson, 1984; Kellert and Wilson, 1993; Kellert, 1997) argue that people have an inherent need to associate with the broader natural world, and when this need is met they will in turn experience psychological benefits (Roszak, 1995). However it is important to note how Klassen (2010) suggests that while youth in urban centres have less connectedness to nature, rural youth are also showing signs of disconnectedness. Hence a greater understanding of how CNT constructs are shaped within modified environments, and the implications of such changes in modified environments is still lacking (Young, 2000; Luck et al., 2004).

3.5. Stakeholder involvement

There is doubt that successful nature management can be designed or implemented without taking in consideration the relationship with the broader society. For instance, conserving rural landscapes has been shown to require complex coordination with many public and private stakeholders (Donahue, 1999; Sample, 1994). Despite the potential links between peoples' CNT and planning, only 74% of the papers involved stakeholders somewhat in their studies with the vast majority of them (60%) being involved simply for data gathering purposes and to obtain their views (11%). This implies that although there were varying degrees of public involvement, only 3% of the papers attempted to apply the findings through true participatory or consultative research beyond the mere acknowledgement of local people's reflections and attachment to nature. Nonetheless, it is crucial to note that despite the appeal of participatory research, this in itself raises numerous other academic and political challenges that go beyond the mere production of data (Cornwall and Jewkes, 1995). More needs to be done in order to make the case on how CNT research can contribute towards ensuring that the location of power in the participation process remains with the local people involved (Hovik et al., 2010), while fostering and leveraging this connectedness, or lack of it, towards effective participatory conservation efforts and more responsible environmental behaviour (Ernst and Stefan, 2011).

3.6. Spatial mapping of CNT constructs

Spatial mapping and analysis of geographically referenced information is being used extensively in the social sciences to gain spatial perspectives that can solve complex environmental problems which are embedded in space and time (Goodchild and Janelle, 2010). This is especially the case due to the proliferation of location-based personal devices over the last decade. In view of recent efforts towards community involvement in natural resource management, spatial mapping has emerged as a powerful tool to bring communities' knowledge and points of view to the attention of public authorities or decision-makers. In fact, participatory mapping is nowadays being used extensively to create maps that represent community values and perceptions, land use patterns, local knowledge and practices that can empower decision making while empowering stakeholders (Brown and Ramirez-Gomez, 2013). Participatory mapping refers to "*community-based research and development approaches that use local people to map places*", and which facilitate public involvement in policy making (Sieber, 2006) by projecting cognitive spatial knowledge into cartographic and visual descriptive datasets (Herlihy and Knapp, 2003). Despite these benefits, our review did not come across any efforts that tried to map CNT specifically, even though a lot of work has gone towards using mapping approaches for measuring and displaying similar cognitive constructs, for example landscape values and place attachment (Brown and Raymond, 2007; Brown et al., 2015). Applying '*geographic visualisation*' techniques to display social constructs like CNT could provide an alternative cartographic landscape that could provide policy makers with multiple and exploratory perspectives of data to understand spatial and social construct patterns better (Crampton, 2001). Mapping respondents' response to a CNT measure would allow for the spatial projection of CNT expressions of value towards nature and provide a unique point of view to identify social risks associated with potential land use change. Despite the above, only 4% of the CNT papers reviewed attempted to include this perspective in their research.

If we are serious about the view that people are part of an ecosystem, then good ecosystem management should stand to gain from the mapping of social or personal meanings or value people attribute to nature; or how we view human–environment relationships and the extent to which people agree or disagree on these meanings (Brown et al., 2013). McLain et al. (2013) identify three broad potential uses of socio-spatial data in environmental planning, namely to: a) secure land tenure and manage natural resources; b) identify local ecological knowledge; and c) identify peoples' connection to place (Brown et al., 2013). Participatory spatial mapping of intangible assets like CNT and similar nature-place-human specific priorities can be a useful approach to better integrate local knowledge in conservation planning since it can identify areas of common values or disagreement and also act as an educational tool. CNT spatial mapping can allow planners to identify areas of distinctive human connection and relate that

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data layer with relevant land characteristics for areas in need of biodiversity protection (Colchester, 1998) and integrated resource management, while contributing towards participatory decision making and providing a reference point for monitoring or evaluation (Table 1).

