Level of attention mediates the association between connectedness to nature and aesthetic evaluations of photographs of nature

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Aesthetic experiences of nature are associated with beneficial psychological and behavioural outcomes. We investigated in a laboratory study whether an individual's level of connectedness to nature is associated with their aesthetic sensitivity to images of natural scenes, and whether the amount of attention allocated to the images mediated this association. Participants (N = 82) viewed 14 photographs depicting natural scenes and evaluated them on three aesthetic dimensions and completed the Connectedness to Nature (CN) and Openness to Experience (OtE) scales. CN positively predicted pleasure, beauty and aesthetic emotion, independently of OtE. The amount of attention participants paid to the images mediated the relationship between connectedness to nature and aesthetic pleasure, and connectedness to nature and beauty ratings. These findings extend our understanding by showing that attention is an important mechanism through which nature connectedness influences aesthetic responses of pleasantness and beauty in response to natural scenes. The findings have real-world implications as appreciation of the aesthetic qualities of nature is associated with a number of beneficial psychological outcomes.

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Abstract

Aesthetic experiences of nature are associated with beneficial psychological and behavioural outcomes. We investigated in a laboratory study using a correlational design whether an individual's level of connectedness to nature is associated with their aesthetic sensitivity to images of natural scenes, and whether the amount of attention allocated to the images mediated this association. Participants (N = 82) viewed 14 photographs depicting natural scenes and evaluated them on three aesthetic dimensions and completed the Connectedness to Nature (CN) and Openness to Experience (OtE) scales. CN positively predicted pleasure, beauty and aesthetic emotion, independently of OtE. The amount of attention participants paid to the images mediated the relationship between connectedness to nature and aesthetic pleasure, and connectedness to nature and beauty ratings. These findings extend our understanding by showing that attention is an important mechanism through which connectedness to nature influences aesthetic responses of pleasantness and beauty in response to natural scenes. The findings have real-world implications as appreciation of the aesthetic qualities of nature is associated with a number of beneficial psychological outcomes.

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Introduction

72   Natural scenes can evoke a wide range of aesthetic responses, from simple liking and

73 preference to more complex emotional states such as awe and wonder (Joye & Bolderdijk, 2015;

74 Silvia et al., 2015). These sensory pleasures and emotional responses are no doubt of intrinsic

75 worth, but importantly they may also be associated with a number of positive psychological and

76 behavioural outcomes. For example, several studies have shown that an appreciation of the

77 aesthetic qualities of a natural environment influences outcomes such as tourist visits (Awaritefe,

78 2004), increases well-being and prosocial behaviours (Capaldi et al., 2017; DeLucio & Mugica,

79 1994; Zhang, Howell, et al., 2014; Zhang, Piff, et al., 2014), and increases pro-environmental

80 behaviours such as conservation and environmental citizenship (Diessner et al., 2018). Given the

81 robust evidence demonstrating its broad importance, it is vital to extend our understanding of the

82 psychological factors associated with aesthetic responses to nature.

83   Empirical studies in environmental aesthetics have tended to investigate aesthetic

84   preferences for different types of landscape, for example forests and savannahs (Heerwagen &

85   Orians, 1993) and how such preferences are associated with the landscape's formal and structural

86   properties (for reviews, see Ulrich, 1983; Yang et al., 2021). However, it is well-established that

87   aesthetic preferences and experiences result from an interaction between stimulus properties and

88   the way these properties are processed and integrated by the viewer (e.g., Jacobsen, 2006).

89   Factors as diverse as whether a landscape is viewed during a pandemic-related lockdown, to

90   demographic characteristics of the viewer such as cultural background and socio-economic

91   status, are known to influence landscape preferences (e.g., Felisberti & Harrison, 2022;

92   Swanwick, 2009; Yu, 1995). So far, though, there have been relatively few studies examining the

93   role of psychological traits, such as personality and related person-centered constructs, in relation

94   to aesthetic appreciation of the natural world (Yang et al., 2021).

95   Accounts of aesthetic experience that emphasise the importance of the psychological

96   connection between the viewer and the object viewed provide the theoretical background to this

97   study. In the environmental aesthetics literature, this psychological connection is fundamental in

98   the engaged aesthetics account of Berleant (1992), who proposed that the unity of perceiver and

99   object is essential for the emergence of aesthetic experiences of nature. A similar emphasis can

100 be found in theories of aesthetic responses to human-made artefacts. For example, positive

101 aesthetic outcomes (such as being moved and flow-like states) are thought to occur when an

102 artwork is congruent with some important aspect of the viewer's identity (Pelowski et al., 2017).

