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Using the Natural Environment for Emotion Regulation

Conceptual and Empirical Explorations

Thesis for the degree of Philosophiae Doctor

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Norwegian University of Science and Technology
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Department of Psychology



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Preface and acknowledgements

This thesis consists of one theoretical paper, and two empirical papers. Through conceptual discussions, a field study, an experiment, and a survey with stimulus presentations, the use of nature for emotion regulation is investigated. The topic of this thesis speaks of the potential that lies in the natural environment, the potential to use it for emotion regulation, and the role it can play with regards to human well-being. Hopefully, increased focus on the relevance of nature with regards to well-being can also contribute to the protection of natural environments. Emotion regulation is often utilised as a conceptual background in clinical research as well as in environmental psychology, but this thesis is explicitly focused on it.

The three papers this thesis is built around have been published in international peer reviewed journals, and selected results have been presented locally, and at an international conference.

I would like to thank my main supervisor, Associate Professor Einar Strumse, for his support and confidence in me, and for sharing his extensive knowledge of environmental psychology, and indeed psychology in general, whenever necessary. I am also grateful to Professor Leif W. Rydstedt, who has contributed a lot as co-supervisor during the second half of this work, his research experience and ability to focus on the relevant details has been highly appreciated. In addition, I would like to thank Professor Torbjørn Rundmo for being co-supervisor on this research project and for introducing me to research in general; talking with him is always very constructive and motivating. Many thanks also to Kyrre Svarva for helping me with questionnaires.

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Svein Åge Kjøs Johnsen, Lillehammer, March 2014.

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Brief descriptions of main concepts

Several concepts are applied in this thesis. In general, they should be appropriately explained and defined in the text. However, in order to enhance readability, very rudimentary descriptions of the main concepts are given here.

Affordance: properties of the environment in relation to some behaviour in a person-environment system

Conscientiousness: personality trait, associated with being organised and thorough

Ego depletion: describes the state when self-control strength is temporarily reduced following the exertion of self-control, implies a resource model of self-control

Ego restoration: the replenishment of willpower, or self-control strength

Emotion: a more or less coordinated set of responses (e.g., physiological, hormonal, motivational, behavioural) to a situation of relevance to the individual

Emotion regulation: processes or strategies that increase or decrease an emotional response

Emotional affordance: the possibilities for emotional expression and experience afforded by the environment (in a person-environment system)

Emotional potential: the potential of an environment to increase or decrease an emotion

Executive functioning: refers to processes relevant for planning, focusing, shifting attention, and problem-solving

Extraversion: personality trait, sociability, tendency towards positive emotional states

Mood: semi-stable emotional state (see also emotion)

Neuroticism: personality trait, tendency towards negative emotional states

Person-environment system: a holistic model of *persons in situations* (i.e., transactional or interactional)

Personality: the manners of acting, feeling, and thinking characteristic to an individual

Self-control: often associated with willpower, see self-regulation

Self-regulation: the management of one's behaviour, thoughts, and feelings in order to achieve some goal, conscious and unconscious

List of papers

This thesis is based on one theoretical and two empirical papers.

Paper I:

Johnsen, S. Å. K. (2011). The use of nature for emotion regulation: Toward a conceptual framework. *Ecopsychology*, 3, 175-185.

Paper II:

Johnsen, S. Å. K. (2013). Exploring the use of nature for emotion regulation: Associations with personality, perceived stress, and restorative outcomes. *Nordic Psychology*, 65, 306-321.

Paper III:

Johnsen, S. Å. K., & Rydstedt, L. W. (2013). Active use of the natural environment for emotion regulation. *Europe's Journal of Psychology*, 9, 789-819.

Summary

The topic of this thesis is the use of nature for emotion regulation. This is investigated through a theoretical analysis, a field study, an experimental study, and a survey study with stimulus presentations. There are two aspects that can be studied with regards to emotion regulation: the attempts to regulate emotion, which can be emotion regulation strategies, and outcomes of such emotion regulation strategies. The first paper included in this thesis is a theoretical analysis of the use of nature for emotion regulation. In this paper, positive emotion regulation is distinguished from negative emotion regulation (e.g., decreasing sad feelings), which mainly occurs later in the emotion regulation process. It is also argued that the environment can have both a direct and an indirect effect on emotions. For example, the environment could make it somewhat easier to process emotions cognitively. In addition, there may be individual differences with regards to the experience of nature. People may benefit differently from nature; some may benefit more from the purported increase in positive emotions, some may benefit more from the restoration of cognitive resources, whereas others may benefit from affective restoration (e.g., decreases in negative emotions). The analysis of the use of nature for emotion regulation might also be relevant for a general analysis of environment-focused emotion regulation. In the second paper an attempt was made to measure the use of nature for emotion regulation and to explore relations between such usage and personality, stress and a number of restorative outcomes. The participants completed the questionnaire while being in a natural environment. Three aspects of emotion regulation in nature were found: positive emotion regulation, negative emotion regulation, and the increase of negative emotion while not in nature. Furthermore, a novel restorative outcome concept, termed ego restoration, was introduced, and it was attempted to measure this concept by operationally defining it as perceived changes in “willpower”. The main conclusion in the paper was that people who use nature for emotion regulation also report cognitive benefits from being in nature. In addition, the results showed that neuroticism was associated with negative emotion regulation. The third paper reports results from two studies, one experimental study showing that actively using a picture of nature for emotion regulation can have a beneficial impact on positive mood (although the results indicated that this effect may be complex). One

conclusion from this study was that relying exclusively on the strategy of using nature for regulating one's emotions may not be recommended, people may require a variety of strategies. The second study, a survey, showed that the motivational tendency to visit a natural environment when happy was associated with positive mood, albeit weakly. Moreover, a novel concept was introduced to measure the perception of an environment, emotional potential, referring specifically to the potential of an environment to increase positive and reduce negative emotions. To conclude, nature appears to possess a number of special properties beyond the capacities of simple activation of positive emotion, and reduction of negative emotion. The evidence reported in the articles included in this thesis leads to the conclusion that the use of nature for emotion regulation generally divides into 1) the regulation of negative emotion, which is associated with self-reported restoration and a perceived increase in self-control strength, and 2) the regulation of positive emotion, which is also associated with restoration to some extent. Actively using nature to regulate negative emotions may increase positive mood, but it should not be over-exploited because the strategy may be less effective over time. The emotional potential of a classically beautiful natural environment may be perceived as relatively high, meaning that people generally perceive this type of environment as reducing negative and increasing positive feelings. Moreover, the motivation to visit such an environment while experiencing positive emotions was weakly associated with positive mood.

