Is 1-Minute of Nature Enough? Presence and Durations of Nature View during Walking and Attention Restoration

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Received: 6 Apr 2022; Revised from: 12 Jun 2022; Accepted: 18 Jun 2022

Print-ISSN: 2228-9135, Electronic-ISSN: 2258-9194 https://doi.org/10.56261/built.2022v19i0.246242

Abstract

Walking in nature provides several health benefits including restoring attention capacity. However, researchers do not know the extent to which the duration of green exercise affects attention restoration. This lack of evidence prevents designers and planners from effectively providing this nature's co-benefit.

This study tested the extent to which a view of nature and durations of nature while walking may impact attention restoration. 79 participants completed attentionally demanding tasks and walked on a treadmill for 15 minutes; they were randomly assigned 0, 1, 5, and 15-minute views of nature.

Participants who saw nature during the walk had greater attentional score improvements. No difference was found among durations. This finding suggested that only 1 minute of nature in a 15-minute walk has a potential to restore attention. This implied that designers should focus on distributing views of urban nature into barren spaces before adding nature to the places which are already green.

This study was one of the first that compared duration of contact with nature for differences in attention restoration. More studies should explore differences in attention restoration with greater ranges of duration to allow landscape designers and urban planners to effectively design cities to reap the full co-benefits of green exercise.

Keywords: Walking with nature views, Attention Restoration, Dose of Nature

1. Introduction

Contact with nature offers several benefits to human health, especially in urban spaces (Coutts & Hahn, 2015; Suppakittpaisarn et al., 2017). There are several possible ways people can experience nature in everyday life, one of which is green exercise. Exercising while experiencing nature can provide synthesis of positive improvement towards human health (Barton et al., 2016; Lahart et al., 2019). To help people easily access these benefits, cities and neighborhoods should incorporate natural elements in everyday walking spaces. However, there is increasing challenges in encouraging people to be outside during the air pollution seasons and possibly recurring airborne pandemic (Blocken et al., 2020; Wiwatanadate, 2014). Thus, designers and planners must understand whether the visual contact with nature during indoor and semi-indoor exercise can also improve well-being. In this way, people can gain health benefits, including attention restoration, from daily life in different circumstances. Attention is a valued resource for the modern society which can be restored effectively by experiencing nature (S. Kaplan, 1995). However, the evidence is unclear about the extent to which durations of nature may impact attention restoration (Sullivan et al., 2014). Understanding these questions may provide stronger design and planning suggestions for urban landscapes that benefit human health and well-being.

1.1 The health benefits of urban nature

Urban nature provided several benefits for people's well-being, including temperature regulation and stormwater management (Erell et al., 2011; Watson & Adams, 2010). It contributed to ecological benefits, such as providing wildlife habitats and connecting and allowing natural processes in the urban area (Tzoulas et al., 2007), which contributes to the concept of planetary health: if the ecosystems around humans are healthy, then the humans who live in it also benefit (LANCET, 2020). Furthermore, growing body of evidence has linked spending time with nature to several human health co-benefits (Coutts & Hahn, 2015; Hartig et al., 2014; Sullivan et al., 2014; Suppakittpaisarn et al., 2017). In larger scales, greener neighborhoods correlated to lower risks of depression (Bezold et al., 2018), cardiovascular diseases (Donovan et al., 2013), and obesity (Kim et al., 2016). In the more individual scales, contact with nature helps people deal with acute stress and mental fatigue (B. Jiang, Chang, et al., 2014; B. Jiang, Li, et al., 2014; Li & Sullivan, 2016). This encourages designers, planners, and policy makers to provide several accessible ways that people can make contact with nature in their everyday life.

1.2 Ways to contact nature: green exercise and daily walks

There are several ways that people can have daily experiences of nature. Urban nature can come in many forms, including parks, street trees, and trees in residential yards and neighborhoods. Together, these urban natural components compose the urban forests. People could gain benefits just by looking out from the windows, taking a seat in a park, or engaging in nature play. However, one of the ways to increase benefits with experiencing nature is through exercise 'in' and 'with views of' nature.