103 Together, these theoretical views show that a sense of psychological relatedness, or connection,

104 between the viewer and the object viewed may be an important factor governing aesthetic

105 evaluations and experiences of nature.

106   Based on the above considerations, the starting point for the current study is that a

107 person's psychological connectedness and affiliation with the natural world, reflecting the degree

108 to which nature is incorporated into their sense of self, may have an important influence on their

109 aesthetic appreciation of nature. A sense of connection with nature, commonly referred to as

110 'connectedness to nature', is a trait-like construct characterized by an emotional connection and

111 attachment to the natural world, and by beliefs about a person's connection to the natural world

112 (Mayer & Frantz, 2004; Perrin & Benassi, 2009). A key component of connectedness to nature is

113 the degree to which nature is included within an individuals' cognitive representation of self

114   (Schultz, 2002). Here we investigated whether connectedness to nature may influence an

115   individual's aesthetic sensitivity to natural scenes.

116   There is an emerging literature showing that individual differences in connectedness to

117   nature may influence a number of different perceptual and emotional responses evoked by

118   viewing natural environments (Berto et al., 2018; Clayton, 2021; Davis & Gatersleben, 2013;

119   McMahan et al., 2018; Tang et al., 2015). For example, Berto et al. (2018) showed that

120   participants with higher levels of connectedness to nature reported higher levels of perceived

121   restorative effects, and higher levels of preference, for natural landscapes. McMahan et al.

122   (2018) reported that participants with higher levels of connectedness to nature had more positive

123   emotional outcomes (measured using both explicit and implicit measures of emotional state)

124   from exposure to immersive simulations of natural and built environments. For visitors to both a

125   wild natural landscape and a manicured environment, Davis and Gatersleben (2013) found that

126   higher levels of connectedness to nature predicted more positive emotional experiences - both

127   high and low arousal emotions (exciting and calming). They also found that those high in

128   connectedness to nature had less negative or fearful experiences in more extreme/scary natural

129   environments, i.e., it may have provided a buffering effect against negative emotional responses.

130   Evidence also supports the notion that people high in connectedness to nature may experience

131   enhanced perceptual qualities (such as legibility, mystery, and restorative potential) of images of

132   natural landscapes (Tang et al., 2015), and that individuals who are more connected to nature

133   (measured using the Environment Identity Scale) may be more emotionally affected by images

134   of degraded (i.e., polluted) landscapes (Clayton, 2021). Despite the large variety of types of

135   landscapes shown, taken together these studies provide evidence that connectedness to nature is a

136   potentially robust predictor of a variety of perceptual and emotional responses evoked by

137   viewing natural environments.

138   Existing evidence also shows that individuals with a stronger degree of connectedness to

139   nature have a higher self-reported tendency to perceive natural beauty (Harrison & Clark, 2020;

140   Zhang, Howell, et al., 2014). In these studies, higher levels of connectedness to nature were

141   shown to be associated with increased engagement with natural beauty, as measured by the

142   Engagement with Natural Beauty (ENB) scale (Diessner et al., 2008), which reflects a

143   dispositional sensitivity to affective and physiological responses evoked by natural beauty. A

144   limitation of these studies, though, was that their measurement of aesthetic experiences of nature

145   involved using a memory-based reporting format where participants self-reported how they

146   typically felt. Retrospective self-report is associated with a number of distinct biases (Conner &

147   Barrett, 2012), therefore the current study aimed to avoid these limitations by measuring

148   aesthetic responses in the moment.

149   Viewing natural scenes can elicit a number of different aesthetic experiences that vary in

150   complexity and depth (Silvia et al., 2015). Our choice of measures was guided by the affect-

151   space framework for aesthetic experience (Schubert et al., 2016). The affect-space framework

152   characterizes aesthetic experiences in terms of hedonic tone and aesthetic judgement. Here we

153   measured responses reflecting shallow hedonic tone (pleasantness), deep hedonic tone (awe,

154   being moved, profundity) and aesthetic judgement (beauty) to capture a range of aesthetic

155   responses to the scenes.

156   Openness to experience (a personality trait defined by curiosity and receptivity to new

157   experiences; Costa & McCrae, 1992) is a consistent predictor of aesthetic appreciation. Previous

158   findings have shown that openness to experience is a robust predictor of aesthetic responsiveness

159   to artworks (Chamorro-Premuzic et al., 2009; McCrae, 2007; Palumbo et al., in press) and to

160   music (Colver & El-Alayli, 2015), and studies have found that participants who scored higher in

161   openness to experience reported greater engagement with natural beauty (Harrison & Clark,

162   2020; Zabihian & Diessner, 2016) and rated nature scenes as more emotionally evocative (Silvia

163   et al., 2015). Therefore, in the current study it was important to investigate the unique

164   contribution of connectedness to nature on aesthetic experience, by controlling for participants'

165   degree of openness to experience.