3.7. Research methods used for measuring CNT

The aim of this section is to provide an overview of CNT measures mentioned or used in the wider literature to measure, quantify and categorize the human relationship with our natural environment. We review the distinctiveness of these measures as a further contribution to the theoretical understanding of connection to nature, and undertake a critical analysis of their strengths and weaknesses. Out of the papers reviewed for the first dataset, 49% actually use one or more tools to quantify CNT, and some of the studies reviewed have even developed psychometric scales of their own. Although a number of the papers reviewed or assessed numerous instruments that measure CNT, it is clear that other established CNT measurement tools were omitted since they were not published in peer-reviewed journals. Consequently a wider and less restrictive literature review beyond the SCOPUS journal and date parameters was undertaken for this section in order to create a second dataset. Table 2 below builds on previous compilations published by Bruni, Schultz and Saunders (2013), Hefler and Cervinka (2009) and Tam (2013a,b,c) in order to fill the gap in the existing literature by reviewing a compendium of CNT tools. Please note that only measures which are most cited and are intended for an adult target audience were reviewed, and this list is not deemed to be exhaustive. The measures are sorted in chronological order so as to show how measures have evolved over time. It is important to note that the majority of measures reviewed are essentially unidimensional in scope since they tend to identify one specific aspect of the connection between humans and nature; which are typically related to affective affiliation, cognitive representation, or relationship commitment (Tam, 2013a,b,c). On the other hand, other scales like the Environmental Identity scale (EID) tend to expose multiple dimensions of CNT like the interaction with natural elements, importance of nature, importance of affiliation with nature, and emotions toward nature (Tam, 2013a,b,c; Clayton, 2003) or behavioural attitudes.

There is clearly substantial similarity and possible overlap between the various measures and constructs of CNT reviewed above, even though they theoretically focus on different aspects of CNT. These similarities are even acknowledged by the authors themselves in some cases. Mayer and Frantz (2004) suggest that CTN and INS are highly inter-correlated ($r = .55$) and have similar correlations with behaviour (Tam, 2013a,b,c). Nisbet et al. (2009) also noted similarities between the NR and CTN scales, and Howell et al. (2011) confirmed a strong inter-correlation ($r = .61$) between these two scales. Also, Davis et al. (2011) show how COM is strongly correlated with CTN, EID, and INS ($r = .57$ to .68, Tam, 2013a,b,c). More recently Kim-Pong Tam (2013a,b,c) undertook an important cross-border and empirical study to understand better how seven of the various measures discussed above are similar to, or different from, each other. Table 3 below shows the correlation and its respective 95% confidence interval of each possible pair of measures related to CNT against criterion variables for one of the cohort samples. The criterion variables used by Tam included (i) the five traits and values of personality and individual differences (Costa and McCrae, 1992); (ii) contact with nature; (iii) "*subjective wellbeing which includes both a cognitive component (satisfaction with life) and an affective component (pleasantness of emotions)*" (Diener et al., 1999); and finally (iv) environmental behaviour which included attitudinal support for environmental movement/causes and self-reported ecological behaviour. Tam's findings in fact show "*strong convergent validity and little incremental validity among these measures*", which suggests that they can be considered as measures of the same underlying construct. This should instil more confidence in the use of these measures.

Nevertheless, these results also suggest that while the subtle statistical divergences of these measures cannot be ignored, it is evident that NR and EID show a persistent correlation with the criterion variables, and that the NR scale was consistently reliable *"for traits, subjective well-being, and environmental behaviour"* (Tam, 2013a,b,c). Also Tam shows that the multi-dimensional measures consistently showed better results which suggests that CNT is

Table 1
Descriptive variables and answer categories used.

	Variables	Questions	Categories
1.	Study Category:	What type of study is this?	(i) Empirical research (i.e., qualitative and quantitative studies), (ii) Reviews, and (iii) Essays/comments.
2.	Research integration	Is the study stand-alone or part of a wider programme of research?	i) Stand-alone, ii) wider.
3.	Funding	Did the study receive funding?	Yes/No. (i)No funding; (ii)State funding; (iii)NGO funding; (iv)EU funding; (v)Internal funding; (vi)Source not specified.
4.	Journal and country:	Which journals are publishing about CNT, and which countries are papers coming from?	(i) Journal name; (ii) Origin of main author.
5.	Disciplinary focus:	Does the study emanate from a specific disciplinary standpoint?	(i)Psychology, (ii)Human geography, (iii)Biology, (iv)Physical geography, (v)Sociology, (vi) Medical, (vii) Conservation.
6.	Spatial focus:	Is the study focused on a particular type of environment? If yes, what type of environment?	Yes/No. (i) Natural areas (not directly modified for human purpose); (ii) Rural areas; (iii) Urban areas, (iv) Office environments; (v) Outdoor areas or urban parks; (vi) Contaminated/polluted environments; (vii) Other.
7.	Stakeholder Involvement	Does the study involve stakeholders?	(i)No stakeholders involved; (ii)Official agencies; (iii)NGOs; (iv)Locals; (v)Resource users; (vi)Research community; (vii)Minority groups.
8.	CNT mapping	Does the study involve spatial/geographic mapping of CNT or related concepts?	Yes/No.
9.	CNT Measurement	Is the study focused on the measurement of CNT?	Yes/No.
10.	Policy and Management	Does the study have practical implications for policy and environmental management?	Yes/No

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Table 2
Measures of CNT, with a brief description of the dimensions identified and variables measured. (CR = Cognitive representation, Affective affiliation = AA, Relationship commitment = RC).

