



# The Impact of Children's Connection to Nature

A Report for the Royal Society for the Protection of Birds (RSPB)

November 2015



College of Life and Natural Sciences



# The Impact of Children's Connection to Nature

A Report for the Royal Society for the Protection of Birds  
(RSPB)

Dr Miles Richardson, Prof. David Sheffield, Dr Caroline Harvey & Dominic  
Petronzi

Nature Connectedness Research Group

November 2015

*The authors and the RSPB would like to thank the Calouste Gulbenkian Foundation  
for funding this research.*



## Contents

Executive Summary .....	7
Context .....	8
Methodology .....	9
Design .....	9
Educational Attainment.....	9
Connection to Nature Index .....	9
Children’s Pro-environmental Behaviours.....	9
Children’s Pro-nature Behaviours .....	10
Health and Well-being.....	10
Demographics.....	10
Additional Items .....	10
Schools.....	10
Participants .....	11
Ethical Considerations .....	11
Recruitment.....	12
Procedure .....	12
Data Entry .....	13
Quality Assurance .....	13
Analysis .....	13
Results .....	14
Demographics.....	14
Internal Reliability of the Measures.....	15
Connection to Nature Scores .....	16
Tests of Relationships with CNI.....	16
Connection to Nature Index .....	16
Regression Analysis: Connection to Nature Index .....	17
Health Measure .....	17
Pro-environmental Behaviour Measure .....	17
Pro-nature Behaviours.....	17
Additional Education Attainment Correlations.....	17
Regression Analysis: English Attainment .....	18
Mediation Analysis.....	18
Connection to Nature Threshold.....	18
Connection to Nature Threshold: Full data set.....	18

Key Findings.....	20
Implications .....	21
References .....	22
Acknowledgements.....	23
Appendix A Pro-environmental and pro-nature measures.....	24
Children’s Pro-environmental Behaviours (Collado et al., 2013) .....	24
Children’s Pro-nature Behaviours .....	24
Appendix B Correlation and P-Value Matrix .....	25

## Executive Summary

Connecting with nature should be part of every child's life as it has the potential to aid nature's revival while benefiting the child. To embed nature connection within our social norms, there is a need to be able to understand the benefits and set targets for levels of nature connection.

This report presents findings on the impact of connection to nature from a survey of 775 children, using the child as the unit of analysis, rather than aggregated data. The results demonstrated that children who were more connected to nature had significantly higher English attainment, although this wasn't repeated for Mathematics. Further, the 1.5 Connection to Nature Index (CNI) level was found to be a significant threshold across other measures, with those children with a CNI of 1.5 or above having significantly higher health, life satisfaction, pro-environmental behaviours and pro-nature behaviours.

The analysis found strong correlations between CNI and pro-nature behaviours and pro-environmental behavior. A positive correlation was also evident between CNI and days spent outdoors and days spent in nature over the past week, suggesting that the more time spent in nature is associated with child's connection to nature. Finally, weak correlations were found between connection to nature, health and life satisfaction.

When more refined attainment results for English were explored, (n = 512) further weak correlations were found between English attainment and attendance, English and life satisfaction, and between English attainment and connection to nature. There are a multitude of factors associated with a child's English attainment, so, although the correlations are weak, it is noteworthy that connection to nature is as important to children's achievement in English as life satisfaction and attendance at school.

## Context

There is an acknowledged need to reconnect people with nature (e.g. Defra, 2011) owing to the benefits to human health and well-being (e.g. Hartig et al., 2001; Howell, Dopko, Passmore, & Buro, 2011; Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009), the state of nature (e.g. Barnosky et al., 2011) and the links to pro-environmental behavior (e.g. Frantz & Mayer, 2014).

Children's contact with the natural world is in decline (Charles and Wheeler, 2012) and according to recent research from the RSPB, 4 out of 5 UK children are not connected to nature (RSPB, 2013a). Added to this, a recent assessment of the UK's nature by 25 conservation groups has found that the populations of many species are declining, with one in three having reduced to half in number over the last 5 decades (RSPB, 2013b). Should children continue to be disconnected from nature and not value and respect the importance of protection and conservation, the natural world will further diminish (Miller, 2005). Further, children who spend less time in nature suffer in their health and wellbeing, and miss out on opportunities to develop physically and mentally (Fjortoft, 2001). As well as physical benefits, a connection to nature has been shown to relate to happiness in adults with a similar effect size as established factors, such as income and education (Capaldi, Dopko & Zelenski, 2014).

Despite these issues, there has been limited research attention to the problem of disconnection from nature in children. In order to supply evidence to support greater integration of nature into children's lives, the current research aimed to understand the association between connection to nature, educational attainment, health and wellbeing, pro-environmental behaviour; and pro-nature behaviours.