166   There is evidence to suggest that viewers with higher levels of connectedness to nature

167   may allocate more attention to natural scenes, in other words that they show enhanced visual

168   engagement with natural scenes during a viewing episode, compared to viewers with lower

169   levels of connectedness to nature (Bingjing et al., 2022; Wu et al., 2013). Wu and colleagues

170   (2013) recorded participants' eye movements (Experiment 2) while they viewed images of real-

171   world scenes and found that participants higher in connectedness to nature visually explored the

172   landscape scenes more thoroughly than participants lower in connectedness to nature. Similarly,

173   Bingjing et al. (2022) reported that, in a virtual environment, participants who scored higher in

174   connectedness to nature spent more time looking at natural features, such as trees, within scenes,

175   as indexed by both total visit duration and total fixation duration. Given that eye movements are

176   informative about patterns of visual attention (Rayner, 2009), together these studies provide

177   evidence that people higher in connectedness to nature may allocate increased levels of attention

178   to natural scenes compared to people lower in connectedness to nature.

179   Moreover, empirical findings demonstrate an association between the amount of visual

180   attention allocated to a natural scene (or indeed an artwork) and the evoked aesthetic response.

181   For example, Van den Berg and colleagues (2016) showed that viewing time was positively

182   correlated with a scene's perceived restorativeness (i.e., its potential to evoke positive emotion

183   and relaxation). Along similar lines, it has been shown that increased visual attention to

184   artworks, as indexed by longer overall viewing times, was related to enhanced aesthetic

185   evaluation of the artworks (Brieber et al., 2014; Palumbo et al., in press). It seems likely that

186   enhanced attention to the image allowed extraction of more detailed information about important

187   features or compositional properties of the image, contributing to an enhanced evaluation of the

188   image's aesthetic qualities. Here we measured attention to each image using a self-report scale

189   which has been used in several previous studies (Wu et al., 2012; Silvia et al., 2015) and which

190   has been shown to be closely correlated with more objective measures of attention derived from

191   eye tracking (Wu et al., 2015).

192   Recently, Palumbo and colleagues (in press) showed that visual attention (measured by

193   dwell time) mediated the relationship between a personality trait (openness to experience) and

194   aesthetic responses to artworks. Greater visual attention to the artworks in those higher in

195   openness to experience may have allowed them to extract more information about the

196   compositional properties of the artwork, resulting in an enhanced aesthetic response. Based on

197   the conceptual similarity with the above mediation model, we reasoned that in the case of

198   viewing images of nature, a viewer's level of attention to the image might explain the

199   relationship between the viewer's level of connectedness to nature and their aesthetic experience

200   of the image. We investigated this by testing whether participants' self-reported level of attention

201   mediated the relationship between connectedness to nature and the aesthetic experiences evoked

202   by the images.

203   The current study aimed to investigate the relationship between connectedness to nature

204   and participants' aesthetic experiences evoked by viewing photographs of natural scenes, and in

205   particular, to test the role of attention as a mediator in this relationship. Firstly, we predicted that

206   participants higher in connectedness to nature would rate images of natural scenes as more

207   pleasing and beautiful and give higher ratings of aesthetic emotion, compared to participants

208   lower in connectedness to nature, while controlling for openness to experience. Secondly, we

209   predicted that connectedness to nature would be positively related to the level of attention that

210   participants paid to the images. Thirdly, we predicted that the level of attention paid to the scenes

211   would mediate the association between connectedness to nature and aesthetic responses. We

212   extend previous research in several ways. Firstly, we measured three aspects of participants'

213   aesthetic experiences, namely pleasure, beauty and aesthetic emotions. Further, we investigated

214   whether connectedness to nature uniquely predicted aesthetic experiences, by controlling for

215   openness to experience (a trait that strongly predicts aesthetic responsiveness). Finally, we

216   investigated whether the association between connectedness to nature and aesthetic evaluations

217   would be mediated by the amount of attention that participants paid to the images.