1. Introduction

1.1. Background

There is nothing new about studying the effects of seeking natural environments for health reasons (e.g., Kaplan & Kaplan, 1989), but most studies are about passive exposure, meaning that there is little or no information on what people should do in the natural environment, or how nature should be used. However, that nature may be used for emotion regulation is in many cases assumed implicitly. Emotion regulation may be an important concept both with regards to psychological and physical health (John & Gross, 2007; DeSteno, Gross, & Kubzansky, 2013). A number of researchers are presently investigating healthy and unhealthy emotion regulation strategies, and usage of the natural environment could prove to be a relevant alternative.

1.2. Aims of the thesis

The main aim of this thesis was to investigate the notion of using the natural environment for emotion regulation. Although previous studies may have touched upon the topic, very few studies have focused explicitly on the use of nature for emotion regulation. Therefore a relatively broad and exploratory approach was taken.

- The first aim was to develop a conceptual framework for this theme.
- The second aim was to conduct a field study to explore whether people actually use nature to regulate their feelings, whether such usage would be related to restoration, and how such emotion regulation may present itself.
- The third aim was to explore associations between personality, emotion regulation, and restoration and to test a larger theoretical model.
- The fourth aim was to test the use of nature for emotion regulation experimentally.
- The fifth aim was to study the perception of emotion regulation in natural as well as other types of environments.

1.3. Theories

The purpose of this section is to present the theoretical background for this thesis. Different perspectives on the environment, the person, and the person-environment relationship are considered to be relevant here. Restoration theories may shed some light on how the environment could be relevant to cognition and emotion, and what the effects of seeking natural environments might be. Theories on self-regulation can give indications on how people manage their internal and external resources in the face of various challenges. In fact, emotion regulation can be considered a type of self-regulation, specifically about managing emotions, although this may not be the ultimate goal of the person. There may be fundamental dispositions that make a person more or less inclined to experience, or focus on, certain emotions, and for this reason personality becomes relevant. Indeed, theories about the person-environment system are of interest, and therefore the theory of affordances is explored. Although psychoanalytic theories have been criticized for being un-testable and speculative, they are rich in content and may offer a broadening perspective with regards to affect and the management of affect. Finally, knowledge of, and experience with, the natural environment is relevant in the present context, and accordingly place attachment and place identity are concepts to consider, although the scope of this moves beyond basic theory.

1.3.1. Restoration theories

One way of looking at restoration is to consider it a process which returns a system to a state not dominated by reactions to the demands placed upon the system. A common feature of all restoration theories is that they are aimed at explaining what happens when a person, who may be cognitively fatigued, stressed, or experiencing heightened negative emotion, is exposed to a restorative environment. The theories also focus on defining the qualities of such environments, and to some extent explain why they are restorative. This section includes an introduction to attention restoration theory which focuses mainly on the cognitive aspects of restoration. It also includes an outline of

evolutionary explanations of affective reactions to nature, and an integrative framework for the two perspectives. The recovery perspective from work psychology is also presented.

1.3.1.1. Attention restoration theory: cognitive gains from nature exposure

Attention restoration theory is as the name implies about the restoration of attention, specifically the restoration of directed attention (see Kaplan, 1995; Kaplan & Kaplan, 1989). The theory builds on a distinction originally made by William James between voluntary and involuntary attention. Directed attention (i.e., voluntary attention) involves the ability to concentrate, to focus, and to inhibit distractions and is a mechanism that becomes fatigued after extended use (Kaplan, 1995). For example, feeling mentally exhausted after concentrating on a task for a long period of time would be recognizable to many people. This state is thought to result from directed attention fatigue (Kaplan, 1995). Fortunately, directed attention is a renewable resource that can be restored if it is allowed to rest; this can be achieved through an exposure to a restorative environment, and is made possible because a fascinating stimulus triggers effortless attention (i.e., involuntary attention) (Kaplan, 1995). The basic idea is that while involuntary attention is being used, directed attention may recover (Kaplan, 1995). There are several components to a restorative environment. Briefly, these are seeking restoration by *being away*, in an environment of a certain *extent* where the setting is coherent and envelops you, an environment that is *fascinating* containing objects and a visual setting that can be viewed without effort, and is functionally *compatible* with your behaviour, in the sense that you can master the environment (Kaplan, 1995). Natural environments contain objects that are fascinating enough to hold attention, but capacity is not overwhelmed, and attention is captured softly (Kaplan & Berman, 2010). This has been called soft fascination and has been distinguished from hard fascination (e.g., an action movie) where it is difficult to think about anything else than what one is seeing (Kaplan, 1995; Kaplan & Berman, 2010). It is interesting to note that the component *being away*, that a person seeks a different environment to rest,

on one level presupposes self-regulation. In addition, certain aspects of self-regulation may not function properly if directed attention is not adequately restored (Kaplan & Berman, 2010).

1.3.1.2. The psycho-evolutionary stress reduction framework: proposing a relation between nature and affect

The basic idea behind the psycho-evolutionary framework is that human-beings may be genetically disposed to respond positively towards certain natural environments (Ulrich, 1993). People's *negative* reactions toward certain aspects of nature (e.g., snakes and spiders), is associated with avoidance, extending even to settings where such animals could be encountered, and could have an evolutionary origin (see Öhman & Wiens, 2004). Human-beings might also respond adaptively to advantages or resources contained within the environment (Ulrich, 1993). The psycho-evolutionary framework states that people have inherited a biological preparedness to acquire and retain certain responses to unthreatening nature, and in the absence of danger, respond with liking, stress recovery or restoration, and enhanced cognitive functioning whenever they are exposed to unthreatening natural environments (Ulrich, 1993). Responding with liking, and approach behaviour, towards environments containing natural elements may have been adaptive, because of a heightened probability of finding water and food (Ulrich, 1993). Moreover, certain characteristics associated with safety have been suggested that may contribute to the restorative effects of nature, these are visual openness (e.g., savanna-like environments), calm water, and perhaps the presence of a campfire (Ulrich, 1993).

1.3.1.3. The perceptual fluency account: an integrative framework

Although much can be said in favour of the evolutionary account in the previous section, there are a few unresolved issues, for example, how can human beings have specifically evolved restorative responses to settings that should have been ubiquitous (Joye & van den Berg, 2011). By focusing on perceptual fluency it may be possible to

avoid some of the problems inherent in the psycho-evolutionary theory (Joye & van den Berg, 2011). In the perceptual fluency account, the relevant aspects are related to the perceptual processing of the visual scene, that is, how easy the stimulus organization is processed (Joye & van den Berg, 2011). Geometric aspects, specifically fractal¹ contents of the scene, contribute to the ease of processing (Joye, 2007), and may be accompanied by positive emotions and the resting of directed attention because the scene can be viewed without effort (Joye & van den Berg, 2011).

1.3.1.4. Recovery (from work)

There is a large body of research on recovery after work which may be relevant to the present discussion. Researchers working within this topic appear to have progressed from focusing on recovery as something that can happen when people engage in activities which do not share important features with work tasks towards becoming more focused on psychological detachment from work.