#	Date/authors	Measurement scale	Abb.	Dimensions of CNT	CNT constructs identified			Factors, attitudes, constructs or variables measured	Measurement tool
					CR	AA	RC		
1	1998/Stern and Dietz De Groot J.I.M. and Steg L (2007)	Environmental Value Orientations Scale	EVO	Uni-dimensional	☒	☒		Measures value orientations towards the environment. ▪ Egoistic values – respondent's interest in environmental issues that affect people personally. ▪ Socio-altruistic values – environmental actions due to moral obligations and that may have consequences on other human beings ▪ Biospheric values – cost and benefits to nature as a whole	23-item measure, scored on a 9-point Likert scale.
2	1994/Thompson and Barton	Ecocentric and Anthropocentric Attitudes Toward the Environment Scale	EAATE	Uni-dimensional	☒	☒	☒	Measures 2 attitudes (Ecocentric & Anthropocentric) across 3 sub-scales: ▪ Ecocentric attitudes – valuing nature and protecting it because of its inherent value. ▪ Anthropocentric attitudes – a belief that nature is only valued for material benefits that it can give to mankind. ▪ Apathy toward environmental issues - a skepticism of environmental issues and a lack of concern in these issues	33-item measure, scored on 5-point Likert scale.
3	1997/Ellis & Thompson	New Ecological Consciousness scale	NEC	Uni-dimensional	☒	☒		Measures general feelings about environmental degradation, limits to economic growth, and potential crises in overpopulation, ▪ Egalitarian biases ▪ Individualistic biases ▪ Hierarchical cultural biases ▪ Environmental attitudes and beliefs.	10 item measure, scored on a 7 point Likert scale.
4	1997a/Hartig, Kaiser & Bowler	Perceived Restorativeness Scale	PRS	Uni-dimensional	☒	☒		Measures qualities of restorative person-environment transactions. ▪ Being away – getting distance from some ordinarily present or routine aspects of one's life; ▪ Fascination – particular contents and events in the processes of exploration; ▪ Coherence – a function of immediately perceived elements or features of the environment to one another and scope; ▪ Compatibility – match between the person's goals and inclinations, the demands made on the person by environmental conditions and the patterns of information available in the environment for support of purposive and required activities	16 item measure, scored on a 7-point Likert scale.
5	1999/Kals, Schumacher, and Montada	Emotional affinity toward nature	EATN	Uni-dimensional	☒	☒		Measures emotional inclinations toward nature as love for nature and feeling of oneness with nature ▪ Love of nature ▪ Feelings of freedom, ▪ Feelings of Safety ▪ Feelings of Oneness with Nature	16-item measure, scored on a 7-point Likert scale.
6	1997/2000/Dunlap, VanLiere, Mertig, & Jones	New Ecological Paradigm	NEP	Multi-dimensional	☒	☒		Measures sentiments and attitudes towards nature and the environment. ▪ Ecological worldviews ('primitive beliefs') ▪ Environmental concerns ▪ Degree to which the respondent views humans as an integral part of the natural environment and their relationship with it.	15-item measure, scored on a 5-point Likert scale.
7	2002/Schultz	Inclusion of Nature in Self Scale	INS	Uni-dimensional	☒			Measures beliefs regarding one's feelings of connection to the natural world	Visual measure of 7 pairs of overlapping circles, scored

(*continued on next page*)

Table 2 (*continued*)

#	Date/authors	Measurement scale	Abb.	Dimensions of CNT	CNT constructs identified			Factors, attitudes, constructs or variables measured	Measurement tool
					CR	AA	RC		
									by scoring each of the 7 sets on a scale of 1–7
8	2003/Clayton	Environmental Identity scale	EID	Multi-dimensional	☒	☒		Measure the extent to which individuals identify with the natural environment and environmental causes. ▪ Individual's past and present interactions with the environment, ▪ His/her self-identification with nature, ▪ Environmental ideology ▪ Feelings of personal connection	28 item measure, scored on a 5-point Likert scale
9	2004/Schultz, P. W., Shriver, C., Tabanico, J., & Khazian	Implicit Associations Test	IAT	Uni-dimensional	☒	☒		Measures attitudes with strong affective components ▪ Classification of words into four categories – 2 representing a concept discrimination such as flowers versus insects, and two representing an attribute discrimination such as pleasant versus unpleasant ▪ Distinguishing between 'nature' words (ex. animals, trees) and 'built' words (car, city).	Computer based test which measures latencies of responses to these tasks, and interpreted in terms of association strengths.
10	2004/Mayer & Frantz	Connectedness to Nature Scale	CNS or CTN	Uni-dimensional	☒	☒		Measures the extent to which respondents feel a part of the natural world and how emotionally connected they are to it.	14-item measure, scored on a 5-point Likert scale.
11	2005/Beckers	Human actions in and reactions toward nature		Uni-dimensional	☒	☒	☒	Measures behavioural influences by assessing the number of behavioural steps and the difficulties of each step separately. ▪ Reason (i.e., the intention) behind a behaviour. ▪ People's connection with nature indirectly as a predictor of people's conservation.	21-item measure, scored using a simple yes/no format and two 5-point Likert scales.
12	2007/Dutcher, Finley, Luloff & Johnson	Environmental Connectivity or Connectivity with nature	ECS or CWN	Uni-dimensional	☒			Measures the extent land owners feel a sense of connection with their natural surroundings.	4 questions scored on a 5-point Likert scale, and three sets of Venn Diagrams depicting configurations of 2 overlapping circles that represents yourself and nature; and respondents are asked to choose a set that reflects how they feel about nature.
13	2008/Leary, Tipsord and Tate	Allo-inclusive identity	AID	Uni-dimensional	☒	☒		Measures extent to which individuals may include broader categories of people, animals, and inanimate entities in their self-concepts ▪ Eight items concern other people with or without a relationship to the respondent, ▪ Other eight items refer to animate and inanimate objects in the natural world.	16-item visual measure depicting 8 sets of overlapping circles and 8 sets that depict animate and inanimate objects in the natural world; and respondents are asked to choose which best describes their relationship with the depicted entities.
14	2009/Davis, Green, and Reed	Commitment to Environment	COM	Uni-dimensional	☒		☒	Measures commitment to the environment. ▪ Psychological attachment ▪ Long-term orientation	11-item measure, scored on a 9-point Likert scale
15	2009/Nisbet, Zelenski, & Murphy	Nature Relatedness Scale	NR	Multi-dimensional	☒	☒	☒	Measures the affective, cognitive, and experiential aspects of an individual's connection to the natural world, and a sense of appreciation and understanding of the interconnectedness of life in the world. ▪ Self – an internalized identification with nature, reflecting feelings and thoughts about one's personal connection to nature".	21-item measure, scored on a 5-point Likert scale.

