Empathetic Connection to Nature: A Mechanism of Action Between Nature Engagement, Child Psychological Wellbeing, and Pro-Environmental Behaviour

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Abstract

There is growing concern worldwide regarding both child psychological wellbeing and environmental degradation. Nature engagement has been suggested to be both beneficial for child wellbeing as well as increasing pro-environmental behaviour, making it an attractive site of intervention for these concerns. As an emerging field of research, the mechanisms linking nature engagement with psychological wellbeing and pro-environmental behaviour are not well understood and lack empirical evidence. Using path analysis, we explore how nature engagement effects pro-environmental behaviour and psychological wellbeing through an empathetic connection to nature. In a sample of 349 Australian primary school children, we found that nature engagement was positively correlated with pro-environmental behaviour (β=0.17, p<.05), and that this relationship was partially mediated by empathetic connection (indirect effect: β= 0.1472, p<.05). Despite no direct effect of nature engagement on psychological wellbeing being evident (p>.05), there was a significant indirect effect, with nature engagement being positively associated with empathetic connection (β=0.46, p<.05), and empathetic connection in turn being associated with wellbeing (β=0.13, p<.05). Our findings contribute to the growing body of nature engagement research and gives new insight into mechanisms of action. Additionally, the school context in which data was collected can be used to advocate for greater incorporation of nature engagement within school curriculums.

Keywords: nature engagement, children, empathetic connection, wellbeing, pro-environmental behaviour

Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any University, and, to the best of my knowledge, this thesis contains no materials previously published except where due reference is made. I give permission for the digital version of my thesis to be made available on the web, via the University's digital research repository, the Library Search and through web search engines, unless permission has been granted by the School to restrict access for a period.

Stella Lycos

September 2021

Contribution Statement

In writing this thesis, my supervisor and I collaborated to generate research questions of interest and design the appropriate methodology and analyses. An ethics application for the study had already been completed by my supervisor and approved prior to my commencement. Before I commenced my Honours thesis, data collection was already being facilitated by my supervisor. Measures used for my study were contributed to by my supervisor, and the project industry partner, Resilient Youth Australia. Surveys were administered to the primary schools in conjunction with the Roots and Shoots Resource Box for Schools Program which was facilitated by the Jane Goodall Institute of Australia. I conducted the literature search and ran statistical analysis in SPSS under guidance of my supervisor. I wrote up all aspects of the thesis.

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Chapter 1

Empathetic Connection to Nature: A Mechanism of Action Between Nature Engagement, Child Psychological Wellbeing, and Pro-Environmental Behaviour

Spending time in nature has long been considered beneficial for child growth and development (Jackson-Barrett & Hammond, 2018). More recently, empirical studies have substantiated this idea showing time in nature benefits aspects of child wellbeing such as physical health, and cognitive function (Collado & Staats, 2016; Mygind et al., 2019; Gill, 2014). Evidence for the high value placed on child outdoor experiences is reflected in the emphasis on outdoor play for children, and more recently through education options such as Forest Schools (Otto & Pensini, 2017). The rationale for child nature engagement is built on the promotion of child physical and emotional development, with nature engagement shown to buffer against stress and motivate sustainable and ecological behaviour (Nawaz & Blackwell, 2014). Such a concept is not novel in many non-Western cultures. For example, within Australia this tradition can be seen in Aboriginal knowledge, which has long highlighted the importance of connection to nature for wellbeing. In Aboriginal culture, spending time in nature is seen as a cornerstone for social and emotional wellbeing and has been found to protect against poor mental health (Jackson-Barrett & Hammond, 2018). Similarly, researchers have highlighted the importance of nature engagement in Canadian Indigenous adolescents, finding that it increases resilience and wellbeing outcomes (Hatala et al., 2020). Despite these traditions, and the emerging evidence, this knowledge is being largely ignored in Western society. For example, children in the United Kingdom (UK) spend just 2% of their time after school in greenspaces, with children's experiences and knowledge of nature being increasingly facilitated through screens in the classroom (Wheeler et al., 2010). In Australia, more than 90% of children have access to

computers and electronic games, with television now being the single largest leisure time activity (Yu & Baxter, 2016). These trends are in part the consequence of rapid urbanisation which not only destroys natural habitat but physically blocks direct experience with nature, as concrete is poured over the landscape, skyscrapers obscure sunlight, and trees are cut down to make room for apartments (Beery & Jørgensen, 2016; World Wildlife Fund, 2014). In 2014, the United Nations reported current levels of urban populations in Europe at 73% and in 82% in North America (United Nations, 2014). With more than half the global population living in cities, opportunities for children to connect with nature are limited, and an 'extinction of nature experience' takes place (Soga & Gaston, 2016). Simultaneously, humanity face the existential threat of declining biodiversity and climate change which have ultimately been caused by destructive human behaviours (Keith et al., 2021). As engagement with nature is known as a potent motivator for pro-environmental behaviour, the decrease in nature contact for children risks perpetuating human ambivalence towards the natural world (Keith et al., 2021; Rosa et al., 2018). The shift away from direct contact with nature led Louv (2005) to coin the term *Nature Deficit Disorder* to describe the breaking bond between children and the environment. Along with a disconnection from nature, children are increasingly becoming disconnected from themselves, with childhood rates of mental disorders becoming an increased global concern.

The World Health Organization affirmed that world-wide, 10-20% of children experience mental health disorders (World Health Organisation, 2020). In Australia, the 2013-14 Australian Child and Adolescent Survey of Mental Health and Wellbeing found almost one in seven children aged 4 to 17 years old experience mental disorders (Lawrence et al., 2015). Researchers have called policy makers to action, highlighting the importance of implementing early intervention, as mental disorders typically begin in childhood and persist, causing high individual

and collective burdens (Barican et al., 2021). Given increasing evidence for the association between nature engagement with pro-environmental behaviour and aspects of wellbeing, there remains a question as to how promoting child nature engagement may help remedy both the decline in child wellbeing and a rapidly degrading natural environment.

Engagement with Nature

The empirical research on child nature engagement, despite recent growth, is relatively young. To date, research has used an array of different theoretical frameworks, with researchers applying a wide variety of methods (Whitburn et al., 2020). Although this exploration is important in characterising the field, it means that there is significant heterogeneity in how measures are operationalised and assessed. An example of this is seeking to measure nature engagement itself. Measurement of nature engagement in the literature has looked at play with adults present (Beery & Jørgensen, 2016), play in forests (Borge et al., 2003; Tiplady & Menter 2020), risky play with natural objects (Brussoni et al., 2017; Lavrysen et al., 2017; Sandseter & Kennair, 2011), time spent in urban green spaces (Hordyk et al., 2015; Kyttä et al., 2012), and in school gardens (Malberg-Dyg & Wistoft, 2018). Despite this variety of contexts, engagement with nature broadly pertains to time spent outdoors, whether it be by playing in the backyard at home or being outside at school during lunch or recess (Gill, 2014).

Many benefits have been reported for child nature engagement. In a systematic review on studies reporting these benefits, researchers found strong support for nature engagement resulting in pro-environmental attitudes and increased social skills, as well as some support for improved wellbeing and self-confidence (Gill, 2014). However, research into *how* nature engagement results in these benefits is only more recently being explored. Researchers have begun to identify a sense of nature connectedness that develops with increased time spent in nature, which may be

one such mechanism linking nature with the apparent benefits (Andrejewski et al., 2011). For example, researchers who were interested in reducing *Nature Deficit Disorder* through increasing nature engagement via Forest Schools for children, found that after attending, children reported a sense of nature connection and the feeling of belonging to a wider community (Cudworth & Lumber, 2021). Researchers in Mexico sought to explore whether a sense of connection to nature in children differed depending on urban or rural living conditions. They found that children who lived rurally reported significantly higher levels of connectedness, thought largely due to rural living conditions affording greater opportunities for nature engagement (Duron-Ramos et al., 2020). This pattern has also been reported in earlier work and suggests that intimate contact with nature in childhood creates a meaningful bond with the environment (Bunting & Cousins, 1985). When formed during childhood, this bond has been found to carry through to adulthood, shaping future environmental attitudes, and heightening the restorative effects of nature exposure in later life (Chawla & Cushing, 2007; Hinds & Sparks, 2008).

It is suggested that as time in nature increases, children have a greater opportunity to observe their own emotions reflected in the environment around them, creating a sense of being 'one' with nature, resulting in increased care for what is non-human (Cudworth & Lumber, 2021), as well as an increased sense of care for themselves (Berger & Lahad, 2010; Collado & Staats, 2016). However, as for the field more generally, there are discrepancies in the literature as to the way nature connectedness is construed. Researchers have explored connection to nature in the context of environmental identity (Clayton, 2003), environmental sensitivity (Chawla, 1998), and a sense of belonging to nature (Nisbet et al., 2008). Being clear on how to best operationalise a connectedness to nature is important for the field to progress, and to investigate it as a potential mechanism for the benefits of nature engagement.

What is Nature Connectedness?

Nature connectedness is a relatively recent field of study which has come about through increasing evidence that nature engagement can create a sense of emotional affinity or love for the environment (Chawla, 2020). Connection to nature is defined by Mayer and McPherson-Frantz (2004) as an individual's affective, experiential connection to nature, or more simply, described by Barthel et al. (2018), as a sense of 'oneness' with nature. In all instances there is a central theme of identifying the closeness and affinity of individuals towards the natural environment (Sedawi et al., 2020), which may be best described as an environmental empathy. Indeed, of a variety of instruments used to measure connectedness to nature, all contain the common element of empathy (Cheng & Monroe, 2010; Clayton, 2003; Mayer & McPherson-Frantz, 2004; Sobko et al., 2018). This is due to the assumption that the closeness felt by someone who believes themselves to be connected to nature is in part due to the ability to empathise with the environment around them. Findings by Cheng and Monroe (2010), in the development of their connectedness to nature measurement, suggest that children who have empathy for non-human creatures displayed a heightened sense of oneness with nature, and were more likely to spend time in nature. As a result, such children would display both enhanced psychological wellbeing and greater sense of responsibility towards nature. This is consistent with findings that when individuals have increased direct experience of an object, their evaluations of that object tend towards being more affectively based (Hinds & Sparks, 2008; Millar & Millar, 1996). Further, the direct contact with an object is also more likely to promote stronger attitude-behaviour consistency (Fazio & Zanna, 1981). In short, the level of exposure to nature may dictate the sense of connectedness to nature children develop – largely as *an*

empathetic connection to nature - which in turn promotes pro-environmental behaviour and psychological wellbeing.

Empathetic Connection to Nature and Pro-Environmental Behaviour

Empathy has been regarded by some environmentalist thinkers as a key to conservation efforts (Tam, 2013). Empathetic connection with nature is shown to have a positive relationship with pro-environmental behaviour in children (Cheng & Monroe, 2010). A longitudinal study measuring 10-year-old children's attitudes towards nature after they had participated in a salamander stewardship program, found that children developed increased empathy and concern for nature because of program participation, with this effect persisting for at least two years (Barthel et al., 2018). Otto and Pensini (2017) explored the relationship between connectedness to nature and ecological behaviour in 9-11year old's and found that connectedness to nature was highly predictive of ecological behaviour (Otto & Pensini, 2017). In their study, Tam (2013) introduces the concept of a *Dispositional Empathy with Nature* to describe the tendency to understand and share the emotional experience of the natural world. In adults, dispositional empathy was found to predict conservation behaviour and led Tam (2013) to propose that a theory of empathy with nature could be developed based upon existing understanding pertaining to empathy with humans.

Recently, researchers have been interested in the way an empathetic connection to nature affects a child's place identity. Place identity refers to the extent an individual feels an emotional connection to a place and is thought to have a heavy bearing on how people view themselves in relation to the environment, and that this is an important contributor to having an empathetic connection to nature (Hinds & Sparks, 2008; Sharma-Brymer et al., 2017). Researchers have suggested that although development of an environmental identity is a life-long process, it takes

root at an early age (Kals & Ittner, 2003). Indeed, environmentalist and educator Sobel (1996) advocated that conservation efforts must begin by forming empathy at an early age, and that this empathy will later serve as a foundation for abstract environmental stewardship in adulthood. The idea of an empathetic connection to nature driving environmental behaviour is also consistent with a broader literature surrounding empathetic morality as a cue to action. Hoffman (2000) proposes that empathy is instrumental in the initiation of prosocial action. As an example, in children, one study has shown that contact with animals leads to formation of affective bonds, leading to empathy for the animal which can then be transferred to human relations (Thompson & Gullone, 2003).