218

Materials & Methods

220   *Participants*

221   Eighty-two participants took part in the study. Participants were aged between 18 to 42

222   years ($M = 21.4$; $SD = 3.9$ years), and there were 63 women and 19 men. The study was

223   conducted in accordance with the standard ethical guidelines as defined in the Declaration of

224   Helsinki, and written informed consent was obtained prior the study. The study was approved by

225   the Ethics Committee of the Faculty of Science at Liverpool Hope University (Ethics approval

226   number: S-16-11-2017 NJ 003).

227   *Stimuli and Measures*

228   *Images of Nature*

229   Fifteen colour photographs depicting natural scenes (e.g., waterfalls, mountains, clouds,

230   rivers, sea) were selected from the Pexels online photo database (http://www.pexels.com). Each

231   image was displayed onscreen with a size of 24 cm x 15cm.All of the pictures and the study data

232   can be viewed at this study's Open Science Framework project

233   (https://doi.org/10.17605/OSF.IO/WPXCN).

234   *Connectedness to Nature*

235   As previously described in Harrison and Clark (2020), emotional connection with the

236   natural world was measured with the 14-item Connectedness to Nature Scale (Mayer & Frantz,

237   2004; the authors have permission to use this instrument from the copyright holders). This 14-item

238   scale (e.g., "I think of the natural world as a community to which I belong") is measured on a five-

239   point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). A summed score was

240   derived for each participant with higher scores reflecting stronger connectedness to nature. Mayer

241   and Frantz (2004) provided evidence of its reliability (α = .84) and validity (e.g., positive

242   correlations with environmental concern). The scale displayed a good level of internal consistency

243   in the current sample (α = .83).

244   *Openness to experience*

245   The Openness/Intellect subscale from the Big Five Aspect Scales (BFAS) was

246   administered (DeYoung et al., 2007; the authors have permission to use this instrument from the

247   copyright holders). This subscale measures two distinct, but related, traits: openness to

248   experience and intellect. In the analyses reported here, only the openness trait was included, as

249   this trait reflects aesthetic receptivity and feelings (DeYoung et al., 2012). A good level of

250   internal consistency was observed in the current sample (α = .71).

251   *Self-report items*

252   A series of 7 self-report items measured participants' responses to each image.

253   Participants were asked "Did you find this picture…" followed by the 7 items. Pleasing was

254   measured with 1 item, and beauty was measured with 1 item. Aesthetic emotions were measured

255   with a 4-item aesthetic emotions scale which included items for awe-inspiring, moving, profound

256   and boring (reverse-scored). In the current sample the scale displayed a good level of internal

257   consistency ($\alpha = .79$). Participants responded to each item using a 7-point rating scale (1 = not at

258   all, 7 = very much). A further item asked: "How closely were you paying attention to the

259   picture?" (1 = not at all, 7 = very closely).

260   *Procedure*

261   Each participant was tested individually in a quiet laboratory booth. In the first part of the

262   study, participants viewed a sequence of 14 photographs of natural scenes. The photographs

263   were presented in the center of the computer screen, and each picture was displayed for 10

264   seconds. The pictures were presented in the same order for all participants. After each

265   photograph, the 7 self-report items were displayed on-screen and participants' responses were

266   collected via the keyboard. Before testing began, participants underwent a practice trial with a

267   photograph not used in the main test, to familiarise themselves with the task. Stimulus

268   presentation and response collection were controlled by E-Prime 2.0 Pro.

269   After the computerised test was completed, participants completed the questionnaires in

270   the following order: Openness/Intellect subscale from the Big Five Aspect Scales, followed by

271   the Connectedness to Nature Scale.

272   *Data analysis*

273   Aesthetic pleasure and beauty were measured using the pleasing and beauty items,

274   respectively. Aesthetic emotion was measured using the mean of the awe-inspiring, moving,

275   profound and boring (reverse-scored) items (for a similar method, see Silvia et al. (2015)).

276   *Regression models*

277   The first regression model tested whether connectedness to nature and openness predicted

278   aesthetic pleasure evoked by the photographs. The second regression model tested whether

279   connectedness to nature and openness predicted ratings of beauty. The third regression model

280   tested whether connectedness to nature and openness predicted aesthetic emotion evoked by the

281   photographs.

282   *Mediation analysis*

283   The potential mediating role of attention in the relationships between connectedness to

284   nature and aesthetic pleasure, and connectedness to nature and beauty was analysed using the

285   PROCESS macro for SPSS (Hayes, 2018). This method tests the significance of the indirect

286   effect of the predictor on the outcome through the mediating variable (Hayes, 2018). Confidence

287   intervals for the indirect effect that do not contain zero indicate the presence of a significant

288   mediation effect. A full mediation is obtained when the indirect effect is significant and the

289   direct is not, whereas a partial mediation is obtained when both the indirect and direct effects are

290   significant. A precondition to run the mediation analysis was that there were significant

291   correlations between the predictor and the mediator and between the mediator and the outcome

292   variable. Therefore a mediation analysis could not be conducted where the outcome variable was

293   aesthetic emotion, as the correlation between aesthetic emotion (outcome variable) and attention

294   (mediator) did not reach significance.

