Health & Place 46 (2017) 358–365

Contents lists available at ScienceDirect

Health & Place

journal homepage: www.elsevier.com/locate/healthplace

Place, green exercise and stress: An exploration of lived experience and restorative effects☆

Gunnthora Olafsdottir[a,b,*], Paul Cloke[b], Claus Vögele[a]

[a] Institute for Health and Behavior, Research Unit INSIDE, University of Luxembourg, Faculté des Lettres, des Sciences Humaines, des Arts et des Sciences de l'Education, Maison des Sciences Humaines, 11, Porte des Sciences, L-4366 Esch-sur-Alzette, Luxembourg

[b] Geography, College of Life and Environmental Sciences, University of Exeter, Rennes Drive, Exeter EX4 4RJ, U.K.

ARTICLE INFO

Keywords:
Restorative environment
Stress responses
Green exercise
Context effects
Lived experience

ABSTRACT

This paper reports on inter-disciplinary research designed to investigate the stress-buffering effects of green exercise, and the importance of the context in which exercise takes place. This investigation of *context effects* examines both individual physiological responses (salivary cortisol) and the phenomenological interpretation of *lived experiences* of the intervention, reported by a subsample of participants in a randomized, controlled trial, in which healthy, physically inactive university students were randomly allocated to three activities: walking on a treadmill in a gym, walking in semi-natural recreational area, and sitting and watching nature-based videos on TV. The study found clear indications of context effects, notably in the connections between positive appraisals of perceived circumstances, enjoyment in the enacted context, and physiological stress-reduction.

1. Introduction: exploring environment and stress

This paper draws on the findings of an interdisciplinary research project designed to investigate the idea that natural environments[1] have the potential to perform as affective landscapes that ameliorate or counteract the effects of stress in human physiology and experience. To date, restorative health effects of exposure to nature have been quantified in cognitive measures of mental fatigue (attention performance) and/or the physiological changes related to stress (cardiovascular measures and/or cortisol), as well as in the self-reported changes in perceived stress and mood (as assessed by questionnaires) (Valtchanov et al., 2010). A series of studies suggest a connection between exposure to nature and psychological benefits compared to equivalent effects in urban environments (see Health Council of the Netherlands (2004), Bowler et al. (2010), Thompson-Coon et al. (2011)). Tests in the context of *green exercise* – that is physical activity with direct exposure to nature (Pretty et al., 2003) – confirm that green exercise benefits people more than exercise in less natural environments (see for example Mitchell (2013) on mental health, Marselle et al. (2013) on perceived stress and negative emotions/mood). Other studies (Gladwell et al., 2012; Park et al., 2010; Lauman et al., 2003; Li et al., 2011; Ulrich, 1981) report greater physiological stress-reduction in relation to physical activity in natural as opposed to urban settings (as assessed by changes in heart rate, blood pressure and/or cortisol). Systematic reviews of this literature suggest that physical activity or inactivity in nature compared to urban settings is associated with improved mental health and wellbeing, but over-emphasis on self-reporting and insufficient physiological evidence makes the confirmation of stress-buffering health effects in nature-rich places difficult (Bowler et al., 2010; Thompson-Coon et al., 2011). More research is, therefore, needed, and the scope of current research can usefully be widened to include investigations of lived experience. Physiological stress-responses are mobilized by perceived physical or psychological threats (the "fight-flight response" - Cannon, 1936) that make demands on the organism (Selye, 1955, 1979), which the brain discerns as an emergency and seeks to deal with immediately. Yet, as extensive research on stress appraisal over the last five decades has demonstrated, individuals have the capacity to respond very differently to a given stress situation, depending on their cognitive appraisal (Lazarus and Folkman, 1984). The mindfulness of individuals is, therefore, crucial to the outcome of stress exposure, and the inclusion of personal narratives in research aids the investigation of individual thought-processes, and the identification of appraisals and experiences that arise in the studied context, thereby augmenting and helping to explain physiological outcomes.

In environmental psychology the notion of *restorative environ-*

☆ The authors declare no competing financial interest.

* Correspondence to: Icelandic Tourism Research Centre, Askja, the House of Natural Sciences, University of Iceland, Sturlugata 7, 101 Reykjavík, Iceland.
E-mail addresses: gunnthora@hi.is (G. Olafsdottir), p.cloke@exeter.ac.uk (P. Cloke), claus.voegele@uni.lu (C. Vögele).

[1] Our use of the terms "nature" and "natural environments" suggests outdoor environments, usually beyond the city.

http://dx.doi.org/10.1016/j.healthplace.2017.02.006
Received 5 May 2016; Received in revised form 31 October 2016; Accepted 13 February 2017
Available online 06 March 2017
1353-8292/ © 2017 Elsevier Ltd. All rights reserved.

ments (Hartig, 2004) has been widely used. According to this notion, the diminution of psychological and physiological resources and capacities by the demands of everyday life can be counteracted and restored by access to the environment (Korpela et al., 2014). These restorative effects have been interpreted in the context of: (1) *Attention Restoration Theory* (ART; Kaplan and Talbot, 1983; Kaplan and Kaplan, 1989; Kaplan, 1995) that uses the concepts of attentional recovery and mental fatigue, and associates restoration with psychological connections between fascination and the restored ability to direct attention; (2) *Psychophysiological Stress Reduction Framework* (PSRF; Ulrich, 1981, 1983 see also 1984; Ulrich et al., 1991; Parsons et al., 1998) that focuses on the immediate stress-reducing effects of the environment and frames restorative effects in terms of psychophysiological stress-reduction that occurs when humans encounter non-threatening environments. Both theories suggest that nature-rich places are more likely to facilitate restoration than other places, and imply that attraction to nature and the felt therapeutic effects of "being there" are rooted in biological and psychological processes *that may be examined with context and mind-set dependent interactions with the environment*. ART argues that recovery from mental fatigue and enhanced ability to focus relies on entering a specific mode of attention – a mode of captivating fascination – involving a four-step process where the mind has been distracted from focusing on the circumstances that promoted tired/exhausted/stressed reactions, and instead flows effortlessly in different directions (Kaplan and Talbot, 1983; Kaplan and Kaplan, 1989). According to PSRF (Ulrich, 1981, 1983 see also 1984; Ulrich et al., 1991; Parsons et al., 1998) stress-reduction involves perception and acknowledgement of places as non-threatening so as to enable the person to relax and recuperate.

