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The Restorative Effects of Natural Environments: Nature or Nurture?

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Abstract

In this urbanizing society, humans have less and less physical contact with nature. Research indicates that natural settings induce a higher restoration effect than urban settings. This study explores whether an evolutionary tendency, a culturally learned tendency, or a combination enhance the association with nature and causes these differences in restoration. To answer these questions, we measured the explicit and implicit association with nature and the mood change before and after the exposure to natural or urban slides after introducing a stressor. The results indicate that both environments had a restorative effect on the stress level. However, there were no differences in restoration level found between the different environments and the different associations with nature. In general, the natural slides provoked a sense of 'being away', and for the participants with a high explicit association with nature a sense of 'fascination' which support an evolutionary tendency. The explicit association with nature had a relation with the implicit association, not the need for restoration. In conclusion, there seems to be a mixed pattern of evolutionary and cultural tendencies to report an explicit association with nature.

Key words: Explicit and implicit association with nature, restoration effect, stress recovery,

1. Introduction

Research on the beneficial effects that nature has on humans has been developing for the last century, especially in the area of aesthetic preferences for landscapes (Carlson, 2015). It is a relatively new field of research because environmental aesthetics were associated with art and philosophy up until the last third of the 20th century (Carlson, 2015). Current research has expanded on this topic by providing an insight in human responses towards natural environments (Ulrich, 1993). The growing evidence that natural environments contain psychological benefits such as restorative effects on mental resources highlight the potential of this field in the social sciences (Staats, 2012).

Natural environments are decreasing in our urbanising society and people seek more and more leisure opportunities in urban surroundings. Research indicates that individuals tend to prefer natural environments to urban settings (Ulrich, 1993). The question remains why affective responses and restorative effects occur in natural settings compared to urban environments. Previous research has suggested that this strong affective response towards natural environments could be caused by culturally learned information about natural stimuli that could be rewarding (Ulrich, 1993). Secondly, previous research has indicated that certain natural environments contain evolutionary survival advantages for early humans, and this still might apply today (Ulrich, 1993). Because, certain natural settings still activate mechanisms associated with a search for natural environments that provide safety and food, which affect positive attitudes toward natural environments over urban settings. Which causes certain natural environments to support psychological benefits like the reduction of stress and/or the restoration from directed attention fatigue (Ulrich, 1983; Kaplan, 1995). However, evidence also exist that urban environments contribute to a high restorative likelihood when the setting function like homes, museums, cafes, and malls (Staats, Jahncke, Herzog & Hartig, 2016). Despite the strong positive attitude towards natural environments (Ulrich, 1993) there still exist adverse responses towards natural environments (Bixler & Floyd, 1997). It remains unclear what cause these preferences and restorative effects, and if these aversive responses inhibit restorative effects after exposure to natural settings.

The current research explores whether evolutionary or cultural tendencies cause restorative effects in natural environments compared to urban settings. We try to expand on previous research regarding the restorative effect of natural settings versus urban settings by comparing individuals who prefer nature with individuals who do not prefer nature, leading to this restorative effect.

1.1 Urban versus Natural preferences

Staats, Jahncke, Herzog and Hartig (2016) argue that differences in preference between natural and urban settings may be caused by the diverging behavioural functions of these specific settings. For example, an urban path mostly has a transportive function, while a natural path mostly a recreational function. Research then indicates that the natural setting is more often perceived as restorative (Hartig & Staats, 2006). Busy urban streets, however, are perceived as less restorative and less appreciated. Nevertheless, parks, museums and homes are rated with as highly restorative, and are more likely to be appreciated. Even though these urban recreation opportunities are rated as highly restorative, people still prefer natural leisure opportunities over urban leisure opportunities (Staats, Jahncke, Herzog & Hartig, 2016). Similarly, research indicates that settings which contain certain elements of nature or man-made natural settings (e.g. parks) are preferred over settings that do not contain such elements (Ulrich, 1993). A study by Staats and colleagues (2016) shows that the preference for natural leisure opportunities is higher compared to urban leisure opportunities when people have the need of restoration, for example after a period of experiencing stress. Thus, it could be that people's need for restoration influences their preference for natural settings over urban settings. Still it remains unclear what causes people to seek natural environments, if their need for restoration is high. Could this be caused by our genes or by our cultural background?

1.2 Biological response pattern

An evolutionary perspective on what is causing the different responses toward elements of nature is that early humans learned adaptive responses associated with avoiding danger (biophobic) or seeking rewards (biophilic) to consider nature stimuli to survive (Ulrich, 1993). Here it is argued that nature has different dangerous aspects, but contains survival related advantages as well, like provision of water, food and safety for humankind (Ulrich, 1993). According to the prepared learning theory proposed by Seligman (1970, 1971) some responses towards natural elements and setting configurations have indicated that humans are prepared to learn based on their evolutionary survival advantages. Therefore, these responses are easier to learn and more easily retained. For example, adaptive avoidance and fear responses to fear-relevant natural stimuli (e.g. snakes and spiders) are faster learned and harder to forget (Ulrich, 1993). Although immediate dangers have decreased in modern day life and people no longer feel the need to actively seek out natural survival advantages, the avoidance and approach responses towards natural stimuli might still exist in our gene pool (Ulrich, 1993). Research indicates that aversive responses towards wildland environments still exist and are correlated with negative perceptions of these environments. These aversive responses toward natural environments can not only create feelings of discomfort such as disgust, but also enhance an individual's preference for the indoors, manmade environments, and for modern comforts

(Bixler & Floyd, 1997). This indicates that avoidance responses towards natural environments might still be part of our gene pool.

The functional-evolutionary perspective suggests that certain natural environments also contain survival advantages (Ulrich, 1993). Characteristics like high visual depth and openness contained lower risks for early humans because they provide an overview on possible predatory threats (Ulrich, 1983). This could explain why modern people have a higher preference for savanna-like environments compared to other natural environments (Balling and Falk, 1982). The prospect-refuge theory by Appleton (1996) could also explain the preference of savanna settings, because the propensity to prefer certain environments is caused by the possibility to hide (refuge) and the possibility to observe the environment without being seen (prospect) (Appleton, 1975). Apart from safety, savanna environments provide more food (Appleton, 1975). The habitat theory by Appleton (1975) additionally suggests that people tend to spontaneously consider natural places their habitat when these environments foster the primitive function of satisfying all our biological needs even though the achievement of these biological needs are no longer essential. According to the functional-evolutionary perspective, people should also prefer natural environments that contain water because this also has a survival advantage for early humans (Coss and Moore, 1990). Modern people still prefer elements of water to man-made materials like concrete and glass (Kaplan & Kaplan, 1989). The phenomenon 'evolutionary mismatch hypothesis' could explain affective responses toward natural elements (Li, Van Vugt, Colarelli, 2018). The mismatch hypothesis refers to an 'adaptive lag' that occurs when specific environmental cues are related with the evolutionary survival advantage they had for early humans. When environments change faster than the time needed to adapt to mechanisms of change, it could result in inappropriate behaviour, attitudes and adaptive cognition toward the present environment (Li, Van Vugt, Colarelli, 2018). However, at some aspect's mechanisms can adapt to evolutionary changes. Natural selection, for example, indicates that different species can adapt to their changed environment over time (Williams, 1966). Therefore, according to the evolutionary perspective on the preference of natural environments the survival advantages certain natural environments had for early humans could explain why people prefer natural settings over urban settings. However, could there be other possible explanations for the differences in preference between natural and urban settings?

1.3 Individual and social learning

Besides previously mentioned theory, cultural perspectives may also explain the preference of natural settings over urban settings. There have been many cross-cultural studies on the differences in environmental preference of art and other environments. A study by Barry (1957) indicated that the preference for "arousal potential" in art works differs cross-culturally. He found that the preference for complexity in artwork was high in societies where children were stimulated to be independent, and where there was low affection and protection given in childhood (Barry, 1957). According to the theory of arousal by Berlyne, (1960) people strive towards information intake if this still evokes positive affective responses. Berlyne (1971) argues that people in prosperous societies prefer a high level of arousal potential because they strive for a high level of information intake. Prosperous societies are characterised by urban environments which mostly contain complex social structures, which enhance peoples need to take in a high level of information to understand, adapt and function in these environments (Berlyne, 1971). However, few cross-cultural studies highlight the different preferences for natural environments. Wohlwill (1983) argued that natural settings contain a lower arousal potential than urban settings because of the low intensity of stimulation (e.g. less intense colours, lower levels of sounds) and lower complexity (slower movements, less contrast, more continuity). The learned values towards certain environments could affect how an individual respond towards an environment with specific stimulations. For example, when you were stimulated as a child to be independent or lived in a prosperous society, you are more likely to be open to and prefer settings with a high arousal potential like urban settings. Additionally, Wohlwill (1974) argues that previous experiences with certain levels of environmental variables, such as complexity and intensity of stimulation, cause the stabilisation of an adaptation level towards these environments. The establishment of a stable adaptation level might provoke affective responses like the preference for these setting (Wohlwill, 1974). Furthermore, the non-establishment of a stable adaptation level towards specific environmental stimuli, might enhance aversive behaviour. For example, people who grew up in a noisy, busy, urban environment, probably have less experience with natural settings which contain a lower arousal potential, like quiet, savanna landscapes. And therefore, are less likely to have established a stable adaptation level towards natural environments with low intensity of stimulation and complexity. This might cause aversive responses like being bored or becoming tired after exposure to these natural environments. It could be concluded that the preference for natural environments over urban environments can be caused by the stabilisation of our adaptation level or our learned values towards the arousal potential of certain settings.