## Methodology

### Design

The study employed a quantitative cross-sectional design to administer a 38-item questionnaire to measure children's connection to nature, pro-environmental behaviours, life satisfaction and health (details of measures are provided below). Each school also provided a measure of educational attainment.

### Educational Attainment

Educational attainment refers to the level of education completed by a pupil, often measured by tests and qualification. In the UK, children from 8-12 years are working towards Key-Stage 2. Professionals with expertise in primary education advised that teacher assessment SATs levels held by schools for each child working towards Key-Stage 2 would provide the most appropriate measure of educational attainment, as they offer standardised measures across English and Mathematics. Further, the most reliable source of this information is direct from schools, rather than self-reports from children or parents. A robust measure of educational attainment was more important than wider stratified sampling offered by omnibus surveys which would have to rely on unreliable self-reporting of level, or the incorporation of less reliable short-form measures of educational attainment. Therefore schools provided the latest teacher assessed SATs level for each pupil participating in the study.

### Connection to Nature Index

The Connection to Nature Index (CNI) (Cheng & Monroe, 2012) was validated as reliable and accurate with year 6 children aged 10-11 years. This measure was previously field tested and chosen by the RSPB and University of Essex as a robust and practical measure of connection to nature in children aged 8-12 years (Bragg et al., 2013). The scale consists of 16 items that measure four dimensions or sub-scales: i) enjoyment of nature; ii) empathy for creatures; iii) sense of oneness and iv) sense of responsibility. Children's responses to the items can range from strongly agree to strongly disagree on a 5-point Likert scale. The mean score of the items is used to represent CNI. and the CNI has previously achieved a high internal consistency ( $\alpha = .87$ ).

### Children's Pro-environmental Behaviours

Children's pro-environmental behaviours were measured using 5-items previously employed by Collado et al. (2013). These gauged children's willingness to carry out environmental behaviours such as switching off lights to save energy and to use less water (See Appendix A for details). Again, children could respond using a 5-point Likert scale, ranging from 5 (completely agree) to 1 (completely disagree) with a mid-range response option for those with ambivalent feelings. The mean score of the items is used in the analysis.

### Children's Pro-nature Behaviours

A further set of pro-nature behaviour questions were developed through collaboration between the RSPB and University of Derby. Eight questions were devised to ask children about their nature behaviours, such as whether they put food out for birds and if they pick up litter to provide nature with a better home (See Appendix A for details). In contrast to the previous measures, children could respond by either choosing 1 (yes) or 0 (no) with regards to whether they did the behaviours stipulated in the questions. Affirmative responses were summed to produce the pro-nature behavior score, ranging from 0 - 8.

### Health and Well-being

The Student Life Satisfaction Scale (Huebner, 1991) was used to measure children's well-being, in which responses ranged from 6 (strongly agree) to 1 (strongly disagree) on a 6-point Likert scale. Items 3 and 4 on this scale are reverse scored.

A single health item was also included in the questionnaire pack, in which children rated their general health from 5 (excellent) to 1 (poor) on a 5-point Likert scale. This item has been used successfully in a range of published research (e.g. Ostrove et al., 2000).

A third proxy health measure was recorded by obtaining each child's school absence rate.

### Demographics

The demographic questions asked children for their age, gender and ethnic group, to which they could choose from six ethnicity categories, with the last being "not stated".

### Additional Items

A further two items were included, which asked children how many days they had spent outdoors and in nature during the past week.

### Schools

Participants for the research were recruited through opportunity sampling from fifteen state primary schools, dispersed across the East Midlands region in the UK with postcodes DE11; DE13; DE15; DE21; DE22; DE23; DE24; DE65; SK17 and NG10. The schools ranged in their extent of designated nature areas on the school grounds and dedicated clubs to gardening and nature preservation. For example, one school had an outdoor education practitioner who promoted outdoor education and forest schools, whilst children there could also work towards John Muir Awards and the RSPB's Wildlife Action Awards. The socioeconomic status of each school was determined by the % of pupils eligible for free school meals and the number of pupils who speak English as their first language.

Table 1: Table showing the % of pupils eligible for free schools meals and who speak English as their first language in each school.

	Free School Meals %	English as First Language %	Participants from School
School 1	8.5	97.0	40 (5.2%)
School 2	8.6	98.5	53 (6.8%)
School 3	4.6	-	93 (12%)
School 4	4.4	83.3	32 (4.1%)
School 5	3.9	98.8	57 (7.4%)
School 6	-	-	74 (9.5%)
School 7	25.9	96.4	27 (3.5%)
School 8	10.5	98.4	50 (6.5%)
School 9	46.8	84.2	40 (5.2%)
School 10	-	-	56 (7.2%)
School 11	4.2	96.2	23 (3.0%)
School 12	11.2	96.2	81 (10.4%)
School 13	22.9	95.8	27 (3.5%)
School 14	5.3	-	46 (5.9%)
School 15	6.9	99.0	76 (9.8%).