295   Potential relationships were examined using a percentile bootstrapped mediation analysis.

296   This technique computed bias-corrected confidence intervals at the 95% level for the indirect

297   effect of the mediator using z = 5000 bootstrap samples.

298

Results

Descriptive statistics

301   Table 1 presents descriptive statistics and alphas for connectedness to nature (CN),

302   openness, paying attention, aesthetic pleasure, beauty and aesthetic emotion. We calculated zero-

303   order correlations for each of the measures. Table 1 shows there were medium correlations

304   between CN and openness, CN and aesthetic pleasure, CN and aesthetic emotion, CN and

305   beauty, CN and attention, openness and aesthetic pleasure, and aesthetic pleasure and attention,

306   openness and aesthetic emotion, and beauty and attention There were small correlations between

307   openness and beauty, and aesthetic emotion and attention. There were large correlations

308   between aesthetic pleasure, beauty and aesthetic emotion.

Regression models

Aesthetic pleasure

311   We tested whether connectedness to nature and openness predicted ratings of aesthetic

312   pleasure evoked by the photographs. Results indicated that the regression model significantly

313   predicted aesthetic pleasure, $[F(2,79) = 10.75, MSE = .31, p < .001]$, accounting for 21.4% of

314   the variance ($R^2 = .214$). Connectedness to nature ($p < .001$) was a significant predictor of

315   aesthetic pleasure. Openness did not significantly predict aesthetic pleasure ($p = .226$) (see Table

316   2). Table 2 also displays the multicollinearity statistics (Tolerance and Variance Inflation Factor

317   (VIF)) for the model. The values for VIF are all considerably below 10 and the tolerance

318   statistics are all above 0.2. Together these values suggest that there is no multicollinearity in the

319   data (Field, 2012).

320

321   *Beauty*

322   Next, we tested whether connectedness to nature and openness predicted ratings of

323   beauty. Results indicated that the regression model significantly predicted beauty, $[F(2,79) =$

324   8.41, MSE = .36, $p < .001$], accounting for 17.6% of the variance ($R^2 = .176$). Connectedness to

325   nature ($p = .002$) was a significant predictor of beauty. Openness did not significantly predict

326   beauty ($p = .364$) (see Table 3).

327

328   *Aesthetic emotion*

329   Here we investigated whether connectedness to nature and openness predicted ratings of

330   aesthetic emotion evoked by the photographs. Results showed that the regression model

331   significantly predicted aesthetic emotion $[F(2,79) = 11.19$, MSE = 0.42, $p < .001$], accounting

332   for 22.1% of the variance ($R^2 = .22$). Connectedness to nature was a significant predictor of

333   aesthetic emotion ($p < .001$), but openness to experience ($p = .392$) was not a significant

334   predictor (see Table 4).

335
336   ***Mediation models***
337
338   *Aesthetic pleasure*

339   The potential mediating role of attention in the relationships between connectedness to

340   nature and aesthetic pleasure was examined using a percentile bootstrapped mediation analysis

341   (Figure 1a for a summary of the results). The direct effect of connectedness to nature on aesthetic

342   pleasure was significant ($p < .001$ (LLCI = 0.01; ULCI = 0.05). The indirect effect is significant

343   and mediation can be said to occur if zero falls outside of the 95% confidence interval. The

344   confidence interval for the indirect effect (0.001, 0.019) excluded zero, which is evidence of a

345   significant indirect mediation effect. Therefore, we can conclude that attention partially mediated

346   the relationship between connectedness to nature and aesthetic pleasure.

347   *Beauty*

348   The potential mediating role of attention in the relationships between connectedness to

349   nature and beauty was examined using a percentile bootstrapped mediation analysis (Figure 1b

350   for a summary of the results). The direct effect of connectedness to nature on beauty was

351   significant ($p = .002$ (LLCI = 0.01; ULCI = 0.05). The indirect effect is significant and mediation

352   can be said to occur if zero falls outside of the 95% confidence interval. The confidence interval

353   for the indirect effect (0.002, 0.018) excluded zero, which is evidence of a significant indirect

354   mediation effect. Therefore, we can conclude that attention partially mediated the relationship

355   between connectedness to nature and ratings of beauty.