Contact with urban nature and physical activities can work in tandem to improve human health and well-being (Gladwell et al., 2013; Pretty et al., 2005). For example, in one study, a walk in an arboretum was shown to provide an attentional benefit similar to an ADHD medication (Berman et al., 2008). In another study, a systematic review had investigated 31 papers about exercising in nature and concluded that exercising can mitigate anxiety, anger, fatigue, and depressive emotions while increasing enjoyment (Lahart et al., 2019). And still in other studies, such effects are higher for participants who exercise in outdoor nature compared to those exercising indoors (Lahart et al., 2019). Another multi-study analysis suggested that exercising in nature increased self-esteem and positive moods (Barton & Pretty, 2010).

The benefits are not limited to walking 'in' nature but also walking 'with a view of' nature. Another study experimented on the comparison between exercising while watching images of nature and found that both urban and rural green exercises can improve blood pressure, self-esteem, and moods (Pretty et al., 2005). This suggests that designers and policy makers need to help design the built environment in such a way that people can exercise with accesses and views of nature more frequently and conveniently.

While daily exercises in the park maybe an obvious way for green exercise, another way to offer daily physical activity is walking between places. Providing greener walks and streets has ecosystem services benefits, such as making the streets feel safer (B. Jiang et al., 2017; Suppakittpaisarn et al., 2020), moderating the temperature (Loughner et al., 2012), and lowering the risks of neighborhood crimes (Donovan & Prestemon, 2012). It also encourages people to walk more (Leyden, 2003). Together, we can conclude that urban nature between places might provide extra health benefits for people by both encouraging them to include physical activities in their routines and offering them the benefit of nature.

1.3 Urban environment and attention restoration

One of the benefits of green exercise include attention restoration (Berman et al., 2008). The term 'attention' refers to a mental resource required to process information around us and make decisions. (S. Kaplan & Berman, 2010; Norman, 1969).

Attention Restoration Theory (ART) divides attention into two groups: Involuntary Attention and Directed Attention. Involuntary Attention involved the attention that a person spends without efforts to specific stimuli, such as loud noises. Directed Attention requires effort and is related to focus, short term memory, and self-regulation (Berman et al., 2008; R. Kaplan et al., 1998; S. Kaplan, 1995; Sullivan, 2015). Spending too much directed attention may leave people attentionally fatigued and are less effective in concentrating and making rational, long-term decisions. (R. Kaplan & Basu, 2015; Sullivan, 2015).

The key idea of ART is that people can restore from attentional fatigue by contact with nature. By spending time in the environment with natural elements such as parks and urban forests, a person restores from attention fatigue more effectively than spending time in a built environment such as a street without trees. The explanation is that natural elements remove such people from the attentionally demanding situation and hold their attention more gently, allowing their attention capacity to restore (R. Kaplan & Basu, 2015; S. Kaplan, 1995).

This theory has been proven by experiments in several settings such as schools (Kuo et al., 2018; Li, 2016; Li et al., 2019; Matsuoka, 2010), universities (Felsten, 2009; Tennessen & Cimprich, 1995), workplaces (Lee et al., 2015), and nursing homes (Moore, 2007).

Because directed attention needed to be charged often, resting near natural components in the urban environment could especially benefit people's ability to restore attention. According to a report on benefits of nature, daily access to nature in the urban environment can be more important to those living there. Design experts have recommended that people spend time with the natural components around them (Lindland et al., 2015). Several design and planning studies have also recommended including accessible green spaces and other green infrastructure within the urban fabric (Coutts & Hahn, 2015; Suppakittpaisarn, 2017; Tzoulas et al., 2007).

1.4 Critical Knowledge Gap 1: limitations from urban nature

While being outside with nature can benefit human health, there are some environmental factors that limit people's contact with nearby nature and their health benefits. One of the issues is air pollution. Air pollution is harmful to physical and mental health, especially in smaller particles. Ambient PM10 and PM2.5 is correlated to increased risks of cardiovascular diseases, respiratory diseases, cancer, and Attention Deficit Disorder (Loomis et al., 2013; Markevych et al., 2018; Nowak et al., 2013; Yue et al., 2020). This situation makes air pollution a large health threat, especially for developing countries in a specific time of the year (Romieu et al., 2002). For example, the smog season in Chiang Mai, Thailand, spans late winter-midsummer (Charoenlertthanakit et al., 2020), a time during which the city has the highest air pollution rate in the world (Wiwatanadate, 2014). This also means that while we know that spending time outdoors with nature can benefit health in several ways, breathing in the outdoor air during the high pollution season can cause more harm than indoors, and spending time in pollution-free spaces that are mostly airtight becomes a safer option than outdoor exercise. Policies and actions are thus needed to solve the problem of air pollution from different angles so that the air can be safe for all. While these solutions are being explored, designers and researchers need to find creative ways for people to gain the benefits of nature during high pollution periods.

