

**THE EFFECTS OF INDIVIDUAL FACTORS AND PSYCHOLOGICAL INSTRUCTIONS
ON SUSTAINED ATTENTION AND AFFECT DURING A NATURE WALK**

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JUMISKO, SATU: The Effects of Individual Factors and Psychological Instructions on Sustained Attention and Affect During a Nature Walk

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ABSTRACT

The purpose of this study was to discover whether three individual factors: gender, age and nature relatedness, and psychological instructions on a nature walk have an effect on the change in sustained attention and affect. Also, the connection of the variables representing two theories, ART (attention) and SRT (affect), was studied. The research was conducted in the summer of 2017 and was a part of a project called Restowalk funded by Kone Foundation. Originally, there were 122 participants, most were women (86 %), aged 18-63. The nature walk took place in a well-maintained urban park. The participants followed a pre-defined path and the psychological instructions on a smartphone. They were divided into three groups. One group received instructions related to restoration, one related to imagination-based instructions and one did not receive any instructions. Before and after the walk the participants completed a sustained attention test (SART) and a self-assessment on affect (Affect Grid). Hierarchical multiple regression analysis was used to study the influence of the psychological instructions and individual factors on the changes in sustained attention and affect. The correlations between the sustained attention variables and affect were studied using Pearson correlation coefficient. It was discovered that the instructions had no effect on the changes in sustained attention or affect. Gender and age were connected to one dimension of affect, pleasure. The younger the person, the more increase in pleasure. This was also the case with women as there was more positive change for them in pleasure compared to men. Gender, age and nature relatedness had no effect on the arousal dimension of affect. Nature relatedness had an effect on the change in sustained attention. Altogether, the ones who reported more nature relatedness did worse in the sustained attention test after the walk than the participants who reported less nature relatedness. More nature related participants had less positive change in the sustained attention test compared to less nature related participants. However, it was discovered that this difference did not appear in SART before the walk. As it comes to the connection between sustained attention and affect, statistically significant correlations were found between pleasure and attention but for the arousal dimension of affect no significant correlations were found. Thus, based on this study, no conclusions on the connections between the underlying mechanisms of ART and SRT can be drawn. Further research is encouraged on the influence of psychological instructions on attention and affect along a nature trail, the connections between nature relatedness and attention and the connections between ART and SRT.

Keywords: Nature walk, sustained attention, SART, affect, affect grid, psychological instruction, individual factors, attention restoration theory, stress reduction theory

JUMISKO, SATU: Yksilöllisten tekijöiden ja psykologisten harjoitteiden vaikutus ylläpidettyyn tarkkaavuuteen ja tunnetilaan luontokävelyn aikana

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TIIVISTELMÄ

Tutkimuksessa selvitettiin kolmen yksilöllisen tekijän, sukupuolen, iän ja luontosuuntautuneisuuden, sekä psykologisten harjoitteiden yhteyttä ylläpidetyn tarkkaavuuden ja tunnetilan muuttumiseen luontokävelyllä. Myös tarkkaavuuden elpymisteorian (ART) ja psyko-evoluutiivisen teorian (SRT) yhteyttä selvitettiin tutkimalla ylläpidetyn tarkkaavuuden tehtävien ja tunnetilan korrelaatioita. Tutkimuksen aineisto kerättiin Restowalk-tutkimushankkeessa kesällä 2017. Osallistujia oli alun perin 122, joista suurin osa oli naisia (86 %). Osallistujien ikä vaihteli 18 ja 63 vuoden välillä. Tutkimuksessa osallistujat kävelivät puistopolulla älypuhelimien ohjeiden mukaisen reitin ja suorittivat älypuhelimien opastamat psykologiset harjoitteet reitin varrella. Osallistujat jaettiin kolmeen ryhmään, joista osa sai matkan varrella elpymis-pohjaisia rentoutumiseen liittyviä tehtäviä, osa aisteja ja mielikuvitusta hyödyntäviä tehtäviä ja osa ei saanut tehtäviä lainkaan. Osallistujat tekivät ylläpidetyn tarkkaavuuden (SART) tehtävät sekä täyttivät tunnetilaa mittaavan tunneruudukon ennen ja jälkeen kävelyn. Hierarkkista usean selittäjän regressioanalyysiä käytettiin tutkimaan psykologisten harjoitteiden ja yksilöllisten tekijöiden vaikutusta muutoksiin ylläpidetyssä tarkkaavuudessa ja tunnetilassa. Ylläpidetyn tarkkaavuuden ja tunnetilan yhteyksiä arvioitiin hyödyntäen Pearsonin korrelaatiokerrointa. Luontopolulla tehdyt tehtävät eivät vaikuttaneet ylläpidetyn tarkkaavuuden tai tunnetilan muutoksiin. Osallistujan nuorempi ikä ja naissukupuoli vaikuttivat siten, että heillä tunnetilan miellyttävyyden- ulottuvuuden positiivinen muutos oli suurempi kuin vanhemmilla tai mieshenkilöillä. Sukupuolella, iällä tai luontosuuntautuneisuudella ei ollut vaikutusta tunnetilan virittyneisyys- ulottuvuuden muutoksiin. Luontosuuntautuneisuus vaikutti kuitenkin muutoksiin ylläpidetyssä tarkkaavuudessa. Henkilöiden, jotka arvioivat olevansa enemmän luontosuuntautuneita, suoriutuivat tarkkaavuutta mittaavista tehtävistä kokonaisuudessaan heikommin kävelyn jälkeen kuin henkilöt, jotka arvioivat itsensä vähemmän luontosuuntautuneiksi. Enemmän luontosuuntautuneilla positiivinen muutos ylläpidetyssä tarkkaavuudessa oli siis kokonaisuudessaan pienempi kuin vähemmän luontosuuntautuneilla. Tämä ero ei kuitenkaan tullut esille tarkkaavuustehtävissä ennen luontokävelyä. Ylläpidetyn tarkkaavuuden ja tunnetilan yhteyttä tarkastellessa, yhteys voitiin havaita miellyttävyyden osalta. Ylläpidetyllä tarkkaavuudella ei kuitenkaan ollut havaittavissa olevaa yhteyttä virittyneisyyteen. Tarkkaavuuden ja tunnetilan ja täten laajemmin tarkkaavuuden elpymisteorian ja psyko-evoluutiivisen teorian yhteisistä teoreettisista mekanismeista ei siis voida tehdä päätelmiä tämän tutkimuksen pohjalta. Tunnetilaan ja tarkkaavuuteen vaikuttavia tehtäviä luontopolulla olisi hyvä tutkia lisää. Myös luontosuuntautuneisuuspiirre vaatisi lisätutkimuksia erityisesti tarkkaavuuteen liittyen. Tarkkaavuuden elpymisteorian ja psyko-evoluutiivisen teorian yhteyksiä olisi myös syytä tutkia, koska niistä ei tämän tutkimuksen perusteella voida tehdä johtopäätöksiä.

Asiasanat: Luontokävely, ylläpidetty tarkkaavuus, SART, tunnetila, tunneruudukko, psykologiset tehtävät, yksilölliset tekijät, tarkkaavuuden elpymisteoria, psyko-evoluutiivinen teoria

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1. INTRODUCTION

Urbanization is a growing force all around the world. In 2016, more than half of the world's population lived in urban areas. Also, one in five people lived in a city with more than one million inhabitants. It is estimated that in 2030, this number will grow to 60 % (United Nations, 2016) as people will increasingly move and be born in urban areas. This trend can also be seen in Finland, where, in 2016, 70 % of people lived in an urban-like municipality (Official Statistics of Finland). As cities develop, it is important to bring forth the fact that nature is beneficial to health in many ways. For example, it has been found that nature has a positive effect on perceived general health (Maas, Verheij, Groenewegen, de Vries, & Spreeuwenberg, 2006), mental health (Alcock, White, Wheeler, Fleming, & Depledge, 2014), positive affect (Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009) and eudaemonic wellbeing (White, Pahl, Wheeler, Depledge, & Fleming, 2017).

Even though the beneficial effect of urban nature has been proven in many studies, there have been fewer studies concerning the role of individual factors and how these factors impact the beneficial effects of nature. As we are all unique and things affect us in different ways, it is important to consider our individuality. In this thesis, I aim to investigate how demographic and other individual factors relate to the benefits we gain from nature walks. Age, gender or nature relatedness may have an effect on the strength of the restorative effect nature has on a person or whether nature has an effect at all. More specifically, the restorative effects of nature on sustained attention and affect are at the forefront in this study. The role of psychological instructions along the nature walk will also be studied, as these may enhance the benefits we gain from nature walks.

