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Empathy mediates the relationship between nature connectedness and both callous and uncaring traits

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Nature connectedness and callous/uncaring traits

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25 **SEARCH WORDS**

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27 psychopathy

28

29 **ABSTRACT**

30 Across the world and time, humans share an innate affinity with nature. In addition to its
31 benefits for mental well-being, the psychological construct of nature connectedness has
32 been associated with several psychopathy-relevant traits including agreeableness,
33 perspective-taking, and empathic concern. This study is the first of its kind to investigate
34 whether nature connectedness is associated with indices of psychopathy, specifically, and
35 whether these associations are further mediated by individual variation in cognitive and
36 affective empathy; traits long-considered to be deficient in psychopathy. One hundred and
37 ninety-five participants completed an online survey whereby they were asked to self-report
38 nature connectedness, empathy, and callous, uncaring, and unemotional traits - proxy
39 measures for the affective component of psychopathy in community samples. Nature
40 connectedness was positively associated with cognitive and affective empathy, and
41 inversely associated with callous and uncaring, but not unemotional facets of personality.
42 Furthermore, whereas cognitive empathy mediated the relationship between nature
43 connectedness and both callous and uncaring traits, affective empathy only mediated the
44 relationship between nature connectedness and callous traits. These findings provide
45 evidence that broadens our understanding of the potential benefits of nature
46 connectedness in general, and how subsequently increasing one's nature connectedness
47 and associated ability to take the perspective of another might impact psychopathy, more
48 specifically. As such, this study establishes the groundwork for future investigation and
49 intervention in forensic populations.

50

1. INTRODUCTION

In an age where fast-paced, modern lifestyles contribute to a reduction in the time children and adults spend outdoors (Bratman, Hamilton, & Daily, 2012; Clements, 2004; MacKerron & Mourato, 2013), our innate need for connection with the natural world (Wilson, 1984) is becoming increasingly strained (Nisbet & Zelenski, 2013a). Exposure to nature is associated with a range of health benefits (see Sandifer, Sutton-Grier, & Ward, 2015 for a review), and so it is unsurprising that emerging research in this field has sought to promote engagement with nature through evidencing its relationship to psychological well-being (Nisbet & Zelenski, 2013a).

Often discussed using terms such as connectedness to nature (Mayer & Frantz, 2004), relatedness to nature (Nisbet, Zelenski, & Murphy, 2009), and inclusion of nature in oneself (Schultz, 2001), nature connectedness represents an underlying trait thought to encapsulate individual variation in the way in which people cognitively and affectively construct their interconnectedness with the natural world (Capaldi, Dopko, & Zelenski, 2014; Nisbet et al., 2009; Schultz, 2002). Nature connectedness is thought to vary along a continuum (Mayer & Frantz, 2004), and although considered stable across time (Nisbet et al., 2009), has proved malleable through intervention (Richardson, Cormack, McRobert, & Underhill, 2016; Richardson & Sheffield, 2017).

Nature connectedness is emerging as an independent predictor of well-being, with a range of benefits related to feeling good and functioning well, such as vitality (Kaplan, 1995; Ryan et al., 2010), happiness (Capaldi et al., 2014; MacKerron & Mourato, 2013), improved body image (Swami, Barron, Weis, & Furnham, 2016), and reduced anxiety (Martyn & Brymer,

2016); but see Richardson et al. (2017) for a review. Moreover, nature connectedness has been positively associated with agreeableness, perspective-taking, and empathic concern (Zhang, Piff, Iyer, Koleva, & Keltner, 2014); a series of traits arguably deficient in the developmental disorder, psychopathy (Lynam & Derefinko, 2006). This indicates that the natural environment, and human connection to it, may have relevance to the development and/or potential treatment of psychopathy – an area not previously considered.

Psychopathy is thought to manifest in less than 1% of the population (Hare, 2003), which, nevertheless places a substantial economic and emotional burden on society (Anderson & Kiehl, 2012; DeLisi, Reidy, Heirigs, Tostlbe, & Vaughn, 2018). In the general population, psychopathy-related deficits in interpersonal, affective, and behavioural facets of personality are widely acknowledged (Dawel, O'Kearney, McKone, & Palermo, 2012). In particular, the interpersonal and affective components can be indexed on a continuum through variation in callous, uncaring, and unemotional (CU) traits (Frick, 2004). Whereas callous and uncaring traits are related to the interpersonal facet of psychopathy, as depicted by a lack of guilt, remorse, and empathic concern for others (Byrd, Kahn, & Pardini, 2013), unemotional traits are related to the affective facet of psychopathy, which encompasses shallow affect and sensation-seeking (Kimonis, Cross, Howard, & Donoghue, 2013). Together, CU traits impact peer relationships (Viding & McCrory, 2012), and predict severe expressions of aggression and antisocial behaviour (Frick & White, 2008; Porter & Woodworth, 2006; Waller et al., 2016).