In late 2019, a viral pandemic started across the world. The Coronavirus Disease 2019 (COVID-19) is airborne and can be contracted by closeness to someone who has the disease but has not displayed symptoms (Wu et al., 2020). To stay safe, social distancing was highly encouraged during the pandemic. Running and cycling behind those who have had the virus can risk contracting the disease (Blocken et al., 2020; Freeman & Eykelbosh, 2020). While the risks were low when precautions are made, alternative ways of exercises, such as exercising at home should be encouraged.

Because the spread of this pandemic is predicted to be recurring (Holmdahl & Buckee, 2020), designers and planners should seek to design green infrastructure and built environments in ways that people can benefit from nature while practicing social distancing or quarantine. Window views and views during stationary exercise can provide alternative contact with nature.

In response to air pollution and pandemic situations, indoor and stationary exercises might be alternative ways of gaining exercise benefits and possibly the co-benefits of nature. That is, researchers are continuing to find the extent to which walking on an exercise machine that can be placed indoors and in a protected environment, such as a treadmill, with views of nature can provide restorative benefits of nature. An experiment suggested that a 20-minute treadmill walk with images of nature can restore overall mood and self-esteem (Pretty et al., 2005). However, the body of evidence is still growing (Barton et al., 2016). Filling this knowledge gap may help people who live in places with poor air quality or are under pandemic quarantine to get some benefit from nature.

1.5 Critical knowledge gap 2: dose of nature

Aside the gap regarding the limitations of going outdoors, there are still gaps in the relationship between urban green infrastructure and human health, including dosage (Sullivan et al., 2014). It is established that nearby nature is good for human health (Coutts & Hahn, 2015; Suppakittpaisarn et al., 2017). If landscapes and environmental psychologists are to treat the well-being benefits of nature as a health and well-being strategy, they must understand the effective doses of nature towards certain health and well-being benefits. For example, how much urban nature should be enough to reduce stress and restore attention? How long should a nature break be? How frequently should someone stay in contact with nature? Without answers to these questions, we risk creating designs and policies that are inefficient or ineffective for human health and well-being.

To answer these questions, researchers have worked on the extent to which the intensity, duration, and frequency of contact with nature impact these benefits (Cox & Gaston, 2018; B. Jiang et al., 2015). Some key studies have suggested that the relationships between nature intensity and stress restoration and physical health outcomes are bell-shaped (Bakolis et al., 2018; B. Jiang, Chang, et al., 2014), implying that excess exposure to nature can be less effective. Other studies have shown that the relationship between intensity and preference is similar to those from the power equation, meaning that while more nature is related to higher preference score, the increase in preference is lower as nature increases (B. Jiang et al., 2015; Suppakittpaisarn et al., 2018). A few studies have addressed the effects of varying frequency and duration of nature (Cox & Gaston, 2018), but the body of evidence is still growing.

The questions about dose of nature are relevant to our discussion of attention restoration. To what extent does duration of contact with nature affect attention restoration? Many experiments have used different durations for studying contact such as 40 seconds (Lee et al., 2015), 10 minutes (Li & Sullivan, 2016),and 45 minutes (Berman et al., 2008). A previous study had suggested that the longer the duration of exercise, the more effective the restoration was, but with diminishing rate of increase (Barton & Pretty, 2010). Given this finding, more evidence is needed to confirm that conclusion. The implication of this question of duration may help designers and policy makers create spaces and break policies that accommodate such timeframe more effectively.

To address these knowledge gaps, we asked: 1) To what extent does stationary walking with views of nature help improve attention capacity, and 2) To what extent does the duration of walking with views of nature affect attention restoration?

2. Methods

2.1 Experimental site

The experiment was conducted at Huay Kaew Arboretum, Chiang Mai, Thailand, an urban park located next to Chiang Mai University. Huay Kaew Arboretum was built in 1913 as an experimental station, but later converted to an arboretum in 1953. It is a part of Chiang Mai's urban green infrastructure.