Previous studies suggest a need to be sensitive to the context in which restoration takes place. When in need of restoration, individuals show preference for places they believe will have such an effect (Staats et al., 2003) indicating that activity can be understood as a kind of self-regulation when requiring a restorative breather from the taxing everyday (see also Korpela (1991), Korpela and Hartig (1996)). Drawing on PSRF, Ottosson and Grahn (2008) suggest that one of the reasons for restorative effects is that time spent in nature allows people so see themselves and their lives from a different perspective and this *per se* seems to prompt a sense of well-being. Brymer and Gray's (2009) phenomenological study on the lived experience of extreme green sport show that part of the attraction, and the rewarding outcomes concerned, is linked to the meaningful person-specific relationship their study participants had developed with nature through their athletic adventures.

The current study examined whether green exercise (walking) has greater stress-buffering effects than the same exercise indoors or sedentary and representational exposure to nature. To attend to the mindfulness of individuals, *context effects* were also considered (Di Blasi et al., 2001) by exploring the ways in which stress-buffering effects are influenced by personal, cultural and space/place contexts in which exercise/practices are performed. This study deliberately draws on two very different methodological frameworks. The first, in the genre of environmental psychology and psychophysiology, draws on restoration theories and uses a randomised, controlled intervention trial design to assess psychophysiological responses to standardised tasks involving non-exercise and exercise in indoor and outdoor settings. The second draws on socio-cultural ideas practiced in human geography using qualitative research to explore the individual lived experiences of participants during the experimental period. To engage with responses to context effects within the personal narratives, and to tease out and understand the perception and appraisals of circumstances therein, we draw on the notions of *positionality*, *situated knowledge* and *lived experience*. Positionality (Hartsock, 1987) acknowledges that people perceive the world through the filters of the socio-cultural milieu in which they have been brought up, socialised, educated and familiarised. People exist, therefore, with norms and values that produce both specific styles of perception and different readings of and relations to the world, including the natural world (Rodaway, 1994). Situated knowledge (Haraway, 1991) provides a sensitivity to how individual differences and specificities are drawn on, intellectually and emotionally, in specific circumstances. Thus understanding of the studied event will be co-produced by the activity, its context, and the ways in which individuals situate their engagements within personal systems of interpreting knowledge and experience. Finally, drawing on ideas from phenomenology (see Heidegger (1962)) that articulate the individual as a relational being – as a mind-body-environment entity – an emphasis on the lived experiences of research participants allowed us to acknowledge that experience results from interactions between individuals and settings, and to delve into the co-constitutive creativity emerging from individual participation in the studied events. Together, attention to positionality, situated knowledge and lived experience helped us to identify individual appraisals of the circumstances under study in order to help explain individual physiological responses.

Although these two approaches appear distinct and subject to very different codes of ontology and epistemology, and in some circumstances could be deemed to be oppositional in nature, the research design has remained open to the broad idea that the two distinct sets of findings can work to some degree in tandem, reflecting a co-production of knowledge about the inter-relations between place, exercise and stress. Detailed quantitative results from the research are published elsewhere (Olafsdottir et al. submitted). The purpose of this paper is to examine how the qualitative elements of the research bring additional resources to this co-production of knowledge; how a detailed understanding of the life-experiences of particular participants can both contextualise and help explain their responses to scientific experimentation, and to introduce wider understandings of the performative specificities that occur when everyday lives intersect with scientific interventions.

2. Materials and methods

2.1. Research procedure

The study took place in Reykjavik, Iceland. An ethical approval was granted from the Ethics Research Pannel of the University of Luxembourg and the Icelandic Bioethics Committee (ref. no.12-210-GR). Ninety healthy, physically inactive student participants, were randomly allocated to one of three 40-min activities: walking-in-nature, walking-in-the-gym, or watching-nature-on-TV. The settings involved a sign-posted circular-route in a recreational nature-park (walking-in-nature), a treadmill in a popular gym (walking-in-the-gym), and a "sitting-room" in a university laboratory (watching-nature-on-TV). The quantitative data were collected on-site in a cabin situated right next to the footpath, a gym-customer interview-room and an adjoining laboratory respectively (Fig. 1).

Individuals participated in two identical, individual experimental sessions, first during a relaxed non-examination period (January-February) and then again during a more stressful examination period[2] (April-May). Afternoon appointments ensured optimal timing for cortisol measurements in terms of the circadian rhythm of hypothalamic-pituitary-adrenal cortex (HPA) activity. Participants were instructed not to arrive hungry or thirsty, but to refrain from food or drink intake 1 h prior to the appointment. After explanation of the study protocol and agreed informed consent, psychophysiological effects of the activities were measured by collecting information on mood (PANAS; Crawford and Henry, 2004), heart rate and heart rate variability (ECG), salivary cortisol and attention performance (Necker-

[2] Academic stress is used in stress research as a naturalistic stressor (Lewis et al., 2008; Ignacchiti et al., 2011).

Fig. 1. The research settings and measurement facilities: nature (top left and right), gym (middle left and right); TV (bottom left and right). Source: Olafsdottir (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

cube test; James, 1890/1983; Orbach et al., 1963) immediately before and after the activities. After the post-activity measurements, and with further informed consent, participants undertook a standardised laboratory stress task (socially-evaluated cold-pressor test (SECPT); Schwabe et al., 2008) followed by measurements including all the tested parameters (except attention performance) to investigate differences in acute stress responses relating to these different interventions (Olafsdottir et al. submitted[3]).

During debriefing and recovery, a random subsample of 18 participants, 3 males and 3 females from each group, participated in the qualitative study involving a one-page diary-note about their experience and a semi-structured interview scheduled the following day, in which individuals were asked to narrate their participation within their wider life story. After informed consent, the researcher read the diary-note to get an initial sense of individual experiences. During the interview, particular emphasis was given to provoking responses about what went through their minds and how they felt during the studied activities. In addition, a research diary was kept for participant observation during all times of contact with the study participants where the researcher took note of voluntary comments and the environmental conditions that could have affected measurements and individual experiences during participation.

