University of Glasgow School of Psychology

An investigation into the restorative effects of the outdoors on undergraduate students

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ABSTRACT

Attention Restoration Theory (ART) argues that spending time in nature restores our attentional capacity. The aim of this study was to investigate the effects of green space on well-being, attention and other cognitive abilities in undergraduate students. A between-groups pre-test post-test design was employed to compare the restorative effects on cognitive functioning after interactions with outdoor versus indoor environments. A sample of 30 participants were asked to complete three tasks: 1) a well-being and a mindfulness questionnaire 2) a computer delivered stimulus-response task (SART) and 3) a learning task. These were followed by either an outdoor or indoor condition. Results showed that participants that experienced the outdoors intervention scored higher in well-being and were better able to maintain attention and alertness over a prolonged period of time. This study intends to provide university students with guidance on better ways to structure their study breaks in order to maximise their performance.

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INTRODUCTION

Truly it may be said that the outside of a mountain is good for the inside of a man - George Wherry, *Alpine Notes and the Climbing Foot*, 1896

The conception that spending time in nature can make you feel good is somewhat intuitive. For centuries, people have associated natural settings with peacefulness and tranquillity. Historical accounts from both Eastern and Western cultures, illustrate traditions linking the outdoors, particularly green spaces, with places conducive to reflection and contemplation (Thielen & Diller, 2012).

There is an ever-growing body of evidence focusing on the health and well being benefits that arise from being in contact with nature (Ulrich et al., 1991; Hartig, Mang & Evans, 1991; Kaplan, 1995; Maller, Townsend, Pryor, Brown & St Leger, 2006; Rappe, Kivela & Rita, 2006).

One of researchers' main focuses in the last decade has been on the impact that nature has on our cognitive abilities, particularly, the role it plays in restoring our attention once we have experienced mental fatigue (Kaplan, 1995; Berto, 2005; Berman, Jonides & Kaplan, 2008; Kaplan & Berman, 2010; Opezzo & Schwartz, 2014). This is a common problem faced by a particular population, undergraduate students. After long days spent at University and many hours of studying, students cope with this feeling in a variety of ways such as watching television, going for a walk, or listening to music. What activity would best help students restore their attention following mental fatigue? Would staying indoors have the same effect as going outside for a walk in the park?

Before discussing the present study, which will try to answer some of these questions, we will review the theory and supporting evidence for the potential beneficial effects of nature on our cognitive and attentional functioning.

Attention Restoration Theory (ART)

A theory that seeks to explain the cognitive benefits provided by nature is Kaplan and Kaplan's (1989) Attention Restoration Theory (ART). This theory distinguishes between two types of attentional systems: voluntary or directed attention and involuntary attention (Kaplan & Kaplan, 1989; Kaplan, 1995).

Directed attention allows us to conduct the focus and direction of our thoughts. This is a voluntary process that requires cognitive effort. When an individual spends long periods of time engaged in activities that require a great amount or even continuous cognitive effort, such as reading, writing, problem solving or driving, their directed attention can become exhausted or worn out. This is referred to as mental fatigue and can be seen as an individual becomes impatient and annoyed, easily distracted and unable to pay attention to the task at hand. ART argues that one way to restore a person's directed attention and cognitive functioning is by spending time in what Kaplan and Kaplan (1989) called, a restorative environment. According to the authors, natural settings are the most restorative type of environment, as these allow the directed attention system to recover from depletion by engaging in the other type of attention, involuntary attention (Kaplan & Kaplan, 1989; Kaplan, 1995; Kaplan & Berman, 2010).

Involuntary attention refers to attention that is drawn by stimuli that are naturally fascinating and do not require the cognitive effort of directed attention. People are naturally drawn to things like sunsets and sunrises, flowing streams or rivers, mountains, meadows and forests, etc. The presence of such components in the environment allows attention to be engaged effortlessly whilst allowing the mind to wander and reflect (Berman et al, 2008; Felsten, 2009).

According to Kaplan (1995), a setting that allows for attention restoration must have four attributes. These are: "being away", "fascination", "extent" and "compatibility". "Being away" refers to the idea that a person removes him or herself from the attentionally demanding activity they are attending to. This might either involve moving to a different physical environment (e.g. by going for a walk in the park) or mentally engaging in a completely different task or activity in order to have a break from what lead to the mental fatigue (Thielen & Diller, 2012). "Fascination" refers to the notion that an environment must facilitate effortless attention, i.e. involuntary attention, by possessing stimuli that are inherently fascinating. As noted

by Kaplan (1995), fascination can be present in different surroundings and circumstances and can vary in intensity from soft to hard.

Soft fascination relates to a moderate level of intensity and requires the presence of aesthetically pleasing stimuli. It is typically associated with natural settings and examples might include snow patterns, cloud formations, rolling waves, mountain views, etc. Soft fascination allows for moments of reflection, which in turn provide the best form of restoration (Herzog, Black, Fountaine & Knotts, 1997; Felsten, 2009). Hard fascination, on the other hand, is said to be intense enough to rivet one's attention and does not allow for reflection. Watching competitive sports, such as football or ice hockey, is likely to induce hard fascination (Herzog et al., 1997; Felsten, 2009).

When an environment possesses sufficiently rich content and structure, the third of Kaplan's (1995) proposed attributes, "extent", enables the individual to fully engage his/her mind in its surroundings. They are able to emerge themselves in what might be perceived as a "whole other world" (Kaplan, 1995, p.193) for a period of time long enough to allow directed attention to rest (Allred, 2008; Felsten, 2009). The final attribute of a restorative environment is "compatibility" and this refers to the idea that the environment an individual chooses to engage with should be compatible with what he/she is trying to achieve. For example, if hiking is not something an individual enjoys, it will not act as a restorative experience. The environment must allow individuals to carry out their activities in the manner that is most natural and comfortable to them. A high level of compatibility is thought to promote reflection and therefore, have potential long and lasting effects on one's attentional functioning (Kaplan, 1995; Hartig, Korpela, Evans & Garling, 1997).

Essentially, the combination of these attributes helps people to avoid the need for directed attention, for a long enough period of time to allow restoration. Therefore, leaving one's familiar surroundings, work environment or hobbies will not be restorative unless the new environment exhibits extent, is fascinating and is compatible with the reason that the person is there (Allred, 2008).

Natural vs. Simulated Natural Environments

There is a growing body of evidence supporting the restorative benefits of nature.

Hartig and colleagues (1991) were one of the first to look at the restorative effects of natural environments by asking experienced backpackers to perform a proof reading task either after a wilderness backpacking holiday, other non-wilderness holiday or no holiday at all. Using self-report measures, their results showed that experiences in natural settings had greater restorative effects (Hartig et al., 1991). Whilst some studies feature participants physically in contact with nature, others have resorted to simulations of both natural and urban environments, with simulations of natural settings reporting greater levels of recovery from mental fatigue (Ulrich, 1991; Hartig, Book, Garvill, Olsson & Garling, 1996). Some studies show that even looking at a natural environment through a window can bring positive therapeutic benefits and restore one's directed attention (Ulrich, 1984; Cimprich, 1993; Tennessen & Cimprich, 1995).

Berman and colleagues (2008) had participants walking in a park and in an urban area as well as looking at pictures of nature and urban settings. Using a Backward Digit-Span Test and the Attention Network Test (ANT) to assess directed attention, their results showed that participants that interacted with nature, be it in a non-simulated or simulated way, experienced greater improvements in directed attention (Berman et al., 2008).

Likewise, Berto (2005) employing a pre- and post-test design, found that participants that spend time looking at photographs of nature scenes rather than photographs of city streets and industrial areas, performed better at a sustained attention test (SART) at post-test.

Another study by Kjellgren and Buhrkall (2010) compared the restorative effect of a natural environment to that of a simulated natural one. Participants either went for a walk in the nearby woods or viewed a slide show of pictures from the same woods. Using various different physiological and psychological measures, their results showed that whilst both settings facilitated stress reduction, the natural environment exhibited a higher rating of energy and altered states of consciousness (Kjellgren & Buhrkall, 2010).

Evidence for ART in adult student populations

Undergraduate students spend a lot of their time engaged in activities, such as reading course material, writing essays and reports, problem solving and taking exams, which require sustained directed attention and may lead to mental fatigue, affecting a student's academic performance.

An early study by Tennessen and Cimprich (1995) found that undergraduate students whose bedroom windows in halls of residence faced views of natural scenery, showed increased directed attention when compared with students whose bedrooms faced views of buildings. Likewise, students that chose to use the green spaces around campus more often were shown to rate their overall quality of life and university experience more positively (McFarland, Waliczek & Zajicek, 2008).

In 2005, a study by Lethbridge and colleagues looked at the effects of a restorative intervention on undergraduate nursing students. The intervention group went for a 60 minutes walk after a 2-hour class and the non-intervention group stayed in a windowless room for 60 minutes doing their schoolwork. Their results found non-significant differences between the two groups for perceived attention function, as measured by the Attention Function Index (AFI). However the intervention group was found to score higher in AFI post-test than pre-test when compared with the non-intervention group, indicating a slight trend towards higher levels of perceived attention function when in contact with nature (Lethbridge, Yankou & Andrusyszyn, 2005).