								▪ Perspective – external, nature-related worldview, a sense of agency concerning individual human actions and their impact on all living things. ▪ Experience – a physical familiarity with the natural world and the level of comfort with and desire to be out in nature.	
16	2010/Perkins	Love and Care for Nature Scale	LCN	Multi-dimensional	☒	☒		Measures an individual's personal and emotional connectedness with nature, and his/her underlying construct of love and deep caring for nature. ▪ Psychological determinants of environmental altruism across a range of contexts	15 item measure, scored on a 7-point Likert type scale.
17	2011/Brügger, A., Kaiser, F. G., & Roczen, N.	Disposition to connect with nature	DCN	Uni-dimensional	☒			Measures personal attitude which can be indirectly derived from inspecting past bonding activities via responses to statements that reflect an appreciation of nature. ▪ Past bonding activities ▪ Evaluative appreciation of nature	Assesses 50 behaviours across a 5-point frequency scale from 1 (never) to 5 (very often) and dichotomous yes/no questions.
18	2013/Silvas V. Daniel	Emotional connection to nature	ECN	Multi-dimensional	☒	☒	☒	Measures emotional connections to nature and relates them to: ▪ Concepts or attitudes attitudes to protect nature (ATPN), and ▪ Willingness to protect nature (WTPN).	Assesses 20 polar emotions across a 5-point semantic scale, and assesses AATPN and WTPN across 5-point Likert scales.

Table 3
Descriptive statistics, inter correlations, and factor loadings of the various measures (incl. Studies 1& 2)[a] – Tam, 2013a,b,c.

	COM	CTN	CWN	EATN	EID	INS	NR	AID	LCN
COM	–	.81	.80	.81	.85	.66	.88	.62	.84
CTN	.78	–	.84	.74	.81	.64	.83	.65	.84
CWN	.67	.72	–	.70	.75	.67	.78	.66	.78
EATN	.78	.71	.66	–e	.76	.59	.77	.53	.82
EID	.85	.77	.66	.79	–	.67	.85	.65	.85
INS	.48	.53	.44	.40	.46	–	.63	.86	.67
NR	.80	.76	.66	.75	.82	.44	–	.63	.82
AID	–	–	–	–	–	–	–	–	.62
LCN	–	–	–	–	–	–	–	–	–
Study 1 mean (SD)	4.66 (.83)	4.47 (.67)	4.70 (.87)	4.59 (.69)	4.55 (.76)	4.01 (1.46)	4.42 (.68)	–	–
Study 1 alpha	.83	.79	.61	.84	.89	–	.83	–	–
Study 1 factor loading	.91	.86	.76	.85	.91	.52	.88	–	–
Study 2 mean (SD)	5.21 (1.15)	4.85 (1.04)	5.01 (1.39)	5.01 (1.05)	4.88 (1.22)	4.53 (1.96)	4.92 (1.00)	3.72 (1.52)	5.26 (1.25)
Study 2 alpha	.93	.89	.86	.93	.96	–	.90	.92	.97
Study 2 factor loading	.93	.90	.86	.85	.91	.73	.92	.71	.92
Based on Fisher's r to z transformation (Fisher, 1915)									

[a] Note. The numbers below the diagonal were findings from Study 1, while the numbers above the diagonal were findings from Study 2. All correlations were significant at the .001 level. Study 1 used undergraduate students only and from a Chinese society (Hong Kong), while Study 2 used participants of more diverse background from the USA.

indeed a multi-dimensional construct (Nisbet et al., 2009, 2011; Perkins, 2010).