356   **Discussion**

357   There is a great deal of evidence showing the importance of the appreciation of nature's

358   aesthetic qualities for beneficial outcomes associated from exposure to nature, such as well-being

359   and pro-environmental behaviours (DeLucio & Mugica, 1994; Capaldi et al., 2017; Zhang,

360   Howell, et al., 2014; Zhang, Piff, et al., 2014). However, relatively few studies have explored the

361   role of psychological traits in relation to aesthetic responses to the natural world. The aim of the

362   current study was to investigate the relationship between connectedness to nature and

363   participants' aesthetic experiences (including both shallow and deep hedonic tone, and aesthetic

364   judgement) evoked by viewing photographs of natural scenes, and in particular to investigate the

365   role of attention as a mediator in this relationship. Firstly, we found that connectedness to nature

366   positively predicted aesthetic pleasure, beauty and aesthetic emotion, independently of

367   participants' level of openness to experience. Secondly, we found that the amount of attention

368   participants paid to the images mediated the relationship between connectedness to nature and

369   aesthetic pleasure, and between connectedness to nature and ratings of beauty.

370   As predicted, connectedness to nature was positively associated with aesthetic pleasure,

371   beauty and aesthetic emotion, independently of openness to experience. This finding is in line

372   with studies that have reported a positive association between connectedness to nature and a

373   general disposition to experience natural beauty, as measured using Diessner et al.'s (2008)

374   Engagement with Natural Beauty scale (Harrison & Clark, 2020; Zhang, Howell, et al., 2014).

375   Our results extend these findings by measuring the aesthetic responses of participants in the

376   moment, rather than using retrospective self-report measures which rely on episodic and

377   semantic memories. We found that viewers with higher levels of connectedness to nature found

378   the images more pleasant, more beautiful, and they evoked enhanced aesthetic emotions. This

379   finding adds to a growing body of work showing that the trait of connectedness to nature

380   influences perceptual and emotional responses to natural scenes (Berto et al., 2018; Clayton,

381   2021; Davis & Gatersleben, 2013; McMahan et al., 2018; Tang et al., 2015), but extends our

382   understanding of this association by investigating several specifically aesthetic responses,

383   namely pleasure, beauty and aesthetic emotion. The positive association between connectedness

384   to nature and participants' aesthetic responses to the images of nature is consistent with theories

385   of aesthetic experience which emphasise the importance of the psychological resonance between

386   the viewer and the content of the image (see e.g., Berleant, 1992).

387   In addition, the current study investigated the association between connectedness to

388   nature and the amount of attention paid to the images, as measured by a self-report rating scale.

389 As predicted, we found that participants higher in connectedness to nature paid more attention to

390 the images compared to participants lower in connectedness to nature. This finding is consistent

391 with evidence showing that viewers with higher levels of connectedness to nature allocate more

392 attention to natural scenes during viewing, compared to viewers with lower levels of

393 connectedness to nature, as measured by eye tracking metrics (Bingjing et al., 2022; Wu et al.,

394 2013).

395   Importantly, we showed that the viewer's level of attention mediated the relationship

396 between connectedness to nature and ratings of aesthetic pleasure and beauty. This is a novel

397 finding, showing that the level of attention paid to the images was a mechanism through which

398 connectedness to nature influenced these aesthetic responses to the pictures. In other words,

399 these findings indicate that nature-connected individuals might experience enhanced aesthetic

400 pleasure and beauty in natural scenes because they paid increased amounts of attention to the

401 scenes. It could be that individuals high in connectedness to nature have an increased drive to

402 acquire environmental information from a scene, therefore are motivated to pay it more attention.

403 This notion is supported by evidence from Tang et al. (2015) who showed that participants with

404 a higher degree of connection to nature reported higher ratings of mystery (i.e., encouragement

405 to explore the setting and gain further knowledge) in response to viewing natural scenes.

406   Paying more attention to the scene likely enabled the viewers to extract more detailed

407 information about important features or compositional properties of the scene, leading to

408 enhanced evaluation of the scene's aesthetic qualities. For example, increased attention may have

409 facilitated the recognition and identification of salient features (e.g., trees, water, etc.), properties

410 (e.g., colour, form etc.), and/or compositional aspects (eg harmony, balance etc.) that contributed

411 to the scene's pleasantness and beauty. This notion is in line with empirical findings showing

412   that viewers who allocated more visual attention to artworks (as indexed by viewing time)

413   reported enhanced aesthetic appreciation (Brieber et al., 2014; Palumbo et al., in press) and

414   tended to rate natural scenes as being more restorative (Van den Berg et al., 2016). The findings

415   are in conceptual agreement with the results of the mediation analyses reported by Palumbo et al.