There are two major theories that try to explain the restorative effects of nature: Attention Restoration Theory (ART; Kaplan, 1995) and Stress Reduction Theory (SRT; Ulrich, 1983). I introduce these theories and also present some advancements related to the two theories. After this I review the major research findings on sustained attention and affect related to the restorative nature of natural environments. Then I present some studies on how psychological instructions have been shown to improve the benefits we gain from nature walks. Finally, I present research on the individual factors that might be associated with the positive effect nature can produce.

1.1 Theories on the restorativeness of nature

As stated previously, there are two leading theories that seek to explain the restorative effects nature has on us: Kaplan's (1995) Attention Restoration Theory (ART) and Ulrich's (1983) Stress Reduction

Theory (SRT). The theories emphasize different restoration outcomes and have differing premises. However, some researchers have also studied both of the theories simultaneously (Berman et al., 2012; Hartig, Evans, Jamner, Davis, & Gärling, 2003; Bratman, Daily, Levy, & Gross, 2015). Hence, it has been suggested that the theories can co-exist and may represent different aspects of restoration.

ART (Kaplan, 1995) posits that exposure to nature has a restorative effect because it helps restore attentional capacity. This restoration of attentional capacity takes place when a person does not have to volitionally direct their attention to the environment. This then allows the attentional capacity to rest and restore. There are different components of the environment that enable attention restoration. These are fascination, being away, extent of environment and compatibility. Fascinating objects hold one's attention so that attending to them is effortless. This creates an opportunity to think about other things. Being away comprises getting away, mentally, from one's stressful situation. Extent of environment refers to the fact that a restorative environment has to feel like a world of its own. Finally, compatibility refers to how well one fits with the environment. That is, do I get what I want and need from this environment?

Whereas ART has to do with restoration of attention, SRT (Ulrich, 1981; Ulrich 1983) focuses on affect. According to Ulrich, our first response to visual stimuli is always affective. The cognitive response of attention, that ART proposes, follows this initial affective response. According to Ulrich, the initial response is affective because of our long, evolutionary history in nature. For example, vegetation and water elements elicit positive feelings. The parasympathetic nervous system is also activated in nature and thus it can be said, that nature has a stress-reducing effect. Negative feelings, on the other hand, arise in an urban surrounding and also in nature when there is something dangerous nearby. It has been suggested, that a cognitive response to dangerous things, such as lions, would have been too slow a reaction for survival, and in order to survive our reactions needed to be fast and automatic. Our evolutionary history is also evident from the fact, that we react to snakes and spiders far more aversively than we do to handguns, even though it is self-evident that a handgun is usually more lethal than a snake (Cook, Hodes, & Lang, 1986).

The fast, affective reaction to nature scenes that Ulrich proposes has been confirmed in several studies. For example, Korpela, Klemetilä and Hietanen (2002) found in their study, that the evaluation of environmental scenes is affective and occurs very rapidly, within 200 milliseconds. In their study, the participants were shown pictures of urban and nature environments. The participants were then presented with a vocal expression of joy, anger or emotional neutrality. After this they were asked to judge the vocal expression either as joyful or angry. According to the results, the participants reacted faster to vocal expressions of anger after they were shown a picture of an urban scene than when they were shown a picture of a nature scene. Vice versa, the reaction was faster for a vocal

expression of joy after seeing a nature scene than after seeing an urban scene. A later study by Hietanen and Korpela (2004) also corroborates these findings. In this study, they used grayscale pictures of low, medium and high levels of restorativeness and preference, where the high level one was a nature scene and the low level one an urban scene. The participants were then presented pictures with facial expressions of happiness and anger and were forced to choose if the expression was happy or angry. Also in this study the angry faces were recognized faster after seeing pictures of low restorativeness, that is urban scenes, than after seeing pictures of high restorativeness, nature scenes. The opposite was true for recognizing happy faces, similar to the joyful faces in the previous study. Similar results have been found also in a later study (Hietanen, Klemettilä, Kettunen, & Korpela, 2007) with facial expressions of happiness and disgust.

In the past, ART and SRT were sometimes represented as opposite or competing theories. Since then there have been attempts at uniting the theories and seeing how they fit together. For example, Berman et al. (2012) studied the effect of nature on emotions and cognition simultaneously. In their study of individuals with major depressive disorder, they discovered that positive affect increased after a 50-minute nature walk compared to a walk in an urban setting. They also discovered, that the participants' short-term memory span, a part of cognition, improved. What is more interesting, is that these measures did not correlate. That is, if we view ART as representing cognition restoration and SRT as representing affect restoration, the theories could be said to have two different underlying mechanisms, at least based on the results above. Hartig et al. (2003), however, found in their study that attentional performance, also a part of cognition, did correlate with changes in affect. In their study participants either sat in a room with views of trees and then walked in nature, or they sat in a room with no view and then walked in an urban surrounding. Emotional states and attentional performance were assessed before, during and after the walk. The results show, that performance in the attention task decreased in the urban environment and improved slightly in the natural environment. Similar results were found for the changes in emotional states: positive affect increased, and anger decreased by the end of the walk in the nature environment and the opposite was true for the urban environment. In this study, there was correlation between attentional performance and affect. The differing results between the studies by Berman et al. and Hartig et al. might be due to the fact that two different components of cognition were studied. In fact, when it comes to even one part of cognition, attention, there is unclarity on the part nature plays in its restoration. A review by Ohly et al. (2016) reports that there is uncertainty over which aspects of attention are affected in a nature environment. For example, significant positive effects were found only for three, Digit Span Forward, Digit Span Backward and Trail Making Test B, out of all thirteen measures of attention that were studied. No significant effects were present for the other ten attention outcomes. All in all, the results

seem to be contradictory when it comes to the correlation of cognition and affect. However, the study by Hartig et al. (2003) shows correlation between attention and positive affect. Because the current study focuses specifically on attention, the result found by Hartig et al. is of most importance, even though a different attention test was used, and a different aspect of affect was measured in the current study.

There is a significant number of studies that support ART and SRT. Nonetheless, there has also been criticism towards the two theories. Joye and van den Berg (2011) have criticized the basic tenet of ART and SRT, that nature is restorative because of our evolutionary history in nature. However, further discussion of this assumption is beyond this study. Joye and van den Berg have also proposed an addition to the two theories: Perceptual Fluency Account (PFA). According to PFA the affective value of unthreatening natural scenes is evaluated more positively than that of unthreatening urban scenes. This is said to result from our visual system processing aspects of natural scenes more fluently than aspects of urban scenes. This idea seems similar to the component of fascination in ART, as fascination has been equated with effortless processing.

1.2 Nature and sustained attention

Attention is a broad concept that has been defined in many different ways (Spikman & van Zomeren, 2012). In broad terms, there are two dimensions: selectivity and intensity. That is, we can select what we want to focus on and how intensely. There are also several different aspects of attention we can study. For example, in a focused attention task the subject must respond selectively and ignore any irrelevant stimuli. Whereas, in a divided attention task there are subtasks that are to be performed simultaneously or require more than one type of response. There are also attention tasks that require supervisory control. That is, the subject must devise a strategy, ideally in an unstructured situation. What I am interested in, however, is sustained attention. As the name implies, this aspect of attention refers to a situation where one needs to sustain their attention on something for a longer period of time, in assessments this time varies from 10 to 30 minutes. The reason for studying sustained attention in particular, is that it tells us about slips in attention in our everyday life (Robertson, Manly, Andrade, Baddeley, & Yiend, 1997). Thus, studying sustained attention gives indication to what factors affect how we are able to focus on a single task for a long period of time, such as an important essay or a task at work. There are two different kinds of sustained attention tests: a continuous performance test and a vigilance test. The former task has high event-rate and thus the subject is kept quite busy. The latter test can be quite boring as the subject needs to maintain a level of alertness

when there are just a few stimuli. In this study, a continuous performance test of sustained attention was used.

As the name implies, attention restoration is closely related to ART which has been discussed above. There is evidence that nature has a positive effect on attentional performance (e.g. Hartig et al., 2003). However, as discussed, it is important to keep in mind that different attention tasks measure different aspects of attentional performance and nature might not have an effect on all parts of attention (Ohly et al., 2016). Because of this and because I am interested only in the restoration of sustained attention, I will focus on studies that have measured this part of attention, of which there are at least the following. In a series of studies by Berto (2005) undergraduate students completed a test of sustained attention before and after an experiment, in which they viewed pictures of either restorative nature scenes, geometrical patterns or nonrestorative urban environments. In the study, only the participants who were shown images of restorative environments improved their performance in the attention test. In another study Lee, Williams, Sargent, Williams and Johnson (2015) studied how micro-breaks spent viewing a city scene with or without a green space affect sustained attention. In their study, the participants completed a sustained attention test before and after the micro-break. The break lasted for 40 seconds during which the participants viewed either a city scene with a concrete rooftop or the same scene with a green rooftop with a flowering meadow. It was found that the participants who viewed the green rooftop did better in the test than the ones who viewed the concrete rooftop. According to these results, nature does have a restorative effect on sustained attention.