In general, individuals who score high on callous and uncaring, more so than unemotional traits, are characterised by pervasive deficits in empathy (Hodsoll, Lavie, & Viding, 2014,

White, Gordon, & Guerra, 2015). Empathy is broadly defined as the understanding and sharing of another's emotional experience (Decety & Lamm, 2009; Pasalich, Dadds, & Hawes, 2014) and is typically discussed in the context of cognitive and affective dimensions (Davis, 1983; Decety, 2011). Whereas cognitive empathy refers to an understanding of, and the ability to predict the emotional state of another through perspective-taking, affective empathy refers to the vicarious sharing of another's emotional responses (Reniers, Corcoran, Drake, Shryane, & Völlm, 2011).

Deficits in empathy are robustly associated with higher levels of CU traits (Muñoz, Qualtar, & Padgett, 2011; Pardini, Lochman, & Frick, 2003). However, although this finding is consistently true for affective empathy, the relationship between CU traits and cognitive empathy is only present in some (Anastassiou-Hadjicharalambous, & Warden, 2008; Dadds et al., 2009; Murphy et al., 2018; Pasalich et al., 2014), but not all (Jones, Happé, Gilbert, Burnett, & Viding, 2010; Schwenck et al., 2012; Waller et al., 2016) investigations. Samples in which deficits in cognitive empathy have been found include children with conduct disorder displaying low, but not high levels of CU traits (Anastassiou-Hadjicharalambous & Warden, 2008) and children before, but not after puberty (Dadds et al., 2009; Pasalich et al., 2014). Because social manipulation relies upon the ability to understand, though not necessarily feel the emotions of others, it follows that intact cognitive empathy may benefit psychopathy. Given the purported capacity for individuals to learn and develop empathy (Cozolino, 2010; Dadds et al., 2009), it remains to be seen whether alterations in one's empathic response further mediates empathy-related (e.g., CU) traits.

Although psychopaths have previously been reported to show a preference for inner-city relative to rural, living (Jonason, 2018), this is the first study to investigate associations between nature connectedness and psychopathy-related personality traits. Thus, the current study contributes knowledge to this field and makes a unique contribution to environmental psychology by exploring the relationships between self-perceived connection with nature and callous, uncaring, and unemotional traits within the general population. Nature connectedness was hypothesised to inversely associate with callous and uncaring, but not unemotional traits, and positively associate with both cognitive and affective empathy. We also consider cognitive and affective empathy as potential mediators of associations between nature connectedness and CU traits. As such, it was further hypothesised that affective, but not cognitive empathy, would mediate the relationships between nature connectedness and CU traits.

2. METHODS

2.1. Participants

To determine our target sample size, we conducted an a priori power analysis using G*Power (version 3.1.9.2). Assuming an anticipated medium effect size ($f^2 = 0.15$) and a standard alpha level of .05, a minimum of 129 participants were required to have 95% power in our planned analyses. One-hundred and ninety-five participants (aged 34.85 ± 10.46 years, 28.2% male) provided written informed consent after responding to an online advertisement. All participants were fluent in English, aged between 18-55 years, and were predominantly (95.4%) of UK nationality. Further, all participants were without current diagnosis of psychiatric or neurological disorder, and without any criminal convictions.

2.2. Procedure and Materials

This research was approved by a central university research ethics committee. Participants reported demographic information and completed an online battery of questionnaires comprising: The Nature Relatedness Scale (NRS6; Nisbet & Zelenski, 2013b), the Inventory of Callous-Unemotional Traits (ICU; Frick, 2004), and the Questionnaire of Cognitive and Affective Empathy (QCAE; Reniers et al., 2011). In total, the questionnaires took less than 15 minutes to complete.

The NRS6 comprises 6 items that measure one's connectedness to nature using a 5-point scale (e.g., "I always think about how my actions affect the environment"), with responses ranging from "Disagree Strongly" to "Agree Strongly" (Cronbach's $\alpha = .84$). The ICU comprises 24 items that assess the occurrence and intensity of CU traits using a 4-point scale from "Not at all True" to "Definitely True". Callousness (e.g., "I do not care who I hurt to get what I want"; $\alpha = .55$), uncaring (e.g., "I try not to hurt others' feelings [reverse scored]"; $\alpha = .73$), and unemotional (e.g., "I hide my feelings from others"; $\alpha = .84$) subscales of the ICU are reported in this study. The QCAE comprises 31 items that measure cognitive (e.g., "I can tell if someone is masking their true emotion"; $\alpha = .92$) and affective (e.g., "I often get emotionally involved with my friends' problems"; $\alpha = .85$) empathy using a 4-point scale from "Strongly Disagree" to "Strongly Agree". Higher scores on these measures are related to greater connectivity with nature, CU traits, and cognitive and affective empathy, respectively. Cronbach's α scores are derived from this dataset.