Several other studies have indicated that people differ in their values towards natural environments and that their responses toward natural settings are culturally bound. It is argued that familiarity will also affect responses towards environments (Knopf, 1987). Cultures can contribute to these familiarities with different environments through exposure during childhood, so people who are familiar with natural settings may also show more positive responses towards these environments than people who are not familiar with natural settings through their culture. However, the physical contact between modern children and their experience with natural environments is decreasing. According to Zhang, Goodale & Chen (2014) the reasons for this low physical contact relates to the decreasing natural settings in our urbanizing society as well as the scarce free time children spend in nature. Nowadays children seek their leisure opportunities mostly indoors, spending time on virtual entertainment (Clements, 2004). The results of the study by Zhang, Goodale and Chen (2014) show that school aged children experiencing nature, indicate high biophilia responses and low biophobia responses. Therefore, natural environments may be preferred over urban environments because some cultural characteristics, like low arousal potential, low complexity, and learned values, determine the degree to which natural settings are appreciated. Research does not only indicate that natural environments are more often preferred than non-natural environments, but also that they cause restorative effects (Ulrich et al. 1991).

1.4 Restorative effects of natural environments

Ulrich (1986) showed in his study that exposure to nature results in the increase of positive affect. Following the definition used by Ulrich (1986) positive affect here refers to the neurophysiological activities, preference and the experience of pleasant feelings that arise from the exposure to visual environments. In the case of exposure to natural settings, positive affects like excitement, pleasure and affection are increased (Ulrich, 1986). According to work by Berlyne (1960) arousal creates the most pleasure when it is at a moderate level. Wohlwill (1983) stated that natural settings mostly have a lower arousal potential as compared to urban settings because the elements of natural environments contain lower complexity, higher diversity, more order and congruity. This may also be the case because of the lower psychophysical intensity and a higher reference to symbolic values of natural stimuli (Wohlwill, 1983). This indicates a high relationship between natural environments and pleasure which could cause restorative effects among people in need of restoration. Västfjäll, Friman, Gärling and Kleiner (2002) used the two dimensions of affect defined by Russell (1980) namely: ‘arousal’ and ‘valence’. The arousal dimension refers to the degree of energy involved in an arousal state and varies between a high and low activation level. The second dimension of affect, ‘valence’, refers to unpleasant versus pleasant affects (Vassal et al., 2002). A study by Lymeus, Lindberg and Hartig (2018) indicates that participants after a meditation in a natural environment show an increased

pleasant deactivation. They experience a higher sense of relaxation and calm, as compared to participants who did meditation in a college room. This 'pleasant deactivation' refers to a high positive valence and a low arousal, which were enhanced after meditation in a natural setting. This is in line with the low arousal potential of most natural environments. The pleasant deactivation of the participants after the experience of a nature meditation could be seen as a reduction of stress (Lymeus, Lindberg & Hartig, 2018). Other studies show other restorative effects like that natural environments could restore the capacity to focus attention (Kaplan & Kaplan, 1989).

1.4.1 Attention Restoration Theory/ Extremely attentionally fatigued

According to the Attention restoration theory (ART) intensive concentration on a situation, task or behaviour, also referred to as directed attention, is a scarce resource (Baumeister, 2002). This means that the capacity of directed attention decreases when it is used frequently, sometimes resulting in decreased performances. Situations in which directed attention is not required allow the capacity of mental resources to restore and could result in an enhancement of subjective well-being and performance (Staats, 2012). The degree to which a situation has a restorative effect on directed attention fatigue depends on four perceptions of person-environment relation according to ART. Namely the sense of being away, effortless fascination in the personal environment, sense of extent, and compatibility between what a person wants and what an environment allows. Natural environments often enhance these four perceptions. According to Kaplan (1995), easily accessible natural environments like leisure settings could create a perception of being away from situations that require directed attention. Directing attention toward natural environments is often effortless and does not occupy the mind, which allows 'soft' fascinations for natural settings to occur (Kaplan, 1995). In addition, some natural settings create the perception of extent through its ordered and structured layout (Kaplan, 1995). This causes restorative effects because it enhances the tendency to explore the environment further, so it takes up a lot of a person's attention. Lastly, natural environments provide a perception of compatibility between what people like to do and the natural setting (Kaplan, 1995). In sum, these four perceptions about natural environments cause people to experience less cognitive activation. However, this could also be due to the absence of evaluations by others, which allows a person to experience restorative effects without interruption (Wohlwill, 1983).

1.4.2 Psycho-Evolutionary theory of the Reduction of Stress

Previous research has investigated the effect of different outdoor scenes on stressed individuals (Ulrich, 1993). Ulrich (1983) demonstrated in his study that participants, after exposure to natural environments, show physical symptoms, which indicated a faster recovery of stress as compared to urban environments. In line with the evolutionary perspective, Ulrich (1993) argues that natural environments can cause this quick recovery of stressful experiences because it was necessary for early humans to recover quickly to defend themselves. Therefore, according to Ulrich (1993) modern humans have created evolutionary schemes to retain restorative responses toward the view of unthreatening natural settings, which could cause this quick reduction of stress. Ulrich (1979) also stated that participants experiencing stress before an exam and who have looked at slides of natural settings focused their attention more on the natural environments, which caused a greater psychological restoration as compared to participants who looked at urban settings before the exam. The participants in the natural condition reported fewer negative feelings (e.g., fear, aggression) and more positive feelings than participants in the urban condition (Ulrich, 1979). Later this study has been expanded to urban settings containing natural elements. Again, results show that urban settings containing natural elements produce more recovery from stressful experiences than non-natural urban settings (Honeyman, 1992). So various studies indicate that reduction of stress was measured in a psychological (self-ratings) and physical way (e.g., blood pressure, heart rate, skin conductance, brain electrical activities) (Ulrich et al., 1991). The restoration effect after experiencing stress could also result in an enhancement of the cognitive performance (Kaplan & Kaplan, 1989; Hartig, Mang & Evans, 1991). The question remains if these restorative effects also differ between biophobic and biophilic people? If people with a lower explicit association with nature still experience the restorative effects after exposure to natural environments, an evolutionary tendency to prefer natural settings over urban setting is a more likely explanation for the appearance of these restorative effects than a cultural tendency.

1.5 Transactional response pattern

According to Hartig (1993) the preference for certain environments is not always caused solely by a biological response pattern or by a cultural learning process. Following the transactional perspective, he argues that both evolutionary and cultural factors play a role in environmental preferences. Whether a natural environment is preferred over an urban environment depends on what is salient about this environment for a person. This, in turn, could be influenced by evolutionary, cultural and motivational factors. For example, people tend to prefer nicely maintained parks over wild and unkempt natural environment (Martens, Gutscher, & Bauer, 2011). Here the preferences for tended nature scenes could be caused by mortality salience (Koole & Van den Berg, 2005) for example that the dead wood in the wild nature

scenes cause sadness following the sociocultural perspective. However, when following the psycho-evolutionary perspective this preference for parks over wild natural environments could also be caused by the potential threat that the density of the wild nature scenes could represent (Schroeder and Anderson, 1984). In conclusion, it is important to make sure in this study that the right aspects of the natural and urban settings are made salient. This could influence the preference for natural scenes over urban scenes, or the other way around.

1.6 Inclusion of nature to the self

The concept of connectedness to nature can be seen as including nature in a cognitive representation of the self (Schultz, 2002). Frantz, Mayer, Norton and Rock (2005) argue that nature becomes less and less part of our self-concept due to the industrialism. People do not see themselves as part of the natural world but separate these concepts. Environments can be seen as a part of someone's self-concept (Wikili & Stravidou, 2013). As discussed in the study by Wikili and Stravidou (2013) the preference for natural environments is viewed in this study as a part of a person's place identity. Previous research indicated that a component of place identity (place attachment) has a relation with people's preference for places to recover from stressful periods or for recreation (Adevi and Grahn, 2011). The study by Adevi and Grahn (2011) shows that familiar nature areas are associated with lower levels of stress. Wikili and Stravidiou (2013) show that people who prefer natural settings judge urban settings as less restorative than nature settings whereas people who prefer urban settings judge urban and nature setting with the same restoration potential. This could indicate that people who do see nature as a part of their place identity will experience fewer restorative effects from urban settings than people who do not see nature as a part of their place identity. This because place identity seems to determine how restorative you experience of an environment that is an important part of your self-concept. Multiple self-report measures which examine the connectedness to nature contain a social desirability risk (Coral and Schultz, 2009). People could have the feeling that they need to answer in a way that shows a positive attitude towards nature, because they feel like this is expected of them by today's society. Therefore, these self-report measures do not measure the connectedness with nature outside our self-awareness. Coral and Schultz (2009) proposed an implicit association measure to study strength of association outside of self-awareness. Like the study by Coral and Schultz (2009) the implicit association with nature will be examined in this study which makes it possible to indicate an evolutionary inclination of preference for natural settings. This is due to the fact it could be that both people who prefer nature over urban settings or the other way around have an implicit association between themselves and natural elements. Which can be caused by the evolutionary survival advantages of natural environments and therefore could cause the same restorative effects for people with both preferences.