Similarly, a more recent paper by Berigan and Pielage (2013) examined what type of study break activity would be best for undergraduate students by looking at the effects of nature versus television on attention. Participants either went to the park and sat on a bench, sat outside a campus building in a small grass area, watched a nature video or watch a video of a popular American TV show, all for a 20 minute period. Despite non-significant results, there was a trend shown towards views of nature scoring a higher mean change in attention when compared with the non-nature conditions.

A study by Felsten (2009) suggested that when choosing to have a break indoors whilst on campus, university students rated real nature views to be more restorative than ones that lacked either real or simulated nature views, in accordance with previous studies. However, students also found dramatic wall-sized nature

murals (e.g. those with water features) to be more restorative than real, but ordinary nature views.

As has been presented and discussed, there is a large body of theoretical and empirical evidence supporting ART and the notion that our directed attention is better restored when in contact with natural environments.

The present study

The present study aims to contribute and support previous findings in the field, by investigating the effects of the outdoors, i.e. nature, on well-being, attention and other cognitive abilities in undergraduate students. There seems to be a strong body of evidence for Attention Restoration Theory, especially in childhood research (Faber Taylor, Kuo, Sullivan, 2001b; Kuo & Faber Taylor, 2004; Boldemann, Soderstromc, Blennowe, Englund, & Grahn, 2009; Faber Taylor & Kuo, 2009; Roe & Aspinall, 2011). However, the effects on the student population do not appear as strongly represented in the literature, especially with regards to how findings can help university students seek more effective ways to restore their attention after experiencing mental fatigue.

Taken that into account, this study intends to provide undergraduate students with guidance on better ways to structure their study breaks in order to maximise their performance.

Three conditions were developed to aid in the exploration of these aims. In a pre- and post-test design, well-being, mindfulness, attention and learning test scores were compared across three different restorative/non-restorative conditions. The first condition consisted of participants going for a short 10-minute walk in a nearby park, spending approximately 20 minutes outdoors (condition "WALK"). The second condition consisted of participants remaining in the experiment room for a 20-minute period, and told not to do anything apart from sit in their chair and relax (condition "ROOM QUIET"). In the third condition, participants were once again asked to remain in the experiment room for a 20-minute period, but this time allowed to do what they would do if having a break from revision, for example, be on their mobile phones, go on the internet using the computer in the room or read a book without leaving the room ("ROOM ACTIVE").

It was hypothesised that:

1. Participant's test scores will not differ between conditions at pre-test (i.e. before any intervention).
2. Participant's test scores in the WALK condition will be better than participants in the ROOM QUIET and ROOM ACTIVE condition at post-test (i.e. after the intervention).
3. Participant's test scores will show a greater difference in the WALK condition versus ROOM ACTIVE condition, when compared to WALK condition versus ROOM QUIET condition.
4. Participant's test scores in the ROOM QUIET condition will be better than participants in the ROOM ACTIVE condition.

METHODS

Design

Using a pre-test post-test design, participants were randomly assigned to one of three conditions (between-subjects design). Each condition involved a pre-test of four different measures followed by one of three interventions (detailed in table 1 below) and finally a post-test of the same four measures. It was investigated whether participant's scores on the different measures (DV) differed between the three interventions (IV), i.e. whether going out for a walk in the park (condition 1) compared to when sitting in a room doing nothing but relaxing (condition 2) and also compared to when sitting in a room but allowed to be on your mobile phone/internet (condition 3).

Condition/Intervention	Description of activities	Duration (minutes)
1 WALK	Short 10-min walk in the park, spending no longer than 20 min outdoors.	20
2 ROOM QUIET	Remain seated in the experimental room, asked to do nothing but relax.	20
3 ROOM ACTIVE	Remain seated in the experimental room but allowed to be on their phones, computer, read, etc.	20

Table 1: Details of each condition.

Site

The outdoor natural site chosen was Kelvingrove Park, which is located on the River Kelvin, in the West End of the city, bordering the University of Glasgow (see figure 1, 2 and 3 below). The park is 34 hectares in size and is home to a diverse range of wildlife and habitats, exhibiting all 4 elements of a restorative environment, according to the Attention Restoration Theory (see Appendix A). This makes Kelvingrove Park an ideal site for studying the effects of nearby nature on everyday functioning.

Figure 1: Kelvingrove Park.

Figure 2: River Kelvin, Kelvingrove Park.

Figure 3: Kelvingrove Park has a diverse range of wildlife and habitats.

The indoor setting was a standard individual experimental room in the Psychology Department at the University of Glasgow. The room was small, windowless and it contained a large desk, one computer and two chairs (for an example see figure 2 below).

Figure 4: Example of an experiment room used in the Psychology Department, University of Glasgow.

Participants

The sample consisted of 30 undergraduate Psychology students from the University of Glasgow. Students were invited to participate in the study via personal communication and online social network advertisements. Participants ranged from 1st – 4th year students, between the ages of 18 and 37 (mean age = 24.4) and included 5 males and 25 females. No exclusion criteria were employed and course credits were awarded to first year students.

Measures

Well-being

An adapted version of the Warwick-Edinburgh Mental Well-being Scale (WEMWBS) was used to assess participant's mental well-being. The WEMWBS consists of a 14-item scale with 5 response categories, added up to produce an overall single score, which ranges from 14 to 70. Best estimates range from 3 to 8 WEMWBS points difference between 'before' and 'after' time points. The items are all worded positively and take into account both feelings and thoughts. Permission was gained for use within the current study (please see Appendix B for example).

Mindfulness

The Mindful Attention Awareness Scale (MAAS) was used to assess participant's dispositional mindfulness. The MAAS consists of a 15-item scale, conceived to specifically determine awareness of and attention to our everyday experiences. Higher scores reflect higher levels of dispositional mindfulness. This scale has been validated using various different patient samples and shows strong psychometric properties (Brown & Ryan, 2003) (please see Appendix C for example).

Attention

A modified version of the Sustained Attention Response Task (SART) (Robertson, Manly, Andrade, Baddeley & Yiend, 1997) was used as a measure of directed attention. The SART consists of a computer delivered stimulus-response task. Participants view a continuous array of single digits (0 to 9), and are instructed to withhold pressing the space bar to the number 3 (the target number) and to respond to

all other numbers (non-target numbers) by pressing the space bar. Participants are intended to respond as quickly as possibly whilst keeping accuracy. Each trial included a digit displayed for 250ms on a white screen, followed by a fixation-cross displayed for 900ms. Participants can respond either during the stimulus display or during the inter-trial interval. Task performance is quantified by looking at mean overall accuracy, mean accuracy on target trials, mean accuracy on non-target trials and mean reaction time on non-target responses (Morrison, Goolsarran, Rogers & Jha, 2014).

Perceived Restoration

The Perceived Restoration Scale (PRS) (Hartig et al., 1997; Hartig, Kaiser & Bowler, 2001) was used to measure the restorative quality of the outdoor natural site chosen for use in this study. The PRS was developed based on the Attention Restoration Theory and is comprised of 26 items, which are grouped in four subscales representing the four components of restoration: being away (5-items), fascination (8-items), coherence (4-items) and compatibility (9-items). In the PRS the component of "extent" was replaced by "coherence" to stress the importance of a coherent and understood connectedness to the environment. Participant's judgements are made on a 7-point Likert scale and indicate the degree to which each statement accounts for their experience in a particular setting (0 = Not at all; 6 = Completely) (please see Appendix D for example).

Learning

To assess participant's ability to learn information within each intervention, a comprehension test was included. Two text passages are used and participants will be asked to either "explain the difference" between two concepts or simply asked to write down what they know about a specific topic. The same question is presented prior to and post reading the passage. A marking scheme, consisting of 10 idea units is used to score a participant's performance both prior and post reading the passage. This learning task was based on previous research carried out by a final year student at the University of Glasgow and permission was gained for use within this study. For examples of the text passages and marking scheme used please see Appendix E and F (McCallum, 2014).

Procedure

Participants were asked to meet in the waiting room at the Psychology Department and taken to an experimental room. Information sheets detailing the purpose of the study were provided and consent forms were signed before taking part in the experiment (please see Appendix G for examples of both). Participants were then asked to complete a participant questionnaire (please see Appendix H) followed by the well-being and the mindfulness questionnaire. Next, participants completed the Sustained Attention Response Task (SART), which, in this study consisted of 520 trials and lasted approximately, 10 minutes. Participants were asked to withhold pressing the space bar whenever the number 3 appeared on their screen and to respond to all other numbers between 0 and 9 by pressing the space bar. Following the SART, participants were given a booklet with instructions on how to carry out the learning task and were encouraged not to worry if the material presented was either difficult or unfamiliar (please see Appendix I for example of booklet). Participants were instructed to answer a question with no time limit assigned to do so. Next, participants were told to read a passage of text pertaining to the question asked and time themselves 2 minutes to do so using one of the timers in the room, either a tablet or a phone. Next, participants were instructed to answer the same question once again but timing themselves 3 minutes to do so, using the available timers. At the end of the 3 minutes participants had two short questions to answer with regards to how difficult they found the learning task to be and how restorative did they think the next 20 minutes would be (after being made aware which intervention they had been assigned to). The order of the passages was counterbalanced across participants. For both the SART and the learning task, the researcher stood outside the room and participants were told to either knock or open the door once they had finished each task. These were followed by either a restorative or non-restorative condition.

Participants were randomly assigned to one of three conditions.