[3] Olafsdottir G., Cloke P., Schulz A., van Dyck Z., Eysteinsson, Th., Thorleifsdottir B. and Vögele C., (submitted). Walking in nature has a stress-buffering effect on chronic but not acute sress: A randomized controlled trial. For more information on this manuscript please write to gunnthora@hi.is.

2.2. Analysis of stress responses

Mixed-methods were used to interconnect findings about individual mind-sets and physiological stress responses. On the physiological level we focused on the stress hormone cortisol due to the well-established links with appraisals, although cardiovascular (HR, HRV) and cognitive (directed attention performance) parameters were also measured. Elevated levels of circulating cortisol measured from saliva, blood or urine is the end product of hypothalamic-pituitary-adrenocortical (HPA) axis activation and one of the fundamental markers of the physiological stress response (Michaud et al., 2008). Apart from food intake, it is stress that induces increased cortisol levels in healthy individuals during the day, and changes in cortisol levels can thus be strongly connected to the perception of stress or distress (see Sapolski 2004a, 2004b). Saliva samples were collected from each participant before and immediately after the 40-min interventions and 18 min after the SECPT to allow for cortisol responses to peak. Sixty-seven participants completed all measurements (nature=20, gym=24, and video=23). For the evaluation of restorative effects of different environments on chronic and acute stress, we compared mean scores (Herzog et al., 2003). Outlying values were defined as larger than ± 2 SD (n=1; gym) and were excluded from the analysis. The findings from the analyses of cortisol levels are discussed in detail elsewhere (Olafsdottir et al., submitted[3]). In summary, no significant initial differences were found between groups. As expected, individuals were significantly more stressed during the exam-period compared to the no-exam period. All groups showed statistically significant reductions

in cortisol after both interventions. The green exercise group had the largest reduction, although it was not statistically significant (Olafsdottir et al., submitted[3]). Here we need to emphasise that there is no easy cross-over between group and individual results. The experiment was designed to validate group data, in which individual readings may be statistically unreliable. However, as context for detailed qualitative investigation, the descriptive use of individual readings can help indicatively to locate the experiences of case study individuals within broader group dynamics.

With these caveats, our research design permitted us to delve more deeply into the circumstances summarised in the group responses, by engaging with individual narratives that augment and help to explain person-specific physiological outcomes. To ensure comparability of responses from the interviewed subjects with the sample, the mixed-methods analysis on stress focused on the effect of the intervention of the first experimental trial (the no exam period). Sixteen of the interviewed participants completed the study. Diary notes and narrative interviews were transcribed verbatim, read and analysed using Interpretative Phenomenological Analysis (IPA; Smith, 1996; Smith et al., 2009), which articulates the individual as a relational being and allows detailed examination of lived experiences. In the first instance the analysis focused on answering the question: *How do people in the given activity-situation relate to their circumstances, and what lived experiences arise?* Thereafter a secondary theory-driven focus questioned: *To what extent can personal accounts of lived experiences in situ be explained by the context effect implied by the restoration theories and stress research?* Individual relational landscapes were analysed in terms of positionalities, situated knowledge and lived experience, and whether the embodied relations therein led to threatening or nonthreatening (stressful or not) circumstances – or both. Close attention was given to whether the reported lived experiences matched the conditions for restoration suggested by restoration theories. Finally, individual lived experiences were broadly categorised according to the predominant lived experience/appraisal of the walk/viewing, and examined in the relation to the person-specific changes in cortisol levels.

3. Results

The study found clear indications of context effect, suggesting that appraisal/experience of a non-threatening circumstance accompanied stress-reduction. While those participants who reported having experienced threatening circumstances for the majority of the intervention showed increased cortisol levels by up to 3 nmol/l (gym: n=2), those who reported rewarding, non-threatening experiences for the majority of the time (nature: n=4; TV: n=3), or a mixture of both, yet managed to positively cope with what threatened their enjoyment by deploying person-specific strategies (nature: n=1; gym: n=3; TV: n=3), decreased their cortisol levels from 1–8 and 0–6 nmol/l respectively.

Given the limited scope of this paper, we present three illustrative case-studies, one from each research setting, that represent individuals whose experience was characterised by a (1) sense of threat where cortisol levels indicated *increase* in stress, (2) non-threatening circumstances and an average stress response, and (3) a mixture of both yet managed to cope positively with the threat and achieved an above average *decrease* in stress. Individual narratives connecting lived experiences and contextual specificities with cortisol change are followed by a broader discussion. To ensure confidentiality, pseudonyms are used.

3.1. Walking-in-the-gym: John's experience

The walk took place on a treadmill in the main hall of the gym. The participant was instructed to walk at a self-selected pace similar to that required for a refreshing walk outdoors. John was one of the two individual participants in the gym group who demonstrated *increased* stress levels. He was dealing with a personal dilemma; realising that his partner's previous relationship had never properly ended, John had moved out, and was in the middle of highly emotional discussions about whether the relationship could continue. He reported a sense of betrayal as well as guilt over his actions:

> *I'm afraid that he's doing something that he shouldn't be doing. So… in this paranoia I took his IPad, looked through his emails, and the messages on Facebook, his phone… But I am so so sad that I did. […] When I realised what I had done I, you know, „euuuh! " [disgusted] immediately threw the IPad away and now I feel so guilty.*

John also told us that he finds the gym environment itself stressful:

> *I'm not the gym type. I don't go to the gym. It's stressful for me. […] I also think that the majority of people there are incredibly… I have this stereotypical image of you know „skinkur" and „hnakkar" [Icelandic terms for types of people who are preoccupied with their looks]– everybody is so incredibly fit, and tanned and beautiful.*

Upon arrival John scored 13 nmol/l in cortisol, indicating a high level of stress (according to Hansen et al. (2003), the normal cortisol level for a workday afternoon in healthy persons is between 4 and 9 nmol/l). Moreover, he reported feeling out of place on the treadmill, not least experiencing awkwardness and anxiety because he was wearing gym-wear yet only walking and not conforming to normal behaviour by *running* on the treadmill whilst tuned in to his favourite music.