Data accessed via: [www.gov.uk/government/statistics/schools-pupils-and-their-characteristics-january-2013](http://www.gov.uk/government/statistics/schools-pupils-and-their-characteristics-january-2013)

### Participants

In total, 775 children aged 10-11 years responded to the questionnaire and were all in year 6 in primary school. Four hundred and seven of these were male (52.5%) and 368 were female (47.5%). In the demographics section of the questionnaire, children could identify with one of six ethnic groups provided. Of the children who took part, 615 identified themselves as white (79.4%); 44 children as mixed (5.7%); 68 children as Asian or Asian British (8.8%); 17 children as Black or Black British (2.2%); 14 children identified with other ethnic group (1.8%) and 16 children's ethnic group was not stated (2.1%). The sample size of the research (n = 775) can be regarded as sufficient and acceptable for the implementation of a quantitative measure, as Tinsley and Tinsley (1987) suggested a ratio of 5 to 10 subjects per item. With a total of 38 items, a sample size in excess of 380 is sufficient.

### Ethical Considerations

The research was cleared through the University of Derby Psychology Research Ethics Committee and adhered to the British Psychological Society ethical guidelines. In order to obtain participation, consent letters were sent home to parents through the school, outlining the research being conducted in collaboration with the RSPB and giving them the opportunity to request that their child did not complete the questionnaire. The consent letter also informed parents of the need to obtain children's attendance and teacher assessments for Mathematics and English, although this would be kept confidential. The child's right to withdraw their data 1 month after data completion was also outlined.

### Recruitment

Prior to data collection, permission to conduct the research was sought from head teachers of schools or the head of year six, through a phone call and email which outlined the rationale and requirements of the research. This also reassured the schools that the research had received ethical clearance and that children's questionnaire responses, attendance and teacher assessment levels would be kept anonymous. Once a school had expressed interest in the research, and had given initial consent to participate, they were informed that the school would receive a number of gifts from the RSPB for taking part. In addition, a date was arranged for consent forms to be taken and left with the school reception, to be distributed to year 6 children to take home to their parents for their consideration. A response time frame of one week was implemented and stipulated on the consent letter. After this period had elapsed, the researcher returned to the schools to collect any returned opt-out slips. Following this, a date and time for data collection was arranged with each school to suit their convenience.

### Procedure

The questionnaires were handed out to each year 6 class in register order. The attendance for each child and their teacher assessments for English and Mathematics were also requested in register order for each class, so that each child's information could be matched to their questionnaire, without the need for names. This ensured anonymity. The questionnaires were numbered to allow the researcher to omit the relevant attendance and teacher assessments, in the case of a child being absent. When handing out the questionnaires, the researcher noted the class identity code used in the school, i.e. 6SH, again, so that this could be accurately matched to attendance and teacher assessments.

Prior to the children completing the questionnaire, the researcher was introduced and briefly outlined the questionnaire and what the children would need to do. Children were told that their parents had given consent for them to take part and were informed of their right to stop at any stage through the completion of the questionnaire. They were further assured that their responses were confidential and that there were no wrong answers, and thus not a test in any way. Collectively as a class, children were guided through the process of completing their unique identification code and were told that this was how they would be identified, rather than providing their name.

All children who participated in the research completed the questionnaire in a classroom setting. Although children could start the questionnaire, some required assistance with their ethnic group choice and with the items which gauged how many days they had spent outdoors and in nature during the past week. For the most part, the year 6 children who participated were able to read and comprehend the questions without any problems, although some sought clarification on what a question was asking them. In some schools, children worked through the questionnaire with support from a teaching assistant, although their responses were their own. Once all children in a

class had completed the questionnaire, these were collected in by the researcher and the children were thanked. They were then provided with a research debrief with informed them that the questionnaires were for the RSPB who were looking at the relationship between children's engagement with natural world and their well-being, pro-nature behaviour and educational attainment. The children were also informed that due to their participation, they had earned some rewards for their school on behalf of the RSPB.

### Data Entry

The data gathered by the questionnaires was input onto SPSS.

### Quality Assurance

In order to ensure that the data had been input correctly, and that any missing values were not input errors, 20 questionnaires were drawn at random and were checked against the information previously entered on SPSS.