In the **first condition**, the researcher took participants for a short walk in Kelvingrove Park. The researcher accompanied participants to the entrance of the park, which took approximately 5 minutes from the Psychology Department building, and instructed them to go for a short 10-minute walk on their own, whilst the researcher waited for

them in that particular spot. A stopwatch was provided in order for participants to keep track of time. They were told to relax and enjoy the views, and in the last couple of minutes to find a bench to sit on (there was a few as you walked into the park) and complete the Perceived Restoration Scale (PRS) questionnaire before making their way back. Once with the researcher, the walk back to the Psychology Department took another 5 minutes. During the walk, conversation between researcher and participant was kept to a minimum. The whole outdoors experience lasted approximately 20 minutes.

In the **second condition**, participants were asked to remain in the experiment room and told to do nothing but relax. The researcher left the room and timed 20 minutes before returning.

In the **third condition**, participants were asked to remain in the experiment room but this time were told to do what they would do if they were having a break from studying/revising, within the room confinement. They were allowed to be on their mobile phones, surf the Internet using the computer in the room, read, write, etc. The researcher left the room and timed 20 minutes before returning.

After the interventions, participants repeated all tasks mentioned above. Once they were done, a debriefing sheet was handed out (see Appendix K) and participants had an opportunity to ask any questions if they so wished.

The whole experiment took 1 hour and 15 minutes and participants were tested individually. All procedures were approved by the ethics committee of the School of Psychology at the University of Glasgow.

RESULTS

It was hypothesised that the test scores of the different measures would not differ across conditions at pre-test (i.e. before the intervention), but would vary significantly at post-test (i.e. after the intervention). It was predicted that the WALK condition would yield significantly higher test scores when compared to those in the ROOM QUIET and ROOM ACTIVE conditions. It was also expected that test scores would show a greater difference in the WALK vs. ROOM ACTIVE conditions, when compared to WALK vs. ROOM QUIET conditions. Participant's test scores were also expected to be better in the ROOM QUIET condition than in the ROOM ACTIVE condition.

A one-way between subjects ANOVA was conducted for each measure, with test scores as the dependent variable (DV) and the different conditions as the independent variable (IV), at both pre-test and post-test. The aim was to test whether there was a significant difference between conditions in relation to different cognitive and psychological well-being measures.

Pre-test results showed that test scores for all measures were **non-significant** across the three conditions, as predicted.

Post-test results will be reported with regards to each section below:

Well-Being

From 30 participant's data, means and standard deviations were calculated for the well-being questionnaire scores. As shown below in table 2 and figure 5, the mean well-being score at pre-test for condition 1 (WALK) was 52 with a standard deviation of 10.38. Condition 2 (ROOM QUIET) also had a mean of 52 but with a standard deviation of 9.81, whilst condition 3 (ROOM ACTIVE) had a mean of 50.60 with a standard deviation of 6.06. At post-test, the WALK condition had a mean score of 57.90 with a standard deviation of 6.81, the ROOM QUIET condition a mean score of 50 with a standard deviation of 7.23 and the ROOM ACTIVE condition a mean score of 50.10 with a standard deviation of 6. Overall, the means suggest that participants in the WALK condition scored higher in well-being at post-test than pre-test, as opposed to participants in conditions ROOM QUIET and ROOM ACTIVE, where both mean scores decreased at post-test. These findings are in line with our hypothesis. As the

standard deviation values were relatively high this represents a high level of variance around the mean.

	Pre-Test		Post-Test	
Condition	*Mean*	*Standard Deviation*	*Mean*	*Standard Deviation*
1 (WALK)	**52**	10.38	**57.90**	6.81
2 (ROOM QUIET)	**52**	9.81	**50**	7.23
3 (ROOM ACTIVE)	**50.60**	6.06	**50.10**	6

Table 2: Means and standard deviations for the well-being scores.

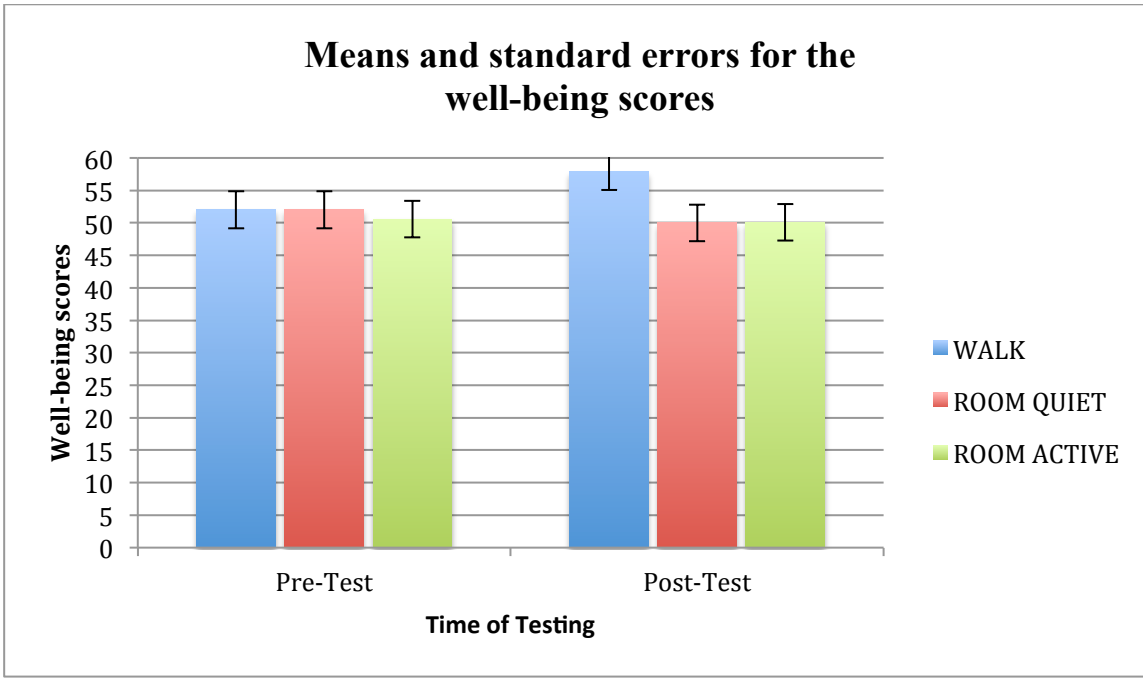

Figure 5: Graph showing means and standard deviations for the well-being scores.

A one-way between-subjects ANOVA was conducted to explore the difference in well-being scores, as measured by an adapted version of the WEMWBS, across different conditions. Analysis at post-test revealed a significant difference between the conditions, F (2,27) = 4.58, p = 0.019. The effect size, calculated using eta squared was 0.25, which is considered to be small. Post-hoc comparisons using the Bonferroni test indicated that the mean score for the WALK condition (*M* = 57.90, *SD* = 6.81) was significantly different from the ROOM QUIET condition (*M* = 50, *SD* = 7.23) and ROOM ACTIVE condition (*M* = 50.10, *SD* = 6). The ROOM QUIET condition yielded a slightly lower mean score than the ROOM ACTIVE condition, however, there was no significant difference between the two.

Mindfulness

As shown below in table 3 and figure 6, the mean mindfulness scores at pre-test for the WALK condition was 3.58 with a standard deviation of 0.58. The ROOM QUIET condition had a mean of 3.47 with a standard deviation of 0.75, whilst the ROOM ACTIVE condition had a mean of 3.67 with a standard deviation of 0.46. At post-test, the WALK condition had a mean score of 3.79 with a standard deviation of 0.66, the ROOM QUIET condition had a mean score of 3.67 with a standard deviation of 0.82 and the ROOM ACTIVE condition a mean score of 3.75 with a standard deviation of 0.54. Overall, the means suggest that participants in all three conditions scored slightly higher in mindfulness at post-test than pre-test. These findings are not in line with our hypothesis. As the standard deviation values were relatively small this represents a low level of variance around the mean.

	Pre-Test		**Post-Test**	
Condition	*Mean*	*Standard Deviation*	*Mean*	*Standard Deviation*
1 (WALK)	**3.58**	0.58	**3.79**	0.66
2 (ROOM QUIET)	**3.47**	0.75	**3.67**	0.82
3 (ROOM ACTIVE)	**3.67**	0.46	**3.75**	0.54

Table 3: Means and standard deviations for the mindfulness scores.