3.8. Links between CNT and environmental policy/management?

Out of the 90 studies identified, only 30% (27) of the papers reviewed tried to link the CNT construct with practical implications for environmental policy and planning efforts. The potential detachment between humans and nature can have serious implications for people's future environmental values, attitudes and behaviour (Vining et al., 2008); and can definitely provide critical leads for CNT constructs' application to management and policy. Research suggests clearly that CNT does indeed throw light towards conservation planning and practice, and where or when social preparedness is underdeveloped and necessary (Sloan, 2002). Similarly the values and knowledge held by local communities is acknowledged as being valuable for biodiversity conservation, and there is a clear need to combine social constructs with biological conservation (Pretty and Smith, 2004). Consequently, assessing and evaluating the driving forces of CNT in our society would rationally seem to be a matter of high priority for environmental policy and management. However, most published studies seem to have a purely exploratory approach that only add small incremental findings and new dimensions to the empirical body of knowledge in CNT; and only provide somewhat limited contributions to the development of environmental management theory. More effective and multi-disciplinary research that is relevant and involves environmental practitioners or policy makers active in the field is necessary; and more feedback is required from those same practitioners on how they think CNT can be useful to conservation research. Future research must explore ways how CNT can be applied to environmental planning and management efforts which offer implications for understanding individuals' orientations toward the environment; and which take cognisance of the unpredictable and contested elements of conservation decisions (Whelan et al., 2002). A good start in this direction was offered by Gosling and Williams (2010) who studied the associations between pro-environmental behaviour and two other types of emotional associations, namely place attachment and CNT, in the context of farmers' management of native vegetation on their land. The findings were consistent with current frameworks and suggest that "*emotional association with nature leads to an expanded sense of self and greater valuing of non-human species, and so to pro-environment behaviour*". This further corroborates the relevance of applying more social and affective strategies in environmental management to promote conservation behaviour.

4. Concluding remarks – some suggestions for future research

While many established authors have made significant contributions to the literature over the last decade, the present work highlights new opportunities for future research on CNT especially with regards to spatial representations of CNT, and applications of the concept in environmental management. Researchers interested in understanding, or influencing people's attitudes and behaviours towards the natural world, may benefit from CNT concepts and measures that assess the subjective experience of ecological self and the interconnectedness of humans with nature. The assumption from the literature is that a focus on interconnectedness and dependence with the environment may result in enduring and committed conservation action. However, further research is needed in order to transpose these notions to different populations or cultures, and to consider whether CNT is felt similarly by the older generation, children and students, or people of different cultures since responses can generally be more diverse (Calder et al., 1981).

Despite the dynamic progress of the CNT literature in ad-hoc empirical papers, the authors express their concern about unclear relations between CNT concepts and other similar psychological constructs like place attachment; and the extent to which such constructs combined can be used as predictors of commitment to the environment. Further interest in exploring more holistic theoretical frameworks that clarify the overlaps in fragmented CNT concepts, rather than just concentrating on CNT constructs in isolation, is therefore necessary. Future research could also delve into the various consequences of CNT to understand whether people who are highly connected to the environment have a significant motivational orientation to compromise on their self-interests for the longer term benefits of conserving the natural world. Similarly more needs to be done towards multi-disciplinary research that is relevant and practical to both environmental managers active in the field in order to ensure that CNT can be useful to conservation research.

A case can also be made concerning the absence and application of geographic visualisation techniques to display social constructs like CNT. This point of view could provide an innovative GIS landscape that can provide policy makers with multiple and exploratory perspectives of CNT expressions towards nature; and provide a unique point of view towards guiding participatory protected area planning and management.

The main progress in the literature seems to have been made in the development of CNT measurement tools. Research indicates that there is strong convergent validity amongst the different measures due to their similarity, and functional associations. However, the predictive potential of each measure could depend partially on whether the application of CNT constructs in conservation literature is more focused on the cognitive, affective or behavioural aspects, or a combination of other factors. Further efforts towards the exploration of multi-dimensional measures is recommended since they consistently stand out as showing better results. In conclusion, future research primarily needs to explore answers to the following pressing questions:

i) How can environmental and resource management practitioners operationalise approaches that include deeper psychological values people assign to natural areas for more effective and inclusive environmental management?
ii) How can CNT be applied effectively to environmental management in combination with similar social constructs like environmental or recreational behaviour?
iii) How can social constructs like CNT be represented spatially?
iv) What qualitative methods might be most appropriate and effective for studying CNT in different populations across time?

Answers to the above questions are necessary for environmental management to develop a broader theoretical framework that includes the profound, affective psychological and physiological responses to natural settings which are more socially sensitive and politically responsive towards resource or ecosystem management.