Attempting to be a "good" research participant, he made a conscious effort to push the boyfriend-thoughts to the back of his mind, worrying they might negatively affect the results of the experiment. However, this emotional concern persisted, as a debate whether or not to tell his partner about spying on him, and as a concern that the "old boyfriend" lived close to the gym and might turn up while John was on the treadmill:

> *I was monitoring the doorway - looking into the mirror that turned towards the doorway with a stress-knot in my gut. I tried to push these thoughts away you know…: „He is probably not the gym type either…" but I couldn't. This sounds so crazy. [laughs]*

With approximately 5 min remaining of the walk, he had decided to tell his partner about having read his emails, and made a conscious decision to spend these last minutes thinking about something nice. He started picturing himself walking outside – on the snowy path in the green area close to the gym. He was amazed by the calming effect of this imagination:

> *John: It was really calming when I pictured myself walking outside in nature*
> *Gunnthora: What kind of nature, describe the setting?*
> *John: There were trees and the trees had snow and it was cold and still and everything was somehow so peaceful.*
> *Gunnthora: And the effect was calming?*
> *John: Yes! It is incredible considering what had been going on hahaha… So yes, I just clicked into a different setting and it was so comfortable [laughs]*

After the walk cortisol in John's saliva had increased by 1 nmol/l.

In John's narrative, we find a person who is predominantly unable to extricate himself from the contextual circumstances of his life. As a result, he found no respite in the gym, indicating how the mind-set of a participant can revolve around a totally different context than the one under study. This vignette also illustrates a person who is randomly assigned to a place and practice that he does not feel comfortable with. When in need of a "breather" he would rather go for a walk/run along the coast. The positional, situational and experiential vagaries that dominate the "performance" of this individual participant would, in statistical terms, be 'averaged out' within analysis of wider group data.

In this case it was not included in the statistical analysis as his cortisol level *after* the intervention was beyond ± 2 SD from the normal distribution in the gym group. Yet they illustrate that even the most careful experimental design and measurement can only partially isolate the role of place and activity in the determination of individual stress levels. Interestingly, the example also shows how a participant can be formed into a research subject, with a concern about whether he is performing as a „good“ research subject by focusing on experimental parameters rather than contextual life experiences.

3.2. Walking-in-nature: Felix's experience

The walking-in-nature exercise took place in a protected nature-park, characterised by patches of woodland, moss-covered lavafields and heathland where the view opens up to the neighbouring mountains, the bay and city. All participants except one (who reported that he was pressed for time) showed reduced stress-levels. Felix was one of five participants who closely reflected the group-average stress-reduction. He arrived at the site tired but happy; life was good. He had recently enrolled on a university masters-program designed for people working full-time. His day-job had become too easy to manage and despite time-consuming academic projects, he enjoyed being back at university and tackling the challenges that compulsory group-work entailed.

Felix expressed gratitude for being assigned to the nature walk because he likes this kind of outdoor exercise and believes in the healing agency of nature. The timing of the experiment was perfect because the past weeks had been hectic, involving some anxiety because of personal issues. Felix found coming to the research site without fully knowing what awaited him a bit of a challenge, but he trusted the experimental design, and after the pre-walk briefing he felt he was unconcerned, and glad to be helping the study. Upon arrival his salivary cortisol level was 7,5 nmol/l, which was well within the normal range of the diurnal cycle. During the walk the familiar positive effects arrived for him almost instantly:

> *I felt it very soon after I started walking… just you know ahhh… started to breathe and appreciate the fact of being there. It was also such perfect timing for me right after my relaxing weekend and I felt the stress starting to go away. There were moments when I got Goosebumps. I sometimes get these physical signs when the stress is leaving my body.*

Felix loved being in nature, and identified particular aspects of visuality, tactility and hapticity which he associated with a performance of connecting with nature:

> *I noticed the sky – it was beautiful and the light was also so lovely…. I noticed the trees that are of course lovely and the snow. There hasn‘t been too much of it so I grabbed some in my hand to make a snowball also to get in touch with nature. I do this very often when I am walking in the forest, I pick up a branch or something and use it as a walking stick or use it to touch different things. I think this is part of my being in nature that I need to touch different things.*

He made a short stop to admire the view, then lay down on the snow so he could appreciate the sky for a while, whilst digging his fingers into the ground to get in touch with nature:

> *Being there conjured up such a wonderful feel-good feeling, it is like, it's like you have arrived to a good place and you even get a feeling that you are home.*

He also reported thinking about things in a different way and finding new perspectives in different areas of his mind-set:

> *You start going through things in your head and sort out what to give attention and what not: „Okay I will leave this at home.“ It is a bit like a vacation even though it is only for an hour or so, you give yourself time and space to think about things that you do not normally think about. And it's very inspirational. The thoughts that occupy your mind they start rolling but you start working on them… somehow you start processing them differently and then ssssssssss…. the cleaning takes place and you get more space to think about things and to think about them differently. You get a different perspective on things. And that happened that day. I left the everyday stressful Felix behind.*

When he returned from the walk his cortisol level had decreased to 4.5 nmol/l – lowering the level by 3 nmol/l in 40 min – feeling refreshed and free from the stressors of everyday life:

> *When I came back from the walk I felt free from the impingement and the city environment that sort of pushes you in a way. So the effect of being in nature is like… you somehow get rid of that.*

Felix's narrative fits well with the hypothesised expectations about environment, practice and stress. He needs restoration, walking in nature is one of his favourite pastimes and the way he would normally seek stress relief, and during the experiment he manages to remove himself from his everyday thought processes and embrace the research environment with excitement and joy. His narrative suggests an absence of dissonance from individual positionality, cultural prescription or parallel life experiences.

3.3. Watching-nature-on-TV: Tim's experience

In this group, participants were asked to watch a 40-min video featuring scenes from the trail used in the walking-in-nature exercise. The video featured background sounds (for example bird song) rather than commentary. Tim was one of two individuals who experienced a far greater than average level of stress-reduction during this activity. His narrative of life experience was dominated by a recent relationship break-up. To buffer the pain and to readjust he decided to move and go back to university, although in doing so he forfeited a good job and a close-knit circle of local friends. He was glad to be back at university, but was regretting his bad choice of subject, although determined to finish the semester. He was in a good mood, excited about his participation and determined to be a “good” research participant by leaving his stressful thoughts at home, although with some anxiety because he did not totally understand the demands of the experiment. His salivary cortisol concentration was 16 nmol/l up on arrival, which is far higher than the normal score of 4–9 nmol/l for healthy individuals, and represents one of the highest baseline scores of the entire sample (5–17 nmols/l).