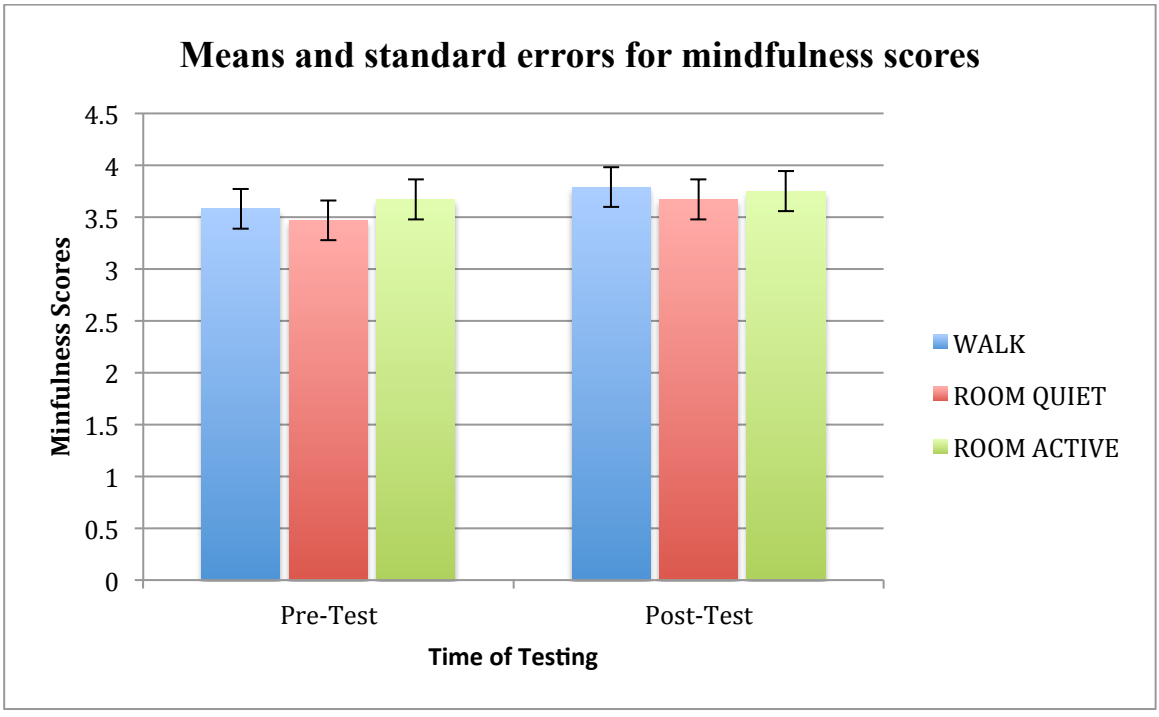

Figure 6: Graph showing means and standard deviations for the mindfulness scores.

A one-way between-subjects ANOVA was conducted to explore the difference in mindfulness scores, as measured by the MAAS, across different conditions. Analysis at post-test revealed a non-significant difference between all conditions, $F(2,27) = 0.081$, $p = 0.922$.

Attention

The SART yields a rich set of outcome variables. Table 4 below, shows the means and standard deviations for all the different variables.

SART Outcome Variables	Pre-Test	Post-Test
Accuracy (Target Trials)	*(1)* **16.8** (7.16) *(2)* **15.3** (8.51) *(3)* **17.6** (7.59)	**12.8** (6.46) **15.1** (9.09) **22.4** (10.63)
Accuracy (Non-Target Trials)	*(1)* **3.2** (5.30) *(2)* **4.4** (4.90) *(3)* **5.3** (7.20)	**1.8** (2.20) **4.4** (3.24) **5.8** (6.14)
Overall Accuracy	*(1)* **20** (10.56) *(2)* **19.7** (10.51) *(3)* **22.9** (13.03)	**14.6** (7.40) **19.5** (10.28) **28.2** (14.94)
Reaction Times (RT) (ms)	*(1)* **341.02** (56.61) *(2)* **357.55** (86.99) *(3)* **319.96** (43.20)	**350.75** (58.33) **345** (82.14) **305.58** (48.60)
Intra-individual RT variability (RT CV) (ms)	*(1)* **0.30** (0.09) *(2)* **0.31** (0.10) *(3)* **0.28** (0.07)	**0.30** (0.05) **0.30** (0.09) **0.31** (0.12)

Table 4: Mean scores for the different SART outcome variables: accuracy on target trials, accuracy on non-target trials, overall accuracy, reaction times (in milliseconds) and intra-individual reaction time variability (in milliseconds). Standard deviations are in parenthesis. Scores are shown across conditions: (1) WALK, (2) ROOM QUIET and (3) ROOM ACTIVE.

One-way ANOVAs were carried out for all of SART-related outcome variables and results are reported separately below.

*Attention Accuracy for Target Trials (**Target Error**)*

This variable refers to the number of incorrect responses (i.e. not withholding pressing the space bar) to trials showing the number 3. As expected, the descriptive analyses showed, at post-test, a lower mean score for the WALK condition than the

ROOM QUIET and ROOM ACTIVE conditions. However, one-way ANOVA revealed a non-significant difference between all conditions, F (2,27) = 2.329, p = 0.117.

*Attention Accuracy for Non-Target Trials (**Non-Target Error**)*

This variable refers to the number of incorrect responses (i.e. withholding pressing the space bar) to trials showing all numbers, apart from 3. As expected, the descriptive analyses showed, at post-test, a lower mean score for the WALK condition than the ROOM QUIET and ROOM ACTIVE conditions. However, one-way ANOVA revealed a non-significant difference between all conditions, F (2,27) = 3.174, p = 0.058.

Overall Accuracy

This variable refers to the two error types combined (target and non-target errors). The descriptive analyses showed, at post-test, a lower mean score for the WALK condition than the ROOM QUIET and ROOM ACTIVE conditions (see figure 8 below).

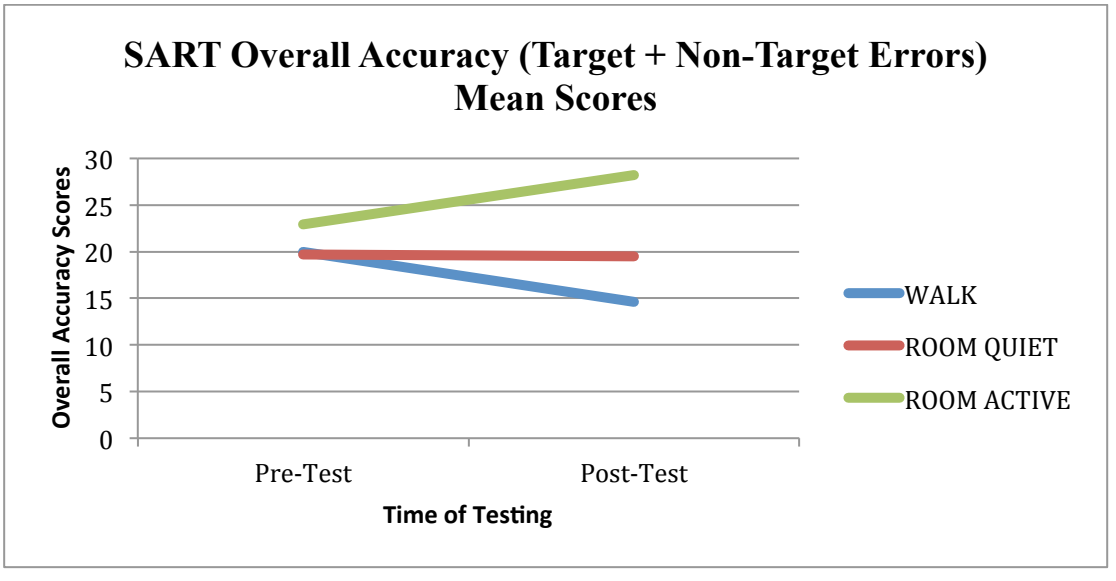

Figure 8: Graph showing SART overall accuracy mean scores for each condition at pre- and post-test.

One-way ANOVA at post-test, revealed a significant difference between the conditions, F (2,27) = 3.712, p = 0.038. The effect size, calculated using eta squared was 0.22, which is considered to be small. Post-hoc comparisons using the Bonferroni test indicated that the mean score for the WALK condition (*M* = 14.60, *SD* = 7.40) was significantly different from the ROOM ACTIVE condition (*M* = 28.2, *SD* = 14.94) but not from the ROOM QUIET condition (*M* = 19.50, *SD* = 10.28). The ROOM QUIET condition yielded a lower mean score than the ROOM ACTIVE condition as expected, however, there was no significant difference between the two. These findings are in line with our hypothesis.

Reaction Times (RT)

This variable refers to the reaction time for both target and non-target errors. The descriptive analyses showed, at post-test, a higher mean score for the WALK condition than the ROOM QUIET and ROOM ACTIVE conditions. However, one-way ANOVA revealed a non-significant difference between all conditions, F (2,27) = 1.450, p = 0.252.

Intra-individual Reaction Time Variability (RT CV)

This variable refers to the variability in response speed indexes. The descriptive analyses show, at post-test, an equal mean score for condition 1 and condition 2, with condition 3 showing a marginally lower mean score. One-way ANOVA revealed a non-significant difference between all conditions, F (2,27) = 0.058, p = 0.944.

Learning

For the learning task, there were two different text passages presented to participants: one on the subject of Calico Cats and the other on the subject of Operant Conditioning. Means and standard deviations for the marking scores of each text passage are reported in table 5 and figure 9 and table 6 and figure 10 below.

	Calico Cats Passage	
Condition	*Pre-Test*	*Post-Test*
1 (WALK)	**0.30** (0.48)	**5.50** (1.43)
2 (ROOM QUIET)	**0.70** (1.25)	**5.50** (1.72)
3 (ROOM ACTIVE)	**0.40** (0.52)	**5.40** (1.43)

Table 5: Means and standard deviations (in parenthesis) for the marking scores at pre-test and post-test.