### Analysis

The analysis of the data explored the internal reliability of the scores for the Connection to Nature Index, Children's Pro-environmental Behaviour Measure and the Life Satisfaction Scale. The response distribution of each of the four sub-scales defined above was analysed and did not impact on the reported findings. Correlations were explored between subscales, English and Mathematics scores, attendance and days spent outdoors and in nature over the past week. In addition, multiple regression and mediation analysis was conducted to determine predictors of English attainment further. Curvilinear analysis revealed linear relationships, therefore the existing benefit threshold level for CNI (i.e. 1.5) was used as the basis for tests of difference above and below the threshold.

## Results

### Demographics

Table 2 presents demographic data including gender, age and ethnicity of children for the overall sample size of year 6 children.

Table 2: Summary of the participant demographics

Demographic	Number of Children	Percentage of Children	Total Number (%)
Overall Group Size	775	100%	775
Male	407	52.5%	775 (100%)
Female	368	47.5%	
Aged 10 years	240	31%	774 (99.9%)
Aged 11 years	534	68.9%	
White	615	79.4%	774 (99.9%)
Mixed	44	5.7%	
Asian or Asian British	68	8.8%	
Black or Black British	17	2.2%	
Other Ethnic Group	14	1.8%	
Not Stated	16	2.1%	

In table 2, it can be seen that more males participated in the questionnaire survey over the 15 schools; females accounted for 5% less of the participant

total than males. In terms of age, children aged 11 years were more represented than children aged 10 years, with a difference of 294 participants. However, age 11 is the more typical age for the year 6 children from January onwards. The results for ethnicity show that the majority of children in this research identified themselves as white, accounting for 79.4% of ethnicity. The next highest represented ethnicity was Asian or Asian British, with 8.8% of children identifying with this group, although was significantly less than white respondents. Children who identified as mixed accounted for 5.7% of the total sample size, whilst Black or Black British, other ethnic group and not stated were accounted for by a similar number of children, and were the least represented ethnic groups. A comparison of CNI scores across demographic groups are shown in table 3.

Table 3 - The mean CNI and standard deviations by demographics

Demographics	Means	Standard Deviation
Male	0.85	.60
Female	1.14	.48
White	1.0	.57
Mixed	0.95	.60
Asian or Asian British	0.98	.50
Black or Black British	0.73	.52
Other	1.34	.26
Not Stated	0.79	.61

Analysis of connection to nature and gender showed that females were more connected to nature than males ( $t = -7.44$ ,  $df = 761.55$ ,  $p < 0.01$ ). Sample sizes did not allow any meaningful investigation of differences in relation to ethnicity.

#### Internal Reliability of the Measures

The 16-item Connection to Nature Index (Cheng & Monroe, 2012) was found to have a high internal reliability score after implementation with 775 year 6 children ( $\alpha = .84$ ). This is a similar value to that obtained in previous research ( $\alpha = .87$ ). In addition, the 5-item pro-environmental behaviour measure ( $\alpha = .74$ ) and the 7-item Life Satisfaction Scale ( $\alpha = .80$ ) were both found to have high internal reliability.

### Connection to Nature Scores

The children's overall CNI score, and score on the four sub-scales was calculated. The results are presented in table 4.

Table 4 - The mean score for the overall CNI scale and each of the four sub-scales

	Overall CNI	CNI - Enjoyment	CNI - Empathy	CNI - Oneness	CNI - Responsibility
Mean	0.99	0.70	1.32	1.36	1.03
Std. Deviation	.56	.73	.61	.61	.72

### Tests of Relationships with CNI

Bivariate correlations were conducted in order to investigate whether there were any associations amongst the sub-scales measures (connection to nature; pro-environmental behaviours; pro-nature behaviours; life satisfaction and; health) of the questionnaire, teacher assessments for mathematics and English, attendance and the number of days spent outdoors and in nature over the last week. See Appendix B for the full correlation matrix. Selected results are listed by measure below.

#### *Connection to Nature Index*

The results demonstrated that there was a weak correlation between the CNI scores and the 1-item health measure (Pearson's  $r(768) = .09$ ,  $p = .01$ ) and the CNI and mean scores of the Life Satisfaction Measure (Pearson's  $r(775) = .14$ ,  $p < .01$ ).

A positive correlation was also evident between the CNI and days spent outdoors over the past week (Pearson's  $r(775) = .17$ ,  $p < .01$ ) and a stronger correlation between the CNI and the number of days spent in nature over the past week (Pearson's  $r(771) = .30$ ,  $p < .01$ ), suggesting that the more time spent in nature is associated with a child's connection to nature.