Clearly, there are similarities between recovery and restoration. With regards to recovery, it is assumed that demands at work may lead to fatigue, stress, or other reactions. The recovery process is thought to return the psycho-physiological system to a state (a pre-demand state) not characterized by these load reactions when the demands have been removed (Sonnetag, 2001). As stated above, psychological detachment from work (i.e., not thinking about work) appears to be central to the recovery process (e.g., Sonnetag & Bayer, 2005). This aspect of recovery appears to be similar to the concept of being away in attention restoration theory.

Different stress responses (e.g., cardiovascular, endocrinological) are interrelated, but they are probably also influenced by the behaviour of the person, the overall situation, and importantly, properties of the stressor (Linden, Earle, Gerin, & Christenfeld, 1997).

¹ Mathematical concept involving self-repeating patterns (Joye & van den Berg, 2011)

If something can be done about a stressor, for example a clear behavioural option is available, physiological responses supporting behaviour may be elicited. If the stressor is uncontrollable, a clear behavioural option is often not available, and a different set of stress responses may be activated. For example, one meta-analysis of laboratory studies reports that uncontrollable stress elicits cortisol responses (Dickerson & Kemeny, 2004). Work stressors are probably varied with regards to both controllability and other properties of the stressor. It seems likely that recovery might be enhanced by visiting a natural environment during leisure. However, that natural environments are restorative environments is merely a curiosity if people do not visit them in order to reduce their stress levels and regulate themselves. The topic of self-regulation is covered in the next section.

1.3.2. Self-regulation: managing resources and challenges

The study of self-regulation, or self-control, in its current form has a relatively short history. Self-regulation is built on the concept of homeostasis and on control theory (see Carver & Scheier, 1982), and is often considered to consist of standards, monitoring, and strength (Tice & Bratslavsky, 2000). A person may have some goal or standard, for example losing weight, and in order to achieve this goal the person needs to monitor his or her behaviour, for example resist tempting foods. In control theory this process would involve a feedback loop where some reference value is compared against the current state of affairs, and changes in behaviour may be necessary in order to move closer towards one's goal. Finally, it should be mentioned that the reference value in itself does not have to be the goal, the feedback loops can be nested within each other, for example consisting of sub-goals in a control hierarchy (Carver & Scheier, 1982). It is also worth mentioning that as society's constraints become more relaxed, and more distractions are introduced, self-regulation becomes more important. This may happen because the normative rules which previously governed behaviour are less rigid, thus it is largely up to the individuals themselves to constrain and regulate their behaviour. The individual must manage distractions and focus on important tasks in an environment where entertainment and other distractions are ubiquitous. Most likely, this places a

demand on self-control strength, and the management of one's own resources suddenly becomes more relevant. The management of feelings is probably closely related to this and emotion regulation (which will be discussed later), is a type of self-regulation.

Some authors distinguish between self-control and self-regulation, where self-control is the effortful and deliberate subset of self-regulation (Baumeister, Vohs, & Tice, 2007). The strength aspect of self-control was not focused upon in earlier versions of self-regulation theory (e.g., Carver & Scheier, 1982), perhaps because it was too close to psychoanalytical ideas relating to ego strength and dynamics, but the ability to utilize willpower (exercise self-control) to achieve goals appears to be highly relevant. Higher self-control seems to be related to a variety of indicators that would normally be considered as adaptive and healthy; better grades, psychological health, and higher levels of empathy (Tangney, Baumeister, & Boone, 2004). In addition, self-control strength has been compared to a muscle, which can become fatigued with use (Baumeister, Vohs, & Tice, 2007). For example, utilizing willpower to resist temptations (eating radishes and resisting chocolates), or concentrating on a task, or even suppressing emotions, have all been found to reduce one's ability to utilize willpower on a subsequent task (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Hagger, Wood, Stiff, & Chatzisarantis, 2010; Tyler & Burns, 2008), this fatigued or depleted state has been termed ego depletion (Baumeister et al., 1998). Implicit within the self-control strength approach is the potential to replenish resources when depletion has occurred. Whenever people do this, consciously or not, it should be considered as self-regulation, or emotion regulation. There may be various ways in which the replenishment of self-control strength could be achieved, but when the environment is used somehow, this would be environmental self-regulation. Kaplan and Berman (2010) rely on the theoretical and empirical overlap between self-control strength (willpower) and directed attention, and between ego depletion and directed attention fatigue in order to point out that directed attention may be the underlying resource for self-regulation and executive functioning. Being such an important aspect of cognition, it seems reasonable to assume that people would attempt to manage directed attention fatigue, for example by attempting to replenish this resource when it has become depleted.

Management, or regulation, of self-control strength is probably best defined as a type of emotion regulation, because, as pointed out by Kaplan (1995), people may not be aware of the state of this mechanism itself, but rather become aware of feeling fatigued, irritable or similar.

Given that there appears to be a theoretical overlap between ego depletion and directed attention fatigue, it seems reasonable to assume that there might be a restorative outcome associated with self-control strength, and although more research is needed, this outcome could be measured via changes in willpower. A suitable name for this concept could be ego restoration (see Johnsen, 2013).

Recently, the concept of allostasis² has become quite popular (e.g., Ganzel, Morris, & Wethington, 2010; Sapolsky, 2007), and it expands upon homeostasis by including the perspective that the organism can adapt to a changing environment. While homeostatic processes attempt to restore balance internally, for example when the organism is exposed to a stressor, the concept of allostasis also relates to the adaptation to the environment (Ganzel, Morris, & Wethington, 2010). That is, behaviour and psychological characteristics can in a sense intervene in the stress process (Ganzel, Morris, & Wethington, 2010), thus moderating the stress response. In allostasis, whether a certain level of physiological activation is adaptive can depend upon the circumstances (Sapolsky, 2007). Some settings can be demanding and require a stress response for adaptive coping, while other settings can be demanding and perhaps elicit an unhealthy stress response. The topic of emotions is discussed in the next section, and emotions are likely to be critical in allostatic adaptation (Ganzel, Morris, & Wethington, 2010), for example by influencing behaviour.

² Allostasis can be considered a process of adaptation where the optimal set-points of a physiological system are determined by the overall situation and where balance can be regained by psychological and behavioural, as well as physiological responses (Sapolsky, 2007).