In this study, the researchers transformed one of the pergolas connected to the nature center overlooking the green spaces into an outdoor experimental room. The reason the researchers selected this space was because of its dense nature view. While the experimental location is semi-indoor, the setting resembled the indoor environment with glass windows. The researchers replaced the meeting table with a treadmill and installed curtains around the pergola, blocking the view of nature to simulate the duration of nature in daily walks (Figure 1).

2.2 Participants

Once the experiment was approved by the relevant ethical committee, referral number CMU 61/034, the participants were recruited from physical posters and social media. The participants were between 18-40 years of age and have never been diagnosed with depression, cardiovascular diseases, ADHD, or other mental morbidity. They also have lived in Thailand for longer than 5 years prior to the experiment. Interested participants called

Figure 1. The pergola's view before (left) and after the experiment setting (right).

or emailed to register and set up the date of the experiment. The experiment was conducted between September and October 2019, during which Chiang Mai had no air pollution and before COVID-19 started. The sample size was calculated by Qualtrics Sample Size Calculator (Qualtrics, 2018), using Z-scores and sample sizes . In this study, the sample size is appropriate at 90% Confidence Level and 10% margin of error. We recruited the participants by physical posters across the city of Chiang Mai, web pages, and social media.

2.3 Attention Measures

We used the Sustained Attention to Response Task (SART) to measure the attention capacity of the participants. SART has been used often in measuring attention. In the SART, a participant was asked to look at a computer screen while placing their index finger on the space bar key. They were instructed to press the key when they see numbers appearing on the screen, except for number 3. The numbers were random in order and sizes. The test took approximately 5 minutes to complete, and it recorded the numbers of correct and incorrect responses.

Table 1 Time spent walking with view of nature for each participant group.

Group Name	Time walking with nature views
Group 1	0 minute
Group 2	1 minute
Group 3	5 minutes
Group 4	15 minutes

2.4 Procedure

At the beginning of the experiment, the participants were asked to confirm their health history and give their informed consent. We collected their gender data but not age due to the limited age range. Their attention capacity was then tested with SART to measure their baseline attention (T1). Next, the research team induced mental fatigue in the participant in two ways: Trier Social Stress Test (TSST), which contained a 5-minute mental subtraction task and a 5-minute speech in front of two or more researchers and a 5-minute proofreading test.

Participants was then taken through SART again to test for their attention capacity after they are mentally fatigued (T2). Following the SART test, participants were then randomly assigned into one of four groups. Each group walked on a treadmill for 15 minutes in a curtained pergola with view of nature behind the curtain. The researchers pulled the curtain open and revealed the view of nature at a different time for each group to allow different durations of nature. Table 1 shows the duration that each group was in contact with nature.

During that time, participants were not allowed to listen to music or use any electronic device. After the rest period, the participant performed SART one last time (T3). The experiment lasted approximately 1 hour and 15 minutes for each participant.

2.5 Statistical analyses

The researchers identified the participants' attention capacity by counting the total number of errors they made in each SART. Then, we calculated the percentage of changes between T2 and T3 using the following formula:

% Change = 100 x ((T2-T3)/T2)

We first tested the comparison between Group 1 (control group) with Group 2-4 via independent t-test. Then we performed the Analysis of Variance (ANOVA) between all four groups to determine whether durations of the walks affect the attention restoration.

3. Results

In this experiment, we asked two questions: 1) To what extent does stationary exercise with view of nature help improve attention capacity? and 2) To what extent does duration of view of nature during walks affect attention restoration? The total participants included 80 people, 40 female and 40 male participants. However, the data from a male participant was not calculated due to data collection error, leaving the sample size to n=79. The results are as follows.

First, does stationary walking with nature view improve attention? We answered it by a t-test to see if the score improvement was different between those who see nature and those who did not. The independent t-test showed that a control group (n=20, M=-3.9, SD = 21.2, SE=4.5) and treatment groups (n=59, M=5.2, SD = 15.1, SE=2.0) demonstrated significant difference in percentage of improvement in SART, t(77)=-2.072, p=0.04. The Common Language Effect Size between the two variables is 0.65, suggesting that the difference is perceptible, with the confidence interval of 0.03 - 1.06. Figure 2 shows the visualization of the data.