However, the strongest correlations were found between the CNI and the total scores for the pro-nature behaviours (Pearson's  $r(775) = .59$ ,  $p < .01$ ) and the CNI and the pro-environmental behaviour mean scores (Pearson's  $r(775) = .60$ ,  $p < .01$ ).

In contrast, no correlations were evident between the CNI scores and teacher assessments for English (Pearson's  $r(775) = .03$ ,  $p = .456$ ) and Mathematics (Pearson's  $r(775) = .001$ ,  $p = .98$ ). Furthermore, a correlation was not found between CNI scores and children's attendance (Pearson's  $r(775) = -.08$ ,  $p = .026$ ).



The correlation graph shows that high scores on the Connection to Nature Index, which indicate an agreement with the positive affect statements towards nature, have a positive association with high scores on the pro-environmental behaviour measure, which also indicate positive behaviours relating to supporting the environment.

#### *Regression Analysis: Connection to Nature Index*

Using regression analysis with CNi as the dependent variable, it was found that life satisfaction mean scores, nature behaviours total scores, pro-environmental behaviour mean scores and days spent in nature over the last week explained a significant amount of the variance of connection to nature ( $F(4, 766) = 170.01, p < .01, R^2 = .47, R^2_{\text{Adjusted}} = .47$ ). This demonstrates that approximately 47% of connection to nature can be accounted for by these variables.

#### *Health Measure*

The 1-item health measure was found to have a correlation with the mean scores of the Life Satisfaction Measure (Pearson's  $r(768) = .26, p < .01$ ), the mean scores of the pro-environmental behaviours measure (Pearson's  $r(768) = .11, p < .01$ ) and the total scores of the pro-nature behaviours measure (Pearson's  $r(768) = .14, p < .01$ ).

The health measure was also found to correlate with the number of days spent outdoors over the past week (Pearson's  $r(768) = .14, p < .01$ ) and the number of days spent in nature over the past week (Pearson's  $r(764) = .11, p < .01$ ).

#### *Pro-environmental Behaviour Measure*

The mean scores of the pro-environmental behaviour measure were found to correlate with total scores of the pro-nature behaviours measure (Pearson's  $r(775) = .56, p < .01$ ). Moreover, the environmental behaviour measure was found to correlate with the number of days spent outside over the past week (Pearson's  $r(775) = .16, p < .01$ ) and the number of days spent in nature over the past week (Pearson's  $r(771) = .28, p < .01$ ).

#### *Pro-nature Behaviours*

The total scores of the pro-nature behaviours measure were found to correlate with the number of days spent outdoors over the past week (Pearson's  $r(775) = .17, p = <.01$ ) and the number of days spent in nature over the past week (Pearson's  $r(771) = .25, p = <.01$ ).

### **Additional Education Attainment Correlations**

When refined Teacher Assessments for English were explored, i.e. using the data in which more refined SATs levels (e.g. 4a, 4b or 4c, rather than 4) were obtained ( $n = 512$ ) significant but small correlations were found between English attainment and attendance (Pearson's  $r(512) = .092, p = .04$ ).

Significant but small correlations were also found between English attainment and connection to nature (Pearson's  $r(512) = .10, p = .02$ ) and mean scores of life satisfaction and English attainment (Pearson's  $r(551) = .18, p < .01$ ). Although weak, this suggests that connection to nature is as important to children's achievement in English as life satisfaction and attendance.

#### *Regression Analysis: English Attainment*

As above, this regression analysis only included the participants who had had more refined English attainment provided ( $n = 512$ ). Using regression analysis with English attainment as the dependent variable, it was found that the Connection to Nature Index, Attendance and Life Satisfaction were predictors of English attainment ( $F(3, 508) = 6.07, p < .01, R^2 = .04, R^2_{\text{Adjusted}} = .03$ ). However, only 4% of the variance of English attainment can be accounted for by the predictor variables.

#### *Mediation Analysis*

The correlations indicated potential mediation within the relationship between CNI and life satisfaction. A mediation analysis was conducted to further explore the relationship between connection to nature and English attainment, with life satisfaction as a mediator. There was a significant total effect between CNI and English ( $t = 2.34, p = 0.02$ ), a direct effect between Life Satisfaction and CNI ( $t = 2.74, p = 0.01$ ) and also between Life Satisfaction and English while controlling for CNI ( $t = 2.86, p < 0.01$ ). Finally, there was a direct effect of CNI to English while controlling for Life Satisfaction ( $t = 2.74, p < 0.05$ ). The criteria for mediation were met (Baron & Kenny, 1986). The bootstrapped indirect effect was significant, with 95% lower and upper confidence intervals of 0.005 and 0.154. The results indicate that life satisfaction was a mediator in the relationship between CNI and English attainment.