1.3.3. Emotions

Currently, there is a lack of consensus on emotions among theorists and researchers, and to some extent pronounced disagreement on what emotions are. Imaging studies of the brain have not been conclusive with regards to what regions of the brain are active in emotional experience (Barrett & Wager, 2006), and some researchers question whether emotions are naturally discrete categories, or whether *joy*, *anger*, and *fear* are categories constructed by the mind (e.g., Barrett, 2006). There may be four main viewpoints within emotion theory; the basic emotions view, appraisal theories, the psychological construction view, and the social construction view (Gross & Barrett, 2011). Most theorists would, however, agree that emotional responses are elicited when we are exposed to events that are somehow relevant to our well-being, and that these responses are experiential, physiological, and behavioural in nature (e.g., Gross & Barrett, 2011; Frijda, 1988; Scherer, 2004). The main characteristics of the four viewpoints are presented in the following. In social construction models it is assumed that emotions are social products, not constructed in the mind, but by people in a culture (Gross & Barrett, 2011). In appraisal theories, appraisals are primary, it is proposed that when one appraises a significant environmental event as being relevant to one's well-being, a set of more or less coordinated responses are activated (Gross & Barrett, 2011). Moreover, appraisal theory is explicitly transactional, meaning that it is the person-environment system which determines the emotion that is activated (Scherer, 2004; Barrett; 2006). Basic emotion models, on the other hand, take emotions to be neurologically hard-wired patterned states that are rapid and automatic (Gross & Barrett, 2011). Finally, the psychological-construction view regards emotions to be mental states which are constructed, or rather recognized, from patterns which involve several components, not limited to core affect, action, and appraisal (e.g., Russell, 2003). Core affect refers to the core experience of a person (Barrett, 2006; Russell, 2003), and is felt as pleasant or unpleasant, and inactive or active, meaning that *valence*, the positive-negative dimension, and *arousal* are fundamental to the emotional experience (Barrett, 2006; Russell, 2003).

It has also been suggested that emotions are highly relevant for an individual's adaptation to the environment. That is, emotional responses (i.e., action tendencies, physiological, and hormonal changes) often support specific actions, and changes in motivational processes exist to help an individual deal with the environment (Frijda, 2004). Although the word environment is probably used here in a broad sense, the notion should not be lost, namely that emotions help adapt us to the environment. In addition, verbal labels such as mental exhaustion, low willpower or, conversely, alertness point toward the notion that people have access to the state of their mental resources, and it seems likely that core affect is relevant in this regard as essentially indicating the status of the person-environment system (see Russell, 2003).

Often, a distinction is made between emotion and mood. To some extent this distinction is artificial. However, in the present context, the distinction is relevant, and mood is here distinguished from emotion in that it may last longer, it is to a lesser extent directed towards an object, and is less dependent upon the situation than emotions are (see Gross, 1998; Larsen, 2000; Russell, 2003). It is worth mentioning that most of the characteristics of emotions can be utilized to enhance or soften emotional responses, for example focusing attention away from an object might soften the emotional response, and seeking a specific situation might elicit an emotion. These are examples of emotion regulation.

1.3.4. Emotion regulation

Emotion regulatory processes decrease, increase, or maintain an emotional response; they can influence the time aspects of an emotional process or have an impact on the coherence or wholeness of emotion, for example when we hide our facial expressions (Gross, 1998; Gross & Thompson, 2007). Moreover, they can be automatic or controlled, conscious or unconscious (Gross & Thompson, 2007).

It is possible to distinguish between different strategies of emotion regulation by considering the emotion generative process. Strategies that take place early in the process, before an emotional response has been elicited are categorized as *situation selection*, or the situation can be changed (*situation modification*), either after an emotional response has been elicited, or when a certain emotional response is anticipated (Gross & Thompson, 2007). It seems sensible to place environmental emotion regulation within these two categories. The other categories are *attentional deployment* (e.g., distraction), *cognitive change* (e.g., reappraisal), and *response modulation* (e.g., suppression) (Gross, 1998; Gross & Thompson, 2007).

Emotion regulation is not inherently healthy or unhealthy (see e.g., Campbell-Sills & Barlow, 2007; DeSteno, Gross, & Kubzansky, 2013). There are healthy strategies and unhealthy ones. Studies have shown that more use of the strategy known as reappraisal is associated with higher positive mood and lower negative mood, while the reverse has been found with regards to the strategy known as suppression (Gross & John, 2003). Reappraisal is also associated with self-esteem and life satisfaction (Gross & John, 2003). Having the capacity to regulate feelings in general is probably both healthy and adaptive in the long run (DeSteno, Gross, & Kubzansky, 2013; Sapolsky, 2007).

Although there are healthy strategies, it is important to consider that the personality of an individual may influence both the need for emotion regulation and the use of certain strategies; this is discussed in the next section.

1.3.5. Personality: fundamental dispositions

Personality traits are essentially somewhat consistent global constructs of individual differences in ways of thinking, behaving, and feeling (e.g., McCrae & Costa, 2008). The big five model consists of extraversion, conscientiousness, openness to experience, agreeableness, and neuroticism (John, Naumann, & Soto, 2008). Research has showed that personality traits, notably extraversion and neuroticism, are associated with

emotions and moods, extraversion is associated with positive mood, while neuroticism is associated with negative mood (Costa & McCrae, 1980; Steel, Schmidt, & Shultz, 2008). Moreover, the same personality traits may be associated with several strategies for emotion regulation (Gross & John, 2003; Ng & Diener, 2009). Some researchers believe that extraversion and neuroticism are representations of fundamental affective orientations toward the world, and that conscientiousness may be part of an affect regulatory component (Clark & Watson, 2008). This makes it relevant to consider personality when studying emotions and emotion regulation.

It is sometimes assumed that the behaviour of a person is either dominated by factors relating to the personality of the individual, or dominated by situational factors, but it is probably a mistake to separate the two, as both aspects are always relevant (Funder, 2006). Moreover, it may be difficult and potentially meaningless, to separate the person and the situation (Barrett, 2006; Funder, 2006). Similar arguments have been made by Magnusson & Törestad (1993) when presenting a holistic model of personality. These authors were early proponents of using dynamic systems theory to understand personality and the person-environment relationship (Magnusson & Törestad, 1993). It is interesting to see how this overlaps a great deal with modern affordance theory (e.g., Heft, 2003).

Given that personality traits are associated with fundamental affective orientations, and the person-environment transactional perspective mentioned above, factors relating to the person should be relevant for psychological research on the natural environment. How nature may be used is discussed in the following sections.

1.3.6. The environmental self-regulation hypothesis

The environmental self-regulation hypothesis was proposed by Korpela (1995), and states that people can use specific environments, their favourite places, for self-regulation. That is, favourite places give opportunities for self-regulation. It is argued

that place identity results from this process. This notion was supported by analyses of essays written by adolescents about their favourite places (Korpela, 1995). It is also argued that favourite places are restorative (Korpela, 1995). Self-regulation is considered in relation to the pleasure principle (that people mostly want to minimize negative emotions and maximize positive ones), the unity principle (that people want to perceive events and themselves in a coherent manner, for example to construct a coherent narrative about themselves), and the maintenance of self-esteem (Korpela, 1995). This approach seems to indicate that the environment is central to self-regulation, and perhaps people choose their favourite places based upon need as some kind of allostatic process.