Taking it a step further, Gebhard et al., (2003) sought to investigate empathetic connections between children and non-animal natural objects. They found in group discussions that children attributed emotions to trees and plants, with researchers arguing that a sense of personhood can be reflected in natural objects as they show a responsiveness to human action and thereby warrant moral concern. Despite the apparent link between empathy and pro-environmental action, the relationship between empathetic connection to nature and wellbeing remains unclear.

Empathetic Connection to Nature and Psychological Wellbeing

Although the evidence is less homogeneous than that relating to pro-environmental behaviour, empathetic connection to nature may also be beneficial in increasing child psychological wellbeing. Broadly, psychological wellbeing is defined as a combination of feeling well in the mental domain and functioning effectively, it does not however, require individuals to always feel good; with the experience of negative emotions being considered a normal part of life (Huppert, 2009). Adding to this, Nussbaum (2011) also suggests that wellbeing includes the

ability to live harmoniously with empathetic concern for animals, and plants. Accordingly, empathy has been identified as a possible intervention target in the promotion of wellbeing (Huang et al., 2020; Shanafelt et al., 2005; Vinayak, 2018). However, evidence for empathy as a protective factor for psychological wellbeing has predominantly been derived from studies of adults in healthcare settings (Kim, 2018; Lamothe et al., 2014; Lee et al., 2001; Morelli et al., 2015; Shanafelt et al., 2005).

Broadly, the ability to empathise with someone requires refraining from being self-orientated and having insight to another person's point of view (Shanafelt et al., 2005). It is hypothesised that individuals who are empathetic in their thoughts and behaviours towards others have an increased capacity for empathy towards themselves. This empathy reduces egoistic self-perspective and selfish behaviour, and in turn enhances wellbeing (Gazzaniga, 2008). In children, empathy is proposed to be an essential component for healthy psychological and social development; empathy helps children in building connections to others allowing them to function more harmoniously (Bryant, 1982). Research has found that children can develop empathetic concern for others between the age of one and two years, and that this leads them to behave pro-socially, and that having these positive social interactions can bolster wellbeing (Zahn-Waxler & Radke-Yarrow, 1990). In a school garden case study by Malberg-Dyg and Wistoft (2018), children reported that since playing and learning in the garden they experienced less conflict with their peers, with one child saying, "I don't understand how you can get mad at each other because I am never angry out there. I am just happy when I am out there". The children then also reported that conflicts were easier to resolve when they arose as "you can just walk away". Indeed, nature can provide space for children to strengthen positive moods, which then lead to less conflict and more prosocial empathetic behaviour.

Although literature supports the idea of empathy towards other humans as being a protective factor for wellbeing, there are few studies exploring how sense of empathy can be applied more broadly to other areas of life such as nature. For children, such studies tend to be limited to the context of Forest Schools or investigations of child-pet relationships. Those promoting the benefits of Forest Schools, suggest that empathetic connection to nature increases psychological wellbeing by increasing a child's sense of belonging (Cudworth & Lumber, 2021). Further, a study by Hawkins et al., (2017) found children who had attachments to pets and felt empathetic towards them were found to have better wellbeing and reduced aggression. In both these cases, an empathetic connection with nature allows children to explore non-human relationships that are free from rejection, open for emotional investment, and increase positive affect and learning about non-human others (Thompson & Gullone, 2003).

Study Aims

Ultimately, through time spent engaging with nature, a deeper sense of empathetic connection can be cultivated, and thus, all children should be able to experience benefits to their wellbeing and have pro-environmental behaviours fostered. In this way, nature engagement and, ultimately, empathetic connection, present as cites for a bottom-up intervention for both environmental conservation and wellbeing. The aim of this study is to explore whether the time children spend in nature promotes empathetic connection, and whether, in turn, this empathy for nature is a predictor of pro-environmental behaviour and wellbeing. We hypothesise that increased engagement with nature will be associated with an increased sense of empathetic connection to nature, and this will mediate child ratings of psychological wellbeing and pro-environmental behaviour.

Chapter 2

Methods

Participants and Protocol

This study was approved by the Human Research Ethics Committee of the University of Adelaide approval number: 20/68. Participants were recruited from primary schools across Australia that were taking part in the Jane Goodall Institute Australia's (JGIA) Roots and Shoots Resource Box for Schools Program, which aims to educate students via interactive and action-based programs about the environment and challenges facing the planet. Roots and Shoots was founded by Dr. Jane Goodall in 1991 with an aim to foster respect and compassion for all living things and to inspire young people to make the world a better place for people, animals, and the environment. Participants engaging in these activities responded to an online anonymous survey prior to participating in Resource Box activities.

Students from both upper (grades 3-7) and lower primary (grades <3) were eligible to participate. In the upper primary sample, 1.3% of respondents (n=5) allocated *prefer not to say* for their gender. Due to the small sample size, these cases were removed as there were not enough data to be representative. Additionally, 1.87% (n=7) of respondents were 13 years old and 2.43% (n=9) were 14 years old. As these ages are not typical of primary school children, they were excluded from our study. A total of 349 responses remained from children aged between 4 and 12 years old. South Australia had the highest rates of responses (n= 175), followed by Queensland (n=54), Victoria (n=49), New South Wales (n=44), Western Australia (n=14), Tasmania (n=9), and the Northern Territory (n=4).

Procedure

From February until the end of May 2021, up to 4000 Australian primary schools were eligible to register for a Roots and Shoots Resource Box for Schools Program. Schools that nominated to join the program were sent a resource kit with online instructions and materials to assist teachers in implementing nature-based learning activities in their classes. Accompanying each kit were a set of unique codes allowing access to a survey on a custom web portal for students and teachers. Codes ensured survey responses could be clustered by school site. Teachers were instructed to facilitate administration of the student surveys prior to undertaking any novel nature-based activity at school. All responses were anonymous and personal identifying information (e.g., name, date of birth etc.,) was not requested. Participants were informed of their right to withdraw at any time without penalty, and schools were given information to provide to parents to both inform about the survey and to allow withdrawal of their child from participation on request.

Materials

Demographics

Participants from upper primary were asked to provide their age, grade, state, and suburb of residence. Upper primary participants were also asked to provide their gender with options being *female*, *male*, and *prefer not to say*. Upper primary participants were also asked to provide their cultural background. All upper primary participant measures and their respective items can be found in Appendix A.

Participants from lower primary were asked to provide their age and whether they are a *boy* or a *girl*. All lower primary participant measures and their respective items can be found in Appendix B.

As part of school registration, postcodes were obtained for participants. Postcodes were used to determine socio-economic status (SES) of residence using the Australian Bureau of Statistics SES for Areas 2016 data sheet (Australian Bureau of Statistics, 2016).

Nature Engagement

Nature engagement for participants was measured using two items pertaining to how much time they spent outdoors at school and at home. The questions were: “I play outdoors when I am at home”, and “I play outdoors when I am at school”. Available responses for upper primary participants corresponded with three options on a Likert-type scale ranging from *hardly ever* (1), *sometimes* (2), and *always* (3). Responses for the lower primary were modified to use comprehensible language for the age group with available responses being *no* (1), *sometimes* (2), and *yes* (3). Higher scores indicate higher levels of nature engagement for both groups.

Empathetic Connection to Nature

Empathetic connection to nature was assessed on a range of nature related domains according to conceptualisations by Cheng & Monroe (2010) Connection to Nature Index (CNI), Richardson et al., (2019) Nature Connection Index (NCI), and Larson et al., (2011) Children’s Environmental Perception Scale (CEPS), all of which have been validated for use in children.

The CNI was designed to measure children’s affective feelings towards the natural world and is based on research regarding children’s environmental attitudes (Cheng & Monroe, 2010). The CNI has a Cronbach’s α of 0.92, and is considered valid (Salazar et al., 2020).

The NCI was created as a measure of nature connectedness suitable for both child and adult populations. In the process of validating the NCI, it was found to be a reliable and valid scale for use in child populations (Richardson et al., 2019).

The CEPS was created to measure a child's personal interest in nature and their attitudes toward and concern about environmental issues (Salazar et al., 2020). The CEPS has been validated across several cultural backgrounds to ensure its validity among diverse audiences. The CEPS has been piloted and revised twice to improve reliability and validity and was found to have a Cronbach's α of 0.75 pre-test, and 0.80 post-test (Salazar et al., 2020).

Empathetic connection to nature was measured by combining scores across three questions pertaining to a sense of oneness with nature, and three questions pertaining to empathy for creatures. This was consistent with previous literature and definitions of empathetic connection to nature (Barthel et al., 2018; Cheng & Monroe, 2010; Clayton, 2003; Mayer & McPherson- Frantz 2004; Sobko et al., 2018).

Sense of oneness with nature was measured by responses to the following three questions: "I feel happy when I'm outside", "I like touching animals and plants", and "I like playing outside". Empathy for nature was measured by responses to the following three questions: "I feel sad when animals are hurt", "I feel that looking after plants and animals is important", and "I feel happy when animals have a clean home".

Responses to each question corresponded with three options on a Likert-type scale ranging from *hardly ever* (1), *sometimes* (2), and *always* (3) for the upper primary. Responses for the lower primary were modified to use comprehensible language for the age group with available responses being *no* (1), s*ometimes* (2), and *yes* (3). Higher scores in empathetic connection to nature items indicates a higher level of empathetic connection towards nature.

Pro-Environmental Behaviour

Pro-environmental behaviour was measured using responses to five items. Two of the items were adapted from the CNI (Cheng & Monroe, 2010), and three were custom items

designed to capture a wider range of pro-environmental behaviour typical for this age range in an Australian context. The custom items avoided concepts that referred to broad environmental activism and feelings about pro-environmental actions. Instead, items aligned to these concepts referred to direct behaviour. The questions adapted from the CNI were “I pick up rubbish” and “I try not to hurt animals and plants”. The custom items were “I turn off the lights at home when they are not needed”, “I help with the recycling at home”, and “I try not to waste water”.

Responses to each question corresponded with three options on a Likert-type scale ranging from *hardly ever* (1), *sometimes* (2), and *always* (3) for the upper primary. Responses for the lower primary were modified to use comprehensible language for the age group with responses ranging from *no* (1), *sometimes* (2), and *yes* (3). Higher scores on pro-environmental behaviour items indicates higher levels of pro-environmental behaviours.

Wellbeing

Upper Primary Participants. In the upper primary students, wellbeing was measured by scores on the Generalised Anxiety Disorder 2-item measure (GAD-2) (Spitzer et al., 2006), the Patient Health Questionnaire-2 (PHQ-2) (Kroenke et al., 2003), and the Cantril Ladder (Cantril, 1965).

The GAD-2 was designed as a brief and easy to perform initial screening tool for generalised anxiety disorders (Spitzer et al., 2006). Since its conception, it has been widely used to assess anxiety (Sapra et al., 2020), providing good sensitivity and specificity (Plummer et al., 2016). The GAD-2 is an adaptation of the GAD-7 (Spitzer et al., 2006) which has been validated for use across older children and adolescents, showing acceptable specificity and sensitivity (Mossman et al., 2017).

The participants were asked how much a symptom applied to them in the past two weeks; "feeling nervous, anxious or on edge", and "not being able to stop or control worrying". Available responses ranged from *not at all* (0), *several days* (1), *more than half the days* (2), and *nearly every day* (3). Higher scores indicate greater levels of anxious feelings. A combined score greater than 3 is the preferred cut-off point for identifying cases which require further diagnostic investigation into generalised anxiety disorder.

The PHQ-2 (Kroenke, et al., 2003) is a widely used and brief measurement of depression (Dadfar et al., 2019), has demonstrated good sensitivity and specificity (Liu et al., 2011), and has been validated for the use in young people (Richardson et al., 2010). Participants were asked how much a symptom applied to them in the past two weeks with symptoms being: "little interest or pleasure in doing things", and "feeling depressed, down, or hopeless". Available responses ranged from *not at all* (0), *several days* (1), *more than half the days* (2), and *nearly every day* (3). Higher scores indicate greater levels of depressive feelings. The authors of the PHQ-2 advise a combined score greater than 3 to warrant further diagnostic investigation into major depressive disorder (Kroenke et al., 2003).

