

1 Understanding the perceived benefits of nature for creativity

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Abstract

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Experience of nature is widely linked to wellbeing, including psychological restoration. Benefits to creativity have been explored in a limited number of studies which refer to theories of restorative environments as frameworks, but it is unclear which aspects of the environment and person-nature transactions are implicated in these processes. In this study, N = 20 members of the British public were interviewed regarding the relevance of natural environments for their personal and professional creative activities. Thematic analysis of interview transcripts revealed that cognitive, affective, and aesthetic appraisals were reported as directly relevant to creativity in nature, while environmental properties, sensory experiences, and the self were reported as informing these appraisals. Similarities to theories of restorative environments were observed in terms of the relevance of affect, cognition, and aesthetics. However, divergences also occurred, especially with regard to perceptions of arousal as beneficial for creativity, the importance of change in the environment, and the relevance of the self. Studies and theoretical modelling of relationships between nature and creativity should include these concepts, as well as those from theories of restorative environments.

Keywords: creativity; nature; restorative environments; attention restoration theory; stress reduction theory

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44 Links between nature and wellbeing are well-discussed in environmental psychology,  
45 particularly in the context of restorative environments. Most studies on the psychological  
46 benefits of nature focus on affective and attentional change (see Berto, 2014; Hartig et al.,  
47 2014; Ohly et al., 2016; Stevenson, Schilhab, & Bentsen, 2018), but links to other cognitive  
48 outcomes, and especially those based around performance, are underexplored. Interest in  
49 relationships between creativity and environment, and particularly the natural environment,  
50 has increased in recent years (e.g., Palanica, Lyons, Cooper, Lee & Fossat, 2019; Studente,  
51 Seppala, & Sadowska, 2016; Williams et al., 2018; van Rompay & Jol, 2016), but it is still  
52 unclear which aspects of nature might benefit creative processes and outputs, and why.

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#### 54 **Nature as a Restorative Environment**

55 Explanations for the benefits of restorative natural environments focus broadly on  
56 information-processing of the perceptual properties of the setting and/or on affective  
57 appraisals of both perceptual properties and their generic meanings. In the former, attention  
58 restoration theory (ART; Kaplan & Kaplan, 1989; Kaplan, 1995) suggests that restorative  
59 environments, and especially those found in nature, engage attention effortlessly through  
60 ‘soft fascination’, offer a sense of ‘being away’ from everyday concerns, are spatially  
61 coherent and extensive, and are compatible with one’s aims and desires. ART posits that  
62 these properties lead to the recovery of directed attention necessary to perform well on  
63 resource-intensive cognitive tasks; an argument that has been built on in recent years by the  
64 processing fluency account (PFA; Joye & van den Berg, 2011), in which the ease of visual  
65 processing of many elements of nature is thought to reduce cognitive demands. The second,  
66 affectively-driven, approach of stress reduction theory (SRT; Ulrich, 1983; Ulrich et al.,

67 1991) suggests that (primarily visuo-spatial) properties of nature such as water, deflected  
68 vistas, complexity, and structure are perceived as pleasant and associated with human  
69 survival, and as such are responsible for reduced arousal and feelings of stress in non-  
70 threatening human environments.

71         These theories are not prescriptive about the practical outcomes of being in restorative  
72 environments beyond such cognitive and/or affective changes, but we suggest that the  
73 prevalence of studies focusing on self-reported cognition and affect, physiological change,  
74 and improvement in objective measures of attention and/or working memory has led to a  
75 shorthand association between restorative environments and basic affective and cognitive  
76 outcomes. What can integration with other domains of psychology, such as the study of  
77 creativity, tell us about the wider psychological benefits of nature? This is a question that has  
78 only recently started to be addressed (e.g., see Williams et al., 2018, for a proposal regarding  
79 creative benefits of attention restoration and mind-wandering in nature).

#### 80 **Nature as an Environment for Creativity**

81         We borrow Plucker, Beghetto & Dow's (2004, p. 90) extended definition of creativity  
82 as "the interaction among aptitude, process and environment by which an individual or  
83 groups produces a perceptible product that is both novel and useful as defined within a social  
84 context". This definition emphasises the influence of multiple interacting factors on the  
85 creative product, including characteristics of the person, process and creative press  
86 (environment). Nevertheless, compared to work on the person and product there has been  
87 relatively little work on the creative environment. Where this is studied it has tended to focus  
88 on the social and organisational, rather than the physical, environment, and more rarely still  
89 on the natural environment (Amabile et al., 1996; McCoy & Evans, 2002; Stokols, Clitheroe,  
90 & Zmuidzinas, 2002).

91 Consideration of creativity as an outcome following nature experiences broadens  
92 applicability of this research topic to those beyond environmental psychology, and takes  
93 study of the effects of nature outside the laboratory and/or inventory measures of affect and  
94 cognition. Likewise, understanding of the role of the physical environment in creativity may  
95 stimulate research in this domain to explore factors beyond the personal and social  
96 environment that may encourage or inhibit creative ideation and outputs. Below we review  
97 available empirical evidence on links between nature and creativity.

98 **Nature and creativity in indoor settings.** The indoor presence of natural materials,  
99 plants, and views to outdoor nature has been conceptualised as relevant to creative  
100 performance in workplaces (Dul & Ceylan, 2011) and amongst undergraduate students  
101 (McCoy & Evans, 2002), and environments possessing such properties are associated with  
102 enhanced creative outputs, both in terms of independent ratings (McCoy & Evans, 2002;  
103 Studente et al., 2016) and new product generation and sales success (Dul & Ceylan, 2014).  
104 Shibata and Suzuki (2002, 2004) observed enhanced creative performance amongst students  
105 in an environment containing an indoor plant, although opposing gender effects were  
106 observed between the two studies. Studente et al. (2016) observed that views to outdoor  
107 nature, indoor plants, and use of the colour green were linked to enhanced visual, but not  
108 verbal, creative outputs, indicating potential domain-specificity of the effects of nature on  
109 creativity. It is not clear how different sensory experiences of nature might relate to creativity  
110 across multiple domains.

111 Studies that examine links between virtual nature (photos, videos, VR) and creativity  
112 are few and do not explore in detail links with cognitive or affective creative processing. Van  
113 Rompay and Jol (2016) observed that participants who viewed images of more spacious and  
114 unpredictable natural environments also displayed enhanced creativity in drawing outputs.  
115 Their proposed explanation for this finding centres on links between unpredictability and

116 inspiration, and between spaciousness and the generation and explanation of new ideas, as  
117 well as a “widening” (p. 146) of attentional capacity and processes following restoration  
118 through nature experience. Palanica et al. (2019) compared the effects of 2D images, 3D  
119 virtual reality (VR) and real-life nature and urban settings on divergent thinking, a measure of  
120 creative potential. They found that nature settings were more beneficial for divergent thinking  
121 than urban settings when viewed in 2D and in VR. However, this benefit disappeared when  
122 real-life exposure to nature and urban settings was compared, although this finding is  
123 contradicted by other work on the effect of outdoor settings reported next.