416   (in press) showing that visual exploration (measured using eye-tracking) mediated the influence

417   of individual differences in personality and cognitive style on aesthetic responses, suggesting

418   that visual exploration is a key mechanism in aesthetic responses to a wide range of stimuli

419   (artworks in a gallery, photographs of nature etc.).

420   Interestingly, increased attention to natural scenes in individuals high in connectedness to

421   nature may also explain the enhanced negative responses to viewing scenes of degraded

422   landscapes by these types of individuals as reported in the study by Clayton (2021). It would be

423   worthwhile in future studies to investigate the amount of attention paid to nature scenes and its

424   influence on the evaluation of the scene using more implicit indices of attention, such as eye-

425   tracking metrics which could address additional questions about the nature of the enhanced

426   attention to the scenes, for example whether enhanced attention is reflected only in increased

427   viewing times, or if it is also associated with increased spatial exploration of the scene.

428   Participants who paid more attention to the images reported higher levels of aesthetic

429   pleasure and beauty, but not higher levels of aesthetic emotion. The reason why participants'

430   level of attention was not associated with ratings of aesthetic emotion is unclear, although it may

431   be that evaluations of aesthetic emotion were based primarily on an early 'gist' perception of the

432   entire scene, rather than on more attentionally demanding evaluative processes that unfolded

433   over a longer time-period. Clearly however, further research is needed to understand this more

434   fully.

435   Openness to experience, which is a personality trait reflecting curiosity and receptivity to

436   new experiences and is a reliable predictor of aesthetic responsiveness (Chamorro-Premuzic et

437   al., 2009; McCrae, 2007; Palumbo et al., in press; Silvia & Nusbaum, 2011), was positively

438   correlated with aesthetic ratings of the scenes. This is in line with studies that showed that

439   participants higher in openness to experience reported increased engagement with natural beauty

440   (Harrison & Clark, 2020; Zabihian & Diessner, 2016). Importantly however, in the current study,

441   openness to experience was not a significant predictor of aesthetic pleasure, beauty or aesthetic

442   emotions, once connectedness to nature was taken into account.

443   Several potential limitations of the current study should be mentioned. Our analyses are

444   correlational, so the causal role of connectedness to nature in aesthetic experience cannot be

445   determined. Although the findings showed that connectedness to nature predicted aesthetic

446   pleasure and aesthetic emotion, it is possible that aesthetic responses to nature could enhance the

447   sense of belongingness to nature, thereby increasing connectedness to nature. Further research

448   studies using experimental approaches (perhaps manipulating the level of connectedness to

449   nature) are therefore needed to elucidate the potentially bi-directional causal relationships

450   between these constructs. It should be noted that viewers evaluated images of natural scenes,

451   rather than real natural landscapes. While doubts have been raised regarding the appropriateness

452   of representations instead of real landscapes (e.g., Hull & Stewart, 1992), nevertheless there is

453   substantial evidence of the appropriateness of using depictions of natural environments as a

454   substitute for field-based studies (e.g., Stamps, 1990). Generalizing the findings of the study

455   should be done with caution due to the relatively small sample size (N = 82), and the possibility

456   of sequencing effects from presenting all the measures in the same order (ratings of photos

457   followed by Openness to Experience, followed by Connectedness to Nature) cannot be ruled out.

458   Further studies should include measures relating to the naturalness of one's neighborhood, and

459   degree of exposure to nature in daily life, as additional control variables. Finally, attention was

460   measured here by self-report; further studies could preferentially use more objective measures of

461   attention, for example eye tracking techniques (see e.g., Berto et al., 2008; Wu et al., 2013).

462

463   **Conclusions**

464   The aim of this lab-based study was to investigate whether individual differences in the degree of

465   connectedness to nature were related to aesthetic appreciation of photographs of scenes from

466   nature, and to explore the role of attention in this potential relationship. We hypothesized that

467   participants higher in connectedness to nature would rate images of natural scenes as more

468   pleasing, beautiful and emotional compared to participants lower in connectedness to nature. We

469   also hypothesized that the level of attention paid to the scenes would mediate the association

470   between connectedness to nature and aesthetic responses. We found that connectedness to nature

471   positively predicted pleasure, beauty and aesthetic emotion, independently of participants level

472   of openness to experience. We also found that the amount of attention participants paid to the

473   images mediated the relationship between connectedness to nature and aesthetic pleasure, and