As a positive indicator of wellbeing in the upper primary students, the Cantril Ladder was used (Cantril, 1965). The Catril Ladder is a widely used measurement of life-satisfaction and has been validated for the use in young people (Levin & Currie, 2014; Mazur et al., 2018). The Cantril ladder asks participants to imagine a ladder with steps numbered from 0 to 8 with 0 representing the *worst possible* life and 8 representing the *best possible life*. Therefore, higher scores on the Cantril Ladder indicate greater levels of life satisfaction.

Lower Primary Participants. To measure negative aspects of wellbeing in the lower primary participants two items were adopted from the Resilience Survey (Resilient Youth

Australia, 2021), which is a widely used measure of youth wellbeing and mental health administered annually to Australian schools. The survey was developed in conjunction with developmental psychologists and educationalists and uses a combination of standardised and custom items. Students from the lower primary school were asked to respond to the questions: “I worry a lot”, and “I often feel sad”, as measures of negative psychological wellbeing. Responses to each question corresponded with three options on a Likert-type scale ranging from *no* (1), *sometimes* (2), and *yes* (3). Higher scores indicated higher levels of negative wellbeing.

In young children, it has been found necessary to avoid concepts requiring comprehension of complex sentences and use of relational terms as a measurement of positive wellbeing (Rebok et al., 2001), making a measurement such as the Cantril ladder inappropriate. Instead, the Longitudinal Millennium Cohort Study found that happiness provided a positive measure of wellbeing (Chanfreau et al., 2014), and similarly, Pollard and Lee (2003) found a recurrence of child wellbeing to be defined by individual’s inherently positive sate, or “happiness”. Therefore, the more readily self-identifiable emotion of “happy” was targeted. Lower primary school participants were asked to rate how much the statement “I feel happy here” applied to them with responses on a Likert-type scale ranging from *no* (1), *sometimes* (2), and *yes* (3). Higher scores indicated greater levels of positive wellbeing.

Chapter 3

Results

Descriptive Statistics

Analyses were conducted in SPSS Statistics version 28.0.0.0, and Amos version 28.0.0 (IBM Corp. Released 2021). Data were firstly examined to explore whether assumptions of normality and heterogeneity were met using the Q-Q plot function. Data from the measure of pro-environmental behaviour and empathetic connection to nature displayed positive skewness and kurtosis upon inspection. Therefore, scores were reflected to allow for a logarithmic transformation, and scores were then reflected again so that they regained their original direction, i.e., higher scores correspond to higher levels of a variable. Data from measures of negative psychological wellbeing in both upper and lower primary students were reverse scored so that when combined with the measures of positive wellbeing, a higher score overall indicated greater levels of psychological wellbeing. Additionally, data from wellbeing items were standardised as z-scores to allow for meaningful comparison across items. The critical alpha level for significance was set at 0.05 for all tests.

Prior to main statistical analysis, descriptive statistics for pro-environmental behaviour, psychological wellbeing, nature engagement, and empathetic connection were obtained, as well as age and SES as covariates, all of which are presented in Table 1. There was a total of 349 responses, with 51.2% (n=179) female, and 48.8% (n=170) male participants; all groups had a median age of seven (female SD=2.15, male SD=2.12, total SD=2.13).

To explore gender differences, t-tests were conducted. There was a statistically significant difference between males (M=2.25, SD=.43) and females (M=2.13, SD=.47) in nature engagement, with males spending more time in nature (t(374)=2.14, p<.05). Gender was

therefore included as a covariant for nature engagement. However, no statistically significant difference in means were found for any of the other variables (p>.05).

Table 1

Means, Standard Deviations and Ranges of Participant Scores Across Measures

	Female (n = 179)				Males (n = 170)				Total (N =349)			
	M	Mdn	SD	range	M	Mdn	SD	range	M	Mdn	SD	range
Age	7.70	7.00	2.15	8	7.41	7.00	2.12	8	7.56	7.00	2.13	8
SES	6.24	7	1.9	9	5.99	7	2.28	9	6.12	7	2.09	9
NE[a]	2.13	1.91	.47	1.61	2.25	2.61	.43	1.61	2.19	2.61	.45	1.61
PEB[b]	2.37	2.30	.67	2.40	2.41	2.30	.69	2.40	2.39	2.30	.68	2.40
EC[c]	2.94	3.40	.58	1.95	2.88	3.40	.63	2.40	2.91	3.40	.61	2.40
W[d]	-.01	.15	.95	6.20	-.03	.15	1.06	6.53	-.01	.15	1.00	6.53

[a] Nature Engagement

[b] Pro-environmental behaviour

[c] Empathetic connection to nature

[d] Wellbeing

Item Reliability

To explore reliability of our measures, correlations were conducted between items in each domain. Due to the non-normal and ordinal nature of many of our variables, Spearman's correlations were utilised in place of Cronbach's α.

Lower Primary Measures

In the lower primary sample, the nature engagement items were significantly and weakly correlated (r_s =.251, p<.05). All items measuring pro-environmental behaviour and empathetic connection were significantly correlated (p<.05), with strength of correlations ranging from weak to moderate. The two items measuring negative states of wellbeing were moderately (r_s =.335, p

<.05) significantly correlated, however, the item measuring positive psychological wellbeing was not correlated with the negative items (p>.05). Spearman's correlations for all items measuring pro-environmental behaviour, empathetic connection, and wellbeing for the lower primary sample, are displayed in Appendix C.

Upper Primary Measures

In the upper primary sample, there was a weak and significant correlation between the items measuring nature engagement (r_s =.257, p<.05). Correlations for items measuring pro-environmental behaviour, empathetic connection, and psychological wellbeing were mainly significant (p<.05) with strength of correlations ranging from weak to moderate; their related r_s values are displayed in Appendix D.

Correlation

A Pearson's correlation was conducted to explore relationships between the variable's empathetic connection, pro-environmental behaviour, and psychological wellbeing. Age and SES were also included as covariates. The results of the correlation are presented in Table 2.

Nature engagement had a moderate and significant positive correlation with empathetic connection, and pro-environmental behaviour (p<.05), indicating that as nature engagement scores increased, so did score of empathetic connection and pro-environmental behaviour. There was also a significant and weak negative correlation between nature engagement and age (p<.05), indicating that as scores in age increased, scores in nature engagement decreased. Similarly, nature engagement had a significant and negative weak correlation with SES (p<.05). Empathetic connection had a weak significant positive relationship with wellbeing, and significant moderate positive correlation with pro-environmental behaviour (p<.05). Lastly, there

was a significant weak negative correlation between scores on SES and wellbeing, indicating that as SES increased, scores on wellbeing decreased.

Table 2

Pearson's Correlation Matrix of Variables

Variable	W	EC	PEB	NE	A	SES
Wellbeing (W)	-					
Empathetic connection (EC)	.149**	-				
Pro-environmental behaviour (PEB)	.121*	.398**	-			
Nature engagement (NE)	.094	.456*	.317**	-		
Age (A)	-.039	-.103	.029	-.285**	-	
SES Decile (SES)	-.132*	-.109	-.35	-.120*	0.35	-

Note: * $p < .05$ (2-tailed), ** $p < .01$ (2-tailed)

Assessment of Model Fit

An initial path analysis model was run with no covariates to assess the model's goodness of fit using a chi-squared test. The results from the chi-square indicated that the initial model was a good-fit and that variance was adequately accounted for ($\chi^2(1) = 1.448$, $p<.05$). However, due to the results of our t-tests and correlation, the covariate variables gender, SES, and age were added to explore whether this would result in a better fitted model. The chi-squared value for the model with covariates included resulted in a comparatively worse fit model ($\chi^2(11) = 17.717$, $p<.05$). Model fit parameters for both models are displayed in Table 3. Differences in chi-square values approached but were not significantly different at $p=.05$. However, differences in Akaike

Information Criterion (AIC) and Bayesian Information Criterion (BIC) indicated substantially poorer fit with covariates (Burnham & Anderson, 2002). On the balance of model fit parameters, we proceeded with the model structure excluding covariates, which was utilised in the final analysis.

Table 3

Goodness of Fit Measures for the Models

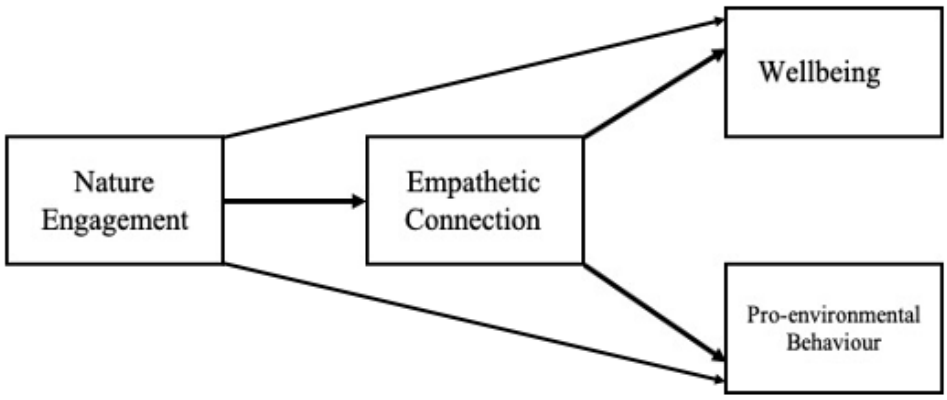
Model	AIC	BIC	χ^2 (df)
No covariates	19.45	54.14	1.45 (1)
With covariates	51.72	117.25	17.72(11)

Path Analysis

Path analysis was used to determine the pathway by which the variables nature engagement and empathetic connection influence the variables pro-environmental behaviour and wellbeing. This method was utilised as it is a comprehensive approach to testing hypotheses that enables investigation of direct and indirect effects simultaneously with multiple independent and dependent variables (Loehlin & Beaujean, 2016; Stage et al., 2004). Figure 1 presents the hypothesised relationships between the variables.

Figure 1

Hypothesised Pathways Between Variables



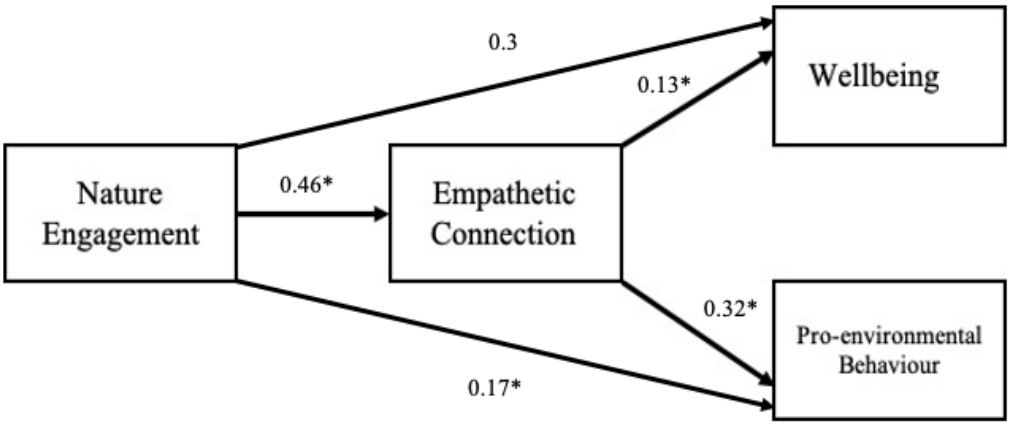
Firstly, we regressed nature engagement onto wellbeing and pro-environmental behaviour. Nature engagement was not significantly related to wellbeing (p>.05); however, it was significantly related to pro-environmental behaviour (R^2=.101, β=.317, p<.05).

A final path analysis of our full model was then conducted with the inclusion of the variable empathetic connection. The results of the path analysis with standardised regression coefficients are presented in Figure 2 and the unstandardised coefficients for our model are shown in Table 4. As can be seen in Figure 2, nature engagement had a significant direct (β=0.17, p=<.05) and indirect (β= 0.1472, p=<.05) effect on pro-environmental behaviour, which is partially mediated by empathetic connection. Partial mediation can be inferred by referring to the decreased regression coefficient value for the direct effect of nature engagement on outcomes once empathetic connection is added into the model. Additionally, empathetic connection has a significant effect on pro-environmental behaviour (β=0.32, p<.05). There was no significant direct effect of nature engagement onto wellbeing (p>.05). However, there was a significant

indirect effect (β=0.0598, p<.05). Finally, empathetic connection had a significant direct effect on wellbeing (β=0.13, p<.05).