124         **Nature and creativity in outdoor settings.** Studies of direct, outdoor experience also  
125 point to links between nature and creativity, although experimental studies of such effects are  
126 few. Several qualitative studies link direct experiences of nature to increases in creativity.  
127 Jones (2013) reports on enhanced self-perceptions of creativity amongst teachers after a  
128 week-long nature-based training session, and in studies of both Australian (Luckman, 2009)  
129 and Danish (Plambech & Konijnendijk van den Bosch, 2015) creative professionals, nature  
130 is identified as a means of reflection, restoration, and inspiration for artists/creatives. A  
131 Swedish ‘outdoor office’ intervention was associated with self-reported feelings of creativity  
132 and inspiration among participants, supported by new cognitive perspectives (Pettersson  
133 Troije et al., 2021). Here, concepts from restorative environments research are linked  
134 explicitly to enhanced perceptions of creative processing and outputs. These studies provide  
135 an encouraging basis for further qualitative research that specifically examines the *qualities*  
136 of nature that might relate to creativity and *why*, and also relates this understanding to  
137 creativity among the general public in addition to creative professionals.

138         With regard to quantitative studies, Tyrväinen et al. (2008) found self-reported  
139 perceptions of creativity to be higher after experience of a Finnish urban forest or park than  
140 an urban city-centre. Atchley et al. (2012) reported greater problem-solving creativity, as

141 measured via the Remote Associates Task (RAT), amongst wilderness visitors on a four-day  
142 hike as compared to pre-hike visitors, although pre- and post-measures were recorded from  
143 different samples which limits comparability. Similar findings were reported by Ferraro III  
144 (2015) when testing creativity via the RAT between wilderness trip and indoor control  
145 groups, and by Yu and Hsieh (2020) in a within-participants study of Chinese participants in  
146 a forest therapy workshop. The authors of these respective studies take their findings as  
147 evidence that natural environments can have cognitive benefits beyond restoration of  
148 attention. Notably the RAT requires a convergent type of cognitive processing (Bae,  
149 Huggins-Manley & Therriault, 2014), which is at odds with the explanation put forward by  
150 Atchley et al. (2012) that natural environments can encourage divergent thinking through  
151 mind-wandering. Again, this points to a need for greater consideration of the types of  
152 cognitive processing that occur during nature-based creativity, in order to draw perspectives  
153 from creativity and restorative environments research into better alignment.

154         It is also notable that the outdoor studies conducted by Atchley et al. (2012), Ferraro  
155 III (2015), and Yu and Hsieh (2020) include physical activity while immersed in nature, such  
156 as hiking, walking, and handling plants. Over two years, Korpela, de Bloom, Sianoja,  
157 Pasanen, and Kinnunen (2017) showed that physical activity in nature, but not experience of  
158 indoor plants or window views, was predictive of well-being, including self-reported  
159 creativity at work. Similarly, being in nature while conducting creative physical activity  
160 (dancing) increases both objective physical engagement in the activity, and positive affect  
161 achieved as a result, as opposed to being indoors (Byrka & Ryczko, 2018). In the interviews  
162 in this study we therefore focused on creative activities such as painting, writing, and dancing  
163 primarily in the context of outdoor experiences of nature, although participant discussion of  
164 indoor nature and its relationship to creativity was not discouraged.

## 165 **Understanding Links Between Nature and Creativity**

166 Consideration of nature as a restorative environment focuses primarily on changes in  
167 affect and cognition. The role of affect and cognition is also of relevance to study of  
168 creativity, and therefore examination of these two concepts is potentially fertile ground for  
169 understanding links between nature and creativity. Here we review key literature on  
170 creativity, affect, and cognition, and identify how nature may be of relevance to those  
171 relationships.

172 **Creativity and affect.** Affect is widely studied in relation to creativity, with positive  
173 affective states being significantly and consistently linked to enhanced creative thinking and  
174 output (Baas, De Dreu, & Nijstad, 2008; Davis, 2009). In their meta-analysis of 102 studies  
175 on this topic, Baas et al. (2008) observed that positive, as compared to neutral but not  
176 negative, affect was significantly linked to creative products. Specifically, positive affect  
177 associated with high arousal or activation (e.g., happiness, joy, and delight) was more likely  
178 to enhance creativity than neutral moods, but low-activation positive affect, such as  
179 relaxation, was not. While this may be attributable to the proportion of studies that induce  
180 high rather than low arousal states before creative tasks (Baas et al., 2008), it also raises the  
181 interesting possibility that *increased* arousal may be implicated in links between nature and  
182 creativity as discussed below, as opposed to traditional framing of nature experiences as a  
183 way to *reduce* arousal (e.g., as in SRT).

184 Baas et al. (2008, p. 793) also explored interactions between affect and task framing  
185 of creative activities, observing that positive affect was linked to enhanced creativity in “fun  
186 and enjoyable” contexts, while negative affect supported creativity in problem-solving or  
187 more serious, defined tasks (see also Kaufmann & Vosburg, 1997). Given that experience of  
188 nature is linked to positive affect (Hartig et al., 2014), it is plausible that such a setting would  
189 also be congruent with enjoyable, less structured forms of creativity, rather than problem-



190 solving (although see findings by Atchley, Strayer, & Atchley, 2012, for a different  
191 perspective).

192         **Interactions between affect and cognition when thinking creatively.** Building on  
193 their previous work on affect and creativity, De Dreu and colleagues propose a dual pathway  
194 to creativity model (DPCM; De Dreu, Baas & Nijstad, 2008; Nijstad, De Dreu, Rietzschel, &  
195 Baas, 2010; Baas, Roskes, Sligte, Nijstad, & De Dreu, 2013). This suggests that flexibility  
196 (i.e., exploring many ideas broadly) and persistence (i.e., exploring few ideas in-depth) are  
197 separate modes of cognitive processing that are affectively influenced and that can each  
198 individually lead to original, fluent, and insightful creative ideation. The DPCM proposes that  
199 high-activation positive affect (e.g., joy) enhances creativity through cognitive flexibility,  
200 whereas high-activation negative affect (e.g. anger, stress) enhances creativity through  
201 cognitive persistence. Extrapolating from this model, we suggest that creativity requiring  
202 cognitive flexibility may benefit from positively valenced nature experiences.

203         Beyond the DPCM, a significant body of work suggests that everyday cognitive  
204 processing mechanisms are an important part of the creative thinking process, including  
205 working memory and executive control of both internally and externally directed attention  
206 (Beaty, Seli & Schacter, 2019; Sio & Ormerod, 2015; Sowden, Pringle & Gabora, 2015).  
207 Given that ART research shows a beneficial effect of nature on such cognitive processes  
208 (Berman, Jonides & Kaplan, 2008; Ohly et al., 2016; Stevenson et al., 2018), we might  
209 further expect that experience of nature is related to creativity.