1.7 Summary of the present study and hypothesis

In conclusion, the current study aims to explore if the preference for natural settings can be caused by an evolutionary tendency, a tendency learned, i.e., created by culture and education, or a combination of these tendencies. We divided this study into two parts. Within the first part of this study, we looked at the implicit nature preference under a stressful condition. We employ a design in which we first measure the explicit association with nature, then introduce a stressor and after this measure the implicit association with nature. First, we examine if there is a restorative effect after the exposure to natural environments and if this is in line with the perceived restoration of the natural slides. In addition, we are going to explore if there is a difference in restorative effects between participants who show a high or low implicit and explicit association with nature. If there is a restoration effect found after exposure to natural environments and this is in line with the perceived restorativeness of the natural slides, then this indicates that natural settings can have an enhanced restorative effect. In addition, if there is no difference found between the restoration level of the participants with a high or a low implicit and explicit association with natures this indicates that an evolutionary tendency may be causing a restoration effect to occur for biophilic participants. We are also going to examine what the relation is between the explicit and implicit association with natural settings. If there is an association between the explicit and implicit association with nature, this indicate that there is a learned tendency that cause the preference of natural settings. However, if there is no significant effect of the explicit association on the implicit association with nature, we consider this an indication of an evolutionary tendency causing the preference for natural settings. Additionally, if there is a difference found between the effects of the explicit or the implicit association on the perceived restorativeness of the natural slides, we also consider this an indication of an evolutionary tendency causing the preference for natural. We are also going to look at the effect between the need for restoration and the implicit association with natural settings. If there is a positive effect found this indicates that people with a high need of restoration will unconsciously associate themselves more with nature which supports the existence of an evolutionary tendency as a causes of nature preference. Within the second part of this study we want to explore if people who state not to prefer natural settings still show signs of restoration after exposure to natural settings. We are going to measure the mood change between the mood after the stressor and the mood after the exposure to natural or urban setting. If the mood increases after natural settings as compared to urban settings, this indicates the restoration effect of natural environments. If people with both a high and low explicit preference show a bigger mood increase after exposure to natural settings as compared to exposure to urban settings, there is an indication that the evolutionary tendency can cause the preference for natural settings.

Research question

Can the restoration effect of natural settings over urban settings for the people who do and do not prefer natural settings be explained by an evolutionary tendency that causes the preference for natural settings?

Hypotheses

1a. People whose pleasant deactivation level increases after the exposure to natural environments will indicate to perceive a higher restorative effect from natural landscape qualities and not urban landscape qualities.

1b. People with a higher explicit association with nature will indicate to perceive a higher restorative effect from natural landscape qualities and not urban landscape qualities than the people with a lower explicit association with nature.

2. People with a higher implicit association with nature will indicate to perceive a higher restorative effect from natural landscape qualities and not urban landscape qualities than the people with a lower implicit association with nature.

3. If nature preference is evolutionary based than the explicit association with nature does not need to be related with the implicit association with nature.

4. People who have a higher need for restoration will show a higher implicit association with nature.

5. If we accept that nature preference is evolutionary based then people who indicate a lower explicit association with nature will show a stronger increase in their pleasant deactivation level after exposure to natural environments than after exposure to urban environments.

6. If we accept that nature preference is culturally based than people with a higher explicit association with nature will show a stronger increase in their pleasant deactivation level after exposure to natural environments than the people with a lower explicit association with nature after exposure to natural environments.

7. If we accept that nature preference is culturally based then people with a higher explicit association with nature will show a stronger decrease in their pleasant deactivation level after exposure to urban environments that the people with a lower explicit association with nature after exposure to urban environments.

2. Method

2.1 Participants and design

One hundred and thirty participants were recruited between the age of 17-60 years. The participation in this experiment was voluntary. To recruit the participants who had a low explicit association with nature, two items that reflect the explicit association with nature were used. Additionally, these two questions were also used to indicate their explicit association with nature during the study. Participants were recruited from different faculties of Leiden University using online recruiting systems like: 'Orsee.3' and 'SONA' and social media like Facebook groups and LinkedIn or by asking them to participate. Each participant could choose between 3 euro's or 1 study credit as a reward for their participation. The participants were randomly assigned to the environmental conditions of a natural or urban slide within a quasi-experimental 2x2 mixed design. The participants with different explicit associations with nature were split equally over the environmental conditions. All the participants were part of the stress condition where the participants did a series of arithmetic tasks in a short period, regardless of their explicit association with nature.

2.2 Antecedent condition

In the antecedent condition, stress was provoked using the Montreal Imaging Stress Task (MIST) (Dedovic, Renwick, Mahani, Engert, Lupien & Pruessner, 2005). Within this stress manipulation condition the participants preformed arithmetic tasks under time pressure and negative social feedback (see figure 1). The MIST took about 15 minutes. The arithmetic tasks differed in their level of difficulty, ranging from only adding to a combination of adding, subtracting, multiplication and dividing. Pressure was created by informing the participants to be as fast and accurate as possible on the arithmetic tasks before the experiment and by repeatedly evaluating the participant's performance with arrows, which represent the average performance on each task. These arrows always indicate a negative performance regardless the performance of the participants.

In the breaks between the blocks of tasks, the participants got the feedback that their performance must increase in order to get the minimum required performance, which should also provoke stress (Dedovic, Renwick, Mahani, Engert, Lupien, & Pruessner, 2005). According to the study by Dedovic and colleagues (2005) the manipulation of the MIST is suitable for inducing stress. Additionally, there have been multiple experiments performed in Leiden that used the MIST successfully as a stressor in their study (Rieder, 2013; Schneider, 2018).

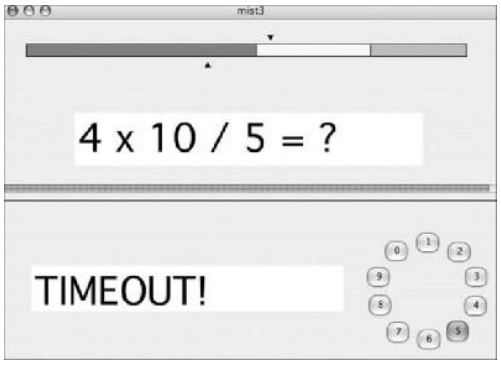

Figure 1. Interface Montreal Image stress Task.

2.3 Measures

2.3.1 Connectedness with nature items used in recruitment

The degree to which an individual includes nature in their self-representation was measured with the 'inclusion of nature in the self' scale (INS) (Schultz, 2002). This single item scale consists of seven sets of circles. Each circle is labelled "self"' or "nature" and the participants choose the circle picture that describes their relationship with natural environments the best on a 7-point scale (see appendix 1). The circle with the most overlap represents an individual who perceives nature as big part of the self-concept and the circle with the least overlap represents an individual who perceives nature separated from the self-concept (Schultz, 2002). Additionally, the item: "I like to walk in forests, parks and other natural settings" on a 5-point scale was used to select the participants for this study.

2.3.2 Explicit association with nature.

In order to assess individual differences in the explicit psychological connectedness to nature the short version of the Nature Relatedness Scale (NR-6) was used. The NR-6 was used in addition to the INS because it creates a broader view on the psychological connectedness with nature of the participants. The short version of the NR consists of 6 items that represent the two dimensions: 'experience' and 'self' and has proven to be a valid measure (Nisbet, & Zelenski, 2013). Each item represents a statement about the explicit association with nature (e.g. "I take notice of wildlife wherever I am") which can be rated on a 5-point scale. Where 1 refers to "strongly disagree" and 5 refers to "strongly agree" (Nisbet, & Zelenski, 2013). The NR-6 is a brief measure and therefore limits the time of this study (see appendix 2). We looked at the reliability of the NR6-items (α= .823) and created a composite score for the NR-6 to see if the use was appropriate. We then computed the correlation between the INS, the single item question and the NR-6 to examine if these tests measure the same construct of 'explicit association with nature'. Based on this reliability analysis of the NR-6 items and the correlations between the items, we decided to use the NR-

6 in its former structure. After this we looked at the correlations between these three explicit measures of association with nature. The correlations between the NR-6 and the INS (r= .600, $p < 0.001$), the INS and the pre-test single item question (r= .386, $p < 0.01$) and the NR-6 and the single item (r= .522, $p < 0.001$) were significant. We performed a factor analysis on the NR-6 to see if the items load on the same dimension and to see how much proportion each item explained of this dimension. The factor analysis showed that all the 6 items of the NR-6 load on the same dimension based on an eigenvalue greater than one which explained 53.491% of the variance and were the communalities are at least .288. Then we created standardized scores for each measure to create a combined 'explicit association with nature' variable. We explored the data of this variable and the data showed a normal distribution and no outliers. We also computed the reliability of this new 'nature preference' variable (α= .854).