Figure 2

Results from the Path Analysis with Standardised Regression Coefficients



Note: * p < .05 (2-tailed)

R-squared indicates that within our model, nature engagement explains 20.9% of variance in empathetic connection. Additionally, both nature engagement, empathetic connection combined explain 18.2% of pro-environmental behaviour, and nature engagement and empathetic connection combined explain 2.3% of variance in wellbeing.

Table 4

Unstandardised Coefficients from the Path Analysis

Dependent variable	Independent variable	Unstandardised coefficient	P value
Indirect effect Pro-environmental behaviour	Nature engagement	.255	.010*
Wellbeing		.072	.569
Direct effect Pro-environmental behaviour	Nature engagement	.255	.002*
	Empathetic connection	.360	<.001**
Wellbeing	Nature engagement	.072	.580
	Empathetic connection	.219	.025*
N observations= 349 Model fit: X^2= 1.448, p= <.05 GFI=.998, CFI= .997 RMSEA=.036			

Note: * $p < .05$ (2-tailed) ** $p < .001$ (2-tailed).

Chapter 4

Discussion

Summary of Overall Findings

As the world is confronted with a growing climate crisis and a decrease in child wellbeing, it is important to consider how the two factors are linked. Understanding this connection will better inform decision making around approaches that promote both environmental and child health. As such, the aim of this study was to explore whether levels of nature engagement would be associated with empathetic connection to the environment and, in turn, whether this would mediate child psychological wellbeing and pro-environmental behaviour. The results of the study show a direct significant relationship of nature engagement with pro-environmental behaviour, and that this relationship is partially mediated by empathetic connection. These results support our hypothesis and suggest that a child's empathetic connection is an important mechanism by which nature engagement leads to children behaving pro-environmentally. Additionally, higher ratings of empathetic connection were predictive of increased psychological wellbeing, although there was no direct effect of nature engagement with psychological wellbeing, nor mediation of wellbeing by empathetic connection to nature. Combined, the results suggest that empathetic connection may be an essential piece of the puzzle explaining how nature can be both a place where psychological wellbeing is protected and bolstered, and pro-environmental actions are engendered.

Supported Predictions

Nature Engagement, Empathetic Connection, and Pro-Environmental Behaviour

The significant mediating pathway from nature engagement to empathetic connection and pro-environmental behaviour is consistent with our hypothesis and broader literature. According

to theories of attitude behaviour consistency, when direct contact with an object is increased, affective attitudes are formed and result in stronger behaviour consistency (Fazio & Zanna, 1981). We found this in our own sample, in which children who report higher levels of nature engagement reported stronger empathetic connection (i.e., affective attitudes), and higher levels of pro-environmental behaviour (i.e., attitude behaviour consistency). This is also consistent with place identity theories, which postulate increased time spent in a place fosters a sense of connection and belonging, and therefore results in caretaking behaviour (Chawla et al., 2015). As Chan et al., (2016) explained, people who protect and care for the environment do so out of relational values; they feel connected to nature or attached to places within it, and therefore care for it.

Our findings are also reflected by conclusions made by Otto and Pensini (2017), Keith et al., (2021), and Andrejewski et al., (2011), who, like us, realised future conservation efforts will rely on today's children. Keith et al., (2021) found that nature connection was a strong predictor of behavioural commitment. Similarly, Otto and Pensini (2017) found that children receiving a nature intervention reported greater connectedness to nature and displayed greater ecological behaviour compared to the control. Unlike our own study, Keith et al., (2021) did not include a measure for time spent in nature. This means postulations could not be made as to how connection to nature was produced. Indeed, a measure of time in nature is a vital part of the narrative if we are to identify how to increase empathetic connection and in turn pro-environmental behaviour.

Like the current study, Otto and Penisini (2017) included a measure of time spent outdoors, although it was in conjunction with outdoor education. They found greater time learning outside was associated with increased nature connection and pro-environmental

behaviour. It is difficult however, to tease apart whether the increase in environmental knowledge or the time spent outside contributed more to the increase in pro-environmental behaviour. According to previous literature in children, an affective connection through increased time outdoors is a greater predictor of pro-environmental behaviour than knowledge alone, as people need to be affectively involved if action is to result (Charles et al., 2018; Roczen et al., 2013). Andrejewski et al., (2011) found evidence for this in their sample of American fifth grade students in which connection to nature and time spent outdoors explained 32% of the variance in pro-environmental behaviour. The mediating effects found in the present results further clarify the pathway by which engagement with the natural world may stimulate pro-environmental behaviour. This suggests that the concept of dispositional empathy with nature put forth by Tam (2013) can be applied to child populations. In this way, children have a dispositional tendency to understand and share emotional experiences with the natural world and feel compelled to act in its favour (Tam, 2013). This study is the first to our knowledge to explore this pathway in a sample of Australian primary school children and to include children from a combination of both urban and rural backgrounds. Our findings are therefore highly representative and generalisable to the broader primary school population in Australia.

Nature Engagement, Empathetic Connection, and Psychological Wellbeing

Our findings also revealed a significant direct effect of empathetic connection to the environment on psychological wellbeing, meaning that children reporting higher levels of empathetic connection also reported greater wellbeing. Consistent with our predictions, this demonstrates that the broader concept of empathy and its benefits can be extended to things such as the environment, namely, as an empathetic connection to nature. Broadly, researchers describe empathy as an essential component of living harmoniously with others and oneself, which is an

important component of psychological wellbeing (Shanafelt et al., 2005; Vinayak, 2018). It follows that an empathetic connection to the broader environment can also bring about these benefits. Although rarely explored, researchers posit these caring relations with nature are necessary because experiences of connection to nature and concern for other species are a part of a well-lived human life (Chawla, 2015; Nussbaum, 2011). Accordingly, Nussbaum (2011) have included the ability to live harmoniously and with concern for plants and animals in their capabilities approach to human welfare and wellbeing. As an extension to this idea, it is also thought that the relational values children forge with nature increase their sense of belonging to a place or community, which in turn protects their psychological wellbeing (Jax et al., 2018). In support of this, Cudworth and Lumber (2021) reported that in children who attended Forest Schools, nature connection was linked to the sense of belonging to a wider community, and that this belonging also promoted wellbeing.

Finally, whether someone has a connection to nature is thought to be a precursor to whether they can effectively use it as a place of respite to increase psychological wellbeing (Kaplan & Kaplan, 1989; Hinds & Sparks, 2008). In interviews with Finnish children, those who reported somewhere in nature as their favourite place stated that they used nature to reflect on personal matters and clear their minds (Korpela et al., 2002). Historically, humans have turned to nature, be it in gardens, reserves, or backyards, for sanctuary from the happenings around them (Chawla et al., 2015). It is postulated that in nature, children can see their own emotions reflected in the natural scenes around them (Sobel, 2014). In his book ‘Beyond Ecophobia’, Sobel (1996) gives examples of a child describing their emotions as being *like* that of animals, e.g., feeling free like a bird. In his essays on Gardens and the Human Condition, Pogue-Harrison

(2009), recites part of a poem by Wallace Stevens (1954) which speaks to this idea more broadly in nature:

> "Passion of rain, or moods in falling snow;
>
> Grieving's in loneliness, or unsubdued
>
> Elations when the forest blooms; gusty
>
> Emotions on wet roads on autumn nights" (lines 24-28).

Our findings, combined with the literature to date, suggest primary school aged children can recognise feelings of empathy and connection to the world around them, and that these feelings have implications for their wellbeing. Further, the results highlight that it is the way children appraise nature that truly matters in terms of its benefits to their psychological wellbeing, more than just the time spent in nature alone.

Unsupported Predictions

Although nature engagement had a significant direct effect onto empathetic connection, a finding which is consistent with the literature (Cheng & Monroe 2010; Collado & Staats, 2016; Barthel et al, 2018; Larson et al., 2018) and which in turn was predictive of psychological wellbeing, nature engagement itself was not directly associated with wellbeing. Despite only partially supporting our hypothesis of a mediating effect, the results are in keeping with a broadly inconclusive literature and suggest the relationship between nature and wellbeing is more complex or influenced by factors beyond those investigated here (Charles et al., 2018; Holland et al., 2018; Mygind et al., 2019; Tillman et al., 2018).

In their systematic review, Mygind et al., (2019) found that studies reporting on psychological states post-nature engagement intervention, demonstrated a greater number of inconclusive findings compared to significant benefits. In contrast, Chawla's (2015) review of

studies reported an overall benefit of nature for psychological wellbeing. However, this conclusion may not be generalizable to a typical population as included studies comprised children experiencing war and poverty (Chawla et al., 2014), clinically depressed populations (Maas et al., 2009), and children attending alternative schooling (Roe & Aspinall, 2011). Additionally, most of the studies reporting psychological benefits of nature did so by correlating it with proximity to greenspace rather than a direct engagement with nature (Aggio et al., 2015; Flouri et al., 2014; Maas et al., 2009; Wells & Evans, 2003). Although these studies provide the impetus to further investigate the link between nature and psychological wellbeing, the implications for interventions are less clear. Children are unlikely to have the autonomy to change the contextual factors of their lives, and larger systemic factors such as poverty and safety may act as barriers for their guardians to provide access to greenspaces. Indeed, the gap in the literature focusing on grassroots, bottom-up approaches of nature engagement, wellbeing, and accessible interventions was a driver for the present study. Although we did not find a direct association between nature engagement and wellbeing, the indirect path through empathetic connection warrants further exploration as it can point to areas of methodological improvement and mechanisms of action.

The operationalisation of psychological wellbeing in our lower primary sample may have been a further contributing factor for the non-significant findings. Firstly, the positive wellbeing item in the primary school sample asked participants to rate how much of the time they felt "happy here". As the survey was administered in at school, it is possible that data from our positive wellbeing item is limited to a school context, not capturing happiness children feel outside of school. Secondly, Correlations between wellbeing items used in our lower primary sample showed that the negative indicators of psychological wellbeing did not correlate with the

positive indicator (See Appendix C). This suggests a lack of reliability in the measure, despite recommendations for the inclusion of both negative and positive elements as a more valid representation of psychological wellbeing (Cho & Yu, 2020). Although child wellbeing is a widely used concept, it generally has a weak theoretical basis in younger children (Statham & Chase, 2010). In a recent review, relatively less research targeting younger children was reported, with a scarcity of age relevant indicators for ages 5 to 11 (Cho & Yu, 2020). Issues relating to comprehension and attention span acts as a barrier for development of a psychometrically sound self-report measure of wellbeing in young children. Many measures instead report objective wellbeing, such as SES which often relies on secondary data (Cho & Yu, 2020), or needs to be administered by an adult (Deighton et al., 2014). As there is a growing recognition of the importance of the child voice in policy making around health services, there is a need for brief, accessible, and valid measurements to capture the subjective perspective of young children (Cho & Yu, 2020). Although correlations for wellbeing items in our upper primary participants reflected good measure validity, broader literature and our own findings suggest clear operationalisation and valid self-reports at younger ages is more problematic. As a large proportion of our sample was comprised of lower primary school students (71.5%), it is possible that the operationalisation of wellbeing had an overall effect on outcomes.