2.3. Statistical Analysis

Pearson correlations were computed between the predictor variable (nature connectedness), the predicted variables (callousness, uncaring, and unemotional traits), and the mediator variables (cognitive and affective empathy). To determine whether there were any indirect effects of nature connectedness on CU traits, through cognitive and affective empathy, the PROCESS procedure was used to test parallel multiple mediation models (Hayes, 2013, model type 4).

3. RESULTS

Means, standard deviations, and bivariate correlations for nature connectedness, CU traits, and cognitive and affective empathy are displayed in Table 1.

Table 1. Intercorrelations, means, and standard deviations for psychometric measures

	M	SD	1	2	3	4	5	6
1 Nature Connectedness	3.69	0.89	-					
2 Callousness	4.96	3.17	-.16*	-				
3 Uncaring	6.20	3.56	-.22**	.30***	-			
4 Unemotional	6.83	3.55	-.12	.30***	.31***	-		
5 Cognitive Empathy	59.32	9.57	.24***	-.35***	-.35***	-.37***	-	
6 Affective Empathy	34.85	6.44	.24***	-.35***	-.25***	-.39***	.46***	-

* $p < .05$, ** $p < .01$, *** $p < .001$

3.1. Effects of nature connectedness on callous-unemotional traits through empathy

Nature connectedness showed significant negative relationships with callous (Beta = -.16, $SE = .08$, $p = .04$) and uncaring (Beta = -.22, $SE = .07$, $p = .001$), but not unemotional (Beta = -.16, $SE = .07$, $p = .08$) traits, and significant positive relationships with both cognitive (Beta =

.24, $SE = .07$, $p = .002$) and affective (Beta = .24, $SE = .07$, $p = .002$) scores of empathy. These findings indicate that individuals who are more connected to nature report lower callous and uncaring traits and higher degrees of cognitive and effective empathy.

In model 1 (see Figure 1.), cognitive (Beta = -.24, $SE = .07$, $p = .002$) and affective empathy (Beta = -.23, $SE = .07$, $p = .001$) was significantly associated with lower scores of callous traits, with the direct relationship between nature connectedness and callous traits rendered no longer significant (Beta = -.05, $SE = .07$, $p = .54$). This finding suggests mediation by both cognitive and affective empathy (see Table 2.). Assessing the significance of the indirect pathways, even though their independence could not be specified (Beta < -.01, $SE = .04$, 95% BcA CI = [-.07, .07]), the negative associations between callous traits and both cognitive (Beta = -.06, $SE = .03$, 95% BcA CI = [-.12, -.02]) and affective empathy (Beta = -.05, $SE = .02$, 95% BcA CI = [-.11, -.02]) were significant (5,000 bootstrap resamples).

In model 2 (see Figure 2.), cognitive (Beta = $-.28$, $SE = .10$, $p < .01$), but not affective (Beta = $-.10$, $SE = .07$, $p = .19$), empathy, was significantly associated with lower scores of uncaring traits, with the direct relationship between nature connectedness and uncaring traits no longer significant (Beta = $-.13$, $SE = .06$, $p = .52$). This finding suggests the association between nature connectedness and uncaring traits was mediated by cognitive empathy (see Table 2.). When assessing the significance of the indirect pathway, the negative association between uncaring traits and cognitive empathy (Beta = $-.07$, $SE = .03$, 95% BcA CI = $[-.14, -.02]$) was significant (5,000 bootstrap resamples).

[TABLE 2 HERE – Requires horizontal page spread]

4. DISCUSSION

For the first time, this investigation has provided initial insight into the relationship between nature connectedness and psychopathy-related (e.g., CU) traits in the general population.

Our hypotheses regarding links between nature connectedness and CU traits were supported. In line with predictions, a greater connectedness with nature was associated with lower scores on callous and uncaring, but not unemotional traits. Furthermore, nature connectedness was positively associated with higher scores on measures of both cognitive and affective empathy. However, results of the mediation analyses were largely unexpected. Whereas cognitive empathy mediated relationships between nature connectedness and both callous and uncaring traits, affective empathy only mediated the former association.