210         In their study of the relationship between nature and innovation, Leong, Fischer, and  
211 McClure (2014) observed that connectedness to nature was related to both innovation and  
212 holistic cognitive styles, suggesting links between nature, creative thinking, and global  
213 processing, which the DPCM suggests is important for cognitive flexibility. While  
214 connectedness to nature is associated with both nature experience and restorative experiences

215 in nature (e.g., Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009), it is not the same as  
216 these two concepts. As such, study of the links between nature experiences and cognitive  
217 processes necessary for creativity is needed.

218 Williams et al. (2018) propose that nature experiences may benefit creativity through  
219 both *attention restoration*, achieved through external orientation of attention towards  
220 elements of the environment, and *mind wandering*, achieved through internal orientation  
221 towards one's thoughts. This theory suggests that shifts between these two processes over  
222 time may serve to both restore attention and generate associations between ideas. Williams et  
223 al. outline a need to further examine the processes underpinning creativity in response to  
224 nature. In this study we take a step towards answering such a call by qualitatively examining  
225 perceptions of not only if, but why, nature may be related to creativity.

## 226 **Aims and Research Questions**

227 With the above literature in mind, this study aimed to examine perceived links between  
228 self-reported creativity and experience of nature amongst residents of the United Kingdom  
229 (UK). Given the paucity of literature and theory on *why and how* nature and creativity might  
230 be related, a qualitative approach was undertaken using semi-structured interviews and  
231 thematic analysis of transcripts. This approach enabled examination of the kinds of  
232 environmental properties and experiences that might underpin perceived nature-creativity  
233 relationships in individuals' own words, in the context of their own personal creative  
234 interests. These interviews were conducted in 2012 and included questions regarding  
235 restorative experiences, data from which were analysed from the perspective of soundscapes,  
236 and published in Ratcliffe, Gatersleben, and Sowden (2013). The data presented below are  
237 drawn from the same interviews, but are not analysed or discussed in the aforementioned  
238 paper and relate specifically to creativity. Data were analysed from the perspective of the  
239 following two research questions:

- 240 1. Which aspects of nature are perceived to benefit or hinder creative processes and  
241 outputs?  
242 2. What are the potential mechanisms that might underpin these links?  
243

## 244 **Method**

### 245 **Participants and Design**

246 Twenty adult residents of the UK (ten female;  $M$  age = 49.5 years,  $SD$  = 18 years)  
247 were recruited to participate in an interview-based study on the topic of ‘perceptions of  
248 surroundings’. Recruitment was conducted through local and online advertising in London  
249 and South East England, and snowball sampling through the first authors’ academic contacts.  
250 This recruitment took place based on age quotas informed by contemporary UK demographic  
251 estimates (ONS, 2011), with at least three participants per bracket; that is, four males and  
252 three females in the age bracket 18-44 years, three males and four females aged 45-64, and  
253 three males and three females aged 65 years and older. Participants did not receive  
254 compensation for taking part in the study. In line with the policies of the university where the  
255 research was conducted, the study did not require specific ethical review but was conducted  
256 in accordance with institutional ethical guidelines.

### 257 **Materials**

258 **Demographics and creativity information.** Prior to the interview, participants were  
259 asked to provide brief demographic details and information about their creative interests or  
260 activities, of which the latter was incorporated into relevant questions within the semi-  
261 structured interview. Participant demographics and their creative interests are listed in Table  
262 1.

263 **Semi-structured interview schedule.** After a brief warm-up section in which  
264 participants were asked to tell the interviewer about their favourite place, they were asked the

265 following questions in relation to the creative activities indicated via the creativity  
266 information questionnaire. Open-ended questions regarding creativity are provided below  
267 (see Appendix A for full interview schedule).

- 268 • What kind of environments would help you think about and take part in [creative  
269 activity]?
- 270 ○ Would you go to a natural environment?
  - 271 ▪ If yes, can you describe it for me?
  - 272 ▪ What about that place do you find helpful? (Prompt used in case of  
273 participant non-response: *For example, things you can*  
274 *see/hear/smell/touch?*)
  - 275 ▪ Why do you think that is?
- 276 ○ If no, why is that?
- 277 • Are there any natural environments that would make it harder for you to think about and  
278 take part in [creative activity]?
- 279 ○ Can you describe them for me?
  - 280 ▪ What about them might make it harder?
  - 281 ▪ Why do you think that is?

## 282 **Procedure**

283 Participants provided informed consent prior to completing the demographics and  
284 creative activities measures, and the semi-structured interview. Interviews were conducted on  
285 a one-to-one basis between the participant and the first author in a private space (the  
286 participant's home where possible, or otherwise a quiet location such as the university  
287 office). Interviews were audio-recorded and transcribed verbatim with each participant's  
288 permission, supported by researcher notes taken during the interview. The names of  
289 participants, other individuals, and identifying locations were removed during transcription.

290 Due to a technical error, parts of the interview with Participant 18 relating to creativity were  
291 not recorded and data were reconstructed as far as possible from researcher notes  
292 immediately after the interview. Interviews ranged from 20 to 50 minutes long. After the  
293 interview, participants were thanked and debriefed.

## 294 **Analysis**

295 Thematic analysis (Braun and Clarke, 2006) was used to analyse interview transcripts,  
296 supported by ATLAS.ti software. Transcripts were read in full individually, and text coded  
297 where it related to creative activities and the natural environment, with initial theme names  
298 drawn from the data where possible. This process was conducted per transcript, with previous  
299 transcripts cross-checked and coded for any new themes arising from later transcripts. Once  
300 all transcripts had been coded in such a way, themes were grouped into sets of master- and  
301 sub-themes based on overarching communalities, as shown in Figure 1. To check the validity  
302 of the coding, the first author and an independent coder examined 18 randomly selected  
303 quotes (three per theme) and compared allocation to themes. Inter-rater reliability between  
304 these two coders was, on average, moderate to substantial (*M* Cohen's  $\kappa = .61$ ; Landis &  
305 Koch, 1977).

306

## 307 **Results**

308 Six master themes, each with constituent subthemes, were identified through thematic  
309 analysis: a) affective, b) cognitive, and c) aesthetic appraisals; and d) environmental  
310 properties, e) sensory experiences, and f) the self. These are illustrated in Figure 1.  
311 Subthemes are ordered by frequency of occurrence across interview transcripts in Table 2.  
312 Themes of affective, cognitive, and aesthetic appraisals were reported as directly relevant to  
313 creativity in nature, while environmental properties, sensory experiences, and the self were  
314 reported as informing these appraisals. Each theme is expanded on below.