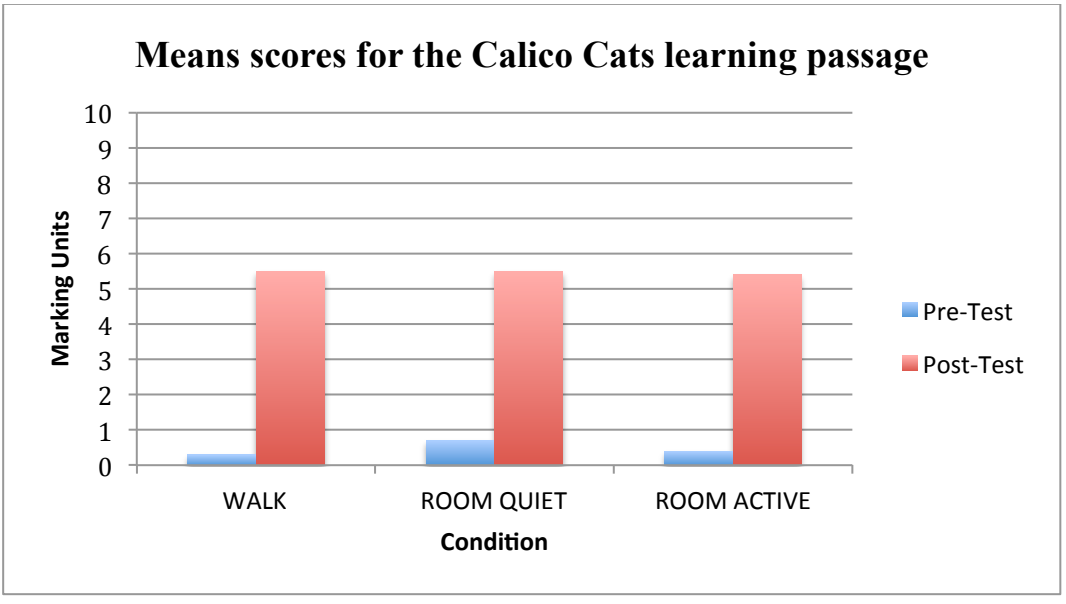

Figure 9: Graph showing mean scores for the Calico Cats text passage used.

Condition	Operant Conditioning Passage	
	Pre-Test	*Post-Test*
1 (WALK)	**2.00** (2.05)	**4.80** (2.53)
2 (ROOM QUIET)	**2.80** (2.90)	**5.50** (2.76)
3 (ROOM ACTIVE)	**3.60** (2.63)	**5.50** (2.80)

Table 6: Means and standard deviations (in parenthesis) for the marking scores at pre-test and post-test.

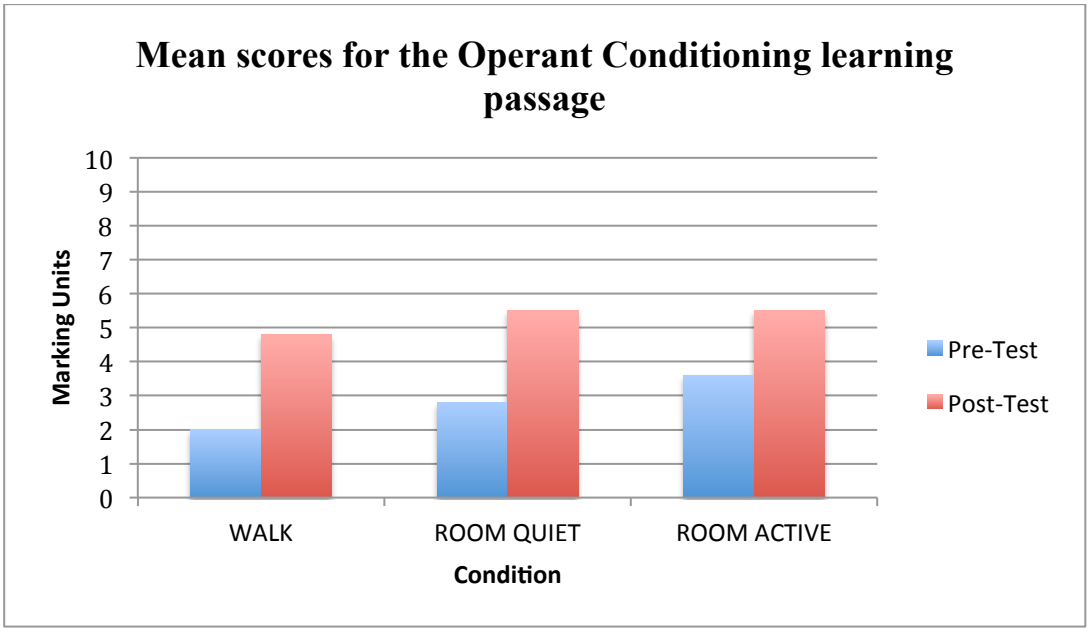

Figure 10: Graph showing mean scores for the Operant Conditioning text passage used.

A one-way ANOVA was carried out for the marking scores of each passage. Both analyses revealed non-significant differences between all conditions, $F(2,27) = 0.014$, $p = 0.986$ (Calico Cats passage); $F(2,27) = 0.224$, $p = 0.801$ (Operant Conditioning passage).

Perceived Restoration

The Perceived Restorativeness Scale (PRS) was used to assess the restorative value of the natural site chosen for use in this study, Kelvingrove Park. Table 7, below, shows the mean scores for each of the restorative components that make up the scale, with being away scoring the highest and coherence scoring the lowest out of all components. The overall PRS score of 4.42 is considered to fall between the "rather much" and "very much" labels on the scale (Hartig et al., 2001), meaning participants rated Kelvingrove Park as a highly restorative environment.

Restorative Components	**Mean Score**
Being Away	4.60
Fascination	4.65
Coherence	4.03
Compatibility	4.40
Overall PRS Score	**4.42**

Table 7: Perceived Restorativeness Scale scores for the natural site used in this study, Kelvingrove Park.

DISCUSSION

Overview of Results and relation to the Previous Theory and Research

This study looked at the effects of three different interventions – going for a walk in the park (WALK), sitting in a room doing nothing (ROOM QUIET) and sitting in a room allowed to be on your phone, go on the internet, read a book, etc. (ROOM ACTIVE) – on well-being, attention and other cognitive abilities in undergraduate students. Results demonstrated that the outdoors setting, when compared with the other two conditions, had a higher restorative value, which was in line with this study's hypothesis. However, only two measures showed significant differences: well-being and attention. All findings are further addressed below.

Well-Being

As predicted, participants that were allowed to go for a walk in the park scored significantly higher on well-being measures than those that remained indoors for the 20 minute intervention. Overall scores for the 10 participants in the WALK condition were higher at post-test than pre-test for all 14 items on the well-being scale. Items included statements on optimism, usefulness, relaxation, interest, confidence, cheerfulness and energy. Of note, out of all items, "cheerfulness" had the highest increase in mean score at post-test. Participants in both ROOM QUIET and ROOM ACTIVE conditions, showed a slight decrease in well-being scores at post-test, however, no significant difference was found between the two indoor settings. Findings showed that even though well-being scores didn't change significantly from pre-test to post-test in the indoor conditions, being outside for as little as 20 minutes had a significant impact on how participants felt physically and psychologically. Despite a small effect size, these findings are in line with the literature on Attention Restoration Theory (ART).

One of the earlier studies, carried out by Ulrich and colleagues (1991) found that one of the inevitable consequences of viewing natural environments seemed to be a shift to a more positive physiological, psychological and emotional state. Since then, an ever-growing body of literature has investigated the effects of green space on well-

being. Studies have linked interacting with nature with lower levels of stress (Roe et al., 2013), diminished symptoms of anxiety and depression (Beyer et al., 2014), and improved cognition in children with ADHD (Faber Taylor & Kuo, 2009) and individuals suffering from depression (Berman et al., 2012). More recently, in one of the few longitudinal studies in this area, Alcock and colleagues (2014) showed that moving to greener urban areas had long lasting mental health benefits on their residents, highlighting the importance of implementing environmental policies to increase urban green spaces (Alcock, White, Wheeler, Fleming & Depledge, 2014).

Attention

As expected, participants that went out for a walk in the park showed greater sustained attention task performance at post-test than those that remained indoors. Participants in the WALK condition demonstrated a significantly greater overall SART accuracy than those in the ROOM QUIET and ROOM ACTIVE conditions. This finding was also in line with Kaplan's (1995) Attention Restoration Theory. Again, it is important to note that the effect size that was found was very small. Reasons for this will be address in a later section.

Sustained attention refers to the ability to consciously sustain a direct focus on specific stimuli. When an individual experiences mental fatigue, their mind often wanders from the activity they find themselves attending to, resulting in performance errors. The SART measures two types of errors, target errors and non-target errors. Target errors refer to the failure to press a key in response to a stimulus and suggest total lack of attention and disengagement from the task. Target errors occur when there is failure to withhold a response to a less frequent stimulus, suggesting that the task is being carried out in an involuntary rather than controlled way. The overall accuracy of the SART, therefore, accounts for several kinds of attentional failures (Robertson et al., 1997; Morrison et al., 2014).

In the present study, participants in the outdoors condition were the only ones that experienced a restorative setting and therefore, were the only ones that recovered their directed attentional capacity to a sufficient enough degree, to actually perform better at post-test. This finding was in line with a study by Berto (2005), which had individuals perform the SART before and after viewing either restorative scenes (i.e. lakes, woods, rivers, forests, seas, etc.) or non-restorative scenes (i.e. buildings, city

streets, housing estates, etc.). Their results showed that only individuals that viewed restorative scenes demonstrated an improvement in SART performance at post-test.