At the start, he did not like the video, principally because of annoyance at the lack of music. “Documentaries”, he argued, “always have music or commentaries”. Then he remembered the purpose of the experiment:

> *…then I thought that the sounds of nature were of course the best music for this video. Of course! And then I became open to put together what I was seeing and what I was hearing and that was much more effective… when I stopped focusing on „where's the music? ! “ [smiles…]*

After this realisation, having made a conscious decision to be open to what the video had to offer, he noticed the beauty in different natural phenomena: the ice-sheet on the trail and the melting water that ran underneath it; the powerful sweeping sound of the wind going through the woods. In these ways he began to recognise the beauty and power of nature:

> *Everything was so beautiful. Sometimes I felt …really small because nature is much more powerful than humans.*

Sensing this power reminded him of the documentary *Earth after*

Humans (de Vries 2008–2010) which speculates that if humans would disappear, it would take nature 5 years to obscure any signs of human existence:

> *...like we had never been here. [on Earth]... It reminded me of how strong nature is and it conjured a deep sense of respect for it.*

The sky and the slowly moving clouds in the video also arrested his attention, along with the snow that was blowing off the mountain top. Before he knew it his experience was one of being completely swept away:

> *I didn't see the TV anymore, I became totally absorbed with the movie. The snow blowing off the mountains reminded me of a dream I had dreamt a long long time ago when I was in secondary school learning about Skadi – the winterqueen of heathen mythology. She was coming down the mountain on her sledge that was pulled by her wolves. She is the token of extreme winter so she isn't particularly good person, but she is so so beautiful and strong. It didn't stop me from watching the mountain – I was in total awe of the mountain even though I just saw the top of it. But mountains are so big and there was so much going on simultaneously with the natural forces and I was in awe because of that.*

After the intervention Tim's cortisol level was 8 nmol/l in cortisol, lowering his baseline by 8 nmol/l.

Tim's narrative illustrates a deviation from what might have been anticipated. His life circumstances were reflected in a high initial indication of stress, and his early responses to the practicalities of "watching nature on TV" were negative. Nevertheless, Tim illustrates a capacity to translate the virtual televised experience of being-in-nature into a more meaningful personal series of imaginative and emotional responses that not only serve to deflect him from his current situated life experiences, but also results in a marked indication of stress reduction.

3.4. Contexts at work

De Certeau (1984) analyses human practice in terms of three main types of mechanism: *the believable*, that is the positional and situated knowledge that authorise practice; *the memorable,* that is how practice builds on past experiences; and *the primitive,* that is organic reactions to place and context. Using this framework, the three narratives presented above can be used to explore the enacted context with attention to positionality, situated knowledge and lived experience in an effort to tease out individual appraisals of the circumstances and individual physiological responses. According to PSRF (Ulrich, 1981, 1983) and ART (Kaplan and Talbot, 1983; Kaplan and Kaplan, 1989) preconditioning a restorative effect of an environment involves being able to set aside the mind-set formed by stressful life experiences (PSRF and ART) and appraising the situation as nonthreatening (PSRF).

John's positionality is mainly characterised by translations between three distinctive contexts and roles that shape his engagements with self and'other' in a negative way: being a lover, a participant in gym-exercise and a research participant. As a lover, John was occupied by recent negative relational events. What authorises this practice are a series of unwritten expectations about faithfulness, trust and mutual affection. When these conventions are usurped, a negative judgement is authorised, and John's mind-set reveals the directive agency of these ideas. He was sad, angry, and self-pitying on the one hand, and guilty on the other. In these circumstances, the thought of the 'old boyfriend' showing up in the gym created stress, with the consequence that the relational landscape produced and appraised in this instance becomes threatening rather than stress-relieving. As an additional stress factor, John did not feel "at home" in the gym – his positional and situational production of knowledge lead him to regard the gym – as a place for people (unlike himself) who are pre-occupied with their looks and body-image and accordingly he perceived/appraised it as a threatening environment. Also, the performance of walking did not "fit in" with this environment, and the gym clothes he was wearing did not match this performance. His mind-set reflects a sense of "proper" gym performance where you exercise hard, sweat and listen to loud music that helps you work through the pain. Failure to live up to these norms degrades his performance and he is therefore unable to relax because he feels out of place. Accordingly, he is forced to remove himself from this negativity in order to focus on something more positive. He chose to go for an imagined walk in winter-wonderland, where everything was perfect and beautiful, where he experienced a sense of calm and peace. John's cortisol level increased from 13 to 14 nmol/l, an unsurprising outcome given that he spent most of his time experiencing fear, guilt and anxiety. The calming effect of the imagined nature-setting suggests that the parasympathetic system was initiated with those thoughts. But as it only happened at the very end of the intervention it might not have been long enough to for the cortisol to decline. Also it was immediately counteracted after the treadmill stopped, when he had to let go of the Romantic daydream and get himself to the room for measurements. Then the pressure was on again – he wanted to be a good research subject.

Felix's relational landscape tells a different story. He is satisfied with life; tired but unconcerned. As a research participant, everything matches Felix's needs at the time to relax and recuperate. His narrative situates him within Romanticist ideas about the therapeutic value of walking in nature and its contrast with everyday life. The natural world on this occasion lived up to his expectations perfectly – there was nothing that threatened his enjoyment of the walk. He performed the setting in a trusting manner, and was able to remove himself from the thoughts that had characterised his everyday. The outcome was a cortisol drop from 7,5 – 4,5 and a nurtured feeling of renewal.