#### **Connection to Nature Threshold**

Pupils scoring 1.5 or over on CNI were found to have significantly higher (half a grade point) English Attainment ( $F(1, 511) = 4.21, p = 0.04$ ), but this wasn't repeated for Mathematics ( $F(1, 511) = 1.96, p = 0.16$ ), see table 5 for means and standard deviations.

#### *Connection to Nature Threshold: Full data set*

The 1.5 CNI level was also found to be a significant marker across other measures, with those with a higher CNI having greater health ( $F(1, 767) = 9.11, p = .003$ ), life satisfaction ( $F(1, 774) = 5.10, p = .024$ ), pro-environmental behaviours ( $F(1, 774) = 169.90, p < .01$ ) and pro-nature behaviours ( $F(1, 774) = 165, p < .01$ ), see table 6 for means and standard deviations.

Table 5 - Means and standard deviations for English and Mathematics attainment in comparison to CNI scores.

		N	Mean	Std. Deviation
English	< 1.5	403	9.21	2.44
	=> 1.5	109	9.74	2.19
	Total	512	9.33	2.40
Mathematics	< 1.5	403	8.80	2.26
	=> 1.5	109	9.14	2.18
	Total	512	8.87	2.24

Where 9 = SATS level 4c and 10 level 4b.

Table 6 - The means and standard deviations for Life Satisfaction, Pro-Nature Behaviours, Pro-Environmental Behaviours and Health in comparison to CNI scores.

		N	Mean	Std. Deviation
Life Satisfaction	< 1.5	621	4.66	.92
	=> 1.5	154	4.85	.79
	Total	775	4.71	.90
Pro-nature Behaviours	< 1.5	621	3.14	1.72
	=> 1.5	154	5.06	1.45
	Total	775	3.52	1.84
Pro-environmental Behaviours	< 1.5	621	3.26	.80
	=> 1.5	154	4.16	.56
	Total	775	3.44	.84
Health	< 1.5	615	4.07	.88
	=> 1.5	153	4.31	.79
	Total	768	4.12	.87

## Key Findings

This report presents findings on the impact of connection to nature from a survey of 775 children. The survey aimed to understand the extent of the association between connection to nature and specific benefits of educational attainment, health and wellbeing, pro-environmental behaviour; and pro-nature behaviours. Benefit threshold levels were also investigated.

The results demonstrated that there was a weak correlation between the CNI scores, health ( $r = 0.09$ ) and life satisfaction ( $r = 0.14$ ). A positive correlation was also evident between the CNI and days spent outdoors ( $r = 0.17$ ) and days spent in nature ( $r = 0.30$ ) over the past week, suggesting that the more time spent in nature is associated with child's connection to nature. However, the strongest correlations were found between the CNI and pro-nature behaviours ( $r = 0.59$ ) and pro-environmental behavior ( $r = 0.60$ ).

When the more refined attainment results for English were explored, ( $n = 512$ ) correlations were found between English attainment and attendance ( $r = 0.09$ ), English and life satisfaction ( $r = 0.14$ ), and between English attainment and connection to nature ( $r = 0.10$ ). Regression analysis showed that connection to nature, life satisfaction and attendance were all significant predictors of English attainment. There are a multitude of factors associated with a child's English attainment, so, although the correlations are weak, it was found that connection to nature is as important to children's achievement in English as life satisfaction and attendance at school.

With regard to CNI thresholds, it was found that pupils scoring over the 1.5 threshold had significantly higher English Attainment, although this was not repeated for Mathematics. Further, the 1.5 CNI level was found to be a significant marker across other measures, with those with a higher CNI having greater health, life satisfaction, pro-environmental behaviours and pro-nature behaviours.

## Implications

There has been limited research into children's connection to nature. The research presented above confirms that associations between well-being and a connection to nature found in adults can be found in children, while also highlighting specific educational benefits for children. This suggests that nature should be part of every child's life.

Embedding nature connection within our social norms is best started in childhood and the positive benefits to attainment provide evidence to support such an approach through school. Rather than frame nature as a resource and place for occasional outdoor learning, there is a need for a more embedded and nuanced approach to ensure greater connection to nature. Research suggests that this approach should ensure contact with nature that highlights the enjoyment and wonder of it, while recognising our place within the natural world in order to build empathy and a sense of responsibility for it (Cheng & Monroe, 2012).

Just as level of school attendance is recognised as key to educational attainment, the findings presented show that targets for a connection to nature can be set and bring about meaningful benefits to both human and nature's well-being. Wider research evidence with adults suggests that nature can provide a new paradigm for health and well-being.