Callous and uncaring traits lend themselves to the interpersonal dimension of psychopathy, and as such are associated with manipulative behaviours and a lack of guilt, remorse, and concern for others (Byrd et al., 2013). Recently, individuals scoring high on a measure of psychopathy have reported a preference for inner-city, relative to rural, living (Jonasen, 2018). Although no measure of connectedness to nature was taken in that study, said findings likely represents the psychopath's attraction to residing in areas that suit their need for an exciting and fast-paced lifestyle (Jonason, Koenig, & Tost, 2010) as well as the provision of ample opportunity to mate, exploit, and mask their amoral and antisocial behaviour (Jonasen, 2018; Jonason, Foster, McCain, & Campbell, 2015; Jonason & Webster, 2012). It logically follows that individuals scoring high on psychopathy-related traits have a reduced connection with nature, which they may perceive as being boring and detrimental to obtaining exploitative social opportunities (Jonason, 2018). These findings align well with

previous investigations denoting associations between nature connectedness and several psychopathy-relevant traits including agreeableness, perspective-taking, and empathic concern (Berenguer, 2007; 2010; Schultz, 2000; Zhang et al., 2014). The lack of an association between nature connectedness and unemotional traits in the current investigation was not surprising, and likely indicates further delinquency-related disparity between the unemotional, and callous and uncaring subscales of the ICU (Byrd et al., 2013).

As expected, the inverse relationships between nature connectedness and callous and uncaring traits were mediated by higher self-reported empathy. Previously, increasing one's connection with nature has been associated with pro-social behaviour (Zhang et al., 2014) and increased empathic concern for the biosphere, as well as creatures within it (Berenguer, 2007; 2010; Schultz, 2000; Shelton & Rogers, 1981). However, with previous investigations predominantly relating exposure to nature with increases in nature-directed empathy, this investigation suggests comparable relationships between nature connectedness and human-directed empathy, or at least an underlying concept connecting the two.

Within the current literature, there exists some contradiction as to whether deficits in cognitive empathy do (Anastassiou-Hadjicharalambous, & Warden, 2008; Dadds et al., 2009; Murphy et al., 2018; Pasalich et al., 2014) or do not (Jones et al., 2010; Schwenck et al., 2012; Waller et al., 2016) predict CU traits. Conceptually, intact cognitive empathy is necessary for manipulating others; a key characteristic of psychopathy (Hare, 2003), yet, results of this investigation evidenced inverse relationships between all three CU traits and both cognitive and affective dimensions of empathy. Regarding our mediation analyses, cognitive empathy mediated associations between nature connectedness and both callous

and uncaring traits. These results are likely explained by previously-identified associations between nature connectedness and perspective-taking (Zhang et al., 2014). The ability to understand the perspective of another is key for demonstrating cognitive empathy (Reniers et al., 2011), and as such, it is possible that individuals with greater levels of cognitive empathy are able to demonstrate greater care for others, as well as concern for the impact of their own behaviour – especially in non-forensic samples such as the one described in this study. Elsewhere, perspective-taking has been identified as a core mediator between callous and uncaring traits, and reactive aggression (White et al., 2015); a behavioural facet of psychopathy (Hare, 2003).

Interestingly, whereas deficits in affective empathy are thought to underpin the presence of CU traits (Blair, 2013), affective empathy in this investigation was only found to mediate the relationship between nature connectedness and callousness. Although affective empathy was inversely associated with CU traits through bivariate correlations, its absence of mediation in the relationship between nature connectedness and uncaring traits might be a function of the self-report measure of empathy used. A recent review by Murphy et al. (2018) suggests conceptual disparity between the QCAE used in this investigation and alternative measures of affective empathy such as the Interpersonal Reactivity Index (IRI; Davis, 1983) and the Affective and Cognitive Measure of Empathy (ACME; Vachon & Lynam, 2016). Specifically, the QCAE conceptualises affective empathy in the absence of compassion and empathic concern, and so posits that in order to emotionally resonate with another, one's emotional response must only be interpersonally appropriate, and not similar in form. Therefore, the absence of affective empathy-driven mediation between

nature connectedness and uncaring traits might result from conflicting conceptualisations of affective empathy, and so requires further investigation – potentially using alternate means.

4.1. Limitations

Limitations of this research and associated future avenues of investigation are discussed below. First, this study relied solely on self-reports of personality traits, some of which (e.g., CU traits) are not considered to be socially desirable, and all of which were measured using only a single measure. Therefore, there is need to replicate these findings across comparable measures and populations, as well as to explore alternative means of capturing responses. Examples of which might involve the use of vignettes to assess empathic ability (see Sethi, O’Nions, McCrory, Bird, & Viding, 2018) and implicit association tasks to index nature connectedness (see Schultz, Shriver, Tabanico, & Khazian, 2004). Moreover, we cannot rule out that connectedness in general, not nature connectedness specifically, is the driving force underpinning these associations, and so this should be controlled for in the future. Second, although good internal consistency (.70) for the callous subscale has been reported in a comparable sample elsewhere (Byrd et al., 2013), the Cronbach α reported in this investigation was reasonably low (.55). Therefore, interpretations of these results should be made with caution. Third, this investigation focused entirely on CU traits; a proxy measure for subclinical psychopathy. Psychopathy, though a distinct construct, overlaps with other non-pathological personalities such as Machiavellianism (i.e., a willingness to manipulate others to achieve one’s own goals) and narcissism (i.e., a grandiose view of oneself); together referred to as the Dark Triad (Paulhus & Williams, 2002). Such traits have recently been shown to be higher in individuals favoring inner-city, relative to rural, living (Jonason, 2018) and as such represent a logical future step for investigation in relation to