1.3 Nature and affect

Whereas the study of the connection between nature and sustained attention links easily to ART, the study of affect and how it relates to nature can be traced back to SRT. There are several different definitions of affect and other concepts relating to affect, such as mood and emotion. Thus, there seems to be no consensus on the definition of these different concepts. Additionally, they are at times used interchangeably.

One definition for emotions, moods and affect comes from Russell and Snodgrass (1987). They make a distinction between a short-term emotional event and a long-term emotional disposition. By the latter, the authors refer to a tendency to think or feel a certain way on certain occasions. They use love for one's parent as an example, for this disposition exists even in times when one is not consciously thinking about it and surfaces from time to time on certain occasions. By short-term emotional event, on the other hand, the authors refer to something that happens in one moment or

extends to a maximum of a few days. They further categorize these events to affective appraisals, emotional episodes and moods. Affective appraisal is defined as an interpretation or judgement of someone's or something's pleasantness, repulsiveness and so on. Emotional episodes are defined as reactions to things. Falling in love, getting frustrated by something or frightened of a snake are examples of emotional episodes. Mood, on the other hand, is not directed towards anything, which separates it from the previous. Mood is defined as a person's subjective state at a given moment and is affected by core emotions. For example, a person can feel calm, excited or happy. Russell and Snodgrass define pleasure and arousal as the key dimensions of mood. This dimensionality encompasses the idea that pleasure and arousal constitute of continuums and that our emotions fall on different points along the continuum at different times (Russell, Weiss, & Mendelsohn, 1989). Pleasure can be thought of as a bipolar opposite of displeasure. Whereas, arousal is seen as a bipolar opposite of sleepiness. The two dimensions are also considered to be independent of one another. In this study, affect encompasses these two dimensions and is thought to fall between mood and affective appraisal. Mood is often considered to last for a longer time compared to affect. Affective appraisal, on the other hand as defined by Russell and Snodgrass, has an object, whereas in this study there was no specific object for affect.

As mentioned, it is evident that nature is connected to changes in positive affect (e.g. Berman et al., 2012; Hartig et al., 2003). To add to these findings, a meta-analysis by Bowler, Buyung-Ali, Knight and Pullin (2010) shows, that self-reported emotions are a clear indication of the benefits of nature environments. In the studies overall, subjects reported negative emotions, such as anger and sadness, less after exposure to natural environments compared to built environments. Also, Mayer et al. (2009) did a series of studies investigating how nature impacts positive affect. They found that a 15-minute walk in nature did indeed increase positive emotions compared to a walk in an urban environment. Also, the effect was larger after an actual walk as opposed to only viewing images of nature or urban settings. Tyrväinen et al. (2014) studied how a short visit to an urban nature environment affects physiology and psychological measures, such as vitality and affect. The participants all visited three different locations on separate days. These locations were a constructed urban park, a large urban woodland and a built-up urban environment with only few urban trees. As was expected, positive affect increased in the two green environments and decreased in the built environment. Thus, it is clear from these studies that exposure to nature environments is beneficial for emotional wellbeing when compared to urban environments.

1.4 Psychological instructions during a nature walk

It has been suggested that active engagement with one's environment might boost the restorative benefits we gain from nature. These kinds of tasks might help individuals to get out more and benefit more from their immediate nature surroundings even if these surroundings were not ideal in a restorative sense. There have been at least two kinds of instruction materials that have been developed and used for research on nature walks, those by Duvall (2011) and those by Korpela, Savonen, Anttila, Pasanen and Ratcliffe (2017).

Duvall (2011) has studied the benefits of awareness plans for nature walks. In his study, participants were encouraged to walk outdoors for at least 30 minutes three times a week. There were two different groups: a standard care group, that set a goal with the researcher to walk on specific days, and an engagement group, that received awareness plans, which were to be put into practice during the walks. The idea behind providing these awareness plans was that with their help a familiar surrounding could be experienced in a new way, thus making it more probable that a person would go out again and maintain a new walking routine. The awareness plans included, for example, focusing on one's senses and taking on a new role. The results show that only the engagement group became more satisfied with the walking environment. Especially, satisfaction with the variety of nature, the walking paths and trees that would provide shade increased.

Korpela et al. (2017), on the other hand, have studied how restorative tasks affect the benefits we gain from nature walks. They examined, whether psychological instructions in a nature trail are connected to mood enhancements and self-reported restoration. The study took place in Finland, Sweden, Luxembourg and France. In each country, a well-being trail was set up and psychological instructions were printed on signposts along the forest trails. The tasks included, for example, instructions on relaxation, self-observation and favourite places. Knowledge on ART and SRT were used when planning the tasks. Also, the tasks were placed in a specific order according to what is known about the order of restorative outcomes. It was discovered that satisfaction with the psychological instructions positively correlated with self-reported restoration and enhancement in mood.

From these studies, we can conclude that psychological instructions affect how satisfied we are with our environment (Duvall, 2011) and that satisfaction with the instructions is connected to restoration and changes in mood (Korpela et al., 2017). Similar instructions to the two above were also used in this study.

1.5 Individual factors

Although the study of natural and urban environments and how they affect health has had a fair amount of attention, there has not been that much research on the way individual differences influence the restorative effects to be gained from nature environments. Here I will discuss research on some of the possible individual factors that might have an effect on mood and attention restoration, namely gender, age and nature relatedness.

1.5.1 Gender and age

Including gender as a variable in a study is not without its problems (e.g. Hyde, 2014; Zell, Krizan, & Teeter, 2015). However, as gender is oftentimes included when studying the effect of individual factors, I decided to include it in this study as well. There have been contradictory findings on how gender affects the restorativeness of nature. Annerstedt et al. (2012) found in their longitudinal study that women had a reduced risk for poor mental health when they had access to a certain type of nature. The same tendency was observed with men, but the results were not significant. However, according to a study by Raanaas, Patil and Hartig (2012), a bedroom in a rehabilitation centre without a nature view affected the mental health of men negatively compared to a bedroom with a nature view. In the same study, it was discovered that a bedroom without a nature view had a negative influence on self-reported physical health in women. However, a study by Richardson and Mitchell (2010) goes against this finding. They suggest that men, not women, benefit more from nature when it comes to physical health. In their study, they found that men who lived in greener areas had a lower cardiovascular and respiratory disease mortality rate compared to those who lived in less green areas. No significant association was found for women. Astell-Burt, Mitchell and Hartig (2014) add to the findings on mental health. They posit that the connection between urban green space and mental health varies across the life course and that it follows a gender-specific trajectory. For males, the positive effect of green space emerged in early adulthood. For women, however, green space appeared to be protective later, in mid-40s and above. The amount of green space also had an effect for women. Those with the greenest and also the least green neighbourhoods reported similar levels of general health, whereas those living in a moderate degree of green space reported the highest levels of general health. Overall, when age was not considered, green space had a connection with better mental health among men but not with women. As it comes to feeling restored, Virtanen and Korpela (2012) found in their study on favourite places, that men less likely feel restored in their favourite places compared to women. 6 % of the favourite places were in a city centre, 9 % in an outside space that encouraged physical

exercise and 46 % were in an urban forest. However, this finding might result from the fact, that on average the men were older than the women. This would have an effect, because it was also discovered that it is more likely for younger people to feel restored in their favourite places than it is for older people. Also, men reported places in the city centre as their favourite places more often than women. This could influence the findings, considering that feelings of restoration were not reported as much in favourite places located in the city centre. As for positive affect, a study by Ulrich (1981) showed that exposure to a slide presentation of vegetation scenes had a more beneficial influence on positive affect than a presentation with urban scenes, and that the influence was stronger for women than for men.

As is evident, there is contradiction on how age and gender affect the restorativeness of nature. It seems that age and gender have a synergistic effect on the mental health benefits we gain from nature. However, it is not yet clear how these demographic factors induce the positive effects on mental health. The effects on physical health are also conflicting. However, it seems that the influence of nature on positive affect might be stronger for women than for men.