As well as the broader benefits to children, understanding nature is important to learning in many core academic subjects. The research findings in this study should be built on to corroborate that nature should be placed at the heart of children's school education. Further research is also necessary to identify how else nature can best be brought into a child's life, in order to improve their connection to nature and achieve the associated benefits of well-being, educational attainment and pro-nature behaviours.

## References

- Barnosky, A. D., Matzke, N., Tomiya, S., Wogan, G. O. U., Swartz, B., Quental, T. B., Marshall, C., McGuire, J. L., Lindsey, E. L., Maguire, K. C., Mersey, B. & Ferrer, E. A. (2011). Has the Earth's sixth mass extinction already arrived? *Nature*, 471, 51–57 doi:10.1038/nature09678
- Bragg, R., Wood, C., Barton, J. and Pretty, J. (2013). Measuring connection to nature in children aged 8 - 12: A robust methodology for the RSPB. University of Essex.
- Capaldi C. A., Dopko R. L. and Zelenski J. M. (2014). The relationship between nature connectedness and happiness: a meta-analysis. *Frontiers in Psychology*, 5. doi: 10.3389/fpsyg.2014.00976
- Charles, C., & Wheeler, K. (2012). *Children & Nature Worldwide: An Exploration of Children's Experiences of the Outdoors and Nature with Associated Risks and Benefits*. Children and Nature Network and the IUCN's Commission on Education and Communication.
- Cheng, J. C. H., & Monroe, M. C. (2012). Connection to Nature Children's Affective Attitude Toward Nature. *Environment and Behavior*, 44(1), 31-49.
- Collado, S., & Corraliza, J. A. (2013). Children's Restorative Experiences and Self-Reported Environmental Behaviors. *Environment and Behavior*, 0013916513492417.
- Defra (Department for Environment, Food and Rural Affairs). (2011). *The natural choice: securing the value of nature* (Vol. 8082). The Stationery Office.
- Fjortoft, I. (2001). The natural environment as a playground for children: The impact of outdoor play activities in pre-primary school children. *Early childhood education journal*, 29(2), 111-117.
- Frantz, C. M. & Mayer, F. S. (2014). The importance of connection to nature in assessing environmental education programs. *Studies in Educational Evaluation*. Retrieved February 10, 2014 from <http://www.sciencedirect.com/science/article/pii/S0191491X13000436>
- Hartig, T., van den Berg, A., Hägerhäll, C., Tomalak, M., Bauer, N., Hansmann, R., Ojala, A., Syngollitou, E., Carrus, G., van Herzele, A., Bell, S., Camilleri Podesta, M. T., & Waaseth, G. (2011). Health benefits of nature experience: Psychological, social and cultural processes. In Nilsson, K., Sangster, M., Gallis, C., Hartig, T., De Vries, S., Seeland, K., & Schipperijn, J. (Eds.), *Forests, trees, and human health* (pp. 127-168). Dordrecht: Springer. doi:10.1007/978-90-481-9806-1

Howell, A. J., Dopko, R. L., Passmore, H. A., & Buro, K. (2011). Nature connectedness: Associations with well-being and mindfulness. *Personality and Individual Differences*, 51, 166-171. doi:10.1016/j.paid.2011.03.037

Huebner, E. S. (1991). Initial development of the student's life satisfaction scale. *School Psychology International*, 12(3), 231-240.

Mayer, F. S., Frantz, C. M., Bruehlman-Senecal, E., & Dolliver, K. (2009). Why is nature beneficial? The role of connectedness to nature. *Environment and Behavior*, 41, 607-643.

Miller, J. R. (2005). Biodiversity conservation and the extinction of experience. *Trends in ecology & evolution*, 20(8), 430-434.

Ostrove, J. M., Adler, N. E., Kuppermann, M., & Washington, A. E. (2000). Objective and subjective assessments of socioeconomic status and their relationship to self-rated health in an ethnically diverse sample of pregnant women. *Health Psychology*, 19(6), 613.

RSPB. (2013a). Connecting with Nature. RSPB. Available online at: [http://www.rspb.org.uk/Images/connecting-with-nature\\_tcm9-354603.pdf](http://www.rspb.org.uk/Images/connecting-with-nature_tcm9-354603.pdf)

RSPB. (2013b). State of Nature. Available online at: [https://www.rspb.org.uk/Images/stateofnature\\_tcm9-345839.pdf](https://www.rspb.org.uk/Images/stateofnature_tcm9-345839.pdf)

Tinsley, H. E., & Tinsley, D. J. (1987). Uses of factor analysis in counseling psychology research. *Journal of Counseling Psychology*, 34(4), 414.

## Acknowledgements

We would like to thank all the schools and children who took part in the research.