1.3.7. Psychoanalytic perspectives on the environment and psychological health

Though psychoanalytic or psychodynamic perspectives may have a lot to say about emotions and affects, only a few psychoanalytic theorists focus on the environment, and mostly then with reference to the social environment. Perhaps the writings of Winnicott (1971/2005) and Hartmann (1958) have offered the most relevant theoretical perspectives. Winnicott (1971/2005) has postulated a 'potential space' between the inner world of an individual and the outer objective world. This potential space allows for creativity and play and for experimentation with reality. For example, two people being creative together would operate within a potential space between them that is neither entirely in the objective world nor entirely in the inner world of either individual. The environment in which an individual happens to be can increase or decrease this potential space. One typical example is the intrusive parent; this would be an environment which demands attention. Though it is not explicitly stated in this theory, undemanding environments may be the best settings for potential-space experiences. Demanding environments exhibit two aspects. They may be unambiguous with regard to what behaviours are to be performed in them, and they may demand one's attention. Many of today's most common environments could perhaps to some extent constrain this hypothetical potential space. It is interesting to note that Kaplan

(1983), in a discussion of person-environment compatibility, has proposed that mental activity that has its source in the environment (i.e., environmentally driven), for example, required action, will subjugate mental activity that has its source in the person, such as reflection. In short, a demanding environment is incompatible with reflection. On the whole, environments may have properties that support or constrain creative thinking.

In another perspective, Hartmann (1958) has focused on the equilibrium between the environment and the individual, and how regulation returns the system to a stable state when it has been disturbed. Hartmann (1958) has suggested three categories of adaptation, or regulation, and ascribes the first two to Freud, namely, alloplastic and autoplasic change, that is, a focus on the environment and the individual, respectively. The third form involves choosing a new environment (i.e., environmental change). Now, these concepts could be adapted to the area of emotion regulation and compared with the current concepts; for example, situation modification and situation selection could be considered as examples of alloplastic and environmental change, respectively. Of course, this level of specificity is not present in Hartmann's (1958) original theory.

More recent developments in psychoanalysis, however, are specifically concerned with emotion regulation. One approach is through the concept of mentalization, which relates to the ability to reflect upon one's feelings while experiencing them, and may be highly relevant for psychological health (Fonagy, Gergely, Jurist, & Target, 2002). Any situation or environment that makes it easier to integrate emotion and cognition should be associated with health and well-being in this approach.

1.4. Place attachment, place identity, and emotion regulation

Having favourite natural places probably involves an attachment to these places (Korpela, 2003; Korpela & Hartig, 1996) and perhaps such attachments can expand to involve unspecified natural places (Korpela & Hartig, 1996; Scannell & Gifford, 2010).

Indeed, Scannell and Gifford (2010) have proposed that a psychological bond could develop to any place which is meaningful to an individual. A tripartite model of place attachment has been suggested to organize this topic; the three parts are factors relating to the person, the place, and the process. Place attachment with regards to emotion regulation would mainly involve the process dimension of this model, which relates to cognition, affect, and behaviour, for instance, through an emotional bond to a place (Scannell & Gifford, 2010). Developing an attachment to a place may involve exploration and positive emotions in a specific place and distress that leads to the seeking of the caregiver (Morgan, 2010). But it should eventually also lead an individual to develop feelings of safety while in the place (Johnsen, 2011; Morgan, 2010). Feeling safe in a place may be important for place attachment (Scannell & Gifford, 2010). In addition, feeling unsafe may hinder restoration (Staats & Hartig, 2004). At least one study has demonstrated that negative emotions may precede one's visit to a favourite place, which indicates that people may visit their favourite natural place to regulate emotions (Korpela, 2003).

Perceiving oneself as connected with nature or not has been found to be associated with biospheric environmental concerns (Schultz, Shriver, Tabanico, & Khazian, 2004), in this study relationship to nature was measured using two circles, one representing nature and one the self at various degrees of overlap. This is thought to be a measure of how connected one feels to nature, and interestingly, in one presently unpublished study conducted by Evensen & Johnsen (2014), a significant correlation ($r = 0.47, p < 0.01, N=150$) between a scale measuring the use of nature for negative emotion regulation, and attachment to, or identity overlap with, nature was found.

1.5. Environment-focused emotion regulation

Using the environment to regulate emotions is a process that seeks to maintain, increase, or decrease an emotional response. It could to some extent be considered a subset of environmental self-regulation and there may be some conceptual overlap, for example when an environment is sought because it affords an opportunity to reflect upon an

emotion or a negative situation. However, it is important to point out that using the environment to regulate emotions is not directly connected to the concept of favourite places and does not necessarily involve place attachment. It is an active process in the sense that it involves a choice on some level, but it does not have to be a completely conscious choice. Environment-focused emotion regulation is a collection of strategies which can be placed within the first two stages in the process model of emotion regulation (Gross, 1998), however, they may also be considered within the perspective of person-environment congruency. That is, they can involve processes of allostasis and homeostasis (see Sapolsky, 2007).

Environment-focused emotion regulation is a dynamic process in the sense that it involves modifying the environment (e.g., listening to music, tidying up) in order to achieve emotional ends, or changing from one environment to another. This is an important point, entailing, among other things, that it could be the change of environment in itself that is important, not what environment one changes to or from. Moreover, depending upon the circumstances, the important aspect could be the environment one changes to (the environment that pulls), or the environment one moves away from (the environment that pushes). Similarly, modifying the environment could in itself be relevant, or any specific aspect changed, added or removed, could be the relevant factor to consider.

At times it can be difficult to differentiate between an activity and environment-focused emotion regulation, for example exercising can be motivated by a desire to regulate an emotion. However, if there is a preference for a particular environment involved, it could be categorised as environment-focused emotion regulation.

1.6. Emotional potential and emotional affordances

Environment-focused emotion regulation has the potential of being an important concept, and although it is straightforward to place it within the process model of

emotion regulation (Gross, 1998), the concept can be further developed. Among the most important aspects pertaining to this are the perception and use of different environments. If a person is to use an environment for emotion regulation, the environment must offer such opportunities, and the person must perceive these opportunities. At the heart of this lies affordance theory (e.g., Gibson, 1986; Greeno, 1994). This ecological approach does not study the individual in isolation, but rather the relationship between the person and the world (Heft, 2013). Stated briefly, an affordance refers to properties of the environment in a person-environment system (Greeno, 1994). Whenever a person needs to perform the equivalent of emotional labour, the environment must afford such behaviour. This makes it possible to discuss *emotional* affordance as a concept.