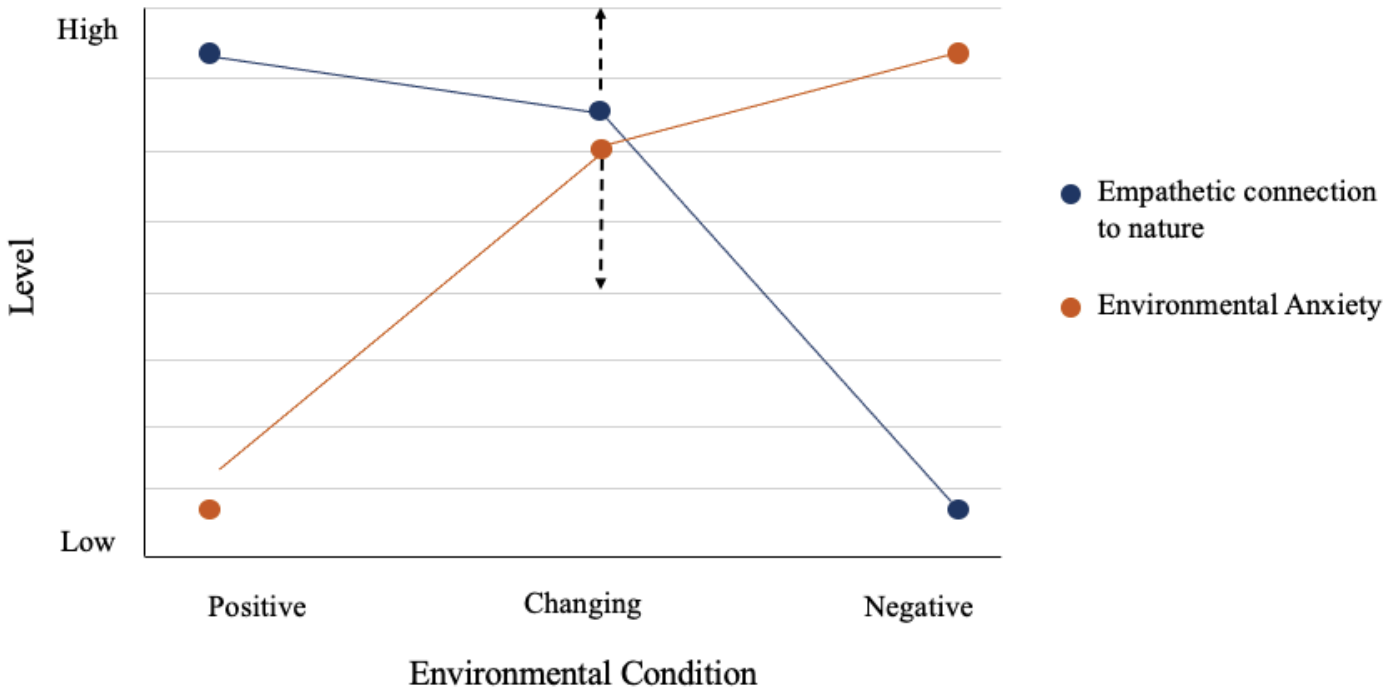
Finally, Chawla (2020) suggests that there are two parallel negative and positive streams in which connection can be investigated. The positive steam refers to an experience of oneness with nature which fosters joy and respect for the environment. The negative stream factors in a child's fears and worries about nature, like climate change (Chawla, 2020). Indeed, it has been reported that the study of negative experiences in the environment are no less powerful than positive ones in influencing an individual's relationship with nature (Sedawi et al., 2020). For

example, in a study on the experiences of Indigenous Bedouin children in Iran, children reported feeling disgust towards environments around them as they had become polluted and 'dirty'. More broadly, the term 'climate anxiety' has come into popular use as a growing number of young people are reported to be worried and stressed about climate change (The Lancet, 2021). This was reflected in a 2020 poll conducted by the Royal College of Psychiatrists in the UK; 57% of child psychiatrists reported having seen clients who were distressed about the environment and climate crisis (The Lancet, 2021). Although our model had the capacity to reflect negative relationships in this way, our hypotheses were geared more toward the so-called positive stream. Given the growing concern for the environment internationally, and the likelihood of negative environmental experiences, future studies should also aim to investigate how these separate streams may contribute toward overall child psychological wellbeing.

Combining the findings of this study with the broader literature, we propose that connection with nature, the associated wellbeing, and environmental anxiety, follow opposing trajectories as a function of whether the environment is experienced as a positive, changing, or negative state (Figure 4). The most labile point of these trajectories lies at the place of changing environmental conditions, which, in the proposed model, combines both high connection and high anxiety, and from which either anxiety or connection can be reduced because of environmental state and/or experience. The implication of this model is that positive nature-based activities could play a critical role in shifting the balance towards nature connectedness, and by consequence improve wellbeing and promote pro-environmental behaviour, in turn helping to reduce or reverse negative environmental change.

Figure 3

Proposed Model for Trajectories of Empathetic Connection to Nature and Environmental Anxiety as a Function of Positive, Changing, or Negative Environmental State



Unexpected Findings

Gender

In the current study boys reported spending more time outdoors than girls; a notion which is consistent with previous studies (Boxberger & Reimers, 2019; Klinker et al., 2014; Larson et al., 2011). However, if boys spend more time outdoors, we might also expect this to be reflected as higher scores in both empathetic connection and pro-environmental behaviour given the overall effects shown. This was not the case however and suggests the genders may differ in *how* time is spent outdoors. Indeed, there is growing evidence that suggest how time is spent outdoors is germane in whether an empathetic connection is developed (Bang et al., 2015), with Cudworth

and Lumber (2021) positing that spending time in nature but viewing yourself as separate to it does not foster a sense of connection. Literature reports that boys engage in more sporting activities outdoors than girls (Boxberger & Reimers, 2019; Klinker et al., 2014; Larson et al., 2011), and that these activities tend to ignore the natural environment, ascribing nature a utilitarian role (Bang et al., 2015), and do not lead to developing a connection to nature (McCullough et al., 2016, Sharma-Brymer et al., 2017). In further support of this idea, when gender was included in our model as a covariate, it yielded a worse model fit. This further suggests that the type of nature engagement boys partook in did not reinforce a stronger pathway to empathetic connection for nature. While not within the scope of the current study, a future extension of this work would be to quantify the types of outdoor engagements had by children in relation to wellbeing and environmental outcomes. Capturing information on specific modes of nature engagement may better inform a tailored approach to nature-based interventions.

Age

There was a negative correlation between nature engagement and age, indicating that as scores in age increased, scores in nature engagement decreased. This phenomenon has been coined the “adolescent dip” (Olsson & Gericke, 2016), and describes the decrease preference children have for outdoor environments as they approach adolescence (Keith et al., 2021; Olsson & Gericke, 2016). In their study, Keith et al., (2021) found the adolescent dip beginning at around age 12, however, our study found that this dip may be occurring at a younger age in childhood. These findings are important for implementing interventions as there is strong evidence that childhood experiences in nature characterise adult environmental attitudes (Chawla, 2020; Chawla & Derr, 2012; Evans et al., 2018). In a retrospective study of two thousand American adults, Wells and Lekies (2006) found that experience in nature before age 11

is associated with the development of influential positive environmental attitudes. Our findings suggest that there is a decrease in nature engagement even earlier than this, not only adding to emerging evidence but also suggesting the need for earlier intervention prior to adolescence as previously suggested (Keith et al., 2021).

Socioeconomic Status

There was a significant, negative correlation between SES and nature engagement, suggesting higher SES scores correlated with lower scores of nature engagement. These findings may be suggestive of differences between urban and rural settings, as urban areas are more commonly associated with higher SES in Australia, with the opposite true of rural areas (Australian Institute of Health and Welfare, 2005). Rural living has been found throughout the literature to be correlated with increased nature engagement and nature connectedness, whereas children living in urban settings spend significantly more time indoors (Duron-Ramos et al., 2020; Hinds & Sparks, 2008). This is consistent with findings made by Keith et al., (2021) who reported urban settings in Australia afford fewer meaningful interactions with nature. Also, Hinds and Sparks (2008) found children from rural backgrounds reported significantly more time engaging with nature as adults than those who grew up in urban settings. These postulations were not thoroughly explored in our current study but certainly provide a basis for future research to explore this relationship more explicitly.

Practical and Theoretical Implications

Our findings suggest that development of an empathetic connection to nature should be a focus of interventions aimed at increasing pro-environmental behaviour and psychological wellbeing in children. Additionally, it is important to apply these interventions before children begin distancing themselves from the natural environment, with current findings suggesting this

to take place before adolescence. A potential space for intervention to be applied are pre-schools and primary schools. There have already been reports of success in achieving increased nature connection in Forest Schools (Cudworth & Lumber, 2021), and schools with animal stewardship programs (Barthel et al., 2018), however, these options may not be accessible to everyone or feasible in all contexts. Other possible interventions include the implementation of programs like the Roots and Shoots Resource Box for Schools program, which was the context for the current study, as it is provided to interested schools without cost and includes clear directions for teacher use. Additionally, there is a growing basis of evidence for the integration of traditional Aboriginal knowledge into schools, as it has been found to create both culturally responsive teaching, and to enrich all children's sense of place and connection to country (Jackson- Barrett & Lee-Hammond). Therefore, greater incorporation of nature engagement into nation-wide curriculum should become a priority action.

Limitations

In addition to limitations already discussed, it is worthwhile to reflect on the time-period in which this data was collected. In mid-to-late 2020 when collection was underway, children all over the world were experiencing significant disruption to their lives due to the COVID-19 pandemic. For many Australian children, this has meant significant periods of home schooling, and their access to outdoors being restricted (Westrupp et al., 2021). There is growing evidence surrounding the impacts of COVID-19 on mental health, with a recent Australian survey on adolescents reporting significantly higher levels of anxiety, sleep disturbances, and distress compared to before the pandemic (Li et al., 2021). Like increased pollution, COVID-19 may lead to negative appraisals of outdoor environments and represent a 'changing' environmental state (see Figure 4), where there are increased perceived hazards of engaging with the outdoors. In this

way, COVID-19 presents as a barrier to nature engagement and connection (Rice et al., 2020). Our findings suggest that an empathetic connection to nature plays a role in wellbeing and even more so in pro-environmental behaviour, and so we now need to understand what connecting to nature looks like in a world of increased changing environmental states and possible restriction to direct nature engagement.

Finally, it is worth noting that the cross-sectional nature of our study does not allow us to draw firm conclusions about causation. It is possible that those with poorer mental health are less likely to engage with outdoor environments and spend more time indoors. This time spent indoors would mean less time engaging with nature and less empathetic connection to nature. Our model however, places wellbeing at the end of our pathway assuming nature engagement and empathetic connection will positively affect wellbeing. Nevertheless, the practicality and affordability of cross-sectional studies like our own are integral in providing a basis for future longitudinal and controlled experimental studies. The knowledge gained by studies such as the current one will inform the targets and measurement strategies for future experimental approaches, ultimately establishing causative pathways as well as understanding the directionality of mechanisms at play. Further, broader application may then be possible for populations where there are arguably more significant gains to be made, such as in clinical samples.

Conclusion

This study contributes to an ongoing narrative, one which is becoming more urgent and compelling than ever: children benefit from nature, and in turn benefit nature. Our study suggests that an empathetic connection fostered through nature engagement is an important part of why children behave pro-environmentally. In this way, we build upon previous literature, and give

evidence of a pathway previously unexplored in Australian children. Our study also demonstrates that Australian primary school children typically feel empathetically towards nature and this has a positive association with wellbeing. These findings are significant as they align with broader literature pertaining to empathy and wellbeing and demonstrate the ability to extend this beyond human interactions and into the natural world. Our study also suggests that children may begin to disengage with nature younger than previously thought, moving the importance of implementing such engagement opportunities towards younger ages. Fostering this empathetic connection can then be used to enact societal change toward having care for nature, and toward ourselves as individuals.