nature connectedness. Fourth, because of an unexpected disparity in the quantity of male and female responders, it was not possible to explore sex differences within this study, and as such generalisability of these findings are limited. This is an important consideration for future investigation as males typically report greater levels of psychopathic traits than females both in general, and using the ICU, specifically (Kimonis, Branch, Hagman, Graham, & Miller, 2013). Fifth, the authors acknowledge that although statistically significant and supported by a sufficient sample size, correlation coefficients between nature connectedness and other psychological traits were relatively low. Finally, causal relationships cannot be derived from this data. It remains to be seen whether reduced nature connectedness contributes to the development of atypical interpersonal and affective functioning, or whether psychopathy-related traits help reduce interconnectedness with nature. Despite these limitations, this study contributes to this emerging area of research, and provides compelling evidence to suggest a role of nature connectedness in mediating deviant personality.

5. CONCLUSION

This study is the first investigation into the relationship between nature connectedness and psychopathy-related personality. The key finding of this research is that in addition to its benefits for general physical and mental wellbeing, an increased connection to nature is inversely related to callous and uncaring, but not unemotional traits. Thus, if future research can identify a causal link between said traits, increasing nature connectedness through an intervention (e.g., the Three Good Things Nature Intervention; Richardson & Sheffield, 2017), may provide a cost- and resource-efficient means of protecting against the manifestation of costly psychopathy-related behaviour. As such, the impact of this field of

study is potentially far-reaching and could provide the basis for national and international policy changes. However, for now, the present study adds to academic knowledge and the growing body of evidence suggesting that nature connectedness is a desirable population trait with potential for societal impact.

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REFERENCES

- Anastassiou-Hadjicharalambous, X., & Warden, D. A. (2008) Physiologically-indexed and self-perceived affective empathy in conduct-disordered children high and low on callous-unemotional traits. *Child Psychiatry and Human Development*, 39(4), 503-517.
- Anderson, N. E., & Kiehl, K. A. (2012). The psychopath magnetized: Insights from brain imaging. *Trends in Cognitive Sciences*, 16(1), 52-60.
- Berenguer, J. (2007). The effect of empathy in proenvironmental attitudes and behaviors. *Environment and Behavior*, 39, 269-283.
- Berenguer, J. (2010). The effect of empathy in environmental moral reasoning. *Environment and Behavior*, 42, 110-134.
- Blair, R. J. R. (2013). Psychopathy: Cognitive and neural dysfunction. *Dialogues in Clinical Neuroscience*, 15(2), 181–190.
- Bratman, G. N., Hamilton, J. P., & Daily, G. C. (2012). The impacts of nature experience on human cognitive function and mental health. *Annals of the New York Academy of Sciences*, 1249, 118-136.
- Byrd, A. L., Kahn, R. E., & Pardini, D. A. (2013). A validation of the inventory of callous–unemotional traits in a community sample of young adult males. *Journal of Psychopathology and Behavioral Assessment*, 35, 20–34.
- Capaldi, C. A., Dopko, R. L., & Zelenski, J. M. (2014). The relationship between nature connectedness and happiness: A meta-analysis. *Frontiers in Psychology*, 5, 976.
- Clements, R. (2004). An investigation of the status of outdoor play. *Contemporary Issues in Early Childhood*, 5, 68–80.
- Cozolino, L. (2010). *The neuroscience of psychotherapy: Healing the social brain*. New York: W. W. Norton & Company.

370 Dadds, M. R., Hawes, D. J., Frost, A. D., Vassallo, S., Bunn, P., Hunter, K., & Merz, S. (2009).
 371 Learning to 'talk the talk': the relationship of psychopathic traits to deficits in empathy
 372 across childhood. *Journal of Child Psychology and Psychiatry*, 50(5), 599-606.

373 Davis, M. H. (1983). Measuring individual differences in empathy: Evidence for a
 374 multidimensional approach. *Journal of Personality and Social Psychology*, 44, 113-126.