1.5.2 Nature relatedness

The study of nature relatedness or connectedness to nature originates from Wilson's (1993) Biophilia Hypothesis. Wilson states that because of our long evolutionary history in nature, we have a need to be in nature and feel connected to the broader natural world. This, according to Wilson, is the reason why nature is so beneficial for us. There have been several ways to measure nature relatedness. For example, Mayer and Frantz (2004) have developed a connectedness to nature scale (CNS), which was designed to measure a person's affective, experiential connection to nature. According to Mayer and Frantz, nature connectedness is a trait-like characteristic that entails feeling emotionally connected to the natural world. Bratman, Hamilton and Daily (2012) suggest in their review that nature connectedness could be a major contributing factor when it comes to the beneficial effects of nature. They point out that people's opinions about nature probably impact the way in which nature environments affect their mood and cognition. Mayer et al. (2009) propose that connectedness to nature could act as a mediator between nature and the benefits we gain from it, as opposed to stress reduction or attention restoration. Mayer et al. also point out that connectedness to nature could provide an additional aspect to why nature is restorative, in addition to the classical viewpoints of attention restoration and stress reduction. They also note that nature connectedness and ART have similar qualities. That is, the four factors that according to ART lead to attention restoration and that were discussed before possibly increase an individual's experience of being connected to nature. This

was studied by Korpela, Hartig, Kaiser and Fuhrer (2001). According to the study, the four restorative qualities correlated with the aspects that made the environment a favourite place. Thus, it might be that people look for these kinds of places without realizing that they contain these restorative qualities. There have also been some opposing results when it comes to the significance of nature relatedness. In a study by Passmore and Howell (2014), the level of trait connectedness to nature did not moderate the impact of the nature intervention on well-being. Also, Korpela et al. (2017) found in their nature walk study, referenced before, that nature relatedness did not moderate the effect of the nature walk on mood or restorative change. Thus, it might be that a well-designed nature trail, the tasks of which satisfy the user, is enough for the nature environment to impact well-being, regardless of personal nature relatedness (Korpela et al., 2017). Because of these contradictory findings, it is highly interesting to study whether nature relatedness plays a role in the restorative effect of nature on sustained attention and affect.

1.6 Research questions and hypotheses

I will study the effects of a nature walk on the restoration of sustained attention and affect. I will study these effects in the three different groups, where one group has had no instructions, the other has had instructions related to restoration, and the third instructions related to senses and imagination. The effects of age, gender and nature relatedness on the changes in sustained attention and affect are also of interest and will be studied while controlling for the effects of the psychological instructions. Lastly, the correlation of attention and affect will be studied.

Based on previous research cited above, it is predicted that nature has a positive effect on sustained attention and affect and psychological instructions should strengthen this positive effect. The findings related to age and gender are somewhat contradictory. However, it is quite clear that these factors have some kind of effect on nature and restoration and this is why it is beneficial to study these factors. It is assumed that nature relatedness affects the benefits of the nature walks in a positive manner.

Thus, my research questions and hypotheses are the following.

Q1. Do nature walks with no instructions, with restorative and with imagination-based instructions affect sustained attention and affect?

H1. Nature walks with the different instructions have a positive effect on the measures of sustained attention and affect. The effect should be stronger for the groups with instructions compared to the one without.

Q2. Do gender, age and nature relatedness have an effect on the change in sustained attention and affect due to a nature walk when the effects of different psychological instructions have been controlled for.

H2a. & b. Age and gender have an effect on the change in sustained attention and affect. However, it is not clear how.

H2c. There are contradictory findings on whether nature relatedness has an effect on cognition and mood. Thus, it is not known if nature relatedness has an effect on the change in sustained attention and affect.

Q3. Do the changes in sustained attention and affect correlate.

H3. At least one study (Hartig et al., 2003) has found correlation between attentional performance and positive affect.

2. METHODS

2.1 Participants

Originally there were 122 participants in the study. One participant was excluded from the sample, because they completed only half of the assigned tasks along the trail. The self-reports of two participants were missing, because they completed the measurements in the wrong order after the walk. Also, one participant had a problem with the computer in the attention test after the walk. These results were recorded as missing. Thus, the final sample was 121 participants, with some missing data for three individuals. As it comes to affect measures, there were 40 participants in each of the three groups that completed the required measurements and tasks. For the attention measures, however, there were 41 participants in the group with no instructions, 39 participants in the restoration group and 40 in the imagination-based tasks group that qualified. All in all, in the final sample of 121 participants, the average age was 40 and the age ranged between 18-63. Most, 86.0 %, were female, 11.6 % were male and 2.4 % other or preferred not to specify. The participants had visited the area 8 times per average (median 1) within the past six months, though most (46.7 %) had not visited the area before. The number of visits varied between 0 and 320. There was a total of 31 sessions. Additional 13 sessions had to be cancelled due to bad weather. The recruitment of the participants took place using the project's Facebook page, invitations on local email lists, posters in notice boards around the city centre and an event calendar maintained by a regional newspaper.

2.2 Procedure

The study was approved in the spring of 2017 by the Ethics committee of the Tampere region, which is set up by the University of Tampere. The study took place in the summer of 2017 and was a part of a project called Restowalk funded by the Kone Foundation. The measurements were taken at a small office room in a mental health service centre approximately 300 metres away from the beginning of the trail. The actual nature walk trail was in Hatanpää arboretum, a well-maintained urban park by a large lake. It is named as such, because there are a number of different species of trees and other plants in the area. First, the trail went along the lake and then back along the middle of the park. The surface of the route was a gravel walkway for the most part. Temperature at the start of the experiment varied between 3 °C and 22 °C. For most, the weather was clouded (40 %), for third of the participants it was partly cloudy, for quarter it was sunny and for a small number (1.7 %) there was some drizzly rain.

At the start of each experiment the participants came to the mental health service centre in groups of 2 to 6 people. In the office room, they were seated in front of a desk with a laptop, a pen and an envelope, which contained written tasks. The written tasks regarded some background information, for example the amount of sleep and current residency, affect and other variables not used in the current study: restoration, empathy, vitality, and general stress. After this, the researchers (1-3) introduced themselves, the study and the procedure and asked the participants to sign the informed consent document. Then some additional information on the experiment was provided. Participants were also asked not to speak during the measurements.

As a stressor, the participants were asked to introduce themselves to the group and also talk about a hobby they enjoy for approximately two minutes. After this the participants completed the self-reported questionnaires and behavioural measurements and were free to exit the room at their own pace. Outside the room the participants were given instructions for the walk individually. The instructions were both verbal and written on paper. They were instructed to walk alone. Before and after the walk the participants were provided with fruit, fresh juice and water.

To navigate the environment, the participants were provided with a mobile application ActionTrack by the City of Tampere, which gave a signal whenever a participant was close to a signpost. Thus, the participants did not have to look at their phones all the time while walking. Lenovo A Plus smartphones were used. The application also controlled the order in which the tasks were provided so that they could not be completed in a different order than planned. A paper map with instructions was also provided as a back-up, though the participants were encouraged to use the application.

The participants' pulse was measured with a wristband and a chest belt (Polar V800 GPS sport watch) during the walk. Also, saliva samples were obtained before and after the walk. Because of this, the participants were instructed not to consume alcohol and refrain from heavy exercise 24 hours before the study. They were also instructed not to consume caffeine, food or nicotine 2 hours before the study.

After the walk, the participants returned to the room to complete the tasks in the same order as before. After this each participant received some descriptive statistics on the attentional test they had completed. The participants were also asked feedback, which was recorded when there was something unusual. The possibility for anonymous, written feedback was also provided. The experiment took approximately two hours per participant of which the walk lasted for approximately one hour (44-97 minutes). Each participant received a cinema voucher in the end of the experiment.

2.3 Measures

2.3.1 Psychological instructions

As stated previously, the participants were divided into three different groups. One group received no instructions, the other received tasks related to restoration, similar to the study by Korpela et al. (2017), and the third, a control group, received imagination-based tasks similar to Duvall's (2011) intervention studies.

There were seven instructions for the participants in the restoration group. The first one started with breathing and relaxation exercises and exercises intended to increase one's connection with the environment and fascination. The second task had to do with affect and letting go of everyday worries. The third suggested to find a place that was calming. The fourth encouraged one to seek out, explore and memorise a favourite place. The fifth task had to do with recognizing one's mood. The sixth was similar to the second task and the last one similar to the first one.

For the participants in the control group there were also seven tasks. The first instruction had to do with taking on a new role, that of a small child and viewing the world from that perspective. The second task asked the participant to focus on their visual sense and the third to focus on hearing. The fourth was about imagining oneself as a magician and being able to change one's surroundings. The fifth was about the sense of touch and the sixth about the sense of smell, which was purposely positioned near a rose garden. The last task was about taking on the role of a photographer and capturing the picture in their mind's eye.