474   connectedness to nature and beauty ratings. These findings extend our understanding by showing

475   that attention is an important mechanism through which connectedness to nature influences

476   aesthetic responses of pleasantness and beauty in response to natural scenes. Building on these

477   findings, future studies should explore which aspects of visual attention play a role in the

478   connectedness to nature - aesthetic response association, and whether the mediating role of

479   attention is influenced by the type of viewed scene (e.g., urban versus natural, or mundane versus

480   extraordinary nature). The findings have important real-world implications as greater aesthetic

481   sensitivity to nature is associated with several beneficial psychological outcomes, including

482   increased well-being, prosocial and pro-environmental behaviours. It remains an intriguing open

483   possibility as to whether an intervention could increase a person's level of attention to nature

484   (such as for example, via instructions to pay attention more closely), which could lead to

485   enhanced aesthetic appreciation, making more likely the beneficial outcomes associated with

486   exposure to nature.

487

488
489   **Open Science Statement**

490   This study adheres to the following open science standards: data and materials are publicly

491   available at the time of publication, and all manipulations and measured variables are reported.

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495   **References**

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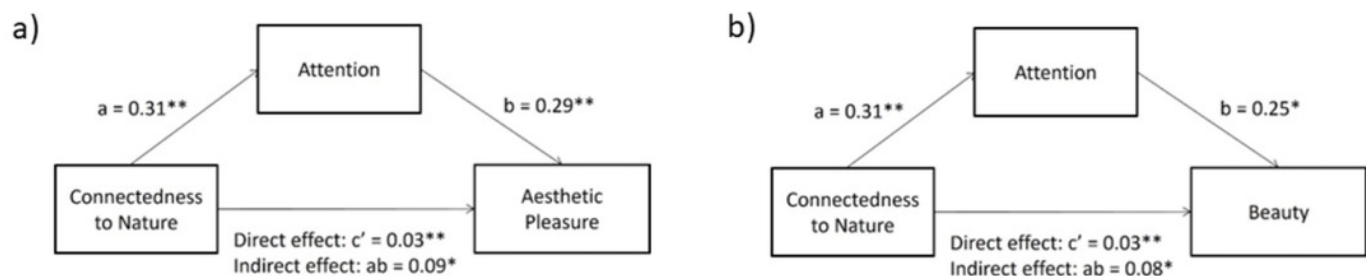
Figure 1

Mediation models

Note. Mediation models showing the mediating effect of attention on the relationship between connectedness to nature and aesthetic experience. Standardized coefficients are displayed. c2 = direct effect. c = total effect. *p < 0.05. **p < 0.01. ***p < .001

a)

b)

Descriptive Statistics, Alphas and Zero-order Correlations for all Measures

Note: To adjust for the multiple correlations that were carried out and control for family-wise error rates, we considered only those correlations to be significant that reached the $p < .01$ significance level. * $p < .01$; ** $p < .001$

Measure	Mean	SD	Alpha	1	2	3	4	5
1. Connectedness to nature	47.28	7.67	.83	1				
2. Openness to experience	25.79	5.59	.71	.43*	1			
3. Aesthetic pleasure	5.47	0.62		.45**	.30*	1		
4. Beauty	5.39	0.65		.41**	.26	.86**	1	
5. Aesthetic emotion	4.54	0.73	.79	.46**	.28	.67**	.64**	1
6. Attention	5.45	0.88		.31*	.13	.40**	.35*	.26

3
4

Results of the Regression Model for Aesthetic Pleasure

Note. b = beta; β = standardised beta; Tol. = Tolerance; VIF = Variance Inflation Factor

1 **Table 2**

2 *Results of the Regression Model for Aesthetic Pleasure*

Predictor	*b*	*β*	*t*	*p*	Tol.	VIF
(Constant)	3.60					
Connectedness to nature	0.03	.39	3.50	< .001	.81	1.23
Openness to experience	0.02	.14	1.18	.226	.81	1.23

3 *Note. b* = beta; *β* = standardised beta; Tol. = Tolerance; VIF = Variance Inflation Factor

Results of the Regression Model for Beauty

Note. b = beta; *β* = standardised beta

Predictor	b	β	t	p
(Constant)	3.62			
Connectedness to nature	0.03	.36	3.21	.002
Openness to experience	0.01	.10	0.91	.364

Results of the regression model for aesthetic emotion

Note. b = beta; β = standardised beta

Predictor	b	β	t	p
(Constant)	2.34			
Connectedness to nature	0.04	0.42	3.82	<.001
Openness to experience	0.01	0.10	0.86	.392