375 Dawel, A., O'Kearney, R., McKone, E., & Palermo, R. (2012). Not just fear and sadness: Meta-
 376 analytic evidence of pervasive emotion recognition deficits for facial and vocal
 377 expressions in psychopathy. *Neuroscience and Biobehavioral Reviews*, 36, 2288–2304.

378 Decety, J. (2011). The neuroevolution of empathy. *Annals of the New York Academy of*
 379 *Sciences*, 1231, 35-45.

380 Decety, J., & Lamm, C. (2009). Empathy versus personal distress—Recent evidence from
 381 social neuroscience. In J. Decety & W. Ickes (Eds.), *The Social Neuroscience of Empathy*
 382 (pp. 199–213). MIT Press, Cambridge.

383 DeLisi, M., Reidy, D. E., Heirigs, M., H., Tostlebe, J. J., & Vaughn, M. G. (2018). Psychopathic
 384 costs: a monetization study of the fiscal toll of psychopathy features among
 385 institutionalized delinquents. *Journal of Criminal Psychology*, 8(2), 112-124.

386 Frick, P. J. (2004). *The Inventory of Callous–Unemotional Traits* (Unpublished rating scale).
 387 University of New Orleans, New Orleans, LA.

388 Frick, P.J., & White, S.F. (2008). Research Review: The importance of callous unemotional
 389 traits for developmental models of aggressive and antisocial behaviour. *Journal of*
 390 *Child Psychology & Psychiatry*, 49, 359–375.

391 Hare, R. D. (2003). *Hare psychopathy checklist-revised (PCL-R): Second edition, technical*
 392 *manual*. Toronto, Canada: Multi-Health Systems.

393 Hayes, A. F. (2013). *Methodology in the social sciences. Introduction to mediation,*
 394 *moderation, and conditional process analysis: A regression-based approach.* New York,
 395 NY, US: Guilford Press.

396 Hodsoll, S., Lavie, N., & Viding, E. (2014). Emotional attentional capture in children with
 397 conduct problems: the role of callous-unemotional traits. *Frontiers in Human*
 398 *Neuroscience, 8*, 1–7.

399 Jonason, P. K. (2018). Bright lights, big city: The Dark triad traits and geographical
 400 preference. *Personality and Individual Differences, 132*, 66–73.

401 Jonason, P. K., Foster, J. D., McCain, J., & Campbell, W. K. (2015). Where birds flock to get
 402 together: The who, what, where, and why of mate searching. *Personality and*
 403 *Individual Differences, 80*, 76–84.

404 Jonason, P. K., Koenig, B., & Tost, J. (2010). Living a fast life: The Dark Triad and Life History
 405 Theory. *Human Nature, 21*, 428–442.

406 Jonason, P. K., & Webster, G. D. (2010). The Dirty Dozen: A concise measure of the Dark
 407 Triad. *Psychological Assessment, 22*, 420–432.

408 Jones, A. P., Happé, F. G., Gilbert, F., Burnett, S., & Viding, E. (2010). Feeling, caring,
 409 knowing: different types of empathy deficits in boys with psychopathic tendencies and
 410 autism spectrum disorder. *Journal of Child Psychology and Psychiatry, 51*(11), 1188–
 411 1197.

412 Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative frame-work.
 413 *Journal of Environmental Psychology, 15*(3), 169–182.

414 Kimonis, E., Branch, J., Hagman, B., Graham, N., & Miller, C. (2013). The psychometric
 415 properties of the inventory of callous–unemotional traits in an undergraduate sample.
 416 *Psychological Assessment, 25*(1), 84–93.

417 Kimonis, E. R., Cross, B., Howard, A., & Donoghue, K. (2013). Maternal care, maltreatment
 418 and callous-unemotional traits among urban male juvenile offenders. *Journal of Youth*
 419 *and Adolescence*, 42, 165-177.

420 Lynam, D. R., & Derefinko, K. J. (2006). Psychopathy and personality. In C. J. Patrick (Ed.),
 421 *Handbook of psychopathy* (pp. 133–155). New York: Guilford Press.

422 MacKerron, G., & Mourato, S. (2013). Happiness is greater in natural environments. *Global*
 423 *Environmental Change*, 23, 992–1000.

424 Martyn, P., & Brymer, E. (2016). The relationship between nature relatedness and
 425 anxiety. *Journal of health psychology*, 21(7), 1436-1445.

426 Mayer, F. S., & Frantz, C. M. (2004). The connectedness to nature scale: A measure of
 427 individuals' feeling in community with nature. *Journal of Environmental Psychology*,
 428 24(4), 503-515.

429 Muñoz, L. C., Qualter, P., & Padgett, G. (2011). Empathy and bullying: Exploring the
 430 influence of callous–unemotional traits. *Child Psychiatry and Human Development*, 42,
 431 183–196.