## 315 **Affective Appraisals**

316 We define appraisals and self-reported states of affect and arousal as states of, e.g.,  
317 pleasure, relaxation, and stress/arousal. These were perceived to be direct influences on, and  
318 results of, creativity. As Participant 1 noted, “certainly mood would be a big one for me, like  
319 physically” in facilitating creative experiences. Non-activated positive affective states such as  
320 *relaxation*, calmness, and a sense of peace were perceived to be important. Participant 1 felt  
321 that natural sound “gets you into the most relaxed state. Relaxation being one of the most  
322 important things for creativity.”

323 However, affective appraisals of nature as arousing were also perceived to be helpful  
324 for creativity and to link with cognition. Participant 10 commented on the *powerful, arousing*  
325 nature of the sea as a source of inspiration: “... I think the most inspiring thing in nature is  
326 the sea. You know, the crashing waves, it kind of makes you feel good. [...] It’s much greater  
327 than we are, and it has so much power.” Further, states of both high arousal and positive  
328 affect, such as *happiness and enjoyment*, were described as products of pursuing creativity in  
329 relation to nature. Participant 4 talked about drawing plants in a green outdoor environment:  
330 “I just enjoy doing it [...] I do find it’s lovely to spend time, an hour or two and I’ll just  
331 make, in the best detail as I can, a representation of that plant.”

332 *Negative affective appraisals* of and responses to nature were generally not perceived  
333 as helpful for creativity, largely because they related to highly-activated perceptions of fear  
334 and threat. As Participant 1 noted, “it’s distrust. So essentially what happens, what comes up  
335 is an element of, ‘I’m not safe here’, you know? And then, at which point, the biggest  
336 concern is, ‘Let me make sure I stay alive. Let me protect myself. Let me check,’ you know,  
337 and pretty much all your focus and attention is there.”

## 338 **Cognitive Appraisals**

339 We define cognitive appraisals/experiences of nature as interest and inspiration,  
340 memory, maintaining/losing focus, a sense of cognitive escape or ‘being away’.

341 Participant 17 felt that *interest in and awareness of* birdsong at a particular time of  
342 year would help her directly in her creative work as a homeopath, by enabling her to form  
343 insights, inspiration, and reflect on her work: “There were birds singing [...] they’re kind of  
344 flashes in the inward eye, as it were.” For Participant 3, the affective state of relaxation  
345 achieved through experience of environmental properties was, in turn, perceived to benefit  
346 *attentional focus* on her writing: “I guess I associate it with, sort of, being relaxed out there.  
347 [...] It would probably be a nice, hot day and you would have a nice, cool drink and that all  
348 kind of helps when you’re sort of just trying to think.”

349 For Participant 2, certain aspects of natural environments also helped her to *maintain*  
350 *focus* when writing, but this was perceived as a cognitive process that did not interact with  
351 affect; rather, their congruency with the rest of the surroundings aided her attention. “So  
352 more like flowers and trees and things like that, I think, are helpful, yeah. [...] because they  
353 kind of don’t distract from the natural environment. Then, yeah, you can just focus on what  
354 you’re doing.”

355 *Loss of focus through distraction* was mentioned by participants as a cognitive  
356 process that would be unhelpful for creativity by drawing attention away from the task at  
357 hand, and this was usually linked to environmental properties that increased arousal or were  
358 perceived as chaotic. For example, Participant 2 reflected on natural environmental stimuli  
359 that would be unhelpful for her drawing and painting: “I guess it would be a really busy  
360 beach, would probably be unhelpful. Places where, yeah, you can get distracted. Yeah, where  
361 you can't really hear the nature, yeah, like other people's music, things like that. Really  
362 chaotic, probably, natural environments.

363 Nature experiences could stimulate *memories* that some participants perceived as  
364 helpful for creativity. For example, Participant 18 said, “You could find something that  
365 inspires you, ideas for stories - trees, people passing by. Sky, clouds, animals, trees in the  
366 breeze. I like them, associations and memories.” Certain natural settings that afforded a sense  
367 of *escape or being away*, such as being on a hill, also facilitated creative activities like  
368 Participant 2’s artwork: “The open [...] feeling, kind of detached from what's below.”

### 369 **Aesthetic Appraisals**

370 We define participants’ aesthetic appraisals of nature as: perceived change, contrast,  
371 and movement in the environment; accessibility/practicality; spatial extent; and beauty.

372 *Change* in the environment, such as the passage of time, movement through or in a  
373 space, and perceptions of contrast, were explicitly related to perceptions of creativity. These  
374 are concepts that are not discussed in depth in theories of restorative environments, and as  
375 such deserve particular attention here as novel findings. Participant 9 reflected on birdsong  
376 when discussing creative activities in the garden, and noted how changes helped generate  
377 wider connection to nature: “... occasionally, probably every year, there’s a blackbird, I  
378 presume it’s a blackbird. Apparently their song changes, I don’t know how I found this out.  
379 [...] It’s something I notice, yeah. It helps you bond with your environment, you know.”

380 Contrast in certain natural environments, and resulting unpredictability, was also perceived as  
381 inspiring and helpful for creativity. For example, Participant 10 said of the sea: “I think it’s  
382 kind of connection with something you don’t really know. It’s the unknown, isn’t it? [...]  
383 And it can go from being very calm and completely like, you know, like a mirror, to then  
384 being gentle into being quite dangerous. You just don’t know. ... So it’s because [...] it’s  
385 temperamental, you know? You don’t know what’s going to happen next. So I think that’s  
386 what makes it so inspiring, really.”



387 Participant 19 also commented on how movement outdoors facilitated intuition and  
388 imagination in his writing, some of which may be prompted by memories or associations.  
389 This may also link to concepts of mind wandering. “I think it just allows [...] intuitive  
390 thoughts to come into your brain more easily than if you’re trying to analyse a particular  
391 problem. If you try to analyse it [...] I could end up with some sort of thing that wasn’t that  
392 creative, whereas if you want to be really creative you have to allow your imagination free  
393 rein, and that means, for me, a lot of it being outside. Or having some outside walking around  
394 rather than sitting down.”

395 *Accessibility and practicality* were mentioned by participants as reasons for choosing  
396 an environment for creative pursuits, and this tended to explain why they might prefer to stay  
397 indoors instead of going into nature: “... everything I need is close at hand. It's just easier just  
398 to be here, really.” (Participant 3). However, the *spatial extent* afforded by nature did  
399 facilitate certain creative activities, such as Participant 10’s dancing: “... years ago there was  
400 a group of us who went to Wales, went to the seaside there, and it was very open. Quite a  
401 barren place, but we did do some dancing by the sea, which was nice. [...] I think just having  
402 the space, you know, vast, open space. And feeling part of the environment. You feel-, when  
403 I was dancing I felt like-, you feel part of it, you feel a sense of freedom, I suppose.”