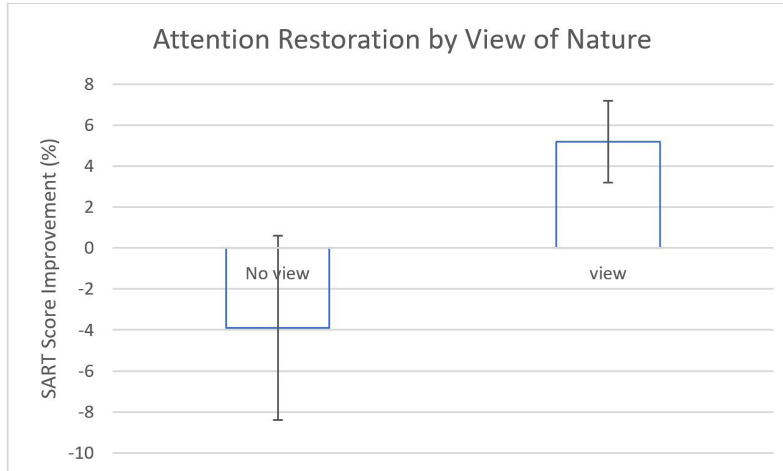

Figure 2. Comparison between attention score improvements of those who saw nature and those who did not.

Next, the researchers asked whether the extent of improvement differ between different durations of nature during the 15-minute walk through the % improvement of attention capacity. The lower the percentage, the less the participants' attention capacity improved between T2 and T3. A negative percentage means that the participants performed worse after the treatment.

When examining the difference between the four groups in ANOVA, the researchers did not find significant difference between each group (F(3,76)=2.1, p= 0.11). However, the histogram of the mean improvements on G1-4 shows promising results for further investigation. Figure 3 shows the visualization of the data with standard errors, and Table 2 shows the descriptive statistics of each group.

Table 2. Descriptive statistics of each duration group

Group	Sample Size	Mean	SE	
0 min	20	-3.9	4.5	21.2
1 min	20	3	1.7	7.7
5 min	19	2.9	2	8.6
15 min	20	9.4	5.2	23.1

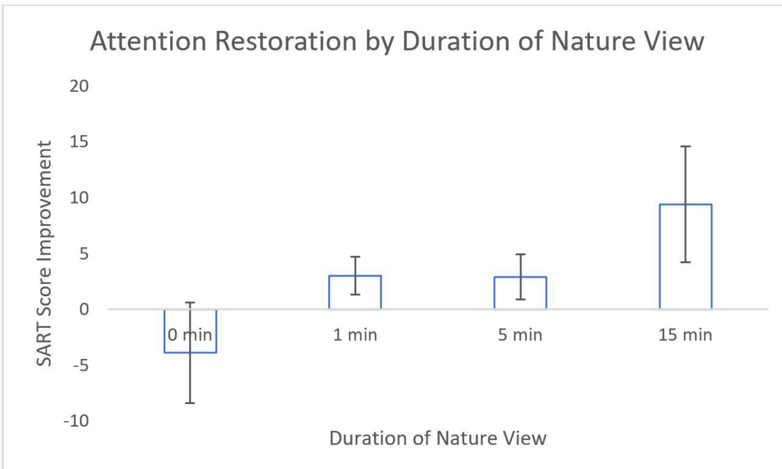

Figure 3 Comparison between attention score improvements between each group (not statistically significant)

4. Discussion

4.1 Key results

In this study, we found that walking on a treadmill with nature views may improve attention restoration. However, we did not find the difference between 1, 5, and 15-minute duration of the views. The findings about positive effect of nature are congruent with previous studies (Coutts & Hahn, 2015; X. Jiang et al., 2020; Suppakittpaisarn et al., 2017) , especially those concerning attention restoration. The difference may be that there is no significant difference between the duration of 1, 5, and 15 minutes, while a previous multi-study analysis found the difference between 5 and 10-60-minute exposure to the improvements in moods and self-esteem (Barton & Pretty, 2010). The incongruence may come from smaller ranges of duration. It might also be because different benefits from exercising in nature may be influenced by duration differently.