2.3.3 Implicit attitude towards nature

The implicit association test (IAT) was used to measure the participant's implicit attitudes towards nature (Greenwald, McGhee, & Schwartz, 1998). Like the study by Schultz, the modified version of the implicit association test which focuses on the connectedness to nature is used in this study (Schultz, Shriver, Tabanico & Khazian, 2004). The IAT uses a computer program that measures the reaction time a participant needs to classify randomly assigned words that are associated with natural and urban settings for example 'animals' or 'car'. The IAT consists of seven blocks of ten trials where each block could be answered with different answer models for example: 'nature–built' or 'nature/me–built/not me' (see appendix 4). The higher the scores the faster the response, which can be interpreted as a stronger association between nature and the self (Schultz et al, 2004).

2.3.4 Current mood

The emotional state of the participants was measured with the Swedisch Core Affect Scale (SCAS). Each of the six items consists of a pair of opposite adjectives for example: 'nervous vs. calm' (see appendix 3). Each pair can be rated on a nine-point scale where one refers to the participant totally agreeing with the negative adjective, five refers to the participant being neutral between the adjectives and nine refers to the participant totally agreeing with the positive adjective. Filling in the questionnaire took about 5 minutes (Vassal, Friman, Gärling, & Kleiner, 2002).

The SCAS was chosen because, compared to other measures that indicate the current emotional state of the participants, the SCAS also includes arousal properties namely: activation/deactivation. According to Russell (1980) the two dimensions pleasure/displeasure and activation/deactivation can be seen from a circumplex point of view where they function as axes which can be rotated around the description of affect. This result in the two dependent axes: 'deactivation vs. pleasant activation' and 'unpleasant activation vs. pleasant deactivation' which represent a combination of the arousal and valence dimensions of affect (see figure 2).

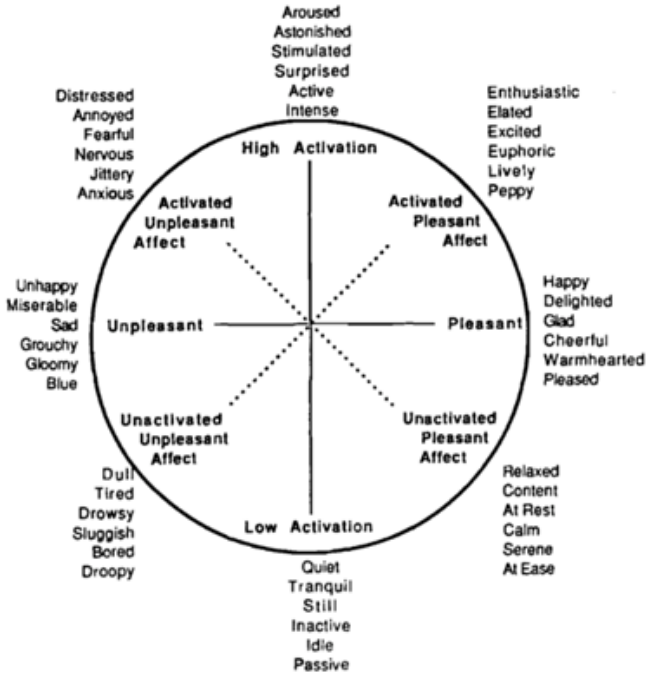

Figure 2. The affect circumplex model

According to previous studies, natural settings increase the positive valence level and decrease the tense arousal level also referred to as 'pleasant deactivation' (Lymeus, Lindberg & Hartig, 2018). Therefore, we chose to use the 'unpleasant activation /pleasant deactivation' dimension of the SCAS as an indication for affect, because an increase in this subscale represents a 'restorative' effect of the environmental conditions (Vistal, Friman, Gärling, & Kleiner, 2002). We performed a factor analysis based on the 'varimax' rotated solution on the items of the SCAS at different time points to examine which set of items was the most suitable to represent the pleasant deactivation dimension. This factor analysis indicated 3 dimensions based on an eigenvalue greater than one where the first dimension explains 53.140% of the variance and the second dimension explains 13.043% of the variance. Based on pattern of component loadings of the SCAS items with a Varimax rotated solution on time point 1 (see table 1), time point 2 (see table 2) and time point 3 (see table 3) we created a new subscale for pleasant deactivation.

The new subscale was based on component 2 because the component loadings load higher that .500 on the items: 5, 6, 7, 8, 11, 12 of the dimension 'pleasant deactivation' at all the different time points resulting. We choose to use this dimension to measure the restoration effect over time.

Table 1: *SCAS time point 1 items component loadings (Varimax rotated solution)*

	Component 1	Component 2
1. Sleepy-Awake	.785	.187
2. Passive-Active	.800	.166
3. Dull-Peppy	.779	.205
4. Indifferent-Engaged	.816	.223
5. Tense-Serene	.100	.780
6. Depressed-Happy	.480	.704
7. Sad-Glad	.484	.690
8, Nervous-Relaxed	.128	.848
9. Bored-Interested	.696	.220
10.Pessimistic-Opptimistic	.595	.463
11. Anxious-Calm	.212	.828
12. Displeased-Pleased	.513	.611

Table 2: *SCAS time point 2 items component loadings (Varimax rotated solution)*

	Component 1	Component 2
1.Sleepy-Awake	.869	.029
2.Passive-Active	.923	.024
3.Dull-Peppy	.891	.166
4.Endifferent-Engaged	.879	.129
5.Tense-Serene	-.143	.830
6.Depressed-Happy	.544	.665
7.Sad-Glad	.475	.687
8.Nervous-Relaxed	.051	.872
9.Bored-Interested	.776	.224
10.Pessimistic-Optimistic	.473	.609
11.Anxious-Calm	-.004	.908
12.Displeased-Pleased	.442	.713

Table 3: *SCAS time point 3 items component loadings (Varimax rotated solution)*

	Component 1	Component 2
1.Sleepy-Awake	.847	.191
2.Passive-Active	.867	,250
3.Dull-Peppy	.861	.276
4.Endifferent-Engaged	.778	.369
5.Tense-Serene	.202	.766
6.Depressed-Happy	.513	.718
7.Sad-Glad	.489	.755
8.Nervous-Relaxed	.170	.880
9.Bored-Interested	.752	.298
10.Pessimistic-Optimistic	.568	.601
11.Anxious-Calm	.193	.824
12.Displeased-Pleased	.501	.724

Then we performed a reliability analysis on the SCAS subscale 'pleasant deactivation' at time point 1 (α= .894), time point 2 (α= .891) and at timepoint 3 (α= .924). The 'pleasant deactivation' factor is highly reliable over time.

2.3.5 Environmental conditions

In this study we used the same scenes as the ones being used in a current study by Collado and Staats (manuscript in preparation) who use 14 slides of natural settings and 14 slides of urban settings (see appendix 5). Each slide was presented 10 seconds on a computer screen at approximately 1 meter away from the participants and the duration of each condition was about 5 minutes. Collado and Staats (manuscript in preparation) selected the slides because children in a non-stress condition rated them with the same degree of beauty in a pilot test of their research. To make sure that the difference in preferences of the slides do not affect the restorative effects in this study.

2.3.6 Perceived restorativeness

To assess how restorative the participants perceive the experimental condition the Perceived Restorativeness Scale (PRS) was used. This measure is often used in studies, which try to determine if environments contain restorative qualities. The PRS uses four restorative factors based on the Attention Restoration Theory (Hartig, Korpela, Evans, & Gärling, 1997; Hartig, Kaiser, & Bowler, 1997). The ART proposed the following four restorative factors: being away, fascination, extent and compatibility (Kaplan, 1995). Earlier research indicates that the factors: 'being away' and 'fascination' are clearly the most influential restorativeness factors (Lindal & Hartig, 2015). Therefore, only the items that represent the restorative factors: 'being away' and 'fascination' were used. This adapted version of the PRS contains 8 items which are statements like: "This place is fascinating" about a given setting which can be rated on an 11-point scale where 0 refers to "not at all" and 10 refers to "completely" (see appendix 6).

We performed a factor analysis on the items of the PRS to see if the subscales that were proposed by Lindal and Hartig (2015) were suitable for our data based on the 'varimax' rotated solution. The factor analysis indicated that with an eigenvalue of 3.858 all the items of the PRS load on the same dimension where 64.304% of the variance is explained by this dimension. The factor loadings of the items defined by the subscale 'fascination' are high and vary from .832 till .896 and the communalities of the items defined by the subscale 'being away' are moderate and vary from .586 till .733. Based on these factor loadings the two subscales can be defined in the same way as is proposed by Lindal and Hartig (2015). In addition, we computed the correlations between all the items of the PRS. These correlations were all significant (see table 4) and the correlation between the subscales 'being away' and 'fascination' was significant (r= .589, p=.000). We performed a reliability analysis on the item of the overall PRS (α= .881) and on the items of the subscales 'being away' (α= .672) and 'fascination' (α= .911) to see if we could create a reliable combined score for the overall PRS and the subscales of the PRS. Based on the high reliability of the overall PRS scores we decided to use the overall PRS score to indicate perceived restoration in this study.