404 Perceived *beauty* was also considered to be helpful for Participant 7’s work as a  
405 therapist, because it related to concepts of ‘goodness’: “... the general beauty and the sound  
406 of the river and the sight of swans. Because I suppose part of being a therapist is to help  
407 people to see wider horizons and to, you know, to integrate good experiences into their life  
408 where they maybe haven't before, so that they can feed themselves, really, on the good  
409 things.”

#### 410 **Environmental Properties**

411 Participants discussed links between creativity and physical environmental properties,  
412 which we define as green/blue space, weather and seasons, plants and animals, and  
413 landscapes. Participant 4 commented that *green nature and the presence of water* contributed  
414 to a sense of psychological escape that could facilitate creativity. “Yeah, again, you've got the  
415 hills, you've got the river, people enjoying the river, and it's generally-, people leave their  
416 troubles, you know, behind.” *Animals* were often mentioned during descriptions of natural  
417 environments, but some participants noted that they could be detrimental to creativity if they  
418 caused disgust: “Well, the foxes leave their mess, don't they? That's not really a great  
419 inspiration to great art. (Participant 4).

420 Affective states were described as being particularly influenced by environmental  
421 properties such as *seasons and the weather*, as Participant 2 noted: “... I think in general I was  
422 kind of happier in the summer, so yeah I guess my paintings are more jolly and joyous in  
423 summer as well.” Participant 16 commented on how change in mood as a function of the  
424 weather might be helpful for verbal creativity and wordplay. Links to high arousal were also  
425 apparent here, in terms of ‘fun’: “... actually, some things like that might actually put [me]  
426 into a different mood and not actually be a bad thing. Like sudden rain, yes, it might make  
427 myself a bit more uncomfortable in the sense that, well, being wet might have its  
428 consequences, not very pleasant, but still it might be a bit of fun...”

429 When discussing *physical landscapes*, Participant 10 linked this to a sense of spatial  
430 extent (see also aesthetic appraisals theme) that was perceived as inspiring, potentially  
431 through sense of achievement: “I like to see the whole picture of an area. Up from a height,  
432 yeah. And I find that inspiring, as well. Especially when you can climb to the top and you  
433 feel you've got there, and then there's the view as well.”

#### 434 **Sensory Experiences**

435 Participants commented on four domains of sensory experience in relation to  
436 creativity, defined as vision, sound, smell, and touch. For some, these were combined as  
437 multi-sensory experiences; for example, prior to discussing the sea above, Participant 10 said  
438 that, “Smelling, hearing, listening. Even just actually getting in the sea, the whole experience  
439 really” was inspiring for her.

440 For others, the senses were more dissociable. Participant 10 emphasised the  
441 importance of her *visual* experience of nature for her art practice, linked to aesthetic  
442 appraisals of beauty. “It’s the form, the shape, the colour. It’s very beautiful, you know.  
443 Nature has its own beauty. Like, you know, in the winter when there’s no leaves on the trees,  
444 you can actually see the shape of the tree, you know...”

445 By contrast, Participant 7 felt that the *sound* of water, such as a river, would be  
446 helpful for her when thinking about her psychotherapy work because it facilitated connection  
447 to nature and vitality. “It’s quite a powerful sound and it’s like a life force.” For Participant  
448 22, *smell* reminded her of previous experiences that would be helpful for her writing, linking  
449 again to concepts of inspiration. “Well, there are certain smells that are very evocative of  
450 certain things, that remind you of things. I mean, there’s nothing like smell to remind you of  
451 certain things or people or places.”

452 Regarding *haptic* experience or touch, Participant 9 commented on gardening as a  
453 creative activity, and emphasised the physical and spatial involvement he felt: “...  
454 occasionally in the summer, I’ll orchestrate the garden. [...] So what I do is, I go out and buy  
455 a load of annuals or something, or geraniums, anything [...] that I haven’t grown, and I just  
456 put them in bigger pots and stand them in between-, build up bricks between the shrubs...”.  
457 This spatial involvement was key to the creative output of the gardening itself: “... so that it  
458 looks like [...] it’s orchestrated, like, arranged. Like a picture, actually. [...]” Participant 9

459 emphasises that this spatial aspect of the environment is multi-sensory in itself: “So it’s like  
460 painting, it’s a bit like painting a picture outside.”

## 461 **The Self**

462 Participants reflected on the role of sense of self in relation to creativity in, or  
463 facilitated by, natural environments. We define this as concepts of identity and attachment;  
464 memories; being alone or with others; and behavioural engagement with nature.

465 For some participants nature was perceived as facilitating creativity because it  
466 enabled awareness of one’s own *identity* (e.g., Participant 7 noted that “being close to nature  
467 makes you closer to your innermost self...”). However, others had less *attachment* to or  
468 familiarity with nature, which meant they found it hard to conceptualise it as a space for  
469 creativity, e.g., Participant 9: “I’m not thinking about work, violin, or composing or practising  
470 or anything. [...] Normally I’m not in a natural environment very much, so I wouldn’t know  
471 how it makes me feel.”

472 Similarly, some participants perceived nature as more or less beneficial depending on  
473 whether they were there *alone or with others*. Participant 3: “I guess if you were kind of out  
474 in the garden, on a nice day. You know, relaxing. Again, probably on your own, not with the  
475 kids running around everywhere, that would be good.” In contrast, Participant 4 spoke about  
476 gardening in his allotment and how that would be facilitated by the presence of others and  
477 associated new information: “Well, I’ve got an allotment [laughs] and, er, there’s always  
478 someone growing something new. You say, ‘How does that taste?’ ‘I’ll give you a few  
479 seeds,’ and I’ll try it out.”

480 Discussion of the self also focused on *memories* that participants had of certain  
481 natural environments, and how they might facilitate creativity (see also the theme of  
482 cognitive appraisals). For example, Participant 19 felt that memories triggered by walking  
483 outdoors could help him generate ideas for writing: “I think the important thing is that it

484 allows your memories to circulate a little more freely. I mean, you're seeing different people,  
485 probably in a park, maybe in a wood. They may jog your memory, depending on what you're  
486 writing. You may want to relate something to childhood or something, and you've actually  
487 got to think back and dig, and if you're sitting purely at a desk, you won't be able to dig."

488 *Behavioural engagement with*, as opposed to merely being exposed to, nature was  
489 also described as helpful for creativity, often in the form of cognitive inspiration through  
490 engagement and play with natural stimuli. Participant 4 noted how he had a 'conversation'  
491 with a bird when making music: "Well, the birds will-, you can have a little conversation  
492 with them. [...] Yeah, you can chat. I remember one time when I was DJing and I was-, the  
493 guy had some sort of bird in a cage in his house, and it was late and I was doing a bit of  
494 scratching on the-, going *wiki-wiki-wiki* [mimics scratching a vinyl record] and the bird in the  
495 kitchen was chatting back to me, going *wiki-wiki-wiki* and I was going *wiki-wiki-wiki*  
496 [laughs]. And, er, I'm not the only one, there's a few people who have taken their inspiration  
497 from birdsong, you know."