As a task, the SART is very cognitively demanding, and does not allow for a learning effect (Manly, Robertson, Galloway & Hawkins, 1999). Therefore, our findings are made stronger by the fact that only the group of participants in the restorative outdoor condition showed any improvement, meaning if learning was a factor, participants in both room conditions would have improved as well.

Interestingly, participants in the ROOM QUIET condition, performed similarly at both pre-test and post-test, with a marginal decrease in mean score at post-test. Although results did not show a significant improvement in the ROOM QUIET condition nor a significant difference between the two indoor conditions, individuals that sat quietly and did nothing performed better than those that were allowed to choose how to spend their 20 minutes. Therefore, the ROOM quiet condition appears to show a general tendency towards being a more restorative setting, at least in so far as it kept participant's performance to the same level across pre-test and post-test.

People tend to engage in leisure activities to relax, unwind and help cope with their daily stresses, however, these chosen activities often have the opposite effect (Olpin, 1996). Many students for example, watch television as their primary way to relax. However, researchers have found that the number of hours people spend in front of the TV is directly associated with increased levels of fatigue, self-reported irritability and reduced life-satisfaction (Frey, Benesch, & Stutzer, 2007; Kaplan & Berman, 2010). In addition, watching TV for long periods of time results in lack of attention, impaired cognitive performance and less effective processing of information (Maass, Klopper, Michel & Lohaus, 2011).

Similarly, the same is argued for newer technologies. Students spend a lot of their time on the Internet, which can lead to distress and anxiety, social isolation, loss of academic productivity and an overall decrease in social interaction (Greenfield, 2000). Engrossing ourselves in emails, social media platforms such as Twitter and Facebook or even a mobile phone may actually have a detrimental effect on our overall attentional capacity. A paper by Ophir and colleagues (2009) from Stanford University looked at cognitive control in light and heavy "media multitaskers". By this term, the authors referred to individuals who take in more than one stream of content at the same time, for example, someone who watches TV whilst scrolling

through Facebook on their phones. Their results showed that heavy multitaskers actually had worse attention spans and were more sensitive to extraneous information than light multitaskers, suggesting that either heavy multitaskers are getting distracted by the different streams of media they are attending to, or that light multitaskers are just better at directing attention when faced with distractions (Ophir, Nass & Wagner, 2009).

This literature can help to shed some light on the findings of the current study. Before participants did the SART test a second time, they were asked to write down what they had done in the previous 20 minutes. All 10 individuals in the ROOM ACTIVE condition reported having been either on their phones or on the available computer checking Facebook, sending emails and texts, browsing the Internet and reading papers. It is therefore not surprising that participants in that condition had the worst task performance.

Mindfulness

Mindfulness generally refers to being aware of the present moment and is usually associated with increased well-being and an overall positive attitude towards life (Eberth & Sedlmeier, 2012). The questionnaire used in this study, the Mindful Attention Awareness Scale (MAAS), measures "dispositional mindfulness" which refers to the innate ability an individual has to experience this state of awareness (Brown & Ryan, 2003). The MAAS scores showed no significant differences between the three conditions. However, as one would expect, the WALK condition at post-test reported the highest mean score for dispositional mindfulness as well as reporting the biggest difference between pre-test and post-test scores, although this difference was only marginally better than in the ROOM QUIET condition.

The literature on mindfulness and green space supports the trend reported in this study. Aspinall and colleagues (2013), using a mobile electroencephalography (EEG) device, tracked participant's emotional experience whilst going for a walk through three different areas of Edinburgh: an urban shopping street, a path through green space and a busy street in a commercial district. Their results showed that participants experienced lower levels of engagement (i.e. directed attention) and frustration, and also an increase in meditation (measured by lower frequency of alpha and theta waves) when passing from a shopping street to a green space area,

consistent with Attention Restoration Theory (Aspinall, Mavros, Coyne & Roe, 2013).

Learning

Little research has focused on the potential effects of green space on academic learning. In order to do so in this study, a learning task was devised, which compared the amount of information learned from two different text passages across the three conditions. The two text passages were replicated, with permission, from a previous final year project carried out on the importance of discussion as a learning method (McCallum, 2014). One text passage was on the subject of the genetics behind the colour of female Calico cats, whilst the other was on the subject of operant conditioning and the difference between negative reinforcement and negative punishment, a topic more familiar to psychology students. Mean scores of each text passage showed no significant differences between the three conditions. However, mean scores for the Calico cats passage seem to exhibit a marked difference from pre-test to post-test when compared with the operant conditioning one. This finding is not surprising since psychology students would find the topic of operant conditioning more familiar than the topic of genetics. Participants would then appear to have "learned" more from the cats passage as they would have had less knowledge to begin with, and thus show a higher score at post-test.

It is also important to consider that individual differences might play a part, whilst prior knowledge will have certainly had an effect on how well each participant performed on the task. Despite the lack of research in this area, some studies argue that learning whilst being outdoors promotes a more effective development of cognitive skills, which in turn are critical for learning (Eaton, 2000; Dillon et al., 2006). A more recent paper by Opezzo and Schwartz (2014) at Stanford University focused on a series of experiments looking at the effect of walking on creative thinking, another key component that aids learning. Participants, either sat inside on a chair, walked inside on a treadmill, walked outside (on a busy university campus) or were rolled outside in a wheelchair. Both divergent and convergent thinking were measured, and results showed that participants that walked both inside (on a treadmill) and outside had significantly increased their creativity, particularly with regards to divergent thinking. Interestingly, walking on a treadmill facing a blank wall

had similar increases on creativity as walking outside (Opezzo & Schwartz, 2014). This finding provides some support to the current study, as our results showed similar patterns across measures, more so for the WALK versus ROOM QUIET conditions than WALK versus ROOM ACTIVE conditions.

Limitations of the Present Research and Future Research Suggestions

The literature on Attention Restoration Theory (ART) uses a variety of different tasks and measures of cognitive function, making it challenging to draw meaningful conclusions from several studies. This study is no different and some limitations will be addressed.

First of all, many studies involve either inducing mental fatigue prior to testing participants, or asking them to "imagine" themselves mentally fatigued. The present study however, tried a more naturalistic approach by asking participants to arrive for testing after having spent at least 2 hours either in lectures or studying at home or the library. Before starting the experiment, participants were also asked to report what they had been doing for the past 2 hours. It is important to note however, that despite all participants having reported being mentally engaged in some form of coursework prior to the experiment, testing took place at different times of the day, ranging from 11am to 3pm. This could have played a significant effect on participant's fatigue level, as some individuals might have been on campus for as long as 5 hours prior to the experiment whilst others may have been there for as little as 2 hours. Ideally, participants would have been tested at the same time of day after spending an equal amount of time studying or revising. This would not take into account individual differences in relation to studying and ways individuals engage with course material, but it would allow us a more comparable study.

Also noteworthy is the fact that the majority of participants were 4th year students in the second part of their final year, meaning high levels of stress, anxiety and fatigue were likely to have been present at baseline due to the highly demanding circumstances 4th year students find themselves in. They were also more likely to benefit from a 20-minute outdoor walk or a 20-minute break sitting in a room doing nothing, when compared with students from lower years, and therefore could have skewed the results towards a significant difference in the walking condition.

The sample used in this study was fairly representative of the undergraduate student population, however, due to the time constraints and limited resources, it was relatively small in size, at a total of 30 participants with 10 in each condition. This most likely accounted for the non-significance of some of the measures used and also for the small effect size reported. A bigger sample would allow us to draw more powerfully valid and accurate conclusions from our results.

Some strengths of this study include the use of a strongly validated measure of sustained attention in the SART (Robertson et al., 1997; Morrison et al., 2014) and also the fact that participants were actually immersed in a natural environment and did not simply look at pictures, which demonstrates high ecological validity.

However, when considering the validity of this study, there are also other procedural limitations that should be taken into account. In the WALK condition, despite efforts to minimize communication, it was impossible to avoid any interaction between participant and researcher during the 20-minute intervention, whilst in the two room conditions, participants were left on their own for the whole intervention period.

One of the most challenging things to investigate in Attention Restoration Theory (ART) research seems to be which particular outdoor feature produces restoration. Participants had to walk through a busy university campus for 5 minutes prior, and 5 minutes after experiencing the walk in the park. Could it be that the walking to and from the park had an effect, without it necessarily being due to experiencing green space for those 10 minutes in between? Or could it be due to just the action of walking in itself and not the location, as participants had to walk from the experiment room to the department's main door in order to leave the building? Or simply the fact they left the setting they were in for a short period of time? Could it be due to just being outside and experiencing, for example, the wind in their face? It appears to be very difficult to isolate what effect, if any, is due to walking to and from the park, and what is due to walking in the park itself.

Future research should focus on what it is specifically about the outdoors that allows for restoration. Lichtenfeld and colleagues (2012) found that briefly flashing a green light prior to a creativity test actually improved participant's creative performance. As seen previously, studies that used simulated natural environments in the form of photographs or video stills also reported higher levels of restoration (Berman et al., 2008; Kjellgren & Buhrkall, 2010). It does pose the question of

whether these findings could be due to the colour green, where the effect might be greater than purely aesthetic (Lichtenfeld, Elliot, Maier & Pekrun, 2012).