1.6.1. Emotional affordance in the literature

A literature search yielded only two articles relating to emotional affordances. The first article, by Schutte, Malouff, Price, Walter, Burke, and Wilkinson (2008), takes an interactional perspective on emotional intelligence. The researchers defined emotional affordance as the likelihood of a situation to facilitate or prompt an emotion. In this study, emotion experts were asked to rate several situations on to what extent the situations elicit emotions or allow awareness of emotion. The findings were that identification and management of emotions were higher in the high affordance situations. In addition, it was found that emotional intelligence was associated with interest in entering the high emotional affordance situations and observer-rated success in these situations. However, no such associations were found with regards to the low affordance situations. The second article investigated emotional responses to a forest setting among a group of boys with behavioural problems (Roe & Aspinall, 2011). Emotional affordance was defined as what is offered along the dimensions of pleasure – displeasure and relaxation – arousal. The researchers found that positive emotional responses increased in the forest setting over time, and the results also indicated increased well-being among the boys (Roe & Aspinall, 2011).

1.6.2. Defining emotional affordance

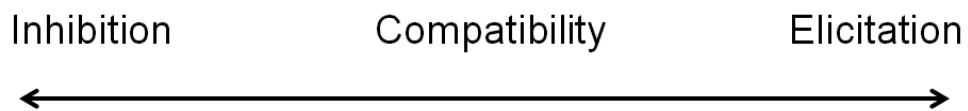
Historically, affordances have been defined in various ways. In any given person-environment system, there are properties of the agent, the environment, and the relation between them that are relevant to the ongoing interaction. In Gibson's (1986) view, the environment affords behaviour for the person or animal. That is, in relation to some behaviour in the interaction, what the environment contributes is termed the affordance (Greeno, 1994). A slightly different view is that affordances are emergent properties of the animal-environment system, that is, the affordance is the relation between the qualities of the animal and the properties of the environment (Stoffregen, 2003; Chemero, 2003). Because affordances are connected to specific person-environment systems, different systems often have different affordances attached to them. For example, a pool of water affords walking for some insects, but not for a human being.

The biggest problem in defining and measuring affordances is maintaining that the focus should be on the relationship, and not on the individual. Psychology has a tendency to focus on the individual and it is difficult to break away from dualistic thinking that separates the mind and the environment. An ecological niche is a set of features relevant to the behaviour of an animal, there is mutuality between a species and its niche (Barrett, 2006; Heft, 2013). Affordances are meaningful and functionally significant elements of a niche (Heft, 2013), and niches can vary between persons (e.g., Barrett, 2006). Although there may be some discussion on how social aspects should be included in affordances, Heft (2003) argues that sociocultural meanings and values are present in most environments, and therefore affordances can be constrained by social practices and norms, and specific affordances can fade over time through lack of use. It would be a mistake, however to say that people perceive the norms of the social environment and that this in turn informs the perception of affordances. Heft (2003) describes affordances as embedded in the (social) environment.

It is important to distinguish between affordance and elicitation. Affordances are opportunities for action, not demands for action (Stoffregen, 2003). A situation that

elicits an emotion would approximate a demand. For example, while the affordance for walking is still present in the situation with the insect and the pool of water, being forced to land and walk on the water is not an affordance. Emotional responses indicate the presence of an affordance, but affordances should not be reduced to the elicitation of emotion or emotional responses. It is also relevant to consider environments producing inhibition; for example environments which are perceived as demanding or dangerous could inhibit certain emotions (see Figure 1).

Figure 1: The environment might inhibit, elicit, or be compatible with an emotion.



Emotional affordances can be revealed when people with different personalities perceive the emotional relevance of an environment differently, when the emotional relevance of an environment or an object changes, and when people use an environment for emotion regulation. Two examples may serve to illustrate the concept of emotional affordance. Several years ago, shopping for groceries in a store was not particularly relevant in an emotional context. Today, with the arrival of fair-trade products, groceries offer opportunities to demonstrate compassion with others, the meaning of the object has changed; the meaning of food has changed. Similarly, the classic study of model-learning, where an adult's display of aggression towards a bobo-doll, influences the behaviour of children witnessing the aggression (Bandura, Ross, & Ross, 1961), can be interpreted as changing the emotional affordance of the situation. That is, at least in the sense that a new option for the display of aggression is made available.

Although caregivers contribute substantially to the emotion regulation of infants and young children, there is a development towards autonomy and even babies have some ability to tolerate frustration and modulate emotion on their own without becoming disorganized (e.g., Eisenberg, Hofer, & Vaughan, 2007; Kopp, 1982). Early emotion regulation involves visual orienting, for example disengaging attention from a distressing stimulus (Rothbart, Sheese, Rueda, & Posner, 2011). Moreover, research has demonstrated that gaze fixations and visual orienting are closely related to emotion regulation among adults as well (e.g., Isaacowitz, Toner, Goren, & Wilson, 2008; van Reekum, Johnstone, Urry, Thurow, Schaefer, Alexander, Davidson, 2007). For example, when instructed to regulate their feelings, people make more fixations than when they are instructed only to attend to affective images (van Reekum et al., 2007). The point I am trying to make here is not merely that distraction and attentional deployment are important strategies for emotion regulation (e.g., Gross, 1998), but how the environment is used, specifically what aspects of the picture (environment) one attends to, and perhaps the gaze patterns themselves, may also be relevant with regards to emotion regulation. In the extension of this, there may be environments that are better suited than others for this type of emotion regulation; environments with properties that afford distraction, cautiously stated. To further develop this idea we may consider the usage of music. It has been suggested that there are musical affordances, for example, attending to music, picking up the melodic and rhythmic patterns lets us “do things” with music, and among these things is emotion regulation (Krueger, 2011). Most of us would probably recognize that music has the potential to affect emotional states, and one empirical study indicates that emotion regulation and self-regulation (e.g., getting in the mood, helping me concentrate) may be relatively common reasons for listening to music (North, Hargreaves, & Hargreaves, 2004). This leads us to the somewhat speculative idea that specific patterns in the environment affords, through interactions with our senses and neurophysiology, a type of tracking control of neurophysiological changes (tracking control typically involves the use of a reference signal, see Albertos & Mareels, 2010). Although it may be easier to argue for the use of music with regards to this type of emotion regulation, it is possible that watching the ebb and flow of waves on a beach, the ups and downs of a hillside on the horizon, or the shape of a forest could support the regulation of physiological arousal by supplying a reference signal of sorts.

Finally, it seems relevant to consider emotional affordances from the theoretical perspective of self-organizing systems, specifically emotional self-organization. The concept of self-organizing dynamic systems is not new in psychology; Magnusson and Törestad (1993) have proposed a holistic model of personality in which psychological functioning is seen as an ongoing self-organizing dynamic process. The authors assert that this process is interactional and focus on the reciprocity between the person and the environment, and the integration of processes and sub-processes (Magnusson & Törestad, 1993). Lewis (2009) describes emotional self-organization at three time-scales: emotional episodes, moods, and personality. Emotional episodes are described as emergent states of cognition-emotion interaction; the system is disturbed, for example by the appearance of a dangerous object, and there is a coupling, or synchronization, of system elements, partially defined by attractors corresponding to specific states (Lewis, 2009). A particularly interesting part of this model is that a system may remain in a specific emotional state until an action can be taken, and it is indicated that moods persist because no action can be taken to resolve them (Lewis, 2009). If we were to include the environment in this, a coupled person-environment system, it would mean that without the presence of specific emotional affordances, people would simply remain in a particular mood or emotion. A somewhat neglected part in all of this is that people often actively maintain their moods. In this context, the concept of emotional affordance appears to be highly relevant.