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ANNEX I. List of articles included in review, sorted in chronological descending order

	Authors	Title	Year	Source title
1	Cynthia McPherson Frantz, F. Stephan Mayer	The importance of connection to nature in assessing environmental education programs	2014	Studies in Educational Evaluation
2	Kim-Pong Tam, Sau-Lai Lee, Melody Manchi Chao	Saving Mr. Nature: Anthropomorphism enhances connectedness to and protectiveness toward nature	2014	Journal of Experimental Social Psychology
3	Jia Wei Zhang, Ryan T. Howell, Ravi Iyer	Engagement with natural beauty moderates the positive relation between connectedness with nature and psychological well-being	2014	Journal of Environmental Psychology
4	Anne Marike Lokhorst, Céline Hoon, Rob le Rutte, Geert de Snoo	There is an I in nature: The crucial role of the self in nature conservation	2014	Land Use Policy
5	Lai Yin Carmen Leong, Ronald Fischer, John McClure	Are nature lovers more innovative? The relationship between connectedness with nature and cognitive styles	2014	Journal of Environmental Psychology
6	Thomas H. Beery, Daniel Wolf-Watz	Nature to place: Rethinking the environmental connectedness perspective	2014	Journal of Environmental Psychology
7	Antal Haans	The natural preference in people's appraisal of light	2014	Journal of Environmental Psychology
8	Stanley T. Asah, Anne D. Guerry, Dale J. Blahna, Joshua J. Lawler	Perception, acquisition and use of ecosystem services: Human behavior, and ecosystem management and policy implications	2014	Ecosystem Services
9	Angel Mario Dzhambov, Donka Dimitrova Dimitrova	Elderly visitors of an urban park, health anxiety and individual awareness of nature experiences	2014	Urban Forestry & Urban Greening
10	Angel M. Dzhambov, Donka D. Dimitrova, Elena D. Dimitrakova	Association between residential greenness and birth weight: Systematic review and meta-analysis	2014	Urban Forestry & Urban Greening
11	Michał Jaśkiewicz, Tomasz Besta	Heart and mind in public transport: Analysis of motives, satisfaction and psychological correlates of public transportation usage in the Gdańsk–Sopot–Gdynia Tricity Agglomeration in Poland	2014	Transportation Research Part F: Traffic Psychology and Behaviour,
12	Sarah L. Bell, Cassandra Phoenix, Rebecca Lovell, Benedict W. Wheeler	Green space, health and wellbeing: making space for individual agency	2014	Health & Place
13	Annick Hedlund-de Witt, Joop de Boer, Jan J. Boersema	Exploring inner and outer worlds: A quantitative study of worldviews, environmental attitudes, and sustainable lifestyles	2014	Journal of Environmental Psychology
14	Alexandra Kibbe, Franz X. Bogner, Florian G. Kaiser	Exploitative versus appreciative use of nature – Two interpretations of utilization and their relevance for environmental education	2014	Studies in Educational Evaluation
15	Jia Wei Zhang, Paul K. Piff, Ravi Iyer, Spassena Koleva, Dacher Keltner	An occasion for unselfing: Beautiful nature leads to prosociality	2014	Journal of Environmental Psychology
16	Marianne E. Krasny, Jesse Delia	Natural area stewardship as part of campus sustainability	2014	Journal of Cleaner Production
17	Kelly L. Haws, Karen Page Winterich, Rebecca Walker Naylor	Seeing the world through GREEN-tinted glasses: Green consumption values and responses to environmentally friendly products	2014	Journal of Consumer Psychology
18	Kate E. Lee, Kathryn J.H. Williams, Leisa D. Sargent, Claire Farrell, Nicholas S. Williams	Living roof preference is influenced by plant characteristics and diversity	2014	Landscape and Urban Planning
19	Angelika Wilhelm-Rechmann, Richard M. Cowling, Mark Difford	Responses of South African land-use planning stakeholders to the New Ecological Paradigm and the Inclusion of Nature in Self scales: Assessment of their potential as components of social assessments for conservation	2014	Biological Conservation
20	Angela Sanguinetti	Transformational practices in cohousing: Enhancing residents' connection to community and nature	2014	Journal of Environmental Psychology
21	F.G. Kaiser, A. Brügger, T. Hartig, F.X. Bogner, H. Gutscher	Appreciation of nature and appreciation of environmental protection: How stable are these attitudes and which comes first?	2014	European Review of Applied Psychology
22	Gesa Sophie Holst, Oliver Musshoff, Till Doerschner	Policy impact analysis of penalty and reward scenarios to promote flowering cover crops using a business simulation game	2014	Biomass and Bioenergy
23	Julian Rode, Erik Gómez-Baggethun, Torsten Krause	Motivation crowding by economic incentives in conservation policy: A review of the empirical evidence	2014	Ecological Economics
24	Yoshihisa Kashima, Angela Paladino, Elise A. Margetts	Environmentalist identity and environmental striving	2014	Journal of Environmental Psychology
25	Jacob B. Hirsh	Environmental sustainability and national personality	2014	Journal of Environmental Psychology
26	Keren Mintz, Tali Tal	Sustainability in higher education courses: Multiple learning outcomes	2014	Studies in Educational Evaluation
27	Angela Loder	'There's a meadow outside my workplace': A phenomenological exploration of aesthetics and green roofs in Chicago and Toronto	2014	Landscape and Urban Planning,
28	Sophia Imran, Khorshed Alam, Narelle Beaumont		2014	Tourism Management,

(*continued on next page*)

(*continued*)