## 498 Discussion

499 Recent evidence has shown links between natural environments and creativity, but  
500 specific environmental properties and potential mechanisms responsible for these links are  
501 under-examined (Williams et al., 2018). This study qualitatively explored: a) which aspects  
502 of nature can be perceived as helpful or unhelpful for creative processes and outputs amongst  
503 a sample of the British general public, and b) potential mechanisms underpinning these links.  
504 Thematic analysis of interviews with these participants indicated that *environmental*  
505 *properties* such as weather, landscapes, plants, and animals benefited or hindered creativity  
506 when they were experienced through different *senses* and through the lens of the *self*. With  
507 regard to potential mechanisms, these experiences generated *aesthetic appraisals*, including  
508 perceptions of change/contrast, spatial extent, and beauty; *affective appraisals* of pleasure

509 and arousal; and *cognitive appraisals* regarding attention, which were perceived to impact on  
510 creative processes and outputs.

### 511 **Environment, Senses, and the Self in Relation to Creativity**

512 Participants in this study described rich, populated natural environments as relevant  
513 for their creative activities, which they experienced in a multi-sensory manner and in the  
514 context of their individual self-identity. Research on restorative environments has focused to  
515 great extent on the value of landscapes and green and blue space for psychological  
516 restoration, but rather less on specific types or elements of nature (Wheeler et al., 2015). The  
517 identification of environmental properties such as weather, plants, and animals as also  
518 relevant for creativity emphasises the need to look beyond ‘nature’ per se when considering  
519 environments that can help or hinder various outcomes. Research should also focus on the  
520 specific content of those natural environments, and moreover how that content is experienced  
521 through non-visual senses; i.e., sound, touch, and smell. Given the growing interest in the  
522 contributions of different sensory modalities, united and separately, to the psychological  
523 benefits of nature (e.g., Benfield, Taff, Newman, & Smyth, 2014; Jahncke, Eriksson, &  
524 Naula, 2015), our findings indicate that such sensory experiences merit further consideration  
525 in the context of benefits to creativity, as well as psychological restoration.

526 In their 2018 paper, Williams et al. suggest that creativity and nature experience may  
527 be linked by alternating processes of mind wandering and attention restoration. In this study  
528 we also find some tentative evidence for the role of mind wandering, especially in relation to  
529 memories triggered by movement, as discussed by Participant 19. His recounting of  
530 imagination and free thought through physical experiences in nature may suggest links  
531 between mind wandering and embodied cognition in nature, which has received increased  
532 attention in environmental psychology literature (e.g., Schilhab & Esbensen, 2019).

533 In this study creativity was perceived to be enhanced either by company or by being  
534 alone in nature, depending on the individual and the task they wanted to accomplish.  
535 Restoration in non-threatening nature can be enhanced by being alone (Staats & Hartig,  
536 2004). Being alone is not explicitly discussed in the context of attention restoration theory,  
537 but may link to concepts of being away and compatibility as presented by Kaplan and Kaplan  
538 (1989) and Kaplan (1995). However, social aspects of restorative natural environments are  
539 less explored, and study of creativity as an outcome may offer avenues for research on social  
540 company in nature.

541 Overall, the role of the individual person in restorative experiences of nature is under-  
542 explored. Memories in relation to place are explored in the context of research on favourite  
543 places and restorative environments (e.g., Ratcliffe & Korpela, 2018) but not in the context of  
544 creativity in nature. This may be a fruitful direction for future research, especially with regard  
545 to the concept of compatibility within attention restoration theory, and models of the benefits  
546 of nature to creativity should take care to include this concept. For example, it may be  
547 interesting to examine whether potential benefits to creativity, achieved through low arousal  
548 in nature, are moderated by introversion, and whether such effects may differ depending on  
549 the creative task (e.g., solitary tasks such as writing versus group activities like dancing).

### 550 **Appraisals of Nature in Relation to Creativity**

551 The present study identified three perceived routes through which the themes above  
552 (self, sensory experience and environmental properties) may contribute to creativity in  
553 response to nature. These were ways in which nature was appraised aesthetically, affectively,  
554 and cognitively.

555 **Aesthetic appraisals** of the natural environment as dynamic and stimulating (through  
556 change, contrast, or unpredictability) were particularly perceived as helpful for creativity.  
557 This is somewhat in contrast to evidence and theory on restorative environments (i.e., that

558 pleasant and non-threatening nature can reduce psychophysiological arousal and enable  
559 recovery from stress; Hartig et al., 2014; Ulrich, 1983). Exploration of such a distinction  
560 would be well-suited to further, experimental studies that examine whether experience of  
561 different types of nature (e.g., dramatic versus mundane) can lead to differential outcomes  
562 (creativity and vitality versus restoration and relaxation).

563 **Affective appraisals and states** such as pleasure or happiness were perceived as  
564 beneficial for creativity, linking to the argument for positive affect as a driver of restoration  
565 found in stress reduction theory (SRT; Ulrich, 1983). Further, in contrast to the literature  
566 showing activating but not deactivating mood states support creativity (e.g. Baas *et al.*, 2008;  
567 De Dreu *et al.*, 2008) both low and high arousal affective states were perceived as beneficial  
568 for creativity here; some participants perceived states of relaxation generated by nature to be  
569 helpful, whereas others perceived the highly-arousing, dominant, and even frightening  
570 aspects of nature (e.g., weather and the sea) to be inspiring in their creative work. This  
571 potential benefit of arousing nature is in contrast to the position put forward in SRT, in which  
572 appraisals of low arousal are deemed more helpful, and indicates a potential difference in  
573 motivations for nature experience between those seeking arousing, inspiring creative  
574 experiences in nature, and those seeking calming or restorative experiences, albeit these  
575 could in turn facilitate creativity.

576 Further, our results align with findings from Ryan et al. (2010) which link nature  
577 experiences to the aroused state of vitality, and with those of van den Berg and ter Heijne  
578 (2005), in which threatening nature experiences were found to elicit not only fear but also  
579 pleasure and fascination, especially amongst sensation-seeking individuals. We highlight here  
580 the need to better include measures of individual differences, including personality traits such  
581 as sensation-seeking, in the study of psychological experiences of nature and their impact on  
582 creativity.