Although emotional affordances may be relevant, the concept is not particularly restrictive, because it should include almost every conceivable opportunity for various emotional responses a particular person can experience in an environment. It should be fundamentally relational, but this makes it difficult to arrive at a working operational definition. For example, with regards to the bobo-doll experiment, what aspects should we focus on, the softness of the doll, the situation as a whole, the social learning? All of these are relevant. It may be necessary to be more specific when measuring affordances

and I suggest using a much more straightforward concept to indicate the presence of an emotional affordance.

1.6.3. Emotional potential

The emotional potential concept refers to the potential of a specific environment to increase or reduce a specific emotion, and could be called the perceived emotion regulatory potential of an environment (Johnsen & Rydstedt, 2013). The concept is to some extent related to the concept of emotional affordance but it is specifically about emotion regulation. Although higher levels of emotional potential may indicate the presence of an emotional affordance, the latter is a larger concept. Furthermore, the concept is useful in that it makes it possible for people to report to what extent they believe that an environment could be used for emotion regulation, and what emotional responses they would expect in a situation or an environment. This makes it an expectancy construct. Such beliefs anticipate the future, but are probably continuously updated by experience.

1.7. Defining nature

There are many ways of approaching the problematic topic of defining nature. One might consider everything to be natural, more or less, and focus instead on wildness, as one author has done (Cookson, 2011). Wildness refers to a special quality of the relation between the animal and its environment, qualities which relate to the basic nature of the animal (Cookson, 2011). An example where this quality is clearly missing would be the animal which never adapts to life in a zoo. Alternatively, a definition of nature might focus on the percentage of greenery, counting the number of natural elements, or other quantitative approaches. In a way, being in a room with one plant could be considered as being in the presence of nature. But it could not be considered a natural environment. However, if more and more plants are moved into the room, at some point the difference becomes relevant, tangible, and the experience becomes different. One might take the opposite approach and consider instead environments that are clearly not

natural; what do these environments signify? In such environments the presence of one small natural element could constitute a relevant difference, as in a study of inner city children (Faber Taylor, Kuo, & Sullivan, 2002). As such, the complete absence of nature may not be healthy. However, perhaps a precise definition is not important. Perhaps it is more relevant to focus on dynamic aspects, for example what environments a person moves to and from, how exposures to different environments can support overall human functioning (e.g., Kaplan, 1983), and in what way nature exposure can contribute to well-being and health. In such cases, one might focus on content, restorative qualities, and perceptual aspects. For example, the optimal fractal dimensions of a scene (see Joye, 2007). A general definition using dynamic aspects, content, and perceptual aspects would indicate a green environment one could potentially move around in, with some trees present, perhaps some water near or distant, and preferably a horizon, or at least some natural scenery in the background.

1.8. Natural environments and the relevance for psychological health

The purpose of this section is not to conduct an exhaustive review of the health potential of nature, but rather to give a few examples of relevant findings in this area of research.

Positive emotions generally increase following nature exposure (e.g. Berman, Jonides, & Kaplan, 2008; Hartig, Evans, Jamner, Davis, & Gärling, 2003). In fact, increasing the amount of greenery seems to increase the ratings of positive feelings toward pictures of urban and gradually more natural scenes, and increasing the amount of water seems to have the same effect up to a point (White et al., 2010).

Following a task designed to produce attentional fatigue, several studies have found that nature exposure restores attentional resources. For example, a nature walk (and sitting in a room with a view of trees) has been found to improve performance on a concentration task more than an urban walk (and sitting in a room with no view), and after the urban walk performance declined (Hartig et al., 2003). Further, walking in nature has been

found to improve performance on the digit span backwards task more than walking in an urban environment (Berman, Jonides, & Kaplan, 2008). There have been a few studies showing a stress-reducing effect of nature exposure. A view to nature has been found to promote a more rapid decline in blood pressure than no view (Hartig et al., 2003). Further results from this study showed that during the subsequent walk in an urban or a natural environment, blood pressure readings were initially different in the two environments, however over the entire time period there was no main effect of environment (Hartig et al., 2003). In another study, the participants watched a filmed walk through an urban or a natural environment, and a lower heart rate was found among those watching nature (Laumann, Gärling, & Stormark, 2003).

Negative emotions have been shown to decrease following an exposure to nature (e.g., Berman, Jonides, & Kaplan, 2008; Hartig et al., 2003), and after watching a frightening movie, watching a walk through nature has been found to improve several measures of affect more than watching an urban walk (van den Berg, Koole, & van der Wulp, 2003).

One study of life stress among children showed that nature moderated its impact. That is, higher levels of nature near the residence reduced the impact of life stress on psychological distress among children living in a rural area (Wells & Evans, 2003). Furthermore, a population study has found similar results for adults, a higher percentage of greenery within a three kilometre radius around the home may moderate the impact of life stress on perceived health (van den Berg, Maas, Verheij, & Groenewegen, 2010).

There have not been many meta-studies in this field, but one systematic review of the effects of nature exposure included twenty-five studies comparing natural environments with synthetic environments and has found beneficial effects of nature exposure on anxiety, anger, sadness, fatigue, and energy, but no effects on blood pressure, cortisol, tranquillity, and attention (Bowler, Buyung-Ali, Knight, & Pullin, 2010).

Finally, it may be relevant to point out that there are factors that can diminish the benefits of nature. Although natural environments are generally found to be judged as more restorative than urban environments (e.g., Herzog, Maguire, & Nebel, 2003), the presence of danger (presented as a scenario) has been shown to dramatically reduce restorativeness ratings of nature (Herzog & Rector, 2009). Moreover, prospect-refuge theory (Appleton, 1975) indicates that people prefer environments with a clear view of possible prospects and the potential for refuge and safety. However, higher levels of refuge also make hidden dangers a possibility. One study has considered precisely the impact of danger defined in this manner and has found that environments with high levels of refuge and low levels of prospect did not restore attention after a fatiguing task, and positive affect increased less in this condition (Gatersleben & Andrews, 2013).