Tim was extremely stressed upon arrival because of his immersion in life-changing events that were taking their emotional toll. He, like John and Felix, desired to be a good research participant to the extent that he took the conscious decision to try to set aside his worries before showing up at the lab. Nonetheless, he had one of the highest cortisol scores of all the participants. The video did not immediately live up to his preconceived image of how nature should be authorised and positioned. He drew upon nature documentary norms, resulting in an evaluation and appraisal of the video that threatened to spoil his enjoyment throughout the event. However, he started to re-analyse how to perform the research scenario, remembering its experimental purpose. Thereafter, his positionality assumed characteristics associated with Romanticism and the Sublime, enabling his engagement with and appreciation of nature as wild, spectacular, incontrollable and powerful; unthreatening attributes that conjured up respect for nature's power and magnificence. These relations evoked feelings of smallness, humility and powerlessness in the face of nature, promoting admiration and respect and culminating in a sublime experience of awe where Tim was momentarily swept away from his everyday sorrows. Afterwards he felt relaxed and amazed by his experience as reflected by a cortisol drop of 8 nmol/l.

The three narratives reveal significant contextual specificity in the positionality and situated knowledge drawn upon by the individuals and impacting upon how they understood, engaged with and eventually made sense of the studied events. The combined research results serve to reinforce aspects of conventional theories used to study the restorative effects of different environments, notably the idea that therapeutic gains in terms of stress-release are preconditioned by the perception of the environment as non-theathening. John's narrative reveals that cortisol increase is related to the continuing perception of various threathening senarios right up until the end of the session. Felix's and Tim's narratives indicate the nurturing effect of being able to direct attention and experience to a place removed from taxing circumstances and settings.

4. Conclusions

To the best of our knowledge, this is one of the first randomized clinical trials that also attempts detailed engagement with personal narratives involved with restoration, thereby interconnecting appraisals of experience and mind-set with psychological and physiological outcomes. Often, a fear of mutually competitive and even mutually destructive findings acts as barrier to research that takes seriously the contributions emanating from different ontological and epistemological frameworks. Because quantitative and qualitative methods work on very different assumptions, and speak such different languages, it is often assumed that they relate oppositionally, each arguing the other's defects rather than consensually granting each other analytical hospitality.

This study provides evidence that the quantitative analysis of cortisol levels as an indicator of differential levels of stress before and after experimental interventions in different environments can be paralleled by an accompanying qualitative study of life-experiences and mind-sets. Statistical confirmation of the basic premise that all the interventions produce stress-buffering characteristics is a finding that resonates with other research (Tyrväinen et al., 2014). Interestingly, although not statistically significant, green exercise showed the greatest potential to counteract pronounced levels of stress. Previous studies suggest a link between restorative effects of nature and having an opportunity to perceive life from a different perspective (Ottosson and Grahn, 2008) and nurturing human-nature interactions (Brymer and Gray, 2009). The thick description provided by qualitative study of the life-narratives and lived experiences of participants in situ attests to those conclusions and provides more information on what contextual circumstances and experiences prevent the anticipated outcome of stress relief and vice versa. Our study found that in these cases, where lived experiences and the embodied relations therein signalled perception of threatening (stressful) circumstances (and increased cortisol levels), the individuals experienced a *threat to what conditioned their optimal conditions and thereby their enjoyment in the enacted context*. In those instances, person-specific endeavours to cope with the stressful circumstances (Schneiderman et al., 2005) were applied without success. By contrast, stress-reduction (illustrated by decreased cortisol levels) was found in those who reported rewarding nonthreatening enjoyable experiences most of the time. These individuals coped positively with whatever threatened their enjoyment in the enacted context. Such findings do not undermine the voracity of the experimental design or of the aggregate findings, but they rather demonstrate the capacity of factors outwith that research design to overpower the ability of particular individuals to conform to aggregate trends.

The study demonstrates not only an indication of the power of the mind to create and ameliorate stress in particular circumstances but also the process of how individuals can hold on to pre-existing stress. Not that retention is necessarily intentional – neither Tim or John thought specifically about stress or about what their relational landscapes were doing to their health. Both experienced devastation and hurt, and such norms are often ingrained in the culture we are situated in, thus raising the likelihood of becoming stressed. Although cultural norms sway us in a certain direction one always has a choice of attitude. In these narratives, both John's relationships with the research settings, and Felix's embodiment within them, were egocentric. Enjoyment (and stress-reduction) is based on everything going to plan and having your wishes fulfilled. Then it is easy to see (as does Felix) the beauty in your circumstances. Unhappiness (and stress) on the other hand is based (for John and Tim at the outset) on *not getting what you desire*. Even though these desires are normatively based on common will, they remain aggressive towards the self and the other as they are demanding things from all the different entities that are supposed to deliver something that will, if fulfilled, make them happy. These sets of relations are totally different from Tim's posture when he was humbly and respectfully admiring nature via the doctrine of Sublime and heathen mythology; expressing amazement about the wonderful other without asking for anything in return. Unselfish relations seem to have considerable stress-buffering effects. Thus, one of the notable results in this research, confirming some of our previous findings (Olafsdottir, 2007, 2013), is that positive outcomes seem to be based on not only being able to remove oneself from the taxing mind-set of the everyday, but also to appreciate and admire other circumstances. We therefore speculate that the reason why interacting with nature is restorative is that (as demonstrated in Felix and Tim's lived experience) it is accompanied with Romanticsm and the doctrine of the Sublime – and those ideas can facilitate openness to admire and appreciate the qualities of the other. These kinds of relationships, enabling individuals to “see the beauty” (of nature) in particular settings and situations with a posture of heart-felt admiration and respect for the other, can be crucial to the process of recognising effective and health-enhancing buffers against the stressors of everyday life.