2.3.2 Attention

Sustained attention was measured using the Sustained Attention to Response Test (SART; Manly, Robertson, Galloway, & Hawkins, 1999; Robertson et al., 1997). SART is a computer-administered, continuous performance paradigm that lasts approximately 5 minutes. The participants are presented with repetitive and predictable stimuli (digits 1-9). The participants have to react to these non-targets by pressing a key and also withhold a response whenever the infrequent target stimulus, number 3, is presented.

The test is thought to require a high level of continuous attention and is thought to be sensitive to occasional slips that people might have in their attentional performance (Berto, 2005). As it is so demanding, it induces cognitive fatigue. Robertson et al. (1997) argue, that the test is resistant to differences in age and estimates of IQ and has only a small load on memory performance. Also, there is no learning effect and therefore the first test should not affect the results in the second test. SART has also been used in previous studies related to attention restoration in a nature environment (Berto, 2005; Lee et al., 2015).

A similar version of SART was used in this study as in the studies by Robertson et al. (1997) and Jussila (2017). There were 225 stimuli, each was presented for 250 milliseconds (msec). In between the stimuli, there was a mask, a circled cross, that appeared on the computer screen for 900 msec. Each digit appeared on the computer screen 25 times. The digits were presented in randomly allocated font sizes, which made the task even more cognitively fatiguing. Before the actual task, the participants were given a chance to practice. During the practice round 18 digits were shown, of which 2 were target stimuli (3). The randomization of the digits was the same as in the study by Jussila (2017) but different compared to the version used by Robertson et al. (1997). In this study the stimuli appeared in groups of 45 randomized digits, where each digit appeared 5 times. There were all in all 5 of these kinds of groups that were presented in a sequence without a pause. This enabled the digits to be presented in a more evenly distributed manner compared to 225 digits being randomly distributed as in the original version.

Four variables of SART were used to evaluate the changes in sustained attention. These are the amount of correct responses, the amount of incorrect responses, standard deviation of reaction times (in seconds) and answering sensitivity. The amount of correct responses tells us the percentage of the right answers (key pressed at the right time). The amount of incorrect responses tells us how much, in percentages, the person has pressed the key at a wrong time. Based on these two variables, the best result would be 100 % correct responses and 0 % incorrect responses. This, however, is not a likely situation and thus more variables need to be considered. The variable standard deviation of reaction

times (referred to as sd of reaction times from now on) informs us about a participant's rhythm. A low standard deviation signifies an even rhythm, whereas a high standard deviation signifies an alternating rhythm and might indicate a failure in sustained attention. Finally, a participant's answering sensitivity is measured using a variable called d-prime (Stanislaw & Todorov, 1999). This variable is well suited to the analysis of SART as it considers both the correct answers and the incorrect ones at the same time. D-prime is used when there are two types of stimuli that need to be separated. When it comes to performing in SART, there seem to be two separate tendencies. Usually people are either highly responsive to all stimuli (with increased amount of both correct and incorrect responses) or they are unresponsive both to the target stimulus and to other stimuli as well (resulting in decreased amount of correct and incorrect responses). Thus, D-prime enables one to examine a participant's individual answering tendency. For example, a perfect score (100 %) based on correct responses alone might be due to the fact that the participant has reacted to all stimuli, including the incorrect ones. Thus, in this kind of situation the amount of incorrect responses would also be 100 % but this would not be evident when the variables were considered separately. Therefore, it is fruitful to study the two variables simultaneously. D-prime uses the reverse measures of the two variables. That is, the portion of the target stimuli (number 3) where the participant has not pressed the key from all the target stimuli and the portion of other digits where the participant has failed to press the key from all the other digits. The values were changed into Z-values, based on which the D-prime variable was calculated using the following formula:

$$Z(\text{correct responses to threes}/25) - Z(\text{incorrect responses to other digits besides 3}/200)$$

The data is thus fitted to normal distribution, where mean value is 0 and standard deviation is 1. A perfect performance on SART, where the key has not been pressed on any of the target data (3) and has been pressed on all other digits besides 3, equals here the value 4.65 and is thus four standard deviations away from the mean. A value close to the mean represents a participant that has equal correct and incorrect responses. A negative value, on the other hand, represents a person that has more incorrect responses than correct responses.

2.3.3 Affect

Affect was measured using the Affect Grid (Russell et al., 1989), a self-assessment method, depicted in figure 1 (translated into Finnish in the study). The Affect Grid can be used to assess affect along the dimensions of pleasure-displeasure and arousal-sleepiness. The Affect Grid has a pleasure score

that ranges from 1 to 9 and an arousal score that also ranges from 1 to 9. The idea behind the Affect Grid was presented to the participants in writing. Then they were instructed as follows: “Evaluate how you feel right now. Mark a box within the grid that best describes how you feel”. High arousal and high pleasantness together depict excitement. High pleasantness and sleepiness represent relaxation. Sleepiness and unpleasantness depict depression and unpleasantness and high arousal together represent stress. The Affect Grid was designed for a quick way to assess single instances of affect and that would be short and easy to fill out.

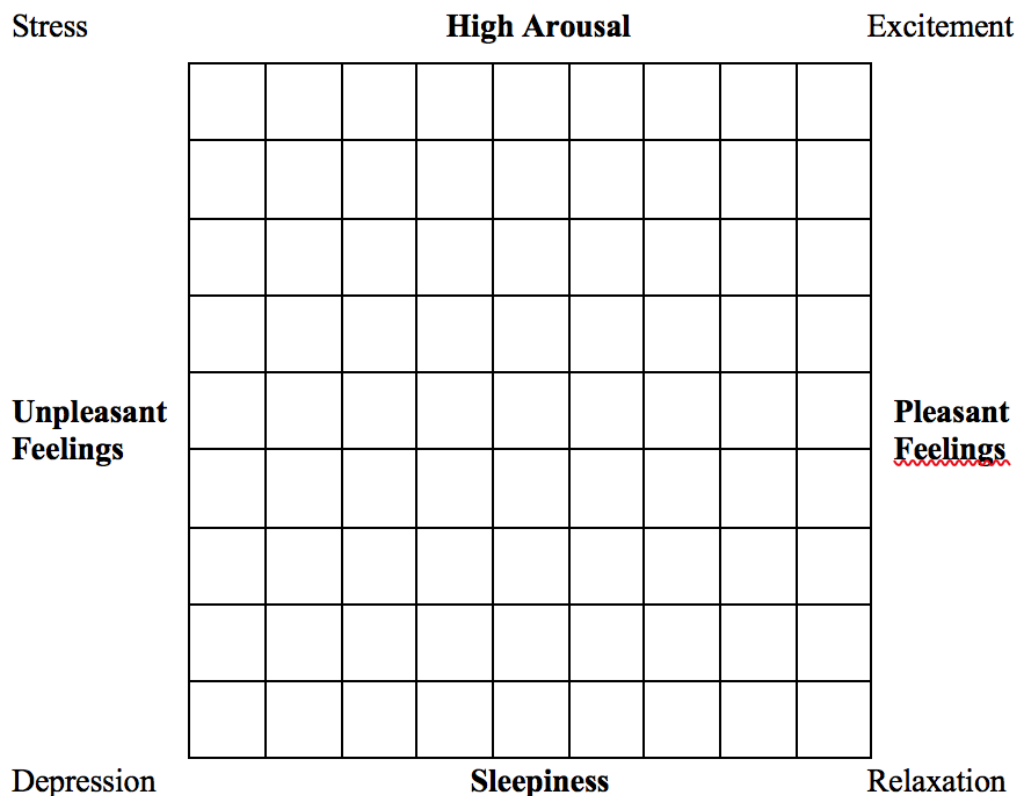


FIGURE 1. The Affect Grid (Russell, Weiss, & Mendelsohn, 1989)

2.3.4 Individual factors

Age (years) was measured before the walk along with other background information, as was the participant’s gender, for which three options were provided. These were woman, man and other/prefer not to specify. Nature relatedness was rated using the NR-6, a short-form version to measure nature relatedness, developed by Nisbet and Zelenski (2013). Nature relatedness was rated on a 5-point Likert scale (1 = Disagree strongly, 2 = Disagree a little, 3 = Neither agree or disagree, 4 = Agree a

little, 5 = Agree strongly) and measured with the following six items. The final NR-6 score was calculated by averaging all 6 items so that the final score ranges from 1 to 5.