Table 4: *Pearson correlations between the different items of the PRS*

	PRSBA2	PRSF1	PRSF2	PRSF3	PRSF4
PRSBA1	.506**	.457**	.352**	.419**	.309**
PRSBA2		.536**	.509**	.561**	.486**
PRSF1			.761**	.681**	.639**
PRSF2				.805**	.684**
PRSF3					.781**

**Correlation is significant at the 0.01 level

2.4 Procedure

The participants initially filled in the INS, a single item question to recruit and equal number of participants with high and low explicit associations with nature. When the participants started the study, they first filled in the NR-6 questionnaire about how emotionally connected they perceive themselves with the natural world. After this, their current mood was measured using the SCAS. After filling in the SCAS the participant underwent the antecedent condition in which stress was induced with the MIST. After the MIST the participants carried out the IAT to see what their implicit association with nature was. Then the current mood of the participants was measured again using the SCAS. After this the participants were assigned to the natural (experimental) condition or to the urban (control) condition based on a randomly assigned an equal number of participants who felt connected to nature and participants who didn't. This experimental and control condition contained 14 slides of natural settings or 14 slides of urban settings. After these experimental conditions, the perceived mood was measured again. Lastly, the participants filled in a questionnaire about how restorative the qualities of the environmental slides were perceived.

3. Analysis and Results

3.1 Manipulation checks

3.1.1 Baseline condition check

We wanted to see whether the participants in the different environmental conditions differed in their baseline level on the 'pleasant deactivation' level at time point one. Therefore, we computed a univariate ANOVA where the 'pleasant deactivation' level was the dependent variable and the 'environmental condition' was the fixed factor. This univariate ANOVA indicated that there were no significant differences between the means scores on the 'pleasant deactivation' level ($F(1,126)= 1.13$, $p= .291$) between the participants ($N=128$) in the urban condition ($M= 6.58$, $SD= 1.33$) and in the nature condition ($M= 6.34$, $SD=1.31$). The participants in the different environmental conditions did not show significantly different mood levels at the beginning of the study.

We also computed a univariate ANOVA to see if the participants with different explicit associations with nature differed in their baseline 'pleasant deactivation' level. Again, the dependent variable was the 'pleasant deactivation' score and 'explicit association with nature' score was used as the fixed factor. This univariate ANOVA indicated that there was no significant difference ($F(1,41)=.96$, $p= .570$) between the means of the participants with different levels of explicit associations with nature at time point 1. These results indicate that the participants with different explicit associations with nature did not differ significantly in their mood level at the beginning of the experiment.

3.1.2 Antecedent condition check

To test whether the MIST functions well as a stressor we examined the difference in the 'pleasant deactivation' level of the participants before and after the stress manipulation with a paired sampled t-test on the pre and post MIST scores of the 'pleasant deactivation' scores. The paired sampled t-test indicated that the means of the 'pleasant deactivation' scores between time point 1 and time point 2 did differ significantly ($t(126)= 9.80$, $p < .001$). These differences in the 'pleasant deactivation' means before ($M=6.45$, $SD= 1.32$) and after ($M=5.38$, $SD=1.38$) the MIST indicate that the MIST had a negative effect on the 'pleasant deactivation' level of the participants, so the stress manipulation worked.

3.1.3 Environmental condition check

Furthermore, the effect of different environments on the current mood was measured with a paired sampled t-test on the pre and post environmental condition of the SCAS 'pleasant deactivation' level. The paired sampled t-test indicated that the means of the SCAS 'pleasant deactivation' scores between time point 2 (*M*= 5.3766, *SD*= 1.37985) and time point 3 (*M*= 6,1391, SD=1,31179), differed significantly (*t*(126)= -9.25, *p*=.000). This difference in 'pleasant deactivation' level before and after the environmental condition indicated that the environmental slides had a positive effect on the 'pleasant deactivation' level so the environmental conditions had a restorative function.

To see if there was an interaction effect between the 'pleasant deactivation' level and the environmental condition, a repeated measure ANOVA was computed with the pre-environmental and post-environmental 'pleasant deactivation' scores as the within subject variables and the environmental conditions functioned as the between subject factor. This repeated measure ANOVA indicated that there was no significant difference between the 'pleasant deactivation' scores (*F*(1,125)= .010, *p*=.919) between time point 2 and time point 3 between participants in the different environmental conditions (see table 6). This indicates that there was no significant difference found in the restorative effects participants show in the natural condition and the restorative effects participants show in the urban condition.

Table 6: *Means and SD of the different environmental conditions*

Environmental condition	Timepoints	*N*	'Pleasant deactivation' (*M*)	*SD*
Urban	Time point 2	63	5.46	1.46
	Time point 3	63	6.22	1.33
Nature	Time point 2	64	5.29	1.31
	Time point 3	64	6.06	1.30

3.1.4. Differences in preference scores of the slides

We wanted to see if participants with different explicit and implicit associations with nature preferred the slides differently. Moreover, if there was a difference in the slide rating between the participants in the urban condition and if participants with different perceived restorativeness of the rated the slides differently. A multiple regression analysis was computed to predict the 'mean preference score' from the variables: environmental exposure, explicit association with nature, the perceived restorativeness of the slides and the implicit association with nature. These variables together significantly predict the mean preference score ($F(4, 123)= 26.10$, $p < .001$). The variables 'explicit nature preference' and 'the perceived restorativeness of the slides' significantly, $p<.05$, predicted the mean preference score.

To see which set of slides was preferred the most by the participants with a high explicit association with nature, we computed the correlations between the mean preference score of the natural slides and the explicit association with nature score. The correlation with the natural slides were all positively significant except slide 4 ($r= .088$, $p= .489$) and slide 14 ($r=.063$, $p= .662$), indicating that participants with a higher explicit association with nature also rated the nature slides higher (see table 7). The correlations between the mean preference score of the urban slides and the explicit association with nature were all not significant except slide 13 ($r= -.225$, $p= .611$), indicating that the preference for the urban slides did not depend on the explicit association with nature of the participants (see table 7).

Table 7*: Pearson correlations between the mean preference score of the natural slides and the explicit association with nature scores*

	Slide 1	Slide 2	Slide 3	Slide 4	Slide 5	Slide 6	Slide 7	Slide 8	Slide 9	Slide 10	Slide 11	Slide 12	Slide 13	Slide 14
Natural slides	.563**	.553**	.532**	.088	.423**	.313**	.465**	.422**	.241	.564**	.334**	.458**	.372**	.063
Urban slides	-.073	-.016	-.138	.147	.179	.209	.215	-.124	-.079	.067	-.164	-.185	-.255*	.065

3.2 Effect of implicit and explicit association with nature on restoration and perceived restorativeness of environmental qualities.

3.2.1 Effect explicit association with nature on perceived restorativeness of natural slides.

It was expected that the participants who showed an increase in their pleasant deactivation level would also indicate to perceive more restorativeness of natural landscape qualities (hypothesis 1a). To test this hypothesis, we computed the relationship between the PRS, the overall preference score and the restoration score between timepoint 2 and 3 on the 'pleasant deactivation' level. These correlations between the perceived restoration score and the SCAS restoration 'pleasant deactivation' change score (r= .12, p= .192) were not significant at a .05 level. This indicates that the participants who show signs of restoration did not indicate to perceive the slides as more restorative than other participants and therefore hypothesis 1a was not supported. Additionally, a significantly positive correlation between the PRS and the mean preference score (r= .65, p < .001) was found, indicating that those who rated the slides highly also perceived the slides to be more restorative. The correlation between the mean preference score and the 'pleasant deactivation' score was not significant (r=-.014, p= .874) indicating that the participants who prefer the slides higher did not show an increase in their restoration level than other participants.

Additionally, it was expected that there will be an interaction effect of the environmental exposure on the perceived restorativeness of the environmental slides and the explicit association with nature (hypothesis 1b). This was tested with a multivariate ANCOVA where the dependent variables were the overall PRS score, PRS fascination and PRS being away, the fixed factor was the environmental condition, and the explicit nature preference as the covariate. The interaction effect between the explicit association with nature score, the environmental exposure and the perceived restorativeness of the natural slides was not significant at a .05 level (F(1,124)= 1.48, p= .225). This indicates that participants who did not have a high explicit association with nature did not indicate to perceive more restorativeness after seeing the natural slides than the participants who did explicitly associate themselves with nature and therefore hypothesis 1b was not supported.

Because hypothesis one was not supported, we wanted to see if there was an effect of the explicit association with nature and the perceived restorativeness of the environmental slides, so we performed the same multivariate ANCOVA. This analysis showed that there was a positive significant effect of the explicit association with nature score on the perceived restorativeness of the environmental slides (F(1,124)= 6.72, p= .011) and on the subscales: 'being away' (F(1,124)= 6.08, p= .015) and 'fascination' (F(1,124)= 5.42, p= .022). This indicates that the explicit association with nature score influenced the perceived

restorativeness of the environmental settings i.e., on the degree that participants have the sense of being away and feel fascinated.

To see which environments created the sense of 'being away' and 'fascination' we computed the same multivariate ANCOVA. This analysis showed that the participants in the urban condition indicated to have a higher 'fascination' level (*M*= 4.71) and lower sense of being away (*M*=3.68) than participants in the nature condition scored on 'fascination' (*M*= 4.22) and being away (*M*= 4.23). Therefore, the environmental exposure influenced the degree that participants feel fascinated and have a sense of being away but had no effect on the perceived restorativeness of environmental slides. These similar perceived restorativeness scores of both the environments, could have been caused by the participants trying to average out their overall preference rating of the slides regardless the environmental condition they where in.