432 Murphy, B. A., Costello, T. H., Watts, A. L., Cheong, Y. F., Berg, J. M., & Lillienfeld, S. O.
 433 (2018). Strengths and weaknesses of two empathy measures: A comparison of the
 434 measurement precision, construct validity, and incremental validity of two
 435 multidimensional indices. *Assessment*. Manuscript submitted for publication.

436 Nisbet, E. K., & Zelenski, J. M. (2013a). Underestimating nearby nature: Affective forecasting
 437 errors obscure the happy path to sustainability. *Psychological Science*, 22(9), 1101-
 438 1106.

439 Nisbet, E. K., & Zelenski, J. M. (2013b). The NR06: a new brief measure of nature
 440 relatedness. *Frontiers in Psychology*, 4, 813.

441 Nisbet, E. K. L., Zelenski, J. M., and Murphy, S. A. (2009). The nature relatedness scale:
 442 linking individuals' connection with nature to environmental concern and behavior.
 443 *Environmental Behavior*, 41, 715–740.

444 Pardini, D. A., Lochman, J. E., & Frick, P. J. (2003). Callous/unemotional traits and social-
 445 cognitive processes in adjudicated youths. *Journal of the American Academy of Child &*
 446 *Adolescent Psychiatry*, 42, 364–371.

447 Pasalich, D. S., Dadds, M. R., & Hawes, D. J. (2014). Cognitive and affective empathy in
 448 children with conduct problems: Additive and interactive effects of callous-
 449 unemotional traits and autism spectrum disorders symptoms. *Psychiatry Research*,
 450 219(3), 625–630.

451 Paulhus, D. L., & Williams, K. M. (2002). The Dark Triad of personality: Narcissism,
 452 Machiavellianism, and psychopathy. *Journal of Research in Personality*, 36(6), 556-563.

453 Porter, S., & Woodworth, M. (2006). Psychopathy and aggression. In C. J. Patrick (Ed.),
 454 *Handbook of psychopathy* (pp. 481–494). New York: Guilford Press.

455 Reniers, R. L. E. P., Corcoran, R., Drake, R., Shryane, N. M., & Völlm, B. A. (2011). The QCAE:
 456 A questionnaire of cognitive and affective empathy. *Journal of Personality Assessment*,
 457 93, 84–95.

458 Richardson, M., Cormack, A., McRobert, L. & Underhill, R. (2016). 30 Days Wild:
 459 Development and Evaluation of a Large-Scale Nature Engagement Campaign to
 460 Improve Well-Being. *PLoS ONE*, 11(2), e0149777.

461 Richardson, M., Maspero, M., Golightly, D., Sheffield, D., Staples, V. & Lumber, R. (2017).
 462 Nature: A new paradigm for wellbeing and ergonomics. *Ergonomics*, 60(2).

463 Richardson, M., & Sheffield, D. (2017). Three good things in nature: noticing nearby nature
 464 brings sustained increases in connection with nature. *Psychology*, 8(1), 1-32.

465 Ryan, R. M., Weinstein, N., Bernstein, J., Brown, K. W., Mistretta, L., & Gagné, M. (2010).
 466 Vitalizing effects of being outdoors and in nature. *Journal of Environmental*
 467 *Psychology, 30*, 159–168.

468 Sandifer, P. A., Sutton-Grier, A. E., & Ward, B. P. (2015). Exploring connections among
 469 nature, biodiversity, ecosystem services, and human health and well-being:
 470 Opportunities to enhance health and biodiversity conservation. *Ecosystem*
 471 *Services, 12*, 1-15.

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

474 Schultz, P. W. (2001). Assessing the structure of environmental concern: Concern for the
 475 self, other people, and the biosphere. *Journal of Environmental Psychology, 21*, 327–
 476 339.

477 Schultz, P. W. (2002). Inclusion with nature: The psychology of human-nature relations. In P.
 478 Schmuck, & W. P. Schultz (Eds.), *Psychology of sustainable development* (pp. 61-78).
 479 Dordrecht: Kluwer Academic Publishers.

480 Schultz, P. W., Shriver, C., Tabanico, J. J., & Khazian, A. M. (2004). Implicit connections with
 481 nature. *Journal of Environmental Psychology, 24*(1), 31-42.

482 Schwenck, C., Mergenthaler, J., Keller, K., Zech, J., Salehi, S., Taurines, R., ... Freitag, C. M.
 483 (2012). Empathy in children with autism and conduct disorder: group-specific profiles
 484 and developmental aspects. *The Journal of Child Psychology and Psychiatry, 53*(6),
 485 651-659.

486 Sethi, A., O’Nions, E., McCrory, E., Bird, G., & Viding, E. (2018). An fMRI investigation of
 487 empathic processing in boys with conduct problems and varying levels of callous-
 488 unemotional traits. *NeuroImage: Clinical, 18*, 298-304.