1. An ideal vacation spot for me would be a remote, wilderness area.
2. I always think about how my actions affect the environment.
3. My connection to nature and the environment is a part of my spirituality.
4. I take notice of wildlife wherever I am.
5. My relationship to nature is an important part of who I am.
6. I feel very connected to all living things and the Earth.

2.4 Data analysis

IBM SPSS Statistics 23 was used for the data analyses. The focus of this research was to study the effect of psychological instructions (Q1) and individual factors (Q2) on the changes in sustained attention and affect due to a nature walk and the correlation of attention and affect (Q3). Consequently, hierarchical multiple regression analysis was used to explore the first two research questions. In the first step of the analysis, the groups with different instructions were added as an independent variable and in the second step the individual factors, age, gender and nature relatedness, were added as additional independent variables. The dependent variables were formed by subtracting the values before the walk from the values after the walk. As gender and the groups with different instructions are qualitative variables, and regression analysis assumes variables as quantitative, dummy variables were formed from these in order to perform the regression analyses. None of the variables were normally distributed according to the Shapiro-Wilk test ($p < 0.05$). However, inspecting the histograms revealed, that there were no striking deviations from a normal distribution to be seen. Also, the sample size is big enough so that parametric tests can be used. As stated previously, three options for gender were provided. However, only three individuals reported their gender as other or preferred not to specify. As this is such a small number of individuals it was decided that they would not be included in the analysis when it comes to the effect of gender. To examine the correlation between attention and affect, Pearson correlations were conducted. More specifically, the values of the changes in sustained attention and affect were used, similar to a previous study by Hartig et al. (2003), where the change scores were also used to study this kind of correlation. Both the SART and the Affect Grid have been shown to have adequate reliability in previous studies (Robertson et al., 1997; Russell et al., 1989).

3. RESULTS

3.1 Test of randomization into groups

TABLE 1. Values for the Attention and Affect Variables at the Start of the Walk Comparing the Randomization to the Three Groups that Received Different Psychological Instructions or No Instructions

Group	No instructions		Restoration		Control		<i>F</i>	<i>df</i>	<i>p</i>
	<i>n</i> =41 SART		<i>n</i> =39 SART		<i>n</i> = 40				
	<i>n</i> =40 AFFECT		<i>n</i> =40 AFFECT						
	M	sd	M	sd	M	sd			
SART – amount of correct responses (%)	.94	.03	.94	.03	.94	.03	.09	2, 117	.915
SART – amount of incorrect responses (%)	.43	.22	.47	.20	.39	.22	1.38	2, 117	.257
SART – sd of reaction times (s)	.14	.03	.14	.04	.15	.04	1.77	2, 117	.174
SART – answering sensitivity	2.49	.75	2.41	.62	2.57	.87	.45	2, 117	.640
AFFECT – pleasure	6.00	1.63	6.00	1.68	6.00	2.06	.00	2, 117	1.000
AFFECT – arousal	5.78	1.61	5.55	1.40	5.43	1.82	.48	2, 117	.620

Table 1 illustrates the values for the dependent variables in the different groups at the beginning of the walk. According to the one-way analysis of variance there are no differences between the groups as it comes to the variables used to measure sustained attention and affect. This indicates that the randomization into the three groups was successful.

3.2 Descriptive information on attention, affect, age and nature relatedness measures and the correlations between them

TABLE 2. Descriptive information on attention and affect. Values are the changes between the values before and after the walk (N=120).

Variables	M	sd	min	max
SART – amount of correct responses (%)	.01	.03	-.08	.14
SART – amount of incorrect responses (%)	-.05	.18	-.64	.40
SART – sd of reaction times (s)	-.00	.03	-.13	.09
SART – answering sensitivity	.24	.69	-1.38	2.53
AFFECT – pleasure	1.47	1.38	-1	5
AFFECT – arousal	-.63	2.06	-6	5

Table 2 gives descriptive information on attention and affect variables. The change in the amount of correct responses in SART was moderate on average. Some had less correct responses after the walk than before the walk and some more, as the change varied between -8 % and 14 %. On average the amount of incorrect responses decreased by 5 %. However, there was notable fluctuation (sd = 18 %). On average the sd of reaction times, which tells us about a participant's answering rhythm, did not change (mean = -.00) and there was not much variation between participants (sd = .03). On average participant's answering sensitivity increased. Most people reported feeling more pleasure and less arousal at the end of the walk than at the beginning.

TABLE 3. Descriptive information on age and nature relatedness overall and in the walk groups. Values were measured at the beginning of the walk.

Variables	M	sd	min	max
Age	39.85	11.02	18	63
No instructions	39.90	11.12	22	63
Restoration	41.68	11.51	23	62
Control	37.97	10.35	18	63
Nature relatedness	3.68	.75	1.17	5.00
No instructions	3.64	.85	1.67	5.00
Restoration	3.77	.55	2.50	5.00
Control	3.64	.81	1.17	5.00

Table 3 provides information on age and nature relatedness overall and in the different walk groups.

TABLE 4. Values for Nature Relatedness Comparing the Randomization to the Three Groups that Received Different Psychological Instructions or No Instructions

Group	No instructions		Restoration		Control		<i>F</i>	<i>df</i>	<i>p</i>
	<i>n</i> = 40		<i>n</i> = 40		<i>n</i> = 40				
	M	sd	M	sd	M	sd			
Nature Relatedness	3.64	.85	3.77	.55	3.64	.81	.36	2, 117	.699

Table 4 provides information on the randomization to the three walk groups as it comes to nature relatedness. As can be seen, there were no significant differences between the walk groups as it comes to nature relatedness scores.

TABLE 5. Correlation coefficients of the continuous variables. Values of the dependent variables, that is the SART and affect variables, are the change scores between the measures before and after the walk (N=120).

Variables	1	2	3	4	5	6	7
1 SART – amount of correct responses	-						
2 SART – amount of incorrect responses	-.88***	-					
3 SART – sd of reaction times (s)	.22*	-.37***	-				
4 SART – answering sensitivity	.92***	-.91***	.30**	-			
5 AFFECT – pleasure	.18*	-.20*	.02	.19*	-		
6 AFFECT – arousal	.12	-.14	.11	.15	.01	-	
7 Age	.02	.03	-.02	-.02	-.18*	-.09	-
8 Nature relatedness	-.20*	.26**	-.30**	-.20*	-.10	-.12	.16

*** $p < .001$, ** $p < .01$, * $p < .05$

Table 5 provides the correlations of the continuous variables. There were statistically significant correlations ($p < .001$) between many of the SART variables measuring the change before and after the walk. There were also statistically significant correlations between the changes in the pleasure score and three out of four SART variables. The participants who had a larger change in the pleasure score also had a larger change in the amount of correct responses ($r = .18$, $p < .05$), a smaller change in the amount of incorrect responses ($r = -.20$, $p < .05$) and a larger change in answering sensitivity ($r = .19$, $p < .05$). The pleasure score also correlated with age ($r = -.18$, $p < .05$) so that the older the respondent the smaller the change in the pleasure score. There were statistically significant correlations also between nature relatedness and the four SART variables. The more nature relatedness a person reported the smaller the change in the amount of correct responses ($r = -.20$, $p < .01$), the bigger the change in the amount of incorrect responses ($r = .26$, $p < .01$) and the smaller the change in the sd of reaction times ($r = -.30$, $p < .01$) and in answering sensitivity ($r = -.20$, $p < .05$).

3.3 Psychological instructions and individual factors predicting the change in sustained attention

TABLE 6. Hierarchical Regression Analysis for Variables Predicting the Change in the Amount of Correct Responses in SART.

Variables	β	ΔR^2	R^2
Step 1: Psychological Instructions		.01	.01
1. Restoration vs No Instructions	-.10		
2. Control vs No Instructions	-.06		
Step 2: Individual factors		.04	.05
3. Gender (1=women, 0=men)	-.04		
4. Age (18-63)	.06		
5. Nature relatedness (1-5)	-.20*		

Note. Psychological Instructions represented as two dummy variables with No Instructions serving as the reference group. Gender also represented as a dummy variable with men serving as the reference group. β = standardized beta coefficient (with all that step's variables included), ΔR^2 = Change in the coefficient of determination (R^2) with all that step's variables included.

* $p < .05$

The results for the hierarchical regression analysis for the change in the amount of correct responses in SART are depicted in table 6. There was no connection found between psychological instructions and the change in the amount of correct responses nor did the individual factors as a model predict this change while controlling for the psychological instructions. However, nature relatedness had a statistically significant effect on the change in the amount of correct responses ($\beta = -.20$, $p < .05$). This means that as the score in nature relatedness increases, the change in the amount of correct responses decreases. That is, people that feel more related to nature had less improvement in correct responses at the end of the walk compared to people who feel less related to nature.