	Authors	Title	Year	Source title
		Environmental orientations and environmental behaviour: Perceptions of protected area tourism stakeholders		
29	Jelle Boeve-de Pauw	Moving environmental education forward through evaluation	2014	Studies in Educational Evaluation
30	Mark Groulx, John Lewis, Christopher Lemieux, Jackie Dawson	Place-based climate change adaptation: A critical case study of climate change messaging and collective action in Churchill, Manitoba	2014	Landscape and Urban Planning
31	Isabelle D. Wolf, Teresa Wohlfart	Walking, hiking and running in parks: A multidisciplinary assessment of health and well-being benefits	2014	Landscape and Urban Planning
32	Annukka Vainio, Riikka Paloniemi	The complex role of attitudes toward science in pro-environmental consumption in the Nordic countries	2014	Ecological Economics
33	Natalia Buta, Stephen M. Holland, Kyriaki Kaplanidou	Local communities and protected areas: The mediating role of place attachment for pro-environmental civic engagement	2014	Journal of Outdoor Recreation and Tourism,
34	Ilias Kamitsis, Andrew J.P. Francis	Spirituality mediates the relationship between engagement with nature and psychological wellbeing	2013	Journal of Environmental Psychology
35	Kim-Pong Tam	Concepts and measures related to connection to nature: Similarities and differences	2013	Journal of Environmental Psychology
36	Kim-Pong Tam	Dispositional empathy with nature	2013	Journal of Environmental Psychology
37	Haywantee Ramkissoon, Liam David Graham Smith, Betty Weiler	Testing the dimensionality of place attachment and its relationships with place satisfaction and pro-environmental behaviours: A structural equation modelling approach	2013	Tourism Management,
38	Eleanor Ratcliffe, Birgitta Gatersleben, Paul T. Sowden	Bird sounds and their contributions to perceived attention restoration and stress recovery	2013	Journal of Environmental Psychology
39	Elizabeth F. Pienaar, Daniel K. Lew, Kristy Wallmo	Are environmental attitudes influenced by survey context? An investigation of the context dependency of the New Ecological Paradigm (NEP) Scale	2013	Social Science Research
40	David R. Jones	'The Biophilic University': a de-familiarizing organizational metaphor for ecological sustainability?	2013	Journal of Cleaner Production,
41	Arjen Buijs, Anna Lawrence	Emotional conflicts in rational forestry: Towards a research agenda for understanding emotions in environmental conflicts	2013	Forest Policy and Economics
42	Silvia Collado, Henk Staats, José A. Corraliza	Experiencing nature in children's summer camps: Affective, cognitive and behavioural consequences	2013	Journal of Environmental Psychology
43	Donald W. Hine, Joseph P. Reser, Wendy J. Phillips, Ray Cooksey, Anthony D.G. Marks, Patrick Nunn, Susan E. Watt, Graham L. Bradley, A. Ian Glendon	Identifying climate change interpretive communities in a large Australian sample	2013	Journal of Environmental Psychology
44	Courtney G. Flint, Iris Kunze, Andreas Muhar, Yuki Yoshida, Marianne Penker	Exploring empirical typologies of human—nature relationships and linkages to the ecosystem services concept	2013	Landscape and Urban Planning
45	Lynda Cheshire, Carla Meurk, Michael Woods	Decoupling farm, farming and place: Recombinant attachments of globally engaged family farmers	2013	Journal of Rural Studies
46	Jacki Schirmer, Helen L. Berry, Léan V. O'Brien	Healthier land, healthier farmers: Considering the potential of natural resource management as a place-focused farmer health intervention	2013	Health & Place
47	Natalia López-Mosquera, Mercedes Sánchez	Direct and indirect effects of received benefits and place attachment in willingness to pay and loyalty in suburban natural areas	2013	Journal of Environmental Psychology
48	Sacha Jellinek, Kirsten M. Parris, Don A. Driscoll, Peter D. Dwyer	Are incentive programs working? Landowner attitudes to ecological restoration of agricultural landscapes	2013	Journal of Environmental Management
49	Mustafa Kahyaoğlu	A Case Study on Primary Science Teacher Candidates' Perceptions towards Alienating from Nature	2013	Procedia — Social and Behavioral Sciences
50	Stephanie Wilkie, Andri Stavridou	Influence of environmental preference and environment type congruence on judgments of restoration potential	2013	Urban Forestry & Urban Greening,
51	Jeou-Shyan Horng, Chih-Hsing Liu, Sheng-Fang Chou, Chang-Yen Tsai	Professional conceptions of creativity in restaurant space planning	2013	International Journal of Hospitality Management,
52	*Birgitta Gatersleben, Matthew Andrews*	When walking in nature is not restorative—The role of prospect and refuge	2013	Health & Place
53	Shawna C. Peckham, Peter N. Duinker, Camilo Ordóñez	Urban forest values in Canada: Views of citizens in Calgary and Halifax	2013	Urban Forestry & Urban Greening
54	Fiona Timmins, Freda Neill	Teaching nursing students about spiritual care — A review of the literature	2013	Nurse Education in Practice
55	Ellen van der Werff, Linda Steg, Kees Keizer	The value of environmental self-identity: The relationship between biospheric values, environmental self-identity and environmental preferences, intentions and behaviour	2013	Journal of Environmental Psychology
56	Lisa M. Smith, Jason L. Case, Heather M. Smith, Linda C. Harwell, J.K. Summers	Relating ecosystem services to domains of human well-being: Foundation for a U.S. index	2013	Ecological Indicators
57	Silvia Collado, Henk Staats, José A. Corraliza	Experiencing nature in children's summer camps: Affective, cognitive and behavioural consequences	2013	Journal of Environmental Psychology,
58	Nik Ramli Nik Abdul Rashid, Naja Mohammad		2012	Procedia — Social and Behavioral Sciences