1.9. Emotion regulation and healthy functioning

Emotion regulation in itself is not necessarily beneficial; it can even be harmful and maintain psychopathology. Examples include maladaptive situation selection: *avoidance*, maladaptive attentional deployment: *ruminatation*, and maladaptive cognitive change: *rationalization* or *self-deception* (Campbell-Sills & Barlow, 2007). Neither is it a goal that all emotion should be regulated, the focus should be on the different emotion regulation strategies. For example, one might ask specifically what strategies are healthy or unhealthy and in what contexts they are healthy or unhealthy. The strategies used for regulating emotion can contribute to higher or lower levels of stress, for example, engaging in future oriented regulation can reduce the impact of stressful events (Sapolsky, 2007). Negative and positive emotions can influence health and disease directly and indirectly (DeSteno, Gross, & Kubzansky, 2013). Two of the most studied emotion regulation strategies are reappraisal and suppression, and it has been found that reappraisal may be associated with lower levels of negative emotions, and better interpersonal functioning, and suppression may be associated with higher negative emotions, lower levels of well-being, and worse interpersonal functioning (Gross & John, 2003). In general, it seems possible that emotion regulation strategies

that take place earlier in the emotion generative process, that are perhaps more future oriented, are healthier, however this is still very much unknown, and more research is needed.

1.10. Summary of the introduction, and aims of the thesis

A number of perspectives were presented in this introduction. Briefly put, the topics are centred on the natural environment, the person, emotions, and emotion regulation. Restoration theories may help explain the effects of the natural environment and indicate outcomes of an exposure to nature (e.g., reduced negative emotion, attention restoration). These predictions are largely supported by empirical findings. The topic of self-regulation may help explain how people manage their resources in their daily lives, one such resource may be the environment, and nature could be used to handle the challenge of cognitive fatigue. Favourite places may also play an important role with regards to self-regulation. The concept of emotional affordance was discussed, this is an interesting topic, and it may help explain the emotional resources and challenges inherent in a person-environment system. Emotion regulation is relevant to psychological health, but specific strategies may be healthy or unhealthy. Personality traits are probably associated with both emotional experience and emotion regulation. In addition, psychoanalytic theories offer a slightly different perspective which may indicate the importance of integrating emotion and cognition for psychological health, such integration may be supported in a natural environment. Moreover, it is speculated that natural environments may allow for creativity and experimenting with reality to a larger extent than many modern environments, such processes are likely to support further adaptation and psychological development.

The overall purpose of this thesis was to explore the use of nature for emotion regulation empirically as well as conceptually. This was divided into the five separate aims. The first aim was to attempt to build a theoretical framework for research into the use of nature for emotion regulation, and attempt to bring together emotion regulation and restoration. The second aim was to develop scales to measure emotion regulation in

the natural environment, and to introduce, and seek to develop a novel restoration concept, namely ego restoration. The third aim was to test a hypothetical model of personality, emotion regulation and restoration, in order to bridge restoration in nature, and the use of nature for emotion regulation. The fourth aim was to test the use of nature for emotion regulation experimentally. Finally, the fifth aim was to investigate the perception and seeking of nature and compare these with other environments.

2. Method

2.1. Samples

The empirical results of the present thesis were based on three different empirical studies using three different samples.

The field study (paper II) was conducted in two different natural environments in Norway; Trollheimen and Jotunheimen. These settings were selected because people present there would be exposed to nature, and might be inclined to use nature to support their personal well-being. The sample ($N = 142$) consisted of visitors to, or hikers in the vicinity of, mountain lodgings during summer. Questionnaires were mainly distributed later in the day, when it was assumed that people were coming down from their hikes. An attempt was made to approach everyone present in the area and to avoid any systematic sampling bias. A total of one hundred and forty six questionnaires were collected, which was approximately 90% of those approached. Four questionnaires were only half completed, blank, or clearly not filled out correctly (tampered with by a child). The participants were between 16 and 79 years old, 52.1% were female, and 38% were male, about 10% failed to report gender. Personality trait t-scores (normalised at $M = 50$, $SD = 10$) showed that the sample was very slightly skewed in the positive direction, and slightly more homogenous, but relatively close to the expected population values, extraversion: $M = 51.11$, $SD = 8.92$, conscientiousness: $M = 51.15$, $SD = 9.01$, and emotional stability: $M = 52.15$ $SD = 8.24$.

The participants in the experimental study (paper III) were psychology students at Lillehammer University College. A few were recruited at the library, but most were recruited while they were attending a lecture (during mandatory coursework). There were 64 participants at baseline, but this dropped to 41 after one week, and then to 35 at week two. At baseline 69% of the participants were female, and after one week 75.6% were female.

The participants in the second study in paper III ($N = 473$) were also students attending lectures at Lillehammer University College, but psychology students were a minority (17%). 66.2% were female. By accessing records showing the number of active enrolled students it was calculated that 57.4% of the population that the students belonged to (courses and classes) participated in this study.

2.2. Environmental stimuli

Naturally, there were no environmental stimuli presented by the researcher in the field study (paper II), but the participants were exposed to two natural environment. Thus, a description of these environments may be necessary. The two natural environments where the questionnaire was distributed were the area called Trollheimen, and in the outskirts of the area called Jotunheimen (at entry/exit points). Jotunheimen is an area with very little tree growth due to its high altitude. Mountains dominate the environment but there are also large areas with grassy hills. There are also inland waters, occasional small trees in the lower areas, and meadows with small hardy flowers. Trollheimen can also be considered a mountain area, but there is somewhat more tree growth with patches of small forests here and there consisting of relatively short birch trees. Inland water and meadows are also present. Both environments would probably receive high ratings on Kaplan's (1995) four restorative factors, *being away*, *extent*, *fascination*, and *compatibility*.

The environmental stimuli that were distributed among the participants in the experimental study reported in paper III were in the form of A4 size pictures. There were three groups and accordingly three stimulus-packages; the experimental group with the soft manipulation received a picture of a natural environment, the main experimental group received two pictures of nature, and the control group received a picture of three balloons. There were several reasons for selecting these pictures in particular. For the control group, a choice was made to use a neutral and perhaps somewhat positive picture that was clearly not related to nature. Several alternatives were considered, but balloons are relatively innocent objects, and it was thought that most people would probably not have strong opinions about them one way or another. The two experimental groups received pictures of nature. These pictures were chosen for several reasons; first, they showed both water and greenery (see, e.g., White et al., 2010), second, they were scenic in the sense that one might want to hang them on a wall, but not in the same way as commercially available landscape posters often are. Both pictures were among the natural environments that had received high ratings in the validation study for study 2 in paper III.

The environmental stimuli in the second study in paper III were used to elicit responses on the perceived relevance of these environments for emotion regulation, and intentions to seek out these environments when experiencing an emotion. Rather than conducting an experimental study using environmental stimuli where some relevant aspect was manipulated, a more exploratory and holistic approach was taken. In part, this choice was made because person-environment fit was the theoretical background for this investigation and we wanted to obtain responses to environments that people would be exposed to on a daily basis. The reasoning was that by using everyday environments, we could at least try to ensure that these were environments that people had been exposed to and probably were so familiar with that we did not require them to respond *in situ* (see Heft, 2003). Six pictures were used to represent six everyday environments. The selected environments were an urban environment with people, an urban environment without people, a classically beautiful natural environment, an unsafe (atypical) natural environment, a shopping mall, and a