583           **Cognitive appraisals and states.** Correlates of attention restoration theory constructs  
584 were observed among participants who felt that nature could increase creativity through  
585 interest and attentional focus, either directly or as a result of increased relaxation, the latter  
586 also reflecting stress reduction theory. This aligns with the concept of fascination from  
587 attention restoration theory (ART; Kaplan & Kaplan, 1989; Kaplan, 1995), in that fascinating  
588 elements of nature may allow recovery of directed attention requisite for creative  
589 performance. This also supports findings from Plambech and Konijnendijk van den Bosch  
590 (2015) that creative professionals perceived nature to offer opportunities for reflection and  
591 restoration.

592           In contrast, aspects of nature that captured attentional focus but were negatively  
593 affectively valenced were not seen as helpful; rather, they were perceived as distractions.  
594 This links to (in)compatibility, and also to the concept of ‘hard fascination’ as put forward in  
595 attention restoration theory (Kaplan, 1995); i.e., environmental stimuli that serve to capture  
596 attention excessively without leaving room for restoration, and suggests that such stimuli may  
597 also inhibit creativity. This, in turn, aligns with work indicating the importance of working  
598 memory availability in creativity (e.g., Sowden et al., 2015).

### 599 **Limitations and Extensions**

600           This study identified perceived qualities and processes relating experience of nature to  
601 creativity amongst members of the British general public. In so doing it adds to  
602 understanding of the kinds of environment that can support creativity, especially through its  
603 qualitative methodology that captures participants’ self-reported experiences and  
604 interpretations. However, we acknowledge that inferences regarding causal mechanisms of  
605 action, and especially changes in cognition or affect, are limited.

606           The data used in this study were collected at the same time as data on perceived  
607 restorative experiences of nature. Participants discussed both topics in their interviews at

608 different points, and may have therefore themselves drawn connections between concepts of  
609 restoration and creativity in their comments. However, given that research in this field uses  
610 theories of restorative environments as foundations to understand links between nature and  
611 creativity (e.g., Williams et al., 2018), we do not imagine that this has raised spurious  
612 connections in this study. Rather, we view this work as a way to better understand potential  
613 reasons why the benefits of nature may extend from restoration to creativity.

614         Participants interviewed in this study were members of the public who enjoyed  
615 various creative pursuits, from artwork to writing and dancing. We did not use any objective  
616 measure of participants' creative performance or achievement, but rather sought to  
617 understand how environment relates to their *own* understanding of creativity. Our sample was  
618 recruited according to age and gender quotas to capture a range of experiences across  
619 demographic groups, and not to compare these experiences between groups. Some  
620 participants discussed creativity in relation to their work, and indeed some worked  
621 specifically in creative fields, while others focused only on hobbies. We think this is a  
622 strength of the work, in that it views creativity as a process that all individuals undertake in  
623 differing ways, but we suggest that further research examines whether the themes identified  
624 in this study also apply to professional creative practice more specifically. It is notable that  
625 three of the participants had occupations relating to physical and/or psychological wellbeing  
626 (e.g., therapy) and may have had an intrinsic interest in related psychological research. We  
627 also did not systematically examine participants' engagement or identification with nature  
628 (e.g., nature connectedness, frequency or length of time spent in nature per week, etc.) which  
629 may be useful to capture in future studies on nature and creativity.

630         Future research in this area may seek to examine whether nature experiences can  
631 causally and quantifiably enhance creative output through change in either cognitive  
632 processing, affective state, or both. Such a study might, for example, compare effects of

633 different types of nature (e.g. tranquil versus dynamic) as well as more traditional natural  
634 versus urban environments; utilise standardised measures such as the Alternate Uses Task  
635 and inventories of mood and cognitive state; and examine mediated relationships between  
636 nature experience, creative outcomes, and cognition/affect. Beyond the laboratory, future  
637 research might also examine *in situ* nature experiences in the workplace and whether and  
638 how these can have quantifiable effects on creativity in a professional setting.

639

### Conclusions

640 Interest is growing in whether nature can offer diverse psychological benefits,  
641 including supporting creativity. In this interview-based study, participants perceived positive  
642 affective states achieved through experience of nature to benefit their creativity; however,  
643 contrary to traditional study of restorative environments, and lab research on mood-creativity  
644 links, both high- and low-arousal affective states arising from nature were considered helpful  
645 for creativity, as was novel and unpredictable nature. Nature was also perceived to benefit  
646 creativity through increased interest and attentional focus, while aspects of nature that  
647 captured attentional focus but were negatively affectively valenced were seen as unhelpful  
648 distractions. The physical properties of environments (landscapes, flora, and fauna), sensory  
649 processing of environments, and factors relating to the self were identified as potential factors  
650 underpinning the aforementioned affective, cognitive, and aesthetic processing indicating the  
651 need for more nuanced experimental research to explore the specific aspects of nature  
652 experiences that support creativity. This study identifies environmental properties and  
653 psychological processes perceived as important in experiences of everyday creativity, and  
654 adds to a growing body of work on the benefits of nature beyond recovery from negative  
655 states.

656

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Table 1. Participant IDs, demographic details, and creative interests.

ID*	Age	Gender	Occupation	Creative interests
1	30	Male	Clinical hypnotherapist	Arts, music, writing, business
2	24	Female	Support worker	Arts, sports, writing, drama
3	36	Female	Product manager	Arts, dance, writing
4	37	Male	Horticulturalist	Arts, music, cooking
5	66	Male	Retired architect	Arts, architecture, antiques
6	66	Female	Retired architect	Arts, music, drama, cooking
7	74	Female	Retired psychotherapist	Arts, dance
9	58	Male	Musician	Arts, dance, writing
10	61	Female	Sessional tutor	Sports, science
12	46	Female	Teacher	Sports, business
13	48	Male	Retail manager	Music, sport, business
14	67	Male	Accountant	Arts, drama, cooking
15	25	Male	Student	Arts, music, sport, drama, gardening
16	22	Male	Student	Music, dance, sport, writing
17	49	Female	Homeopath	Writing
18	24	Female	Student	Singing, childcare
19	64	Male	Retired journalist	Arts, architecture, business
20	63	Female	Retired	Arts, writing, cooking
21	69	Male	Designer	Arts, dance, writing
22	70	Female	Designer	Writing, sports

\* Data from two additional participants (IDs 8 and 11) were withdrawn after interviewing, and so they are not listed here.

Table 2. Frequencies of theme occurrences across interview transcripts.