3.2.2 Effect implicit association with nature on perceived restroorativeness of natural slides.

It was expected that there would be an interaction effect of the environmental exposure on the perceived restorativeness of the environmental slides and the implicit association with nature (hypothesis 2). Therefore, we used a multivariate ANCOVA that we used before, but this time with the implicit association with nature as the covariate instead of the explicit association with nature. This analysis showed that the interaction effect between the IAT, the environmental exposure and the perceived restorativeness of the environmental slides was not significant ($F(1,124)= 1.12$, $p= .293$). This indicates that the participants who implicitly associate themselves with nature did not indicate to perceive more restorative qualities of the slides after exposure to natural environments than the participants who did not implicitly associate themselves with nature and therefore hypothesis 2 was not supported.

Because hypothesis two was not supported we wanted to examine if there was effect of the implicit association with nature on the perceived restorativeness of the environmental slides, so we looked at the correlations these two and they were not significant ($r= .030$, $p= .733$). Therefore, we looked at the correlations between the implicit association with nature and the items of the PRS to see if there was any effect of the implicit association with nature on the perceived restorativeness of the environmental slides. These correlations showed that none of the items of the PRS correlated significantly with the IAT scores (see table 8). Therefore, we did not perform an ANCOVA between the items of the implicit association and the perceived restorativeness of the environmental slides.

Table 8: *Pearson correlations between the IAT scores and the different items of the PRS.*

	PRSBA1	PRSBA2	PRSF1	PRSF2	PRSF3	PRSF4
IAT_Score	.085	.050	.035	-.030	.017	-.022

3.2.3. Relation between the explicit and implicit association with nature.

It was expected that participants who indicated not to feel connected to nature could implicitly associate themselves with nature (hypothesis 3). To test this third hypothesis, we computed the correlation between the IAT and the nature preference scores to see if participants who score high on the explicit nature measure would also score high on the implicit nature measure. This correlation was positively significant (r=. 253, p= .004) and indicates that the explicit association with nature is related to the implicit association with nature and therefore the third hypothesis is not supported.

3.2.4. Relation between the need for restoration and the implicit association with nature.

In order to test the fourth hypothesis, we created a 'need for restoration' scale out of the difference between timepoint 2 and timepoint 1 of the 'pleasant deactivation' scores. Then we computed a correlation between this 'need for restoration' and the IAT scores in order to see if participant's need for restoration, indicated by how much their mood decrease after the stressor affects the implicit association with nature. It was expected that participants with a high need for restoration would also have a high implicit association with nature (hypothesis 4). The correlations between the need for restoration and the IAT score were not significant (r= -.071, p= .427). This indicates that participants with a higher need restoration will not have a high implicit association with nature because of this need for restoration and therefore the fourth hypothesis is not supported. However, the correlation between the combined scale for the explicit association with nature and the IAT show that, like the combined explicit association with nature scale, the IAT is a valid measure to measure the psychological connectedness to nature.

3.3 Effect association with nature and environmental exposure on restoration.

First, we compared the mean preference score between the natural slides and the urban slides to see if the slide were rated differently between the different environmental conditions. To test this, we used an independent sample t-test between the mean preference score and the environmental exposure. This shows that there is no significant difference (t(126)= -.802, p= .423) between the mean preference score of the participants (N=128) in the nature condition *(*M= 4.52, SD= .883) and in the urban condition (M= 4.40, SD= .795). This means that the participants in both the environmental conditions rated the slides as equally beautiful on a seven-point scale.

3.3.1 Effect implicit and explicit association with nature on the restoration level

We expected that participants with a low score on the explicit association with nature scale would have a higher 'pleasant deactivation' level after exposure to natural environments than after exposure to urban environments (hypothesis 5). This hypothesis was tested with a 2-way repeated measure ANCOVA with the pre- and post-environmental scores on 'pleasant deactivation' as the dependent variables. The environmental exposure was used as the independent variable and the 'explicit association with nature' score as the covariate. This analysis showed that the 'pleasant deactivation' level between time point 2 (M= 5.21) and 3 (M= 6.16) significantly increased (F(1,123)= 83.81, p < .001). So, the environmental slides had a restorative effect on the mood of the participants. However, the same analyses showed that there was no significant interaction effect found between the 'pleasant deactivation' score, the explicit association with nature and the environmental exposure (F(1,123)= .340, p= .628). This analysis showed that both the participants in the urban or in the nature condition, show the same increase in 'pleasant deactivation' level regardless their explicit association with nature and therefore hypothesis 5 is not supported.

Because this interaction effect was not significant, we also wanted to see whether there is an interaction effect of the implicit association with nature (IAT) score and the environment on the 'pleasant deactivation' score. we performed the same ANCOVA with the covariate implicit association with nature, instead of the explicit preference for nature, we also did not find a significant effect (F(1,123)= .270, p= .607) of the implicit association with nature on the 'pleasant deactivation' scores over time. This analysis showed that both the participants in the urban or in the nature condition, show the same increase in 'pleasant deactivation' level regardless their implicit association with nature.

Because hypothesis 5 was not supported we looked at the correlations between the explicit association with nature score and the 'pleasant deactivation' scores at time point 2 (r= .018, p= .839) and 3 (r= .040, p= .647) were not significant. Therefore, we looked at the correlations between the difference between time point 3 and 2 for the items that represent the 'pleasant deactivation' level: tense-serene, nervous-relaxed and anxious-calm with nature preference. This showed that only the item 'tense-serene' and the nature preference correlated significantly (r= .190, p= .030). Therefore, we used this item to perform the 2-way repeated measure ANCOVA again this time with the between subject factor 'environmental exposure', the item 'tense-serene' at time point 2 and 3 as within subject factor and 'nature preference' as the covariate. This analysis showed that the 'nature preference' did have a positive significant effect (F(1,123)= 4.70, p= .032) on the tense-serene level of the participants in the different environmental conditions. This shows that the higher the preference for nature the more serene participants became after seeing the environmental slides. It did not matter which

slides the participants saw, which is against the expectations that natural settings would have a bigger effect on the 'pleasant deactivation' level and with that on the tense-serene level of the participants. Therefore, the procedure of watching the slides and rating them for a specific period had a significant effect on the 'pleasant deactivation' level and on the tense-serene level.

3.3.2 Effect environmental condition on the restoration level

It was expected that participants in the nature condition who had a high explicit association with nature would show a bigger increase in their 'pleasant deactivation' level as compared to participants with a low association with nature (hypothesis 6). It was also expected that the participants in the urban condition with a high explicit association with nature will show a bigger decrease in their 'pleasant deactivation' level as compared to participants with a low explicit association with nature (hypothesis 7). To test these hypotheses, we used the same 2-way repeated measured ANCOVA that is used with hypothesis 5 with the pre- and post-environmental scores on 'pleasant deactivation' as the dependent variables. Environmental exposure was used as the independent variable, and the 'explicit association with nature' score as the covariate. There was no significant difference found ($F(1,250)= .008$, $p= .929$) between the mean 'pleasant deactivation' scores on the different the environmental conditions (see table 9).

Table 9: *means and SD at different time points on 'pleasant deactivation' level between the different environmental conditions.*

Time point	Environmental condition	*N*	Pleasant deactivation(*M*)	*SD*
Time point 2	Urban	63	5.46	1.46
	Nature	64	5.29	1.31
Time point 3	Urban	63	6.22	1.33
	Nature	64	6.06	1.30

The same analyses showed that there was no significant interaction effect between the restoration effect, the environmental exposure and the explicit association with nature ($F(1,123)=.130$, $p=.719$). This indicates that in the natural condition, participants with a high explicit association with nature did not show more increase in mood than the participants with a low explicit association with nature. And that in the urban condition, the participants with a low explicit association with nature did not show more increase in mood than the participants with a high explicit association with nature. Therefore, hypothesis 6 and 7 were not supported.

4. Discussion

The main goal of this study was to test whether the differences in preference and restorative effects of natural environments versus urban environments can at least be partially explained by the evolutionary perspective. We enhanced the stress level of the participants with a series of math tasks. Then we showed them either 14 urban or natural slides. Using a self-report measure we measured the emotional state of the participants before the stress manipulation and before and after the environmental slides. Before the environmental conditions we used a test that measured the implicit association with nature. Lastly the participants rated the perceived restorativeness of the qualities of the environmental slides with a self-report measure.

4.1 Conclusion

Our first set of analyses explored what causes the explicit association with nature after a stressful condition and compared this with the implicit association with nature. These analyses showed that the restoration effect of the environmental slides is no indicator for the perceived restorativeness of environmental qualities. Additionally, the results show that the perceived restorativeness of environmental qualities was not affected by the 'implicit' association with nature. The comparison between the effects of the 'explicit 'or 'implicit' association with nature on the perceived restorativeness of the environmental qualities in the different environmental conditions also did not indicate a significant relation. This is not in line with the evolutionary based expectation that natural environments enhance the 'explicit' or 'implicit' association with nature and with that affect the perceived restorativeness of natural settings as compared to urban environments. However, an effect was found between the explicit association with nature and the perceived restorativeness of the environmental qualities regardless the environmental condition. This effect was probably caused by the effect we found between how beautiful the slides were rated and that the perceived restorativeness of the environmental qualities because these rates depend on how high the explicit association with nature was. The higher the explicit association with nature the more beautiful the natural environments were perceived. Taking this into account we can conclude that how beautiful the qualities of natural environments are perceived is an indicator for the explicit association with nature and not the perceived restorativeness of natural landscape qualities. In conclusion, there was a difference found between the effects of the 'explicit' and 'implicit' association with nature on the perceived restorativeness of the environmental qualities. This could be an indication for an evolutionary tendency causing the preference for natural environments over urban settings.