## Appendix A Pro-environmental and pro-nature measures

### Children's Pro-environmental Behaviours (Collado et al., 2013)

1. I carry out activities to protect the environment
2. To save water, I use less water when I take a shower or bath
3. In school, I talk to my teachers and peers about the importance of doing things to protect the environment (e.g. recycling)
4. At home I help to separate (rubbish) and to recycle
5. To save energy I switch off the electrical appliances when I am not using them

Responses on a five-point completely agree to completely disagree scale.

### Children's Pro-nature Behaviours

We are interested in finding out about the kinds of things you do to help look after nature. Example: If you spend time collecting fallen leaves you would tick the "Yes I do this" box.

	Yes, I do this	No, I don't do this
I spend time collecting fallen leaves	✓	

Please tell us if you do any of the following activities by ticking the appropriate box.

1. I put food out to feed garden birds
2. I make homes for nature at school or in the garden (e.g. bugs, hedgehogs)
3. I put insects stuck inside, safely outside
4. I grow flowers and plants that birds and insects will like
5. I take part in events to help nature (e.g. Big Garden Bird Watch)
6. I pick up litter to help nature have a better home
7. I am a member of a wildlife or nature group at school
8. I am a member of a wildlife or nature group outside of school (e.g. RSPB, Wildlife Trust etc.)



## Appendix B Correlation and P-Value Matrix

	CNI	CNI - Enjoy	CNI - Empathy	CNI - Oneness	CNI - Responsibility	Pro-env Behaviour	Nature Behaviours	Life Satisfaction	Health	Days Outdoors	Days in Nature	English	Maths
CNI	1	.924** .000	.773** .000	.736** .000	.710** .000	.601** .000	.589** .000	.140** .000	.094** .010	.168** .000	.301** .000	.027** .456	.001** .983
CNI - Enjoy	.924** .000	1	.579** .000	.632** .000	.509** .000	.587** .000	.611** .000	.133** .000	.123** .001	.174** .000	.272** .000	.031** .388	-.004** .905
CNI - Empathy	.773** .000	.579** .000	1	.557** .000	.472** .000	.379** .000	.372** .000	.071** .049	.019** .597	.120** .001	.284** .000	.000** .990	.006** .867
CNI - Oneness	.736** .000	.632** .000	.557** .000	1	.391** .000	.470** .000	.356** .000	.147** .000	.070** .054	.171** .000	.234** .000	.014** .690	.019** .598
CNI - Responsibility	.710** .000	.509** .000	.472** .000	.391** .000	1	.425** .000	.395** .000	.088** .014	.035** .333	.044** .220	.152** .000	.030** .412	-.014** .697
Pro-environmental Behaviour	.601** .000	.587** .000	.379** .000	.470** .000	.425** .000	1	.555** .000	.117** .001	.114** .002	.156** .000	.282** .000	-.011** .760	.021** .556
Pro-nature Behaviours	.589** .000	.611** .000	.372** .000	.356** .000	.395** .000	.555** .000	1	.073** .043	.143** .000	.170** .000	.249** .000	-.070** .051	-.060** .098
Life Satisfaction	.140** .000	.133** .000	.071** .049	.147** .000	.088** .014	.117** .001	.073** .043	1	.260** .000	.072** .045	.045** .211	.114** .001	.087** .016
Health	.094** .010	.123** .001	.019** .597	.070** .054	.035** .333	.114** .002	.143** .000	.260** .000	1	.141** .000	.111** .002	.002** .963	.057** .115
Days Outdoors	.168** .000	.174** .000	.120** .001	.171** .000	.044** .220	.156** .000	.170** .000	.072** .045	.141** .000	1	.445** .000	.040** .268	.058** .109
Days in Nature	.301** .000	.272** .000	.284** .000	.234** .000	.152** .000	.282** .000	.249** .000	.045** .211	.111** .002	.445** .000	1	.025** .493	.068** .059
English	.027** .456	.031** .388	.000** .990	.014** .690	.030** .412	-.011** .760	-.070** .051	.114** .001	.002** .963	.040** .268	.025** .493	1	.632** .000
Maths	.001** .983	-.004** .905	.006** .867	.019** .598	-.014** .697	.021** .556	-.060** .098	.087** .016	.057** .115	.058** .109	.068** .059	.632** .000	1
Attendance	-.080** .026	-.072** .044	-.093** .010	-.125** .000	.005** .898	-.063** .078	-.031** .385	.036** .311	.030** .404	.007** .852	-.096** .008	.183** .000	.221** .000

\*\* . Correlation is significant at the 0.01 level (2-tailed). \* . Correlation is significant at the 0.05 level (2-tailed).