References

Aggio, D., Smith, L., Fisher, A., & Hamer, M. (2015). Mothers' perceived proximity to green space is associated with TV viewing time in children: The growing up in Scotland study. *Preventive Medicine, 70*, 46-49. https://doi.org/https://doi.org/10.1016/j.ypmed.2014.11.018

Andrejewski, R. G., Mowen, A., & Kerstetter, D. (2011, April 10-20). *An examination of children's outdoor time, nature connection, and environmental stewardship* [Paper presentation]. North Eastern 2011 Recreation Research Symposium, Annapolis, MD, USA. https://scholarworks.umass.edu/cgi/viewcontent.cgi?article=1001&context=nerr

Australian Bureau of Statistics (2016). *Socio economic indexes for areas. Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia, 2016*. https://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/2033.0.55.0012016?OpenDocument

Australian Institute of Health and Welfare. (2005). *Rural, regional and remote health: Indicators of health*. https://www.aihw.gov.au/reports/rural-remote-australians/rural-regional-remote-health-indicators-of-health/contents/table-of-contents

Bang, M. (2015). Culture, learning, and development and the natural world: The influences of situative perspectives. *Educational Psychologist*, *50*(3), 220-233. https://doi.org/10.1080/00461520.2015.1075402

Barican, J. L., Yung, D., Schwartz, C., Zheng, Y., Georgiades, K., & Waddell, C. (2021). Prevalence of childhood mental disorders in high-income countries: A systematic review and meta-analysis to inform policymaking. *Evidence Based Mental Health*, *1*,1-19. https://doi.org/10.1136/ebmental-2021-300277

Barthel, S., Belton, S., Raymond, C. M., & Giusti, M. (2018). Fostering children's connection to nature through authentic situations: The case of saving salamanders at school. *Frontiers in Psychology*, *9*(928). https://doi.org/10.3389/fpsyg.2018.00928

Beery, T., & Jørgensen, K. A. (2016). Children in nature: Sensory engagement and the experience of biodiversity. *Environmental Education Research, 24*(1), 13-25. https://doi.org/10.1080/13504622.2016.1250149

Berger, R., & Lahad, M. (2010). A safe place: Ways in which nature, play and creativity can help children cope with stress and crisis – establishing the kindergarten as a safe haven where children can develop resiliency. *Early Child Development and Care*, *180*(7), 889-900. https://doi.org/10.1080/03004430802525013

Borge, A. I. H., Nordhagen, R., & Lie, K. K. (2003). Children in the environment: Forest day-care centers: Modern day care with historical antecedents. *The History of the Family*, *8*(4), 605-618. https://doi.org/https://doi.org/10.1016/j.hisfam.2003.04.001

Boxberger, K., & Reimers, A. K. (2019). Parental correlates of outdoor play in boys and girls aged 0 to 12: A systematic review. *International Journal of Environmental Research and Public Health*, *16*(2), Article 190. https://doi.org/10.3390/ijerph16020190

Brussoni, M., Ishikawa, T., Brunelle, S., & Herrington, S. (2017). Landscapes for play: Effects of an intervention to promote nature-based risky play in early childhood centres. *Journal of Environmental Psychology*, *54*, 139-150. https://doi.org/https://doi.org/10.1016/j.jenvp.2017.11.001

Bryant, B. K. (1982). An Index of Empathy for Children and Adolescents. *Child Development*, *53*(2), 413-425. https://doi.org/10.2307/1128984

Bunting, T. E., & Cousins, L. R. (1985). Environmental dispositions among school-age children: A preliminary investigation. *Environment and Behavior*, *17*(6), 725-768. https://doi.org/10.1177/0013916585176004

Burnham, K., & Anderson, D. (2002). *Model selection and multimodel inference*: *A Practical Information-theoretic Approach* (2nd ed.). Springer New York. https://doi.org/10.1007/978-0-387-22456-5_5

Cantril, H. (1965). *Pattern of human concerns*. New Brunswick, N.J: Rutgers University Press.

Chan, K. M. A., Balvanera, P., Benessaiah, K., Chapman, M., Díaz, S., Gómez-Baggethun, E., Gould, R., Hannahs, N., Jax, K., Klain, S., Luck, G. W., Martín-López, B., Muraca, B., Norton, B., Ott, K., Pascual, U., Satterfield, T., Tadaki, M., Taggart, J., & Turner, N. (2016). Opinion: Why protect nature? Rethinking values and the environment. *Proceedings of the National Academy of Sciences*, *113*(6), Article 1462. https://doi.org/10.1073/pnas.1525002113

Chanfreau, J., Lloyd, C., Byron, C., Roberts, C., Craig, R., Feo, D., & McManus, S. (2014). *Predicting wellbeing*. National Centre of Social Research London. https://doi.org/10.13140/2.1.3267.4564

Charles, C., Keenleyside, K., Chapple, R., Kilburn, B., Salah van der Leest, P., Allen, D., Richardson, M., Giusti, M., Franklin, L., & Harbrow, M. (2018). Home to us all: How connecting with nature helps us care for ourselves and the Earth. *Children and Nature Network*.

Chawla, L. (1998). Significant life experiences revisited: A review of research on sources of environmental sensitivity. *The Journal of Environmental Education*, *29*(3), 11-21. https://doi.org/10.1080/00958969809599114

Chawla, L. (2009). Growing up green: Becoming an agent of care for the natural world. *The Journal of Developmental Processes*, *4*, 6-23. https://doi.org//10.1.1.519.8387&rep=rep1&type=pdf

Chawla, L. (2015). Benefits of nature contact for children. *Journal of Planning Literature*, *30*(4), 433-452. https://doi.org/10.1177/0885412215595441

Chawla, L. (2020). Childhood nature connection and constructive hope: A review of research on connecting with nature and coping with environmental loss. *People and Nature*, *2*(3), 619-642. https://doi.org/10.1002/pan3.10128

Chawla, L., & Cushing, D. F. (2007). Education for strategic environmental behavior. *Environmental Education Research*, *13*(4), 437-452. https://doi.org/10.1080/13504620701581539

Chawla, L., & Derr, V. (2012). The development of conservation behaviors in childhood and youth. In S. D. Clayton (Ed.), *The Oxford handbook of environmental and conservation psychology* (pp. 527-555). Oxford University Press. https://doi.org/ 10.1.1.519.8387&rep

Chawla, L., Keena, K., Pevec, I., & Stanley, E. (2014). Green schoolyards as havens from stress and resources for resilience in childhood and adolescence. *Health & Place*, *28*, 1-13. https://doi.org/https://doi.org/10.1016/j.healthplace.2014.03.001

Cheng, J. C. H., & Monroe, M. C. (2010). Connection to nature: Children's affective attitude toward nature. *Environment and Behavior*, *44*(1), 31-49. https://doi.org/10.1177/0013916510385082

Cho, E. Y. N., & Yu, F. Y. (2020). A review of measurement tools for child wellbeing. *Children and Youth Services Review, 119*, Article 105576. https://doi.org/https://doi.org/10.1016/j.childyouth.2020.105576

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

Collado, S., & Staats, H. (2016). Contact with nature and children's restorative experiences: An eye to the future. *Frontiers in Psychology, 7,* Article 1885. https://doi.org/10.3389/fpsyg.2016.01885

Cudworth, D., & Lumber, R. (2021). The importance of Forest School and the pathways to nature connection. *Journal of Outdoor and Environmental Education*, *24*(1), 71-85. https://doi.org/10.1007/s42322-021-00074-x

Dadfar, M., Salabifard, S., Dadfar, T., Roudbari, M., & Moneni Safarabad, N. (2019). Validation of the patient health questionnaire-2 with Iranian students. *Mental Health, Religion & Culture*, *22*(10), 1048-1056. https://doi.org/10.1080/13674676.2019.1699042

Deighton, J., Croudace, T., Fonagy, P., Brown, J., Patalay, P., & Wolpert, M. (2014). Measuring mental health and wellbeing outcomes for children and adolescents to inform practice and policy: A review of child self-report measures. *Child and Adolescent Psychiatry and Mental Health, 8*(1), Article 14. https://doi.org/10.1186/1753-2000-8-14

Duron-Ramos, M. F., Collado, S., García-Vázquez, F. I., & Bello-Echeverria, M. (2020). The role of urban/rural environments on Mexican children's connection to nature and pro-environmental behavior. *Frontiers in Psychology, 11*(10), Article 3389. https://doi.org/10.3389/fpsyg.2020.00514

Evans, G. W., Otto, S., & Kaiser, F. G. (2018). Childhood origins of young adult environmental behavior. *Psychological Science*, *29*(5), 679-687. https://doi.org/10.1177/0956797617741894

Fazio, R., & Zanna, M. (1981). Direct experience and attitude-behavior consistency. *Advances in Experimental Social Psychology*, *14*, 161-202. https://doi.org/10.1016/S0065-2601(08)60372-X

Flouri, E., Midouhas, E., & Joshi, H. (2014). The role of urban neighbourhood green space in children's emotional and behavioural resilience. *Journal of Environmental Psychology*, *40*, 179-186. https://www.sciencedirect.com/science/article/pii/S0272494414000565

Gazzaniga, M. (2008). *Human: The science behind what makes your brain unique*. Harper Collins.

Gebhard, U., Nevers, P, Billmann-Machecha, E. (2003). Moralizing trees: Anthropomorphism and identity in children's relationships to nature. In S. Clayton, Clayton S, Opotow, S (Ed.), *Identity and the Natural Environment* (pp. 91-111). MIT Press.

Gill, T. (2014). The benefits of children's engagement with nature: A systematic literature review. *Children, Youth and Environments, 24*(2), 10-34. https://doi.org/10.7721/chilyoutenvi.24.2.0010

Hatala, A. R., Njeze, C., Morton, D., Pearl, T., & Bird-Naytowhow, K. (2020). Land and nature as sources of health and resilience among Indigenous youth in an urban Canadian context: A photovoice exploration. *BMC Public Health*, *20*(1), 538. https://doi.org/10.1186/s12889-020-08647-z

Hawkins, R. D., Williams, J. M., & Scottish Society for the Prevention of Cruelty to Animals (2017). Childhood attachment to pets: Associations between pet attachment, attitudes to animals, compassion, and humane behaviour. *International Journal of Environmental Research and Public Health*, *14*(5), 490. https://doi.org/10.3390/ijerph14050490

Hinds, J., & Sparks, P. (2008). Engaging with the natural environment: The role of affective connection and identity. *Journal of Environmental Psychology*, *28*(2), 109-120. https://doi.org/https://doi.org/10.1016/j.jenvp.2007.11.001

Hoffman, M. L. (2000). *Empathy and moral development: Implications for caring and justice*. Cambridge University Press. doi:10.1017/CBO9780511805851

Holland, W., Powell, R., Thomsen, J., & Monz, C. (2018). A systematic review of the psychological, social, and educational outcomes associated with participation in wildland recreational activities. *Journal of Outdoor Recreation, Education, and Leadership*, *10*, 197-225. https://doi.org/10.18666/JOREL-2018-V10-I3-8382

Hordyk, S. R., Hanley, J., & Richard, É. (2015). "Nature is there; its free": Urban greenspace and the social determinants of health of immigrant families. *Health Place*, *34*, 74-82. https://doi.org/10.1016/j.healthplace.2015.03.016

Huang, H., Liu, Y., & Su, Y. (2020). What is the relationship between empathy and mental health in preschool teachers: The role of teaching experience. *Frontiers in Psychology*, *11*, Article 1366. https://doi.org/10.3389/fpsyg.2020.01366

Huppert, F. A. (2009). Psychological well-being: Evidence regarding its causes and consequences. *Applied Psychology: Health and Well-Being*, *1*(2), 137-164. https://doi.org/https://doi.org/10.1111/j.1758-0854.2009.01008.x

Jackson-Barrett, E., & Lee-Hammond, L. (2018). Strengthening identities and involvement of Aboriginal children through learning on country. *Australian Journal of Teacher Education*, *43*, 6. https://doi.org/10.14221/ajte.2018v43n6.6

Jax, K., Calestani, M., Chan, K. M. A., Eser, U., Keune, H., Muraca, B., O'Brien, L., Potthast, T., Voget-Kleschin, L., & Wittmer, H. (2018). Caring for nature matters: A relational approach for understanding nature's contributions to human well-being. *Current Opinion in Environmental Sustainability*, *35*, 22-29. https://doi.org/https://doi.org/10.1016/j.cosust.2018.10.009

Kals, E., Ittner, H. (2003). Children's environmental identity: Indicators and behavioural impacts. In S. Clayton & S. Opotow (Eds.), *Identity and the Natural Environment (pp. 135-157).* MIT Press.

Kaplan, R., & Kaplan, S. (1989). *The experience of nature: A psychological perspective*. Cambridge University Press.

Keith, R. J., Given, L. M., Martin, J. M., & Hochuli, D. F. (2021). Urban children's connections to nature and environmental behaviors differ with age and gender. *PLOS ONE*, *16*(7), Article e0255421. https://doi.org/10.1371/journal.pone.0255421

Kim, K. (2018). To feel or not to feel: Empathy and physician burnout. *Academic Psychiatry*, *42*(1), 157-158. https://doi.org/10.1007/s40596-017-0871-5

Klinker, C., Schipperijn, J., Kerr, J., Ersbøll, A., & Troelsen, J. (2014). Context-specific outdoor time and physical activity among school-children across gender and age: Using accelerometers and GPS to advance methods. *Frontiers in Public Health*, *2*(20). https://doi.org/10.3389/fpubh.2014.00020

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2003). The patient health questionnaire-2: Validity of a two-item depression screener. *Medical Care*, *41*(11), 1284-1292. https://doi.org/10.1097/01.Mlr.0000093487.78664.3c

Kyttä, A. M., Broberg, A. K., & Kahila, M. H. (2012). Urban environment and children's active lifestyle: Revealing children's behavioral patterns and meaningful places. *American Journal of Health Promotion, 26*(5), Article e137-e148. https://doi.org/10.4278/ajhp.100914-QUAN-310

Korpela, K., Kyttä, M., & Hartig, T. (2002). Restorative experience, self-regulation, and children's place preferences. *Journal of Environmental Psychology*, *22*(4), 387-398. https://doi.org/https://doi.org/10.1006/jevp.2002.0277

Lamothe, M., Boujut, E., Zenasni, F., & Sultan, S. (2014). To be or not to be empathic: The combined role of empathic concern and perspective taking in understanding burnout in general practice. *BMC Family Practice*, *15*(1), 15. https://doi.org/10.1186/1471-2296-15-15

Larson, L. R., Green, G. T., & Cordell, H. K. (2011). Children's time outdoors: Results and implications of the national kids survey. *Journal of Park and Recreation Administration*, *29*(2), 1-20.