		A Discussion of Underlying Theories Explaining the Spillover of Environmentally Friendly Behavior Phenomenon		
59	Annick Hedlund-de Witt	Exploring worldviews and their relationships to sustainable lifestyles: Towards a new conceptual and methodological approach	2012	Ecological Economics
60	Mirjam de Groot	Exploring the relationship between public environmental ethics and river flood policies in western Europe	2012	Journal of Environmental Management,
61	Claire Freeman, Katharine J.M. Dickinson, Stefan Porter, Yolanda van Heezik	"My garden is an expression of me": Exploring householders' relationships with their gardens	2012	Journal of Environmental Psychology
62	Marianne Cohen, Raymond Baudoin, Milena Palibrk, Nicolas Persyn, Catherine Rhein	Urban biodiversity and social inequalities in built-up cities: New evidences, next questions. The example of Paris, France	2012	Landscape and Urban Planning
63	Hesam Kamalipour, Armin Jeddi Yeganeh, Mehran Alalhesabi	Predictors of Place Attachment in Urban Residential Environments: A Residential Complex Case Study	2012	Procedia – Social and Behavioral Sciences
64	Taciano L. Milfont, Chris G. Sibley	The big five personality traits and environmental engagement: Associations at the individual and societal level	2012	Journal of Environmental Psychology,
65	Ernst J., Theimer S.	Evaluating the effects of environmental education programming on connectedness to nature	2011	Environmental Education Research
66	Davis J.L., Le B., Coy A.E.	Building a model of commitment to the natural environment to predict ecological behavior and willingness to sacrifice	2011	Journal of Environmental Psychology
67	Howell A.J., Dopko R.L., Passmore H.-A., Buro K.	Nature connectedness: Associations with well-being and mindfulness	2011	Personality and Individual Differences
68	Perkins H.E.	Measuring love and care for nature	2010	Journal of Environmental Psychology
69	Romig K.	Community and social capital in upper-income neighborhoods: An investigation in metropolitan phoenix	2010	Urban Geography
70	Duffy S., Verges M.	Forces of nature affect implicit connections with nature	2010	Environment and Behavior
71	Gosling E., Williams K.J.H.	Connectedness to nature, place attachment and conservation behaviour: Testing connectedness theory among farmers	2010	Journal of Environmental Psychology
72	Joshanloo M., Afshari S., Rastegar P.	Linking social axioms with indicators of positive interpersonal, social and environmental functioning in Iran: An exploratory study	2010	International Journal of Psychology
73	Bruni C.M., Schultz P.W.	Implicit beliefs about self and nature: Evidence from an IAT game	2010	Journal of Environmental Psychology
74	Perrin J.L., Benassi V.A.	The connectedness to nature scale: A measure of emotional connection to nature?	2009	Journal of Environmental Psychology
75	Lindborg R., Stenseke M., Cousins S.A.O., Bengtsson J., Berg A., Gustafsson T., Sjodin N.E., Eriksson O.	Investigating biodiversity trajectories using scenarios – Lessons from two contrasting agricultural landscapes	2009	Journal of Environmental Management
76	Van Herzele A., Van Gossum P.	Owner-specific factors associated with conversion activity in secondary pine plantations	2009	Forest Policy and Economics
77	Vining J., Merrick M.S., Price E.A.	The distinction between humans and nature: Human perceptions of connectedness to nature and elements of the natural and unnatural	2008	Human Ecology Review
78	Baker S., Morrison R.	Environmental spirituality: Grounding our response to climate change	2008	European Journal of Science and Theology
79	Acevedo M.F., Baird Callicott J., Monticino M., Lyons D., Palomino J., Rosales J., Delgado L., Ablan M., Davila J., Tonella G., Ramirez H., Vilanova E.	Models of natural and human dynamics in forest landscapes: Cross-site and cross-cultural synthesis	2008	Geoforum
80	Malone G.	Ways of belonging: Reconciliation and Adelaide's public space indigenous cultural markers	2007	Geographical Research
81	Townsend M.	Feel blue? Touch green! Participation in forest/woodland management as a treatment for depression	2006	Urban Forestry and Urban Greening
82	Young O.R., Berkhout F., Gallopin G.C., Janssen M.A., Ostrom E., van der Leeuw S.	The globalization of socio-ecological systems: An agenda for scientific research	2006	Global Environmental Change
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