The following set of analyses showed that participants reported a higher sense of 'being away' in the nature condition and a higher sense of 'fascination' in the urban condition, regardless the implicit or explicit association with nature. This is in line with the Attention Restoration Theory that argues that easily accessible natural environments can create a sense of 'being away' which cause restorative effects because natural environments do not require directed attention and allows the capacity of mental resources to restore (Kaplan, 1995; Baumeister, 2002; Staats, 2012). Additionally, how beautiful the slides were rated affected the explicit association with nature and not the perceived restorativeness of the environmental qualities.

The next analyses showed that the explicit association with nature was in line with the implicit association with nature. The higher participants reported their explicit association with nature, the higher implicit association with nature they scored. Therefore, the explicit association with nature is an indicator for the implicit association with nature. This supports the argument that an explicit association with nature can be caused by a learned tendency to prefer natural settings. The literature about learned tendencies argue that the preference for natural settings can be caused by cultural determined components: preference for low arousal potential (Wohlwill, 1983), preference for low complexity (Markus and Kitayama, 1991), stable adaptation level towards certain stimuli in natural environments (Wohlwill, 1974), repeatedly shared information (Ulrich, 1993), learned values (Van Paasschen, Bacci & Melcher, 2015) and motivated experience with natural settings in childhood (Zhang, Goodale and Chen, 2014). We also analysed if the need for restoration is an indication for a high implicit association with nature. Our analyses showed that this is not the case, participants with a big decrease in their mood after the stressor and thus with a high need for restoration did not show a higher implicit association with nature.

To conclude the findings of the first part of analysis, the evolutionary tendency to have a high implicit association with nature is not fully supported by the first part of our study. This is because our study results indicate that the implicit association with nature was probably not caused by an internally driven tendency like the need for restoration but was instead affected by the explicit association with nature. This explicit association with nature was related to the degree participants perceive the natural slides as beautiful and if they perceive a sense of 'being away' and 'fascination' after seeing either natural or urban slides. This therefore supports a cultural learned tendency to have a high explicit association with nature. However, natural slides provoked a sense of 'being away' regardless that association with nature, which can be caused by the low directed attention need in exposure to natural settings. This allows the capacity of mental resources to restore which supports an evolutionary tendency to seek natural settings to experience a sense of 'being away' regardless the explicit association with nature.

Our second set of analyses explored if the exposure to natural settings can cause a stronger mood increase and with that a stronger restorative effect than exposure to urban settings, and if this effect still occurs for people who indicate to have a low explicit preference for nature. We try to test the theory of Ulrich (1993) that exposure to natural settings induce a quicker stress recovery, and thus an increase in mood, than exposure to urban settings. Following an evolutionary perspective, unthreatening natural environments can provoke an evolutionary response scheme, like mood increase. Because early humans actively searched for these environments to seek protection and defend themselves. The results in the second part of this study showed that the natural slides did not cause more increase in the restoration level than the urban slides regardless of the explicit association with nature. This means that participants who had a low explicit association with nature did not show more restoration effects after seeing nature slides as compared to the urban slides. The procedure of seeing the slides and rating them caused a significant stress recovery but the participants in the natural conditions did not show more stress recovery than the participants in the urban condition. This outcome pleads against the functional-evolutionary perspective which suggests that certain natural environments contain survival advantages which causes people to prefer natural settings over urban settings (Ulrich, 1993). The results in second part of this study also showed that the participants in both the environmental conditions rated the slides as equally beautiful. Participants with a high nature preference did not show more restorative effects after seeing urban or natural slides than participants with a low preference for nature. However, the urban slides did enhance recovery after the stressor which indicates that urban environments might also have a restorative effect on the directed attention of people (Stigsdotter & Grahn, 2011). To wrap up the second part of this study, evidence in this study confirms that the exposure to environmental slides can cause stress recovery after a stressful period. However, there is no evidence found for the evolutionary based argument that exposure to natural environments can cause a quicker recovery from stressful situations than urban environments.

The results of this study show a mixed pattern of evolutionary and cultural tendencies to report an explicit association with natural environments. The explicit association with nature had a positive effect on the perceptions of how beautiful the natural slides were and had an effect on the sense of ‘being away’ and ‘fascination’ depending on which slide they saw. This supports the cultural learned tendency to show an explicit association with nature. However, natural environments provoked a sense of ‘being away’ regardless the explicit nature preference with nature. This could be evidence for an evolutionary tendency to seek natural settings in order to experience restoration and a sense of ‘being away’. However, it is not tested in this study whether people with a restoration need actively seek natural environments.

In conclusion, the findings of this study do not confirm the findings of previous research that the preference for natural environments over urban environments is higher, when there is a high need for restoration (Staats, Kievet & Hartig, 2003). Both the natural and urban slides were given the same preference score after the stressor. Additionally, the findings in this study did not support the hypothesis that the exposure to natural environments cause a quicker recovery than the exposure to urban environments because of a high explicit association with natural environments. It seems like the results of this study are in line with the transactional perspective that claims that the preference for natural environments can be caused by both a biological response pattern and a cultural learned process (Hartig, 1993). According to Hartig (1993) the salient aspects of an environment can provoke an evolutionary, a cultural or a mixed tendency to associate oneself with natural environments. Therefore, the beautiful qualities of natural and urban environments that were made salient in this study could have caused an evolutionary or a cultural tendency to prefer natural scenes over urban scenes or the other way around.

4.2 Limitations

We believe that the design, procedure and analyses in this study are suitable for measuring the relation between the association with nature and the restorative effect of natural environments as compared urban environments. Because our results show that the explicit association with nature had a positive significant effect on the perceived restorativeness qualities of different environmental slides and with that on the sense of 'being away' and 'fascination'. Additionally, different environmental slides can enhance a stress recovery after a stressful period. However, we foresee that when a couple of limitations of this study are considered and some adjustments are made to the procedure of the study, future research following the line of this study will probably show the significant results that were initially predicted.

For example, the decision to not include physiological measures in this study, but only using self-report measures. According to Ulrich (1983) self-report measures are sensible to bias and give a limited view on the objective stress recovery effects after exposure to different environments. Ulrich (1991) addressed the importance using psychological measures in studies that try to continuously monitor the stress recovery after environmental exposure. Because previous research has indicated that the restoration of stress is defined by a decrease in levels of blood pressure, heart rate, and muscle tension and an increase in positive emotions. The limited view we gained on the stress recovery after exposure to natural settings as compared to urban settings could have caused that there was no difference found between the level of stress recovery after the exposure to different environmental settings.

The environmental slides used in study were rated as equally beautiful and show no significantly different restoration effect after the stressor. Indicating that the procedure of seeing and rating the urban slides are equally restorative as procedure of seeing and rating the natural slides. This was not expected following the functional-evolutionary perspective that claims that an evolutionary tendency to prefer nature causing natural slides to be more restorative than urban slides (Ulrich, 1993). Participants in this study reported a high sense of 'fascination' after seeing the urban slides as compared to the participants who saw the natural slides who reported a higher sense of 'being away'. Both senses represent a part of the perceived restorativeness of the landscape qualities (Kaplan, 1995). Therefore, the urban slides can also increase the sense of perceived restoration. According to Hartig (1993) it is important to make the right aspects of natural and urban settings salient because this affects if people show an evolutionary or cultural learned tendency to implicitly associate themselves with nature. And with that if the qualities of natural environments are perceived with a higher restorativeness. The aspect that is made salient in the slides from the study by Collado and Staats (manuscript in preparation) is 'beauty' because the slides were rated equally beautiful. However, the urban and natural slides did not represent the same function because the natural slides represent 'natural elements' and the urban slides 'city architecture' which could have caused that different aspects were salient between the natural and urban slides. For example, within the urban slides the architecture of different buildings are made salient which could cause people from prosperous society to experience a sense of fascination after seeing these slides because people from prosperous societies have a higher need for high levels of information intake because this helps them to understand, adapt and function in the urban environments they live in (Berlyne, 1971). It could therefore be that the salience of the city architecture in the urban slides of this study cause a cultural learned tendency to explicitly associate with urban environments and experience a restoration effect after exposure to these urban slides. This could have cause that there was no significant difference found in the restoration level after the natural slides as compared to the urban slides and thus should be considered as a limitation of this study.