The joined forces of quantitative measurements and a detailed qualitative study of participant life-experiences revealed a co-produced complexity that is of interest both for our study findings and for consideration for future research. First, it is clear that individuals participating in this study were not necessarily engaging with place/setting as was originally hypothesised. The research suggests the rather obvious conclusion that participants do not approach the experiments as a blank canvas. Rather, they arrive at the setting, and engage with it, using preconceived ideas about how they are positioned and situated vis-a-vis the places and practices concerned. Stress emerges when these ideas do not match the setting provided to them by the experimental research. The practice needs to match the place – otherwise there is a risk that the experimental research can itself induce stress rather than simply measuring it. Secondly there is continuity between everyday life and research participation. Participants bring their current affairs to the research setting, and some issues are so severe that they cannot be discarded or distracted during the experiment. We did not ask people about their personal circumstances during recruitment, but the study indicates a need to do so before signing them up. Although we should welcome personal differences, it is clear that severe emotional problems will disrupt the testing of hypothesised connections between stress and place-activities. Thirdly, participating in research can be stressful. All the interviewed participants experienced the study itself as a stressor. They arrived at the setting with preconceived ideas about their participation; the research formed participants into „research subjects“ with a stressful expectation that they would be a „good research subject“, which they dealt with in their own particular ways. Participants thereby conjured up a sense of insecurity arising from concomitant senses of both the unknown, and the pressure to conform to the expectations of participation. For John and Tim, performance of the research tasks meant being mentally as well as physically present, and while Tim was able to conform to this expectation, John was not, resulting in his appraisal of not living up to expectations. Felix also experienced subjectification as a research participant, but his initial stress diminished following a conscious decision to stop worrying and trust the researchers not to harm him in any way. Some of this anxiety about being a research participant could have been dealt with by inviting the participants to the study settings in order to conduct face-to-face briefings before the experiment day. Future research should, therefore, give careful thought to the design study settings and monitor individual responses with this in mind.

Acknowledgements

The authors wish to acknowledge that this article is based on the research project *Breathing Spaces: Relating to Nature in the Everyday and its Connections to Health and Wellbeing* (BREATH) jointly funded by the Fonds National de la Recherche Luxembourg (AFR post-doctoral grant ref. 3965162 co-funded by Marie

Sktodowska-Curie) and the University of Luxembourg (F3R-INS_PUL-13BREA/BREATH). We would like to thank the Institute of Physiology, University of Iceland for housing the field study in Iceland and our Icelandic colleagues Thor Eysteinsson and Björg Thorleifsdottir for their invaluable input throughout the procedure. Furthermore we acknowledge the important contribution of the following people and their establishments: Logi Jonsson, Lilja Gudrun Steinsson, Anna Guðmundsdottir, Sveinbjörn Yngvi Gestsson, Sasha Helsper, Agusta Johnson, Hreyfing ehf., Elizabeth Cook, the Heidmörk forestry team, Jon Sigurdsson, Gunnhildur Yrr Gunnarsdottir, Anna Bergljot Gunnarsdottir and Sonja Kaldalons Thorhallsdottir. We thank the participants for their co-operation. The first version of the paper was presented to the Geography of Health Research Group (GHRG) at the RGS-IBG 2014 conference. We are grateful for the comments received then and thank the editor, the guest-editors and the two anonimous reviewers for their insightful comments.