4.2 Contribution to the body of evidence

This study confirms that exercising with view of nature, even on a stationary machine in a semi-indoor environment, can be linked to attention restoration benefits. It contributes to the suggestions that people may benefit from exercising indoors during the bouts of social distancing or during high pollution seasons. However, it should be noted that using electronic devices while spending time in nature may mitigate such benefits (B. Jiang et al., 2018). This study also provided novel evidence that 1 minute of view of nature during walking is enough to restore participants' attention capacity at the similar extent to 15 minutes of nature. The comparisons across durations of nature exposure towards the restoration of attention capacity within the same study are rare and should be further explore and contribute in the future to explore the relationships between dose of nature and mental health.

4.3 Design and Planning Implication

The findings of this research might also encourage designers and policy makers to design public spaces so that the views of nature can be seen from residential windows, porches, and private spaces. While the experimental space was semi-indoor, the physical structure of the space can be similar to a living room with large windows. Thus, we believe that the results may be applicable to the indoor environment. During the pandemic, simply bringing 'nature to every doorstep' might not be enough. Designers and planners need to work to bring 'nature to every window sill' to make sure that urban nature and green infrastructure can equally benefit all citizens alike and to communicate such benefits during deliberative planning and participatory designs (Charoenlertthanakit et al., 2020).

The results also suggested to designers and planners that, in normal times, increasing natural elements in the urban area where there is no nature up to 1 minute walking distance may provide benefits. When making decisions about developing green infrastructure, the findings of the paper suggest that landscape designers and planners focus their priorities on places which have few or no green infrastructure elements. This reflects the design recommendations when investigating landscape preferences: the green infrastructure can provide high and beneficial values when being introduced to less green places (Suppakittpaisarn et al., 2019).

The results can also suggest designing indoor tracks for a quick restorative walk as well as semi-indoor and indoor hallways between classrooms or meeting rooms to have views of nature because only 1 minute of views while walking can improve attention.

4.4 Future research

The study has several remaining questions worthy of future studies. First is the length of the duration selected. While the researchers did not find any differences between 1, 10, and 15-minute of contact of nature, it is possible that longer time periods may influence the attention restoration differently. Combined with the fact that people tend to exercise more than 10 minutes, further studies need to be conducted to reflect real indoor exercises more closely. In this study, the semi-indoor space was used instead of an indoor space because of the appropriateness of the view of nature, accessibility, and availability of the location. However, the intensity of nature, humidity, and traffic noise of the site may also influence the way people interact with nature (B. Jiang, Chang, et al., 2014; Medvedev et al., 2015). Furthermore, the researchers did not ask the participants to look at the view; researchers observed that the participants often looked down at the treadmill's dashboard to see the remaining time, which may cause effects similar to looking at digital screens.

Secondly, this study focused on a narrow age range (18-40). The researchers collected this range to ensure that the data can be used towards younger adults, and thus did not analyze for the difference age may affect attention restoration. Future study may explore age as a part of participants demographics towards attention restoration.

Thirdly, the future studies can expand further upon questions regarding long-term exposure to nature and environment design. Would consistent exposure to nature views provide cumulative effects, or would the occasional nature exposure more important towards attention restoration?

While most previous studies were conducted in East Asia, Europe, and the U.S., this study is the first study conducted about attention restoration in Thailand. This indicates that people, in common, benefit from contact with nature, but the extent to which culture and the physical appearance of 'nature' in different ecosystems interact with such benefits are yet to be explored.

5. Conclusion

This study explored the extent to which stationary walking with views of nature and the duration of views of nature may increase attention restoration. The researchers conducted an experiment by asking participants to walk on treadmills with different durations of views of nature and compared the attention scores before and after the walk. The results of the experiment showed that while attention scores are higher in the groups with some exposure to nature, the score increases do not establish statistically significant differences but showed a promising pattern. The study thus suggested that an exercise with 1-15-minute views of nature can improve attention while people must stay out of public spaces or indoors and that designers and planners should bring nature to every window sill to increase opportunity during the potential pandemic and air pollution crises. This is one of the first few papers that reported the comparisons between different durations of nature towards attention restoration and may contribute to future discoveries in the relationship between duration of nature and health. Future research should explore the differences between different cultures and broader ranges of duration and comparing indoor and outdoor environments.

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