Other studies have looked at the impact of indoor light and colour on psychological mood. Bright colours seem to elicit more positive emotional states and make for better working environments (Kuller, Ballal, Laike, Mikellides & Tonello, 2005). The most restorative settings are generally rich in colour, which again highlights that colour might have a more significant impact that previously thought. Exposure to sunlight has been shown to help postoperative patients heal quicker and require less medication (Walch et al., 2005). Intuitively, people tend to feel better on days when the sky is blue and the sun is shining. It would be of interest to somehow try and isolate the impact that both features could have on an individual's cognitive abilities. The same can be said for certain sounds. Ratclifee and colleagues (2013) found certain birdsongs to be associated with attention restoration and reduction of stress levels. Likewise, the sound of wind in the trees, leaves rustling on the ground, waves crashing on a beach are all associated with relaxation, reflection and meditation. It would be of interest to further investigate their individual contributions.

An additional noteworthy limitation of this study is that it did not measure long lasting effects of the restorative intervention. Another final year project carried out by Lucy Paterson (2015) looked at the effects of exercise on school children across three interventions: free play in a nearby park, organised exercise in the school gym and doing nothing in a classroom. This study investigated lasting effects by measuring attention using the Digit Backward Span (DBS) at pre-condition, post-condition and again after 1-hour class for each intervention. Teachers reported that children appeared more focused and attentive in class after the meadow intervention, however, DBS results indicated otherwise. Lasting effects are of particular significance to the student population and should be one of the main focuses of future research.

Attention is considered to be one of the most important resources in learning. According to the Attention Restoration Theory, natural environments are the ideal settings to restore a person's directed attention once he or she has experienced mental fatigue. Since mental fatigue and stress are so often part of university life, it is important that students are made aware of all the characteristics that make up a fully restorative experience and also how to incorporate them into their everyday life.

Students often choose to engage in activities that, even though at first might seem relaxing and restorative, end up having negative consequences for their cognitive performance and physiological state.

These findings are also of importance for Universities. It allows them to educate students on the numerous health and psychological benefits that are associated with experiencing nature, including but not limited to attention restoration. It also gives them guidance on how to provide students with the best restorative areas, either indoors or outdoors, where they can have a break from their academic work, and allow them to perform at their best.

CONCLUSION

In conclusion and in support of Attention Restoration Theory (ART), the present study found that exposure to nature increased individuals' well-being and ability to sustain attention for a longer period of time. No significant differences were found on mindfulness and learning measures. This study has important implications for university students and seeks to provide guidance into the ways in which study breaks can be structured, in order to maximise academic performance.

Moving forward, research should focus on investigating the individual features that make up a natural environment in order to determine which ones make them more or less restorative. Another important aspect to be further investigated is the long-term effect of restorative experiences on attention, if any exist. Only then, we will be able to determine how truly beneficial ART is for studying purposes.

APPENDIX A: **Kelvingrove Park Green Space Checklist**

Long Grass - *No*

Short Grass - *Yes*

Flowers: Yes / (No) Vivid/ less so - *Not really any flowers, it was Autumn/Winter*

Plenty of green: (Yes) / No

Trees with leaves - *Yes*

Trees without leaves - *Some, mainly brown leaves*

(Pond) / Stagnant water - *Yes, Kelvingrove Pond.*

Vigorously Running water - *Yes, River Kelvin*

Fences - *Yes*

Walls - *Not within the park*

Dirt - *Yes*

Bark - *Yes*

Play area – *Yes, children's park area x 2*

Buildings - *Yes*

Animals (larger) - *Yes, lots of pigeons, squirrels, ducks, birds, dogs*

Insects – *Not really*

People: No other people/ (some people) extremely busy with other people

How far can you see: 50 yards or less / (¼ of a mile) / 5 miles / more

The ground itself: Flat/ slightly hilly/ steep – *Yes, all types present in the park.*

Unlikely play areas: monuments/ benches/ statues or other (please state): *Yes plenty of monuments and benches, some statues.*

Other: *There is two bridges, one by the entrance (main bridge) + a few smaller ones Within the park there is also a football pitch, a skate park and a big fountain.*

APPENDIX B: **Well-being Questionnaire**

Below are some statements about feelings and thoughts.
Please circle the letter that better describes to what extent do you agree with each statement in this moment in time.

STATEMENTS	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am feeling optimistic about the future	A	B	C	D	E
I am feeling useful	A	B	C	D	E
I am feeling relaxed	A	B	C	D	E
I am feeling interested in other people	A	B	C	D	E
I have energy to spare	A	B	C	D	E
I am dealing with problems well	A	B	C	D	E
I am thinking clearly	A	B	C	D	E
I am feeling good about myself	A	B	C	D	E
I am feeling closer to other people	A	B	C	D	E
I am feeling confident	A	B	C	D	E
I am able to make up my own mind about things	A	B	C	D	E
I am feeling loved	A	B	C	D	E
I am interested in new things	A	B	C	D	E
I am feeling cheerful	A	B	C	D	E

APPENDIX C: Mindfulness Questionnaire

Below is a collection of statements about your everyday experience.
Using the scale A-F below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what really reflects your experience rather than what you think your experience should be. Please treat each item separately from every other item.

A	B	C	D	E	F
Almost Never	Very Infrequently	Somewhat Infrequently	Somewhat Frequently	Very Frequently	Almost Always

I could be experiencing some emotion and not be conscious of it until some time later.	**A**	**B**	**C**	**D**	**E**	**F**
I break or spill things because of carelessness, not paying attention, or thinking of something else.	**A**	**B**	**C**	**D**	**E**	**F**
I find it difficult to stay focused on what's happening in the present.	**A**	**B**	**C**	**D**	**E**	**F**
I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.	**A**	**B**	**C**	**D**	**E**	**F**
I tend not to notice feelings of physical tension or discomfort until they really grab my attention.	**A**	**B**	**C**	**D**	**E**	**F**
I forget a person's name almost as soon as I've been told it for the first time.	**A**	**B**	**C**	**D**	**E**	**F**
It seems I am "running on automatic", without much awareness of what I'm doing.	**A**	**B**	**C**	**D**	**E**	**F**
I rush through activities without being really attentive to them.	**A**	**B**	**C**	**D**	**E**	**F**
I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.	**A**	**B**	**C**	**D**	**E**	**F**
I do jobs or tasks automatically, without being aware of what I'm doing.	**A**	**B**	**C**	**D**	**E**	**F**
I find myself listening to someone with one ear, doing something else at the same time.	**A**	**B**	**C**	**D**	**E**	**F**
I drive/walk places on "automatic pilot" and then wonder why I went there.	**A**	**B**	**C**	**D**	**E**	**F**
I find myself preoccupied with the future or the past.	**A**	**B**	**C**	**D**	**E**	**F**
I find myself doing things without paying attention.	**A**	**B**	**C**	**D**	**E**	**F**
I snack without being aware that I'm eating.	**A**	**B**	**C**	**D**	**E**	**F**

APPENDIX D: Perceived Restorativeness Scale (PRS)

Please indicate on the 7-point scale the extent to which the given statement describes your experience in this setting.

	0 = Not at all						6 = Completely
Being here is an escape experience.	0	1	2	3	4	5	6
Spending time here gives me a break from my day-to-day routine.	0	1	2	3	4	5	6
It is a place to get away from it all.	0	1	2	3	4	5	6
Being here helps me to relax my focus on getting things done.	0	1	2	3	4	5	6
Coming here helps me to get relief from unwanted demands on my attention.	0	1	2	3	4	5	6
This place has fascinating qualities.	0	1	2	3	4	5	6
My attention is drawn to many interesting things.	0	1	2	3	4	5	6
I want to get to know this place better.	0	1	2	3	4	5	6
There is much to explore and discover here.	0	1	2	3	4	5	6
I want to spend more time looking at the surroundings.	0	1	2	3	4	5	6
This place is boring.	0	1	2	3	4	5	6
The setting is fascinating.	0	1	2	3	4	5	6
There is nothing worth looking at here.	0	1	2	3	4	5	6
There is too much going on.	0	1	2	3	4	5	6
It is a confusing place.	0	1	2	3	4	5	6
There is a great deal of distraction.	0	1	2	3	4	5	6
It is chaotic here.	0	1	2	3	4	5	6
Being here suits my personality.	0	1	2	3	4	5	6
I can do things I like here.	0	1	2	3	4	5	6
I have a sense that I belong here.	0	1	2	3	4	5	6
I can find ways to enjoy myself here.	0	1	2	3	4	5	6
I have a sense of oneness with this setting.	0	1	2	3	4	5	6
There are landmarks to help me get around.	0	1	2	3	4	5	6
I could easily form a mental map of this place.	0	1	2	3	4	5	6
It is easy to find my way around here.	0	1	2	3	4	5	6
It is easy to see how things are organized.	0	1	2	3	4	5	6

APPENDIX E: **Text Passage - Operant Conditioning**

Adapted from: McCallum, C. (2014). Discussion: Is it worth our time? Final Year Maxi Project Report. School of Psychology, University of Glasgow.