References

Bowler, D.E., Buyung-Ali, L.M., Knight, T.M., Pullin, A.S., 2010. A systematic review of evidence for the added benefits to health of exposure to natural environments. BMC Public Health 10, 456.
Brymer, E., Gray, T., 2009. Dancing with nature: rhythm and harmony in extreme sport participation. J. Adventure Educ. Outdoor Learn. 9, 135–149.
Cannon, W., 1936. The role of emotion in disease. Ann. Intern. Med. 9 (11), 1453–1465.
Crawford, J.R., Henry, J.D., 2004. The positive and negative affect schedule (PANAS): construct validity, measurement properties and normative data in a large non-clinical sample. Br. J. Clin. Psychol. 43 (3), 245–265. http://dx.doi.org/10.1348/0144665031752934.
de Certeau, M., 1984. The Practice of Everyday Life. S. Rendall (transl.). University of California Press, Berkeley.
Di Blasi, Z., Harkness, E., Ernst, E., Georgiou, A., Kleijnen, M.D., 2001. Influence of context effects on health outcomes: a systematic review. Lancet 357, 757–762.
Gladwell, V.F., Brown, D.K., Barton, J.L., Tarvainen, M.P., Kuoppa, P., Pretty, J., Suddaby, J.M., Sandercock, G.R.H., 2012. The effects of views of nature on autonomic control. Eur. J. Appl. Psychol. 112 (9), 3379–3386.
Hansen, Å.M., Garde, A.H., Christensen, J.M., Eller, N.H., Netterstrøm, B., 2003. Evaluation of radioimmunoassay and establishment for reference interval for salivary cortisol for healthy subjects in Denmark. Scand. J. Clin. Lab. Investig. 63, 303–310.
Haraway, D., 1991. Simians, Cyborgs, and Women: The Reinvention of Nature. Free Association Books, London.
Hartig, T., 2004. Restorative Environments. In: Spielberger, C. (Ed.), Encyclopaedia of Applied Psychology 3. Elsevier Academic Press, London, 273–279.
Hartsock, N., 1987. Rethinking modernism: minority versus majority theories. Cult. Crit. 7, 187–206.
Health Council of the Netherlands, 2004. Nature and Health: The Influence of Nature on Social, Psychological and Physical Well-being. Health Council of the Netherlands/Duch Advisory Council for Research on Spatial Planning, The Hague.
Heidegger, M., 1962. Being and Time. Blackwell Publishing, Oxford.
Herzog, T.R., Maguire, C.P., Nebel, M.B., 2003. Assessing the restorative components of environments. J. Environ. Psychol. 23 (2), 159–170.
Ignacchiti, M.D.C., Sesti-Costa, R., Marchi, L.F., Schedraoui-Silva, S., Mantovani, B., 2011. Effect of academic psychological stress in post-graduate students: the modulatory role of cortisol on superoxide release by neutrophils. Stress 14 (3), 290–300.
James, W., 1983. The Principles of Psychology. Harward University Press, Cambridge, (MA(Original work published in 1890).
Kaplan, R., Kaplan, S., 1989. The Experience of Nature: A Psychological Perspective. Cambridge University Press, New York.
Kaplan, S., 1995. The restorative benefits of nature: toward an integrative framework. J. Environ. Psychol. 15, 169–182.
Kaplan, S., Talbot, J.F., 1983. Psychological benefits of wilderness experience. In: Altman, I., Wohlwill, J.F. (Eds.), Human Behavior and the Environment: Advances in Theory and Research. Plenum Press, New York, 163–203.
Korpela, K., 1991. Are favorite places restorative environments? In: Urbina-Soria, J., Ortega-Andeane, P., Bechtel, R. (Eds.), Healthy Environments. Environmental Design Research Association, Oklahoma City, 371–377.
Korpela, K., Hartig, T., 1996. Restorative qualities of favorite places. J. Environ. Psychol. 16, 221–233.
Korpela, K., De Bloom, J., Kinnunen, U., 2014. From restorative environments to restoration in work. Intell. Build. Int. 7 (4), 215–223, Review article.
Lazarus, R.S., Folkman, S., 1984. Stress, Appraisal, and Coping. Springer Publishing Company, New York.
Lauman, K., Garling, T., Stormark, K., 2003. Selective attention and heart rate responses to natural and urban environments. J. Environ. Psychol. 23, 125–134.
Lewis, R.S., Nikolova, A., Changi, D.J., Weekes, N.Y., 2008. Examination stress and components of the working memory. Stress 11 (2), 108–114.
Li, Q., Otsuka, T., Kobayashi, M., Wakayama, Y., Inagaki, H., Katsumata, M., Hirata, Y., Li, Y., Hirata, K., Shimizu, T., Suzuki, H., Kawada, T., Kagawa, T., 2011. Acute effects of walking in forest environments on cardiovascular and metabolic parameters. Eur. J. Appl. Physiol. 111 (11), 2845–2853.
Marselle, M.R., Irvine, K.N., Warber, S.L., 2013. Walking for well-being: are group walks in certain types of natural environments better for well-being than group walks in urban environments? Int. J. Environ. Res. Public Health 10, 5603–5628.
Michaud, K., Matheson, K., Kelly, O., Anisman, H., 2008. Impact of stressors in a natural context on release of cortisol in healthy adult humans: a meta-analysis. Stress 11 (3), 177–197.
Mitchell, R., 2013. Is physical activity in natural environments better for mental health than physical activity in other environments? Soc. Sci. Med. 91, 130–134.
Olafsdottir, G., 2007. Relating to Nature: The Performative Spaces of Icelandic Tourism. Unpublished Ph.D. thesis. University of Bristol, School of Geographical Sciences, Bristol, U.K..
Olafsdottir, G., 2013. "...sometimes you've just got to get away." On trekking holidays and their therapeutic effect. Tourist Studies 13, 209–231.
Orbach, J., Ehrlich, D., Heath, H.A., 1963. Reversibility of the Necker cube: 1. Examination of the concept of 'satisfaction of orientation'. Percept. Mot. Skills 17, 439–458.
Ottosson, J., Grahn, P., 2008. The role of natural settings in crisis rehabilitation: how does the level of crisis influence the response to experiences of nature with regard to measures of rehabilitation? Landsc. Res. 33 (1), 51–70.
Park, B., Tsunetsugu, Y., Kasetani, T., Kagawa, T., Miyazaki, Y., 2010. The physiological effects of Shinrin-yoku (taking in the forest atmosphere of forest bathing): evidence from field experiments in 24 forests across Japan. Environ. Health Prev. Med. 15 (1), 18–26.
Parsons, R., Tassinary, L.G., Ulrich, R.S., Hebl, M.R., Grossman-Alexander, M., 1998. The view from the road: implications for stress recovery and immunization. J. Environ. Psychol. 18, 113–140.
Pretty, J., Griffin, M., Sellens, M., Pretty, C., 2003. Green exercise: Complementary roles of nature, exercise and diet in physical and emotional well-being and implications for publich health policy. CES Occasional Paper 2003-1, University of Essex.
Rodaway, P., 1994. Sensuous Geographies. Routledge, London.
Sapolski, R.M., 2004a. Why Zebras Don't Get Ulcers. The Acclaimed Guide to Stress, Stress-Related Diseases, and Coping 3rd ed. St. Martin's Griffin, New York.
Sapolski, R.M., 2004b. Organismal stress and telomeric aging: an unexpected connection. Proc. Natl. Acad. Sci. USA 101 (50), 17323–17324.
Schneiderman, N., Ironson, G., Siegel, S.D., 2005. Stress and health: psychological, behavioural, and biological determinants. Annu. Rev. Clin. Pschol. 1, 607–628. http://dx.doi.org/10.1146/annurev.clinpsy.1.102803.144141.
Schwabe, L., Haddad, L., Schachainger, H., 2008. HPA axis activation by a socially evaluated cold-pressor test. Psychoneuroendocrinology 33, 890–895.
Selye, H., 1955. Stress and disease. Science 122 (3171), 625–631.
Selye, H., 1979. The Stress of My Life. Van Nostrand, New York.
Smith, J.A., 1996. Beyond the divide between cognition and discourse: using interpretive phenomenological analysis in health psychology. Psychol. Health 11, 161–271.
Smith, J.A., Flowers, P., Larkin, M., 2009. Interpretive Phenomenological Analysis: Theory, Method and Research. Sage, London.
Staats, H., Kievet, A., Hartig, T., 2003. Where to recover from attentional fatigue: an expectancy-value analysis of environmental preference. J. Environ. Psychol. 23, 147–157.
Thompson-Coon, J., Boddy, K., Stein, K., Whear, R., Barton, J., Depledge, M.H., 2011. Does participating in physical activity in outdoor natural environments have a greater effect on physical and mental wellbeing than physical activity indoors? A systematic review. Environ. Sci. Technol. 45 (5), 1761–1772.
Tyrväinen, L., Ojala, A., Korpela, K., Lanki, T., Tsunetsugu, Y., 2014. The influence of urban green environments on stress-relief measures: a field experiment. J. Environ. Psychol. 38, 1–9.
Ulrich, R.S., 1981. Natural versus urban scenes: some psycho-physiological effects. Environ. Behav. 13, 523–556.
Ulrich, R.S., 1983. Aesthetic and affective response to natural environment. In: Altman, I., Wohlwill, J.F. (Eds.), Behaviour and the Natural Environment. Plenum Press, New York, 85–125.
Ulrich, R., 1984. View through a window may influence recovery from surgery. Science 224, 420–421.
Ulrich, R.S., Simons, R.F., Losito, B.D., Fiorito, E., Miles, M.A., Zelson, M., 1991. Stress recovery during exposure to natural and urban environments. J. Environ. Psychol. 11, 201–230.
Valtchanov, D., Barton, K.R., Ellard, C., 2010. Restorative effects of virtual nature settings. Cyberpsychol. Behav. Soc. Netw. 13 (5), 503–512.