Larson, L. R., Szczytko, R., Bowers, E. P., Stephens, L. E., Stevenson, K. T., & Floyd, M. F. (2018). Outdoor time, screen time, and connection to nature: Troubling trends among rural youth? *Environment and Behavior*, *51*(8), 966-991. https://doi.org/10.1177/0013916518806686

Lavrysen, A., Bertrands, E., Leyssen, L., Smets, L., Vanderspikken, A., & De Graef, P. (2017). Risky-play at school. Facilitating risk perception and competence in young children. *European Early Childhood Education Research Journal*, *25*(1), 89. 105.https://doi.org/10.1080/1350293X.2015.1102412

Lawrence, D., Johnson, S., Hafekost, J., Boterhoven De Haan, K., Sawyer, M., Ainley, J., & Zubrick, SR. (2015). *The Mental Health of Children and Adolescents*. Report on the second Australian Child and Adolescent Survey of Mental Health and Wellbeing. Department of Health, Canberra.

Lee, H. S., Brennan, P. F., & Daly, B. J. (2001). Relationship of empathy to appraisal, depression, life satisfaction, and physical health in informal caregivers of older adults. *Research in Nursing and Health*, *24*(1), 44-56. https://doi.org/10.1002/1098-240x(200102)24:1<44::aid-nur1006>3.0.co;2-s

Levin, K. A., & Currie, C. (2014). Reliability and validity of an adapted version of the Cantril Ladder for use with adolescent samples. *Social Indicators Research*, *119*(2), 1047-1063. https://doi.org/10.1007/s11205-013-0507-4

Li, S. H., Beames, J. R., Newby, J. M., Maston, K., Christensen, H., & Werner-Seidler, A. (2021). The impact of COVID-19 on the lives and mental health of Australian adolescents. *European Child & Adolescent Psychiatry*. Advanced online publication. https://doi.org/10.1007/s00787-021-01790-x

Liu, S. I., Yeh, Z. T., Huang, H. C., Sun, F. J., Tjung, J. J., Hwang, L. C., Shih, Y. H., & Yeh, A. W. (2011). Validation of patient health questionnaire for depression screening among primary care patients in Taiwan. *Comprehensive Psychiatry*, *52*(1), 96-101. https://doi.org/10.1016/j.comppsych.2010.04.013

Loehlin, J., & Beaujean, A. (2016). *Latent variable models: An introduction to factor, path, and structural equation analysis* (5th ed.). Routledge. https://doi.org/10.4324/9781315643199

Louv, R. (2005). *The Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder.* Algonquin Books.

Maas, J., Verheij, R. A., de Vries, S., Spreeuwenberg, P., Schellevis, F. G., & Groenewegen, P. P. (2009). Morbidity is related to a green living environment. *Journal of Epidemiology and Community Health*, *63*(12), 967-973. https://doi.org/10.1136/jech.2008.079038

Malberg-Dyg, P., & Wistoft, K. (2018). Wellbeing in school gardens: The case of the gardens for bellies food and environmental education program. *Environmental Education Research*, *24*(8), 1177-1191. https://doi.org/10.1080/13504622.2018.1434869

Mayer, F. S., & McPherson-Frantz, C. (2004). The connectedness to nature scale: A measure of individuals' feeling in community with nature. *Journal of Environmental Psychology*, *24*(4), 503-515. https://doi.org/https://doi.org/10.1016/j.jenvp.2004.10.001

Mazur, J., Szkultecka-Dębek, M., Dzielska, A., Drozd, M., & Małkowska-Szkutnik, A. (2018). What does the Cantril Ladder measure in adolescence? *Archives of Medical Science: AMS*, *14*(1), 182-189. https://doi.org/10.5114/aoms.2016.60718

McCullough, B., Pfahl, M., & Nguyen, S. (2016). The green waves of environmental sustainability in sport. *Sport in Society*, *19*, 1040-1065. https://doi.org/10.1080/17430437.2015.1096251

Millar, M. G., & Millar, K. U. (1996). The effects of direct and indirect experience on affective and cognitive responses and the attitude–behavior relation. *Journal of Experimental Social Psychology*, *32*(6), 561-579. https://doi.org/https://doi.org/10.1006/jesp.1996.0025

Morelli, S. A., Lee, I. A., Arnn, M. E., & Zaki, J. (2015). Emotional and instrumental support provision interact to predict well-being. *Emotion, 15*(4), 484-493. https://doi.org/10.1037/emo0000084

Mossman, S. A., Luft, M. J., Schroeder, H. K., Varney, S. T., Fleck, D. E., Barzman, D. H., Gilman, R., DelBello, M. P., & Strawn, J. R. (2017). The generalized anxiety disorder 7-item scale in adolescents with generalized anxiety disorder: Signal detection and validation. *Annals of Clinical Psychiatry: Official Journal of the American Academy of Clinical Psychiatrists*, *29*(4), 227-234.

Mygind, L., Kjeldsted, E., Hartmeyer, R., Mygind, E., Bølling, M., & Bentsen, P. (2019). Mental, physical, and social health benefits of immersive nature-experience for children and adolescents: A systematic review and quality assessment of the evidence. *Health Place*, *58*, Article 102136. https://doi.org/10.1016/j.healthplace.2019.05.014

Nawaz, H., & Blackwell, S. (2014). Perceptions about Forest Schools: Encouraging and promoting Archimedes Forest schools. *Educational Research and Reviews*, *9*, 498-503. https://doi.org/10.5897/ERR2014.1711

Nisbet, E. K., Zelenski, J. M., & Murphy, S. A. (2008). The nature relatedness scale: Linking individuals' connection with nature to environmental concern and behavior. *Environment and Behavior*, *41*(5), 715-740. https://doi.org/10.1177/0013916508318748

Nussbaum, M. C. (2011). Capabilities, entitlements, rights: Supplementation and critique. *Journal of Human Development and Capabilities*, *12*(1), 23-37. https://doi.org/10.1080/19452829.2011.541731

Nussbaum, M. C. (2011). *Creating Capabilities: The Human Development Approach*. Harvard University Press.

Olsson, D., & Gericke, N. (2016). The adolescent dip in students' sustainability consciousness: Implications for education for sustainable development. *The Journal of Environmental Education*, *47*(1), 35-51. https://doi.org/10.1080/00958964.2015.1075464

Otto, S., & Pensini, P. (2017). Nature-based environmental education of children: Environmental knowledge and connectedness to nature, together, are related to ecological behaviour. *Global Environmental Change, 47*, 88-94. https://doi.org/https://doi.org/10.1016/j.gloenvcha.2017.09.009

Plummer, F., Manea, L., Trepel, D., & McMillan, D. (2016). Screening for anxiety disorders with the GAD-7 and GAD-2: A systematic review and diagnostic meta-analysis. *General Hospital Psychiatry*, *39*, 24-31. https://doi.org/10.1016/j.genhosppsych.2015.11.005

Pogue-Harrison, R. (2009). *Gardens: An essay on the human condition*. University of Chicago Press.

Pollard, E. L., & Lee, P. D. (2003). Child well-being: A systematic review of the literature. *Social Indicators Research*, *61*(1), 59-78. https://doi.org/10.1023/A:1021284215801

Rebok, G., Riley, A., Forrest, C., Starfield, B., Green, B., Robertson, J., & Tambor, E. (2001). Elementary school-aged children's reports of their health: A cognitive interviewing study. *Quality of Life Research*, *10*(1), 59-70. https://doi.org/10.1023/A:1016693417166

Resilient Youth Australia. (2021). http://resilientyouth.org/survey

Rice, W. L., Mateer, T. J., Reigner, N., Newman, P., Lawhon, B., & Taff, B. D. (2020). Changes in recreational behaviors of outdoor enthusiasts during the COVID-19 pandemic: Analysis across urban and rural communities. *Journal of Urban Ecology*, *6*(1), 1-70. https://doi.org/10.1093/jue/juaa020

Richardson, L. P., Rockhill, C., Russo, J. E., Grossman, D. C., Richards, J., McCarty, C., McCauley, E., & Katon, W. (2010). Evaluation of the PHQ-2 as a brief screen for detecting major depression among adolescents. *Pediatrics*, *125*(5), Article e1097-1103. https://doi.org/10.1542/peds.2009-2712

Richardson, M., Hunt, A., Hinds, J., Bragg, R., Fido, D., Petronzi, D., Barbett, L., Clitherow, T., & White, M. (2019). A measure of nature connectedness for children and adults: Validation, performance, and insights. *Sustainability*, *11*(12), Article 3250. https://www.mdpi.com/2071-1050/11/12/3250

Roczen, N., Kaiser, F. G., Bogner, F. X., & Wilson, M. (2013). A competence model for environmental education. *Environment and Behavior*, *46*(8), 972-992. https://doi.org/10.1177/0013916513492416

Roe, J., & Aspinall, P. (2011). The restorative outcomes of Forest School and conventional school in young people with good and poor behaviour. *Urban Forestry & Urban Greening*, *10*, 205-212. https://doi.org/10.1016/j.ufug.2011.03.003

Rosa, C. D., Profice, C. C., & Collado, S. (2018). Nature experiences and adults' self-reported pro-environmental behaviors: The role of connectedness to nature and childhood nature experiences. *Frontiers in Psychology*, *9*, Article 1055. https://doi.org/10.3389/fpsyg.2018.01055

Salazar, G., Kunkle, K. & Monroe, M. C. (2020). *Practitioner guide to assessing connection to nature.* Washington, DC, North American Association for Environmental Education.

Sandseter, E. B. H., & Kennair, L. E. O. (2011). Children's risky play from an evolutionary perspective: The anti-phobic effects of thrilling experiences. *Evolutionary Psychology*, *9*(2), Article 147470491100900212. https://doi.org/10.1177/147470491100900212

Sapra, A., Bhandari, P., Sharma, S., Chanpura, T., & Lopp, L. (2020). Using generalized anxiety disorder-2 (GAD-2) and GAD-7 in a primary care setting. *Cureus Journal of Medical Science*, *12*(5), Article e8224-e8224. https://doi.org/10.7759/cureus.8224

Sedawi, W., Ben Zvi Assaraf, O., & Reiss, M. J. (2020). Indigenous children's connectedness to nature: The potential influence of culture, gender and exposure to a contaminated environment. *Cultural Studies of Science Education*, *15*(4), 955-989. https://doi.org/10.1007/s11422-020-09982-8

Shanafelt, T. D., West, C., Zhao, X., Novotny, P., Kolars, J., Habermann, T., & Sloan, J. (2005). Relationship between increased personal well-being and enhanced empathy among internal medicine residents. *Journal of General Internal Medicine*, *20*(7), 559-564. https://doi.org/10.1111/j.1525-1497.2005.0108.x

Sharma-Brymer, V., Brymer, E., & Gray, T. (2017). Sport participation to create a deeper environmental identity. In B. P. McCullough & T. B. Kellison (Eds.), *Routledge handbook of sport and the environment* (pp. 330-339). Routledge. https://doi.org/10.4324/9781315619514-25

Sobel, D. (1996). *Beyond Ecophobia: Reclaiming the heart in nature education*. Orion Society. https://aura.antioch.edu/facbooks/42

Sobel, D., (2014). Learning to walk between the raindrops: The value of nature preschools and forest kindergartens. *Children, Youth and Environments*, *24*(2), 228-238. https://doi.org/10.7721/chilyoutenvi.24.2.0228

Sobko, T., Jia, Z., & Brown, G. (2018). Measuring connectedness to nature in preschool children in an urban setting and its relation to psychological functioning. *PLOS ONE*, *13*(11). https://doi.org/10.1371/journal.pone.0207057