489 Shelton, M. L., & Rogers, R. W. (1981). Fear-arousing and empathy-arousing appeals to help:
 490 The pathos of persuasion. *Journal of Applied Social Psychology*, 11(4), 366-378.
 491 Sobel, D. (1996). *Beyond Ecophobia: Reclaiming the Heart of Nature Education*. Great
 492 Barrington, MA: The Orion Society.
 493 Swami, V., Barron, D., Weis, L., & Furnham, A. (2016). Bodies in nature: Associations
 494 between exposure to nature, connectedness to nature, and body image in US
 495 adults. *Body Image*, 18, 153-161.
 496 Tam, K. (2013). Dispositional empathy with nature. *Journal of Environmental Psychology*, 35,
 497 92–104.
 498 Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A., & Zelson, M. (1991). Stress
 499 recovery during exposure to natural and urban environments. *Journal of*
 500 *Environmental Psychology*, 11, 201-230.
 501 Vachon, D. D., & Lynam, D. R. (2016). Fixing the problem with empathy. *Assessment*, 23(2),
 502 135-149.
 503 Viding, E., & McCrory, E. J. (2012). Genetic and neurocognitive contributions to the
 504 development of psychopathy. *Development and Psychopathology*, 24(3), 969-983.
 505 Waller, R., Dishion, T. J., Shaw, D. S., Gardner, F., Wilson, M. N., & Hyde, L. W. (2016). Does
 506 early childhood callous-unemotional behavior uniquely predict behavior problems or
 507 callous-unemotional behavior in late childhood? *Developmental Psychology*, 52, 1805-
 508 1819.
 509 White, M. P., Alcock, I., Wheeler, B. W., & Depledge, M. H. (2013). Would you be happier
 510 living in a greener urban area? A fixed-effects analysis of panel data. *Psychological*
 511 *Science*, 24(6), 920-928.

- 512 White, B. A., Gordon, H., & Guerra, R. C. (2015). Callous-unemotional traits and empathy in
513 proactive and reactive aggression in young women. *Personality and Individual*
514 *Differences, 75*, 185-189.
- 515 Wilson, E. O. (1984). *Biophilia*. Cambridge: Harvard University Press.
- 516 Zhang, J. W., Piff, P. K., Iyer, R., Koleva, S., & Keltner, D. (2014). An occasion for unselfing:
517 Beautiful nature leads to prosociality. *Journal of Environmental Psychology, 37*, 61–72.

518 **FIGURE LEGENDS**

519 ***Figure 1:***

520 Parallel multiple mediation models of nature connectedness and its associations with
521 callous traits, through cognitive and affective empathy ($n = 195$; 5,000 resamples); $p < .05^*$,
522 $p < .01^{**}$.

523

524 ***Figure 2:***

525 Parallel multiple mediation models of nature connectedness and its associations with
526 uncaring traits, through cognitive and affective empathy ($n = 195$; 5,000 resamples); $p <$
527 $.05^*$, $p < .01^{**}$.

528

Table 2. Regression coefficients, standard errors, and summary information for parallel multiple mediation models

	Cognitive Empathy			Affective Empathy			Callousness (Y ₁)			Uncaring (Y ₂)			Unemotional (Y ₃)		
	(M ₁)			(M ₂)											
	<i>B</i>	<i>SE</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>P</i>	<i>B</i>	<i>SE</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>p</i>
Nature Connectedness (X)	2.54	0.75	< .001	1.70	0.51	< .001	-.16	.24	.51	-.51	.28	.07	.03	.27	.91
Cognitive Empathy (M ₁)	-	-	-	-	-	-	-.08	.02	< .001	-.10	.03	< .001	-.09	.03	.001
Affective Empathy (M ₂)	-	-	-	-	-	-	-.11	.04	.002	-.05	.04	.21	-.15	.04	< .001
Constant	49.94	2.85	< .001	28.28	1.92	< .001	14.11	1.52	< .001	16.04	1.73	< .001	17.34	1.68	< .001
	<i>R</i> ² = 0.06			<i>R</i> ² = 0.06			<i>R</i> ² = 0.17			<i>R</i> ² = 0.15			<i>R</i> ² = 0.20		
	<i>F</i> (1, 193) = 11.43			<i>F</i> (1, 193) = 11.31			<i>F</i> (3, 191) = 13.08			<i>F</i> (3, 191) = 11.19			<i>F</i> (3, 191) = 15.51		
	<i>p</i> < .001			<i>p</i> < .001			<i>p</i> < .001			<i>p</i> < .001			<i>p</i> < .001		

X = Predictor Variable, M = Mediator Variable, Y = Outcome Variable