Theme	Frequency
<b>Affective appraisals</b>	<b>88</b>
Happiness, pleasure	31
Relaxation, peace, safety	28
Negative affect	22
Awe, excitement, arousal	7
<b>Cognitive appraisals</b>	<b>82</b>
Inspiration	21
Memory	21
Maintaining focus/distraction	17
Reflection, restoration, being away	14
Interest, effortless attention	9
<b>Aesthetic appraisals</b>	<b>81</b>
Change, contrast, (un)predictability	39
Perceived accessibility	20
Spatial extent	13
Beauty	9
<b>Environmental properties</b>	<b>195</b>
Green space	60
Weather and season	45
Blue space	35
Animals	28
Trees, plants, and flowers	18
Landscape	9

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<b>Sensory experiences</b>	<b>111</b>
Sound	46
Vision	29
Touch, haptics	28
Smell	8

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<b>Self</b>	<b>72</b>
Identity and attachment	22
Memories	21
Alone vs company	17
Behaviour and active engagement	12

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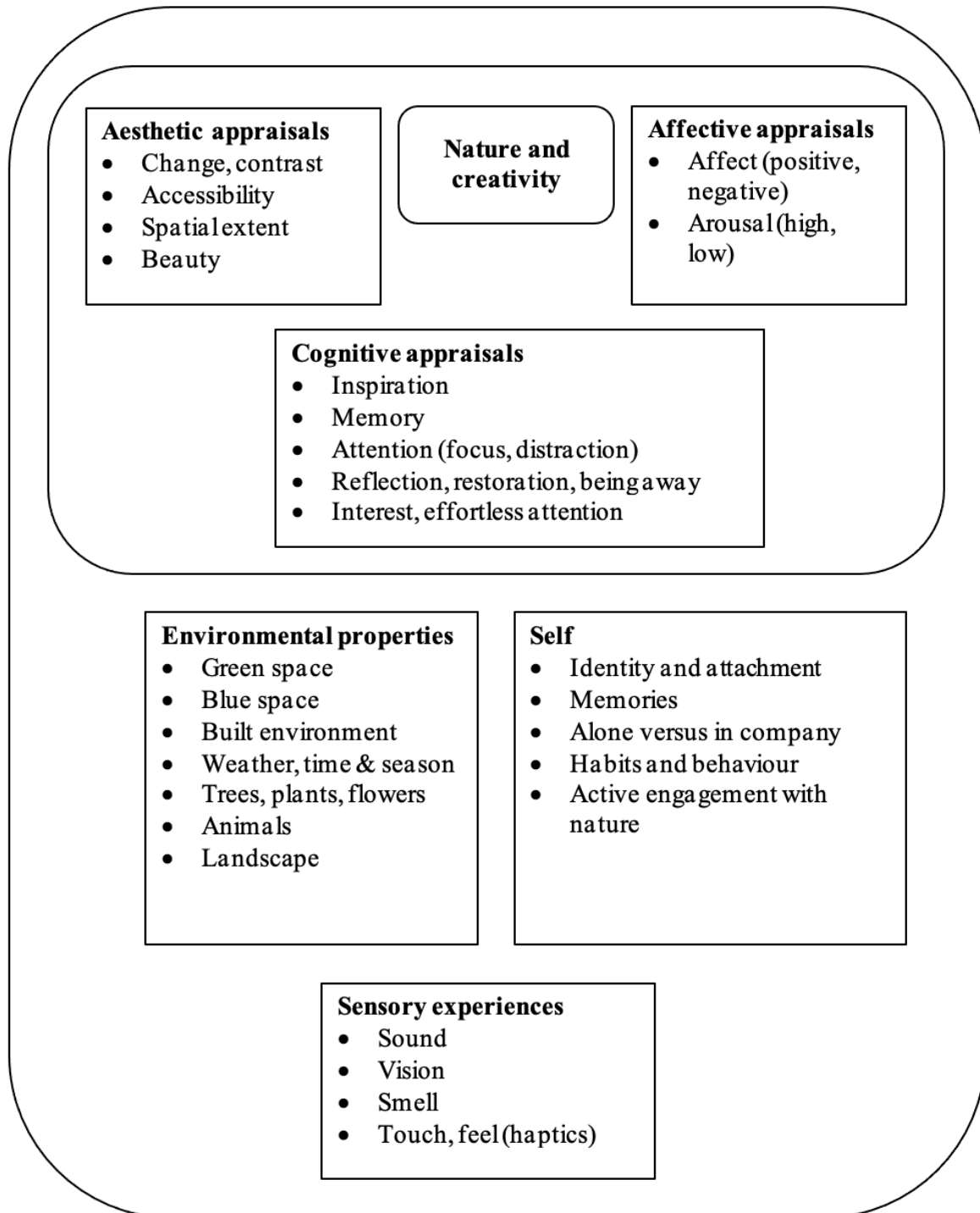


Figure 1. Themes and subthemes identified in analysis.

**Appendix A: Full interview schedule. Responses to creativity questions are analysed in the present manuscript. Responses to questions on ART and SRT were reported in Ratcliffe et al. (2013). Order of sections was counterbalanced.**

## Warm-up

- I'd be interested to know what your favourite place is. [*By 'favourite place' I mean a place that is important to you, or well-liked by you, or valuable to you personally*]. Can you tell me a bit about it?
  - *What is it like?*
  - *Why do you like to go there?*
  - *What kind of things do you do there?*

## Creativity

- Thank you. In this section I'd like to ask you a bit about your [creative activity]. What kind of environments would help you think about and take part in [creative activity]?
  - Would you go to a natural environment?
    - If yes, can you describe it for me?
    - What about that place do you find helpful? (Prompt used in case of participant non-response: *For example, things you can see/hear/smell/touch?*)
    - Why do you think that is?
  - If no, why is that?
- Are there any natural environments that would make it harder for you to think about and take part in [creative activity]?
  - Can you describe them for me?
    - What about them might make it harder?
    - Why do you think that is?

## ART

- That's great, thank you. Now I have a few scenarios that I'd like you to imagine. In the first scenario, I'd like you to imagine that you're exhausted after working hard on a task, and you're finding it hard to concentrate. Where would you go in order to restore your ability to concentrate?



- *Would you go to a natural environment? [e.g. a park, garden, forest, the beach...]*
    - *If yes, can you describe it for me?*
      - *What about that place do you find restorative? [Things you can see / hear / smell / touch]*
        - *Why do you think that is?*
    - *If no, why is that?*
- Are there any natural environments that would make it harder for you to concentrate?
  - *Can you describe them for me?*
  - *Why might they make it harder for you to concentrate?*
    - *Why do you think that is?*

## SRT

- In the next scenario I'd like you to imagine that you are stressed and in a negative mood, perhaps after having an argument. Where would you go in order to relax?
  - *Is there a natural environment that you might go to?*
    - *If yes, can you describe it for me?*
      - *What about that place do you find relaxing? [Things you can see / hear / smell / touch]*
        - *Why do you think that is?*
    - *If no, why is that?*
- Are there any natural environments that would increase your level of stress?
  - *Can you describe them for me?*
  - *What about them do you find stressful? [Things you can see / hear / smell / touch]*
    - *Why do you think that is?*

## Closing

We're coming up to the end of the interview now. Is there anything else about different places, and particularly natural environments, that you would like to talk about? OK, that's great – thank you very much for your time and participation. I'll turn off the recorder now.