Soga, M., & Gaston, K. J. (2016). Extinction of experience: The loss of human–nature interactions. *Frontiers in Ecology and the Environment*, *14*(2), 94-101. https://doi.org/https://doi.org/10.1002/fee.1225

Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archive of Internal Medicine*, *166*(10), 1092-1097. https://doi.org/10.1001/archinte.166.10.1092

Stage, F. K., Carter, H. C., & Nora, A. (2004). Path analysis: An introduction and analysis of a decade of research. *The Journal of Educational Research*, *98*(1), 5-12. https://doi.org/10.3200/JOER.98.1.5-13

Statham, J., & Chase, E. (2010). *Childhood wellbeing: A brief overview* (Policy Brief No. 1). Childhood Wellbeing Research Centre. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.453.9199&rep=rep1&type=pdf

Tam, K.P. (2013). Dispositional empathy with nature. *Journal of Environmental Psychology*, *35*, 92-104. https://doi.org/10.1016/j.jenvp.2013.05.004

The Lancet (2021). A climate of anxiety. *The Lancet Child & Adolescent Health*, *5*(2), 91. https://doi.org/10.1016/S2352-4642(21)00001-8

Thompson, K., & Gullone, E. (2003). Promotion of empathy and prosocial behaviour in children through humane education. *Australian Psychologist, 38*(3), 175-182. https://doi.org/10.1080/00050060310001707187

Tillmann, S., Tobin, D., Avison, W., & Gilliland, J. (2018). Mental health benefits of interactions with nature in children and teenagers: A systematic review. *Journal of Epidemiology and Community Health*, *72*(10), Article 958. https://doi.org/10.1136/jech-2018-210436

Tiplady, L. S. E., & Menter, H. (2020). Forest School for wellbeing: An environment in which young people can ‘take what they need’. *Journal of Adventure Education and Outdoor Learning*, *21*(2), 99-114. https://doi.org/10.1080/14729679.2020.1730206

United Nations (2014). 2014 Revision of the World Urbanization Prospects.

Vinayak, S. (2018). Resilience and empathy as predictors of psychological wellbeing among adolescents. *International Journal of Health Sciences and Research*, *8*(4), 192-200. https://www.ijhsr.org/IJHSR_Vol.8_Issue.4_April2018/29.pdf

Wells, N., & Lekies, K. (2006). Nature and the life course: Pathways from childhood nature experiences to adult environmentalism. *Children, Youth and Environments, 16*(1), Article 41663. https://www.semanticscholar.org/paper/Nature-and-the-Life-Course%3A-Pathways-from-Childhood-Wells-Lekies/1c94a87f065007b3e015f83d18674006f427d951

Wells, N. M., & Evans, G. W. (2003). Nearby nature: A buffer of life stress among rural children. *Environment and Behavior*, *35*(3), 311-330. https://doi.org/10.1177/0013916503035003001

Westrupp, E. M., Bennett, C., Berkowitz, T., Youssef, G. J., Toumbourou, J. W., Tucker, R., Andrews, F. J., Evans, S., Teague, S. J., Karantzas, G. C., Melvin, G. M., Olsson, C., Macdonald, J. A., Greenwood, C. J., Mikocka-Walus, A., Hutchinson, D., Fuller-Tyszkiewicz, M., Stokes, M. A., Olive, L., Wood, A. G., McGillivray, J. A., & Sciberras, E. (2021). Child, parent, and family mental health and functioning in Australia during COVID-19: Comparison to pre-pandemic data. *European Child and Adolescent Psychiatry* 1-14. Advance online publication. https://doi.org/10.1007/s00787-021-01861-z

Wheeler, B. W., Cooper, A. R., Page, A. S., & Jago, R. (2010). Greenspace and children's physical activity: A GPS/GIS analysis of the PEACH project. *Preventive Medicine*, *51*(2), 148-152. https://doi.org/https://doi.org/10.1016/j.ypmed.2010.06.001

Whitburn, J., Linklater, W., & Abrahamse, W. (2020). Meta-analysis of human connection to nature and pro-environmental behaviour. *Conservation Biology*, *34*(1), 180-193. https://doi.org/https://doi.org/10.1111/cobi.13381

World Health Organisation. (2020). *Adolescent mental health.* https://www.who.int/news-room/fact-sheets/detail/adolescent-mental-health

World Wildlife Fund. (2014). *Living planet report 2014: species and spaces, people, and places*. https://www.worldwildlife.org/pages/living-planet-report-2014

Yu, M., & Baxter, J. (2016). Australian children's screen time and participation in extracurricular activities. In Australian Institute of Family Studies (Eds.). *Longitudinal study of Australian children annual statistical report* (pp. 99-125). Australian Institute of Family studies.

Zahn-Waxler, C., & Radke-Yarrow, M. (1990). The origins of empathic concern. *Motivation and Emotion*, *14*(2), 107-130. https://doi.org/10.1007/BF00991639

Appendices

Appendix A

Upper primary measures and their respective items

Demographic Items

1. How old are you?
2. Gender

○	○	○
Male	Female	Prefer not to say

3. What is your year level?

○	○	○	○	○
Grade 3	Grade 4	Grade 5	Grade 6	Grade 7

4. Would you describe yourself as?

○	○	○	○	○	○	○	○	○
Australian	Aboriginal or Torres Strait Islander	African	Asian	European	Maori	New Zealand	Pacific Islander	Other <free response>

5. State you live in
6. Suburb you live in

Wellbeing Measure Items

1. Over the last 2 weeks, how often have you been bothered by the following problems

Feeling anxious, nervous or on edge?

○	○	○	○
Nearly every day	More than half the days	Several days	Not at all

Not being able to stop or control worrying

○	○	○	○
Nearly every day	More than half the days	Several days	Not at all

Feeling down, depressed, or hopeless?

○	○	○	○
Nearly every day	More than half the days	Several days	Not at all

Little interest or pleasure in doing things?

○	○	○	○
Nearly every day	More than half the days	Several days	Not at all

2. Please imagine a ladder with steps numbered from zero at the bottom to 8 at the top. The top of the ladder represents the best possible life for you and the bottom of the ladder represents the worst possible life for you. On which step of the ladder would you personally feel you stand at this time?

○	○	○	○	○	○	○	○	○
0 (Worst possible life)	1	2	3	4	5	6	7	8 (Best possible life)

Nature Engagement Measure Items

1. I play outdoors when at home

○	○	○
Hardly ever	Sometimes	Always

2. I play outdoors when I am at school

Hardly ever	Sometimes	Always
○	○	○

Empathetic Connection Measure Items

1. I feel happy when I'm outside

Hardly ever	Sometimes	Always
○	○	○

2. I like touching animals and plants

Hardly ever	Sometimes	Always
○	○	○

3. I like playing outside

Hardly ever	Sometimes	Always
○	○	○

4. I feel sad when animals are hurt

Hardly ever	Sometimes	Always
○	○	○

5. I feel that looking after plants and animals is important

Hardly ever	Sometimes	Always
○	○	○

6. I feel happy when animals have a clean home

Hardly ever	Sometimes	Always
○	○	○

Pro-Environmental Behaviour Measure Items

1. I pick up rubbish

Hardly ever	Sometimes	Always
○	○	○

2. I try not to hurt plants and animals

Hardly ever	Sometimes	Always
○	○	○

3. I turn off the lights at home

Hardly ever	Sometimes	Always
○	○	○

4. I help with the recycling at home

Hardly ever	Sometimes	Always
○	○	○

5. I try not to waste water

Hardly ever	Sometimes	Always
○	○	○

Appendix B

Lower primary measures

Demographic Items

1. How old are you

○ 4 years ○ 5 years ○ 6 years ○ 7 years ○ 8 years

2. Are you a boy or a girl?

○ Boy ○ Girl

Wellbeing Measure Items

1. I feel happy here

○ No ○ Sometimes ○ Yes

2. I often feel sad

○ No ○ Sometimes ○ Yes

3. I often worry a lot

○ No ○ Sometimes ○ Yes

Nature Engagement Measure Items

1. I play outdoors when at home

○	○	○
No	Sometimes	Yes

2. I play outdoors when I am at school

○	○	○
No	Sometimes	Yes

Empathetic Connection Measure Items

1. I feel happy when I'm outside

○	○	○
No	Sometimes	Yes

2. I like touching animals and plants

○	○	○
No	Sometimes	Yes

3. I like playing outside

○	○	○
No	Sometimes	Yes

4. I feel sad when animals are hurt

○	○	○
No	Sometimes	Yes

5. I feel that looking after plants and animals is important

○	○	○
No	Sometimes	Yes

6. I feel happy when animals have a clean home

○ ○ ○
No Sometimes Yes

Pro-Environmental Behaviour Measure Items

1. I pick up rubbish

○ ○ ○
No Sometimes Yes

2. I try not to hurt plants and animals

○ ○ ○
No Sometimes Yes

3. I turn off the lights at home

○ ○ ○
No Sometimes Yes

4. I help with the recycling at home

○ ○ ○
No Sometimes Yes

5. I try not to waste water

○ ○ ○
No Sometimes Yes

Appendix C

Spearman's correlation matrices for lower primary school measures.

Table C1

Spearman's Correlation Matrix for Lower Primary Wellbeing Items

Item	JG32	JG36	JG37
I feel happy here (JG32)	-		
I worry a lot (JG36)	-.029	-	
I often feel sad (JG37)	-.006	.335**	-

Note: * p < .05 (2-tailed), ** p < .01 (2-tailed).

Table C2

Spearman's Correlation Matrix for Empathetic Connection Items Lower Primary

Item	JG53	JG54	JG55	JG61	JG62	JG63
I feel happy when I'm outside (JG53)	-					
I like touching animals and plants (JG54)	.292**	-				
I like playing outside (JG55)	.517**	.433**	-			
I feel sad when animals are hurt (JG61)	.275**	.326**	.297**	-		
I think that looking after plants and animals is important (JG62)	.379**	.278**	.345**	.236**	-	
I feel happy when animals have a clean home (JG63)	.267**	.355**	.321**	.243**	.505**	-

Note: * p < .05 (2-tailed), ** p < .01 (2-tailed).

Table C3

Spearman's Correlation Matrix for Pro-Environmental Behaviour Items

Item	JG64	JG65	JG66	JG67	JG68
I pick up rubbish (JG64)	-				
I try not to hurt plants and animals (JG65)	.355**	-			
I turn off the lights at home (JG66)	.376**	.230**	-		
I help with recycling at home (JG67)	.348**	.297**	.361**	-	
I try not to waste water (JG68)	.401**	.313**	.401**	.401**	-

Note: * $p < .05$ (2-tailed), ** $p < .01$ (2-tailed).

Appendix D

Spearman's correlation matrices for upper primary school measures.

Table D1

Spearman's Correlation Matrix for Upper Primary Wellbeing Items

Item	(C)	PH1	PH2	PH3	PH4
Cantril Ladder (C)	-				
Feeling anxious, nervous or on edge (PH1)	-.188	-			
Not being able to stop or control worrying (PH2)	-.203*	.679**	-		
Feeling down, depressed, or hopeless (PH3)	-.312**	.505**	.427**	-	
Little interest or pleasure in doing things (PH4)	-.234*	.380**	.351*	.454**	-

Note: * $p < .05$ (2-tailed), ** $p < .01$ (2-tailed).

Table D2

Spearman's Correlation Matrix for Pro-Environmental Behaviour Items

Item	JG21	JG22	JG23	JG24	JG25
I pick up rubbish (JG21)	-				
I try not to hurt plants and animals (JG22)	.374**	-			
I turn off the lights at home (JG23)	.176	.316**	-		
I help with recycling at home (JG24)	.340**	.225*	.200*	-	
I try not to waste water (JG25)	.322**	.286**	.248*	.312**	-

Note: * $p < .05$ (2-tailed), ** $p < .01$ (2-tailed).

Table D3

Spearman's Correlation Matrix for Empathetic Connection Items

Item	JG4	JG5	JG6	JG17	JG18	JG19
I feel happy when I'm outside (JG4)	-					
I like touching animals and plants (JG5)	-.021	-				
I like playing outside (JG6)	.389**	-.004	-			
I feel sad when animals are hurt (JG17)	.036	.276**	.046	-		
I think that looking after plants and animals is important (JG18)	.207*	.364**	.217*	.375**	-	
I feel happy when animals have a clean home (JG19)	.140	.364**	.083	.223*	.474**	-

Note: * $p < .05$ (2-taileded), ** $p < .01$ (2-tailed).