PASSAGE

Operant Conditioning

Negative punishment is an important concept in B. F. Skinner's theory of operant conditioning. In behavioural psychology, the goal of punishment is to decrease the behaviour that precedes it. Punishment refers to change that occurs after a behaviour that reduces the likelihood that that behaviour will occur again in the future. In the case of negative punishment, it involves removing an appetitive stimulus in order to reduce the occurrence of a particular behaviour; negative punishment is that which results because an appetitive stimulus or circumstance is removed as a consequence of response.

Negative reinforcement occurs when the performance of an action results in the omission of an aversive stimulus and the incidence of the behaviour increases as a result of this learning process. The initial phases of skill learning involve what might be termed negative reinforcement as the skill helps to reduce the undesirable effects of the environment. Negative reinforcement is a useful concept when measuring stimulus-behaviour relationships, as it describes a condition in which increased behaviour leads to omission of a stimulus.

QUESTION (Presented both pre-text and post-text)

Within the context of operant conditioning, please explain any similarities and differences between negative punishment and negative reinforcement, including an example for each. Please write in sentences. Your answer could be roughly a paragraph in length. Please give this sheet to the experimenter when you are finished.

MARKING SCHEME: IDEA UNITS

1. Punishment
    a. Reduces the likelihood of behaviour (1)
    b. Removal of a stimulus (1)
    c. Stimulus is appetitive (1)
    d. Correct Example (2)

2. Negative Reinforcement
    a. Increases the likelihood of behaviour (1)
    b. Removal of a stimulus (1)
    c. Stimulus is negative (1)
    d. Correct Example (2)

APPENDIX F: **Text Passage – Calico Cats**

Adapted from: Carpenter, S. K., Wilford, M. M., Kornell, N., & Mullaney, K. M. (2013). Appearances can be deceiving: instructor fluency increases perceptions of learning without increasing actual learning. *Psychonomic bulletin & review*, *20*(6), 1350-1356.

PASSAGE

Calico Cats

A calico cat is a cat that has three distinct coat colours; black, white and orange. Calico cats are almost always female. Why is that? All mammals have two sex chromosomes; X or Y. Females typically have two X chromosomes, males have one X chromosome and a Y chromosome. In cats the X chromosome and not the Y carry the genetic code for displaying a coat colour that is either orange or black. In the cat, the genetic code for displaying a white coat colour is located in a completely separate gene from the one that displays orange or black.

Since female cats typically have 2 X chromosomes, one of the females' X chromosomes can display an orange coat and the other can display black. Since male cats have only one X chromosome, it can only display a coat colour that is either orange or black.

Female cats can simultaneously display a coat colour that is black, white and orange. With the exception of rare genetic abnormalities, male cats only have one X chromosome and can therefore only display a coat colour that is either orange or black, but not both colours together.

QUESTION (Presented both pre-text and post-text)

Please jot down a few points you may know on why "Calico" cats (coloured black, white and orange) are usually female. Please write using sentences.

MARKING SCHEME: IDEA UNITS

1. A calico cat is black, white, and orange.
2. All mammals have X or Y chromosomes.
3. Females have two X chromosomes.
4. Males have an X chromosome and a Y chromosome.
5. The X chromosome displays either orange or black coat colour.
6. A different gene (not the X chromosome) displays a white coat colour.
7. One of the female's X chromosomes can display a black coat.
8. One of the female's X chromosomes can display an orange coat.
9. Males can only display an orange or black coat.
10. Females can simultaneously display a black, white, and orange coat.

APPENDIX G: Information Sheet & Consent Form

PARTICIPANT INFORMATION SHEET

Introduction

We would prefer it if you could read this information before consenting to participate in this study. If you have any questions please ask the researcher.

The purpose of the experiment

The aim of this study is to investigate the effects of green space on attention and other cognitive abilities in undergraduate students.

What will happen?

You will be asked to complete three tasks: (1) a well-being and a mindfulness questionnaire, (2) a computer-delivered stimulus-response task (SART) and (3) a learning task. These will be followed by a restorative or a non-restorative intervention.

You will be randomly assigned to one of three conditions: in two of those you will remain in the experiment room for a 20 minute period, in the third condition you will go for a short 10 minute walk in Kelvingrove Park, spending no longer than 20 minutes outdoors.

After this intervention period, you will repeat all three tasks already mentioned.

The experiment will take between 1h – 1h 15 min.

Your participation

Taking part in this research is entirely voluntary and it is up to you whether or not you decide to take part. You may decide to withdraw from this study at any time without explanation. You have the right to omit or refuse to answer or respond to any question that is asked of you.

A decision not to participate will not have any effect on your status as a student at the University of Glasgow.

Any information about your identity will be kept strictly confidential to the researchers and your answers will be entirely anonymous.

Any questions or concerns, please contact:

Student Name (researcher): 1102375C@student.gla.ac.uk

Steve Draper (supervisor): s.draper@psy.gla.ac.uk

Thank you very much for your time today.

PARTICIPANT CONSENT FORM

Title of Project: Effect of Green Space on attention and other cognitive abilities

Name of Researchers: Student Name, Dr Steve Draper

I confirm that I have read and understood the information sheet for the above study and have had the opportunity to ask questions.

I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason.

Any information, which might potentially identify me, will not be used in published material or in the experimental report.

I agree to participate in the above study.

Name of Participant (Printed)	Signature	Date

Name of Researcher (Printed)	Signature	Date

APPENDIX H: Participant Questionnaire

PARTICIPANT QUESTIONNAIRE

MATRIC NUMBER: _____
YEAR OF STUDY: _____
AGE: _____
GENDER: _____

Please answer the following questions:

1. What have you been doing for the past TWO HOURS?

2. You will be randomly assigned to an intervention, however, if you could choose would you rather (please tick your preferred answer):

a) stay indoors for 20 minutes ☐
b) go outside for 20 minutes ☐

APPENDIX I: **Learning Task Booklet Example**

Learning Task

Please read the instructions below:

On page 3 of this booklet you will find a question, please attempt to answer it but do not worry if you do not write anything. Your answers will not be compared to those of other participants.

On page 4 you will find a passage of text. Please time yourself ***2 minutes*** to read it using the timers available.

Turn to **page 5** and attempt to answer the question again, time yourself ***3 minutes*** to do this.

Once you are done, turn to **page 6** and answer the two questions. Once you have finished, please let the researcher know.

Thank you very much!

Please attempt to answer the question below. Do not worry if you do not write anything. Your answers will not be compared with those of other participants. Once you have finished, turn to page 4.

QUESTION

Please jot down a few points you may know on why "Calico" cats (coloured black, white and orange) are usually female. Please write using sentences.

*Please time yourself **2 minutes** to read the passage below using the timers provided. Once you have finished turn to page 5.*

PASSAGE

Calico Cats

A calico cat is a cat that has three distinct coat colours; black, white and orange. Calico cats are almost always female. Why is that? All mammals have two sex chromosomes; X or Y. Females typically have two X chromosomes, males have one X chromosome and a Y chromosome. In cats the X chromosome and not the Y carry the genetic code for displaying a coat colour that is either orange or black. In the cat, the genetic code for displaying a white coat colour is located in a completely separate gene from the one that displays orange or black.

Since female cats typically have 2 X chromosomes, one of the females' X chromosomes can display an orange coat and the other can display black. Since male cats have only one X chromosome, it can only display a coat colour that is either orange or black. Female cats can simultaneously display a coat colour that is black, white and orange. With the exception of rare genetic abnormalities, male cats only have one X chromosome and can therefore only display a coat colour that is either orange or black, but not both colours together

*Please time yourself **3 minutes** to answer the question below. Once you have finished, please turn to page 6.*

QUESTION

Please jot down a few points you may know on why “Calico” cats (coloured black, white and orange) are usually female. Please write using sentences.

How hard was it to concentrate on this task? (please tick your choice)

A) Extremely difficult, felt anxious and distressed ☐
B) Quite difficult, yet didn't make me upset ☐
C) Couldn't concentrate for more than a minute, due to distractive thoughts ☐
D) I felt sleepy and found it hard to concentrate on anything ☐
E) Found it easy and had no difficulty concentrating on the task ☐

Next you will be asked to go for a 10 minute walk in Kelvingrove Park, remaining outside for no longer than 20 minutes before repeating the tasks, how restorative do you think this intervention will be?

APPENDIX J: Debriefing Sheet

DEBRIEFING SHEET

Dear Participant,

The purpose of this study was to investigate the effects of green space on attention and other cognitive abilities. The idea was to compare the restorative effects on cognitive functioning after interactions with outdoors versus indoor environments.

According to the Attention Restoration Theory, spending time in natural environments increases our ability to concentrate. The SART computer task allowed us to test participant's ability to maintain attention and alertness over a prolonged period of time, whilst the learning task allowed us to test whether interventions made participants more or less efficient at learning information present in a passage of text.

Participants that experienced the outdoors intervention were expected to perform better in the post intervention tasks than those that remain indoors.

The aim of this study is to be able to provide students with guidance on better ways to structure their study breaks in order to maximize their performance.

If you wish to have your data taken out from the analysis, please ask the researchers. If you would like to be contacted with the results of the experiment or if you have any other questions regarding the study please do not hesitate to contact us.

Thank you very much for taking part in our study!

Student Name (researcher): 1102375C@student.gla.ac.uk

Dr Steve Draper (supervisor): s.draper@psy.gla.ac.uk

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