The participants of this study were recruited with the question if nature is a part of someone's self-concept to get an equal number of participants who do and do not associate themselves with nature. The sample in this study was normally distributed with a few extremes. However, none of the participants reported to not see nature as a part of the self-concept and 5,4% of the participants reported to see nature as a total part of their self-concept. To examine the significant differences between the participants with different associations with nature it is important to get higher amounts of these extremes. According to Hartig (2011) large samples are needed when the effect of interest is quite subtle. Here the effect of inclusion of nature in the self-concept on the mood change before and after exposure to

different environments can be very subtle. The limited number of extremes between the participants who do and do not have an explicit association with nature could have caused that there are no significant differences found in this study between participants with different associations with nature and their mood change before and after natural environments.

4.3 Future research

Future research towards the relation between the explicit and implicit association with nature and the restorative effect of natural environments as compared urban environments should make some adjustments to the current design and procedure of this study in order to get a richer view on these relations. Research on the same topic should be aware that the sample size of the extremes in the explicit associations with nature should be large to measure the subtle effect of this association with nature on the restorative effect. Therefore, the recruitment should be focused on enlisting many participants who completely do or do not associate themselves with natural environments. The use of physiological measures, on top of the cognitive measures that are used in this study, should also be considered because it provides a richer view on the stress recovery after exposure to natural environment as compared to urban environments.

Furthermore, the environments that are selected within future research that intend to measure the restorative potential of natural versus urban environments should contain the same salient aspects that represent the everyday environment an average person encounters. Because according to the transitional perspective, different salient aspects of different environments could cause different tendencies to explicitly associate oneself with natural environments (Hartig, 1993). The right aspects can be made salient by selecting environments that contain the same function in everyday life, like the natural and urban slides Hartig and Staats (2006) use in their study which contain a walking function like paths in natural environments and pavements in urban environments.

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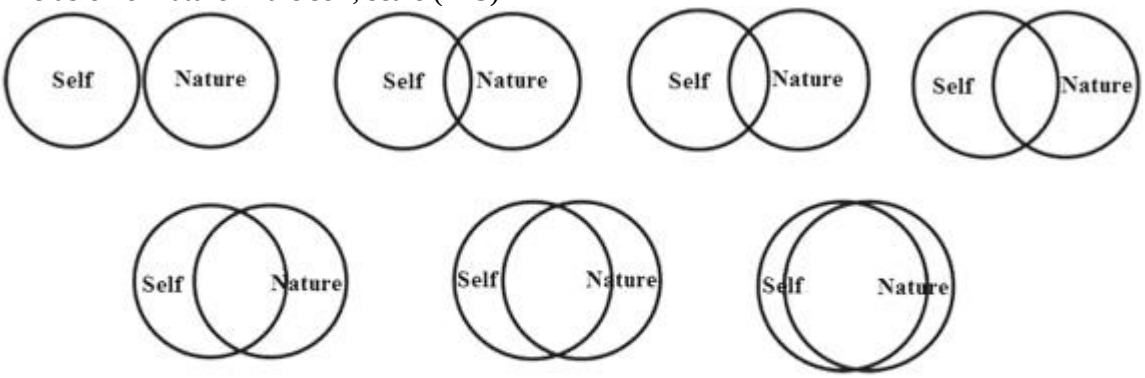
Appendix

1. Inclusion of nature in the self, scale (INS)



22. Please indicate the picture that best describes your relationship with the natural environment. How interconnected are you with nature? ('Self' = you; 'Nature' = the environment)

○ a ○ b ○ c ○ d ○ e ○ f ○ g

2. NR-6

SHORT FORM VERSION OF THE NATURE RELATEDNESS SCALE (NR-6)

Instructions: For each of the following, please rate the extent to which you agree with each statement, using the scale from 1 to 5 as shown below. Please respond as you really feel, rather than how you think "most people" feel.

1	2	3	4	5
Disagree strongly	Disagree a little	Neither agree or disagree	Agree a little	Agree strongly

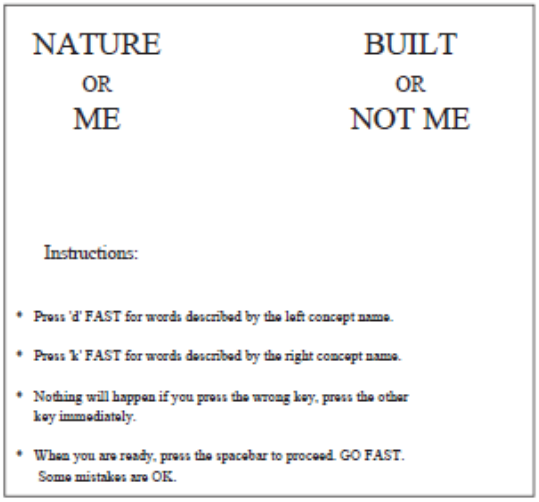
1. My ideal vacation spot would be a remote, wilderness area.
2. I always think about how my actions affect the environment.
3. My connection to nature and the environment is a part of my spirituality.
4. I take notice of wildlife wherever I am.
5. My relationship to nature is an important part of who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

3. SCAS

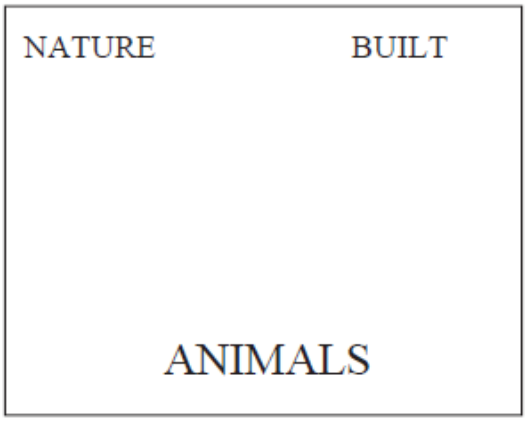
Again you will carry out a questionnaire about your current emotional state.
For each of the following adjectives, please rate the extent to which you are currently experiencing them on a scale of 1 to 9 as shown below.

	1				5				9	
Sleepy	○	○	○	○	○	○	○	○	○	Awake
Passive	○	○	○	○	○	○	○	○	○	Active
Dull	○	○	○	○	○	○	○	○	○	Peppy
Indifferent	○	○	○	○	○	○	○	○	○	Engaged
Tense	○	○	○	○	○	○	○	○	○	Serene
Depressed	○	○	○	○	○	○	○	○	○	Happy
Sad	○	○	○	○	○	○	○	○	○	Glad
Nervous	○	○	○	○	○	○	○	○	○	Relaxed
Bored	○	○	○	○	○	○	○	○	○	Interested
Pessimistic	○	○	○	○	○	○	○	○	○	Optimistic
Anxious	○	○	○	○	○	○	○	○	○	Calm
Displeased	○	○	○	○	○	○	○	○	○	Pleased

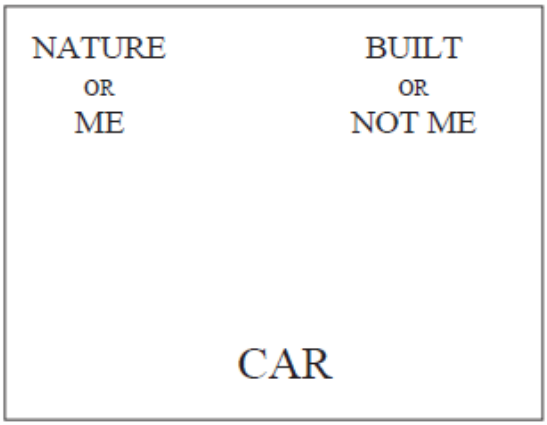
4. IAT



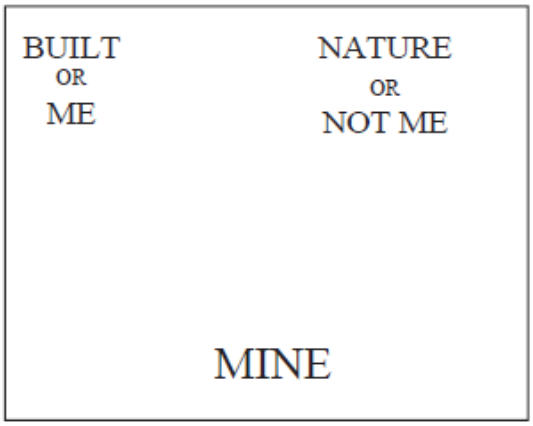
Sample Instructions



Block 1 Sample: Practice Trials. The correct response here is "NATURE."



Block 3 Sample: Compatible Trials. The correct response here is "BUILT OR NOT ME."



Block 6 Sample: Incompatible Trials. The correct response here is "BUILT OR ME."

5.1 Natural slides

5.2 Urban slides

6. PRS

Being Away
It is an escape experience.
Spending time here gives me a good break from my day-to-day routine.
Fascination
The setting has fascinating qualities.
My attention is drawn to many interesting things.
I would like to get to know this place better.
I want to explore the area. (In Study 2 this item was replaced by the item below.)
There is much to explore and discover here.
I would like to spend more time looking at the surroundings.
Coherence (Extent)
There is too much going on.
It is a confusing place.
There is a great deal of distraction.
It is chaotic here.
Compatibility
I can do things I like here.
I have a sense that I belong here.
I have a sense of oneness with this setting.
Being here suits my personality.
I could find ways to enjoy myself in a place like this.

experiencing the given reactions and feelings at that moment using 5-point scales (1 = Not at all, 5 = Very much).