TABLE 7. Hierarchical Regression Analysis for Variables Predicting the Change in the Amount of Incorrect Responses in SART.

Variables	β	ΔR^2	R^2
Step 1: Psychological Instructions		.01	.01
1. Restoration vs No Instructions	.03		
2. Control vs No Instructions	.13		
Step 2: Individual factors		.07*	.08
3. Gender (1=women, 0=men)	.02		
4. Age (18-63)	-.00		
5. Nature relatedness (1–5)	.26**		

Note. Psychological Instructions represented as two dummy variables with No Instructions serving as the reference group. Gender also represented as a dummy variable with men serving as the reference group. β = standardized beta coefficient (with all that step's variables included), ΔR^2 = Change in the coefficient of determination (R^2) with all that step's variables included.

* $p < .05$, ** $p < .01$

The results for the hierarchical regression analysis for the change in the amount of incorrect responses in SART are depicted in table 7. There was no connection found between psychological instructions and the change in the amount of incorrect responses. However, adding the individual factors to the model improved the model by 7 % ($p < .05$). Of the individual factors, only nature relatedness predicted the change in the amount of incorrect responses ($\beta = .26$, $p < .01$). When nature relatedness increases, the change in the amount of incorrect responses increases also. This means that people that feel more nature relatedness had a larger increase in the amount of incorrect responses compared to people who rated themselves as less related to nature.

TABLE 8. Hierarchical Regression Analysis for Variables Predicting the Change in Sd of Reaction Times (s) in SART.

Variables	β	ΔR^2	R^2
Step 1: Psychological Instructions		.01	.01
1. Restoration vs No Instructions	-.09		
2. Control vs No Instructions	-.10		
Step 2: Individual factors		.09*	.10
3. Gender (1=women, 0=men)	-.05		
4. Age (18-63)	.03		
5. Nature relatedness (1–5)	-.30**		

Note. Psychological Instructions represented as two dummy variables with No Instructions serving as the reference group. Gender also represented as a dummy variable with men serving as the reference group. β = standardized beta coefficient (with all that step's variables included), ΔR^2 = Change in the coefficient of determination (R^2) with all that step's variables included.

** $p < .01$, * $p < .05$

The results for the hierarchical regression analysis for the change in sd of reaction times in SART are depicted in table 8. There was no connection found between psychological instructions and the change in sd of reaction times. However, adding the individual factors to the model improved the model by 9 % ($p < .05$). Of the individual factors, only nature relatedness predicted the change in sd of reaction times ($\beta = -.30$, $p < .01$). As nature relatedness increases, the change in sd of reaction times decreases. This means that people who feel more related to nature go from an alternating rhythm to a more even rhythm, which could indicate that they have less failures in sustained attention.

TABLE 9. Hierarchical Regression Analysis for Variables Predicting the Change in Answering Sensitivity in SART.

Variables	β	ΔR^2	R^2
Step 1: Psychological Instructions		.01	.01
1. Restoration vs No Instructions	-.10		
2. Control vs No Instructions	-.12		
Step 2: Individual factors		.04	.05
3. Gender (1=women, 0=men)	-.05		
4. Age (18-63)	.02		
5. Nature relatedness (1–5)	-.19*		

Note. Psychological Instructions represented as two dummy variables with No Instructions serving as the reference group. Gender also represented as a dummy variable with men serving as the reference group. β = standardized beta coefficient (with all that step's variables included), ΔR^2 = Change in the coefficient of determination (R^2) with all that step's variables included.

* $p < .05$

The results for the hierarchical regression analysis for the change in answering sensitivity in SART are depicted in table 9. There was no connection found between psychological instructions and the change in answering sensitivity nor was there a connection between the individual factors as a model and the change in answering sensitivity while controlling for the effect of psychological instructions. In spite of this, nature relatedness had a statistically significant effect on the change in answering sensitivity ($\beta = -.19, p < .05$) on its own. Specifically, as nature relatedness increases, the change in answering sensitivity decreases.

3.4 Psychological instructions and individual factors predicting the change in affect

TABLE 10. Hierarchical Regression Analysis for Variables Predicting the Change in the Pleasure Score.

Variables	β	ΔR^2	R^2
Step 1: Psychological Instructions		.02	.02
1. Restoration vs No Instructions	.15		
2. Control vs No Instructions	.02		
Step 2: Individual factors		.09*	.11
3. Gender (1=women, 0=men)	.22*		
4. Age (18-63)	-.23*		
5. Nature relatedness (1–5)	-.10		

Note. Psychological Instructions represented as two dummy variables with No Instructions serving as the reference group. Gender also represented as a dummy variable with men serving as the reference group. β = standardized beta coefficient (with all that step's variables included), ΔR^2 = Change in the coefficient of determination (R^2) with all that step's variables included.

* $p < .05$

The results for the hierarchical regression analysis for the change in the pleasure score are depicted in table 10. There was no connection found between psychological instructions and the change in the pleasure score. However, adding the individual factors to the model seemed to improve the model by 9 % ($p < .05$). Of the individual factors gender ($\beta = .22$, $p < .05$) and age ($\beta = -.23$, $p < .05$) predicted the change in the pleasure score. As age increases, the change in the pleasure score decreases. That is, the older a person is, the less does a nature walk affect the change in self-reported pleasure. As it comes to gender, women had a larger increase in the change in the pleasure score compared to men.

TABLE 11. Hierarchical Regression Analysis for Variables Predicting the Change in the Arousal Score.

Variables	β	ΔR^2	R^2
Step 1: Psychological Instructions		.01	.01
1. Restoration vs No Instructions	.04		
2. Control vs No Instructions	.13		
Step 2: Individual factors		.02	.03
3. Gender (1=women, 0=men)	-.04		
4. Age (18-63)	-.06		
5. Nature relatedness (1-5)	-.10		

Note. Psychological Instructions represented as two dummy variables with No Instructions serving as the reference group. Gender also represented as a dummy variable with men serving as the reference group. β = standardized beta coefficient (with all that step's variables included), ΔR^2 = Change in the coefficient of determination (R^2) with all that step's variables included.

The results for the hierarchical regression analysis for the change in the arousal score are depicted in table 11. There was no connection found between psychological instructions and the change in the arousal score nor did adding the individual factors to the model change this result. None of the independent variables had a statistically significant effect on the change in the arousal score.

3.5 Sensitivity analysis: Randomization into groups based on a person's nature relatedness

As can be seen in tables 6 to 11, the group a participant belonged to had no effect on the SART scores nor on the affect scores. As this finding was so surprising, it was suspected that some intervening variable might have had an effect on the results. It was hypothesized that a person's nature relatedness might be this intervening variable. Thus, the randomization into the different walk groups according to a person's nature relatedness might not have been successful. To rule this out a one-way analysis of variance was performed. As can be seen in table 4, no differences were found between the different groups in the nature relatedness score. Thus, the randomization was successful and nature relatedness did not act as an intervening variable.

4. DISCUSSION

The purpose of this thesis was to discover whether three individual factors, gender, age and nature relatedness, on one hand and psychological instructions on a nature walk on the other have an effect on the change in sustained attention and self-assessed affect. The correlation of sustained attention and affect was also of interest in this study based on two theories, ART by Kaplan (1995) and SRT by Ulrich (1983). It was hypothesized that psychological instructions should improve the benefits we gain from a nature walk (H1). It was also hypothesized, that gender and age would have some kind of an effect on the change in sustained attention and affect (H2a & b). It was not known if nature relatedness would have any kind of effect on the change in sustained attention or affect (H2c). As it comes to H3, it was hypothesized that there could be correlation between attention and affect, as Hartig et al. (2003) have found correlation between attentional performance and positive affect in their study.

4.1 Main findings

All in all, the findings were quite surprising. The results did not confirm H1. That is, there were no differences found in the change in sustained attention and affect based on whether the person received no instructions, or whether the person received restorative or imagination-based instructions. In previous studies it has been found that participants in walk groups with awareness plans, similar to the imagination-based instructions here, are more satisfied with the walking environment compared to participants with no instructions (Duvall, 2011) but to my knowledge, a similar experiment to the current one has not been conducted before. It has also been previously discovered that feeling satisfied with psychological instructions received on a nature trail, similar to the restorative instructions here, correlates positively with self-reported restoration and enhancement in mood (Korpela et al., 2017). Thus, it could have been the case that effects on affect measures, at least, would have been found in the current study. However, this was not the case. It was suspected that the randomization into the different groups might not have been successful and that a background variable, nature relatedness, might have distorted the findings. Because of this, the randomization into groups based on a person's nature relatedness was studied as a sensitivity analysis. There were no differences found between the three groups based on nature relatedness and thus this background variable did not have an effect on the original analysis. Thus, there could be a different reason, such as another variable or too small a sample size, why there were no differences found in sustained attention and affect in the three walking groups. It could also be the case, that different kinds of measures of sustained attention and affect

would have yielded different results. Additionally, only certain SART variables were used in this study and thus it would require further research to discover what kind of results some additional SART variables (see for example Lee et al., 2015) would provide. Or, it could of course be the case that psychological instructions on a nature walk do not have an effect on the change in sustained attention or affect.

As it comes to H2, the results were quite interesting. As for the part of H2a & H2b, gender and age were connected only to the pleasure dimension of affect. For women the increase in pleasure was larger than for men. This supports the findings by Annerstedt et al. (2012), who found that women have a reduced risk for poor mental health when they have access to nature and also the finding by Ulrich (1981), that a vegetation scene affects positive affect more strongly than an urban scene and that this effect is stronger for women. For younger people the increase in pleasure was larger compared to older people. This agrees with the finding by Virtanen and Korpela (2012) who found in their study that younger people feel more restored in their favourite places than older people do. Of course, it should be noted that in the study by Virtanen and Korpela favourite places were the focus of the study, which of course was not the case in the current study. For the other dimension of affect, arousal, no statistically significant connection was found with gender or age. Neither was there a connection between sustained attention and gender nor between sustained attention and age.

As for H2c, there was a statistically significant connection between nature relatedness and all of the sustained attention variables. This finding is particularly notable as there are no previous studies, to my knowledge, which would have examined this connection. There was no statistically significant connection to either of the two dimensions of affect. This conforms with previous findings by Passmore and Howell (2014), who found that nature connectedness does not moderate the effect of nature on well-being, and by Korpela et al. (2017), according to whom nature relatedness does not moderate the effect of a nature walk on mood. As it comes to the different aspects of sustained attention, it was found that people who reported less nature relatedness had a larger increase in correct responses, a smaller increase in incorrect responses and a larger increase in answering sensitivity compared to those who reported more nature relatedness. All these suggest positive attentional changes, which is very surprising. People who reported less nature relatedness also had a more alternating rhythm at the end of the walk than at the beginning compared to the ones who reported more nature relatedness. This might appear contradictory to the findings above as a more alternating rhythm has been considered to be an indication of lapses in sustained attention (Robertson et al., 1997; Jussila, 2017). However, in this case the participants' even rhythm might have been due to not paying enough attention to correct and incorrect responses resulting in more incorrect responses and less correct responses and pressing the button in even intervals regardless of whether their answer

was correct or not. That is, perhaps the ones who reported more nature relatedness did not complete the sustained attention test in a way that was expected. This raises the question whether these participants understood the instructions correctly and maintained to follow the rules throughout the test.

One explanation for the fact that people who reported more nature relatedness had less improvement in the attention tests after the walk compared to people who reported less nature relatedness, might be that the previous do not perform so well in attention tests in the first place. Although purely speculative, it might be that people who enjoy nature might not have such a long attention span with technological devices. Furthermore, as the attention tests were done on a computer, people who feel connected to nature might not be familiar or enjoy working on a computer as much as people who feel less connected to nature. To figure out whether this could be the case, it was studied with a linear regression analysis if nature relatedness would have an effect on the sustained attention test before the walk. As it turns out, nature relatedness did not have an effect on the sustained attention test before the walk. That is, people who reported more nature relatedness did not initially do worse than people who reported less nature relatedness. It seems to be the combined effect of completing the nature walk and doing the instructed tasks with the smartphone that cause this result. Furthermore, as the walk was carried out in a rather urban nature park, it might not have been satisfactory enough for the more nature related people.

As for H3, the results were contradictory. It was discovered that the change in the pleasure dimension of affect did correlate with the change in most of the sustained attention measures: amount of correct responses ($r = .18, p < .05$), amount of incorrect responses ($r = -.20, p < .05$) and answering sensitivity ($r = .19, p < .05$). That is, the participants who reported a larger increase in pleasure also had a larger increase in the amount of correct responses, a smaller increase in incorrect responses and larger increase in answering sensitivity. One might say that the correlation between the change in sustained attention and pleasure here is positive. That is, the results as a whole could be interpreted so that the larger the increase in pleasure, the larger the increase in sustained attention. Regarding the pleasure dimension the results were similar to the ones found by Hartig et al. (2003), which were that there was correlation between attentional performance and positive affect in so that the participants who had a larger increase in mistakes, also had a smaller increase in positive affect. However, the other dimension of affect, arousal, did not correlate with sustained attention. The results give no conclusive evidence for the relationship between mechanisms underlying ART and SRT. In part attention and affect could be said to have intertwining mechanisms, at least when it comes to sustained attention and pleasure, and in part different underlying mechanisms, when it comes to sustained attention and arousal.

4.2 Limitations and strengths

Some previous studies have investigated the effects of a nature environment by showing pictures or videos to the participants. The current research was done outdoors, where the participants could take in the environment as a whole, which is one of the strengths of this study. This was also a repeated measures design, the same participants completed the tests before and after the walk, which is also a strength of this study. However, it could be that the environment that was selected might have been too urban as there was built environment nearby and the park is quite well-maintained. The participants were not randomly selected from a sample but could sign up for the study of their own volition. As the participants were informed that the study would include being in a nature environment, specifically in Hatanpää Arboretum, it is probable that the participants that enrolled were people that enjoy nature and might score high in nature relatedness. As it turned out, the mean for nature relatedness score was in fact 3.68 (on a scale of 1 to 5). However, this might not actually tell us whether a participant enjoys nature, because nature relatedness tells us about feeling connected to nature and wildlife among other things as can be seen from the items in NR-6 and not specifically about whether a person enjoys nature environments. The use of a smartphone was expected throughout the walk and it is possible that this might have disturbed the participants while trying to enjoy the surrounding environment.

As it comes to the generalizability of the findings, it must be pointed out that most of the participants were women and had enough free time, volition and energy to participate in a research. This, naturally, excludes some groups of people, such as people who identify as other gender besides female or people who do not have enough energy to participate in a study for example due to health or mental health reasons. However, the age distribution was quite good, and the research was conducted during the summer time when many people have their summer vacation and possibly more free time. It should also be pointed out that as the research was done only in Tampere, Finland, the results might not be generalizable to people from other countries and cultures.

4.3 The significance of this study and possibilities for further research

This study provides new information on the impact of psychological instructions and individual factors on a nature walk. New interesting information on the connection between ART and SRT was also discovered. It might be that some additional background variable affected the lack of impact of the psychological instructions on the change in sustained attention and affect. Of course, it could also

be possible that there is no effect to be found as it comes to changes in sustained attention and affect and the influence of psychological instructions on these two variables. However, additional studies should be conducted on this matter in order to discover whether there is a connection or not. Interesting new information was found about nature relatedness and sustained attention, as presumably this connection has not been studied before. Without question, further research should be conducted on this as the results seemed at first to be somewhat counterintuitive and it would be of great interest to find out whether the same kind of correlation would be found in future studies. The type of the nature environment should also be considered because in the present study the nature environment might have been too urban for the participants who reported high nature relatedness. Thus, perhaps the results could have been different if the study had been conducted in a wilderness area. The connection between ART and SRT also demands further research as the results of the current study were contradictory on the matter. It would be of great interest to discover whether the mechanisms underlying the two theories are somehow connected or whether they act as independent systems.

4.4 Conclusions

Further research on the connection between ART and SRT is encouraged, for in the current study the findings were inconsistent. It was discovered that carrying out psychological tasks had no effect on the change in sustained attention or affect. However, it would be fruitful to discover some means to utilize one's environment to its fullest extent in order to keep up a walking routine or to get out more as this has such major health benefits. The results on nature relatedness were quite interesting. It seems that for those who reported more nature relatedness the performance on the attention test did not improve so much as for those who reported less nature relatedness. The fact that a smartphone was used during the walk might have contributed to this finding or it could just be that people who feel less related to nature have better sustained attention. It remains to be seen whether one or the other is true in future studies. It was discovered that women and younger people receive more benefits from an urban nature environment when it comes to self-reported pleasure. In the future it would be beneficial to study what factors contribute to this finding and how to engage men and older people better during a nature walk. Even though other genders besides women and men were left out of the analysis in this study it is extremely important to be as inclusive as possible and also to consider some possible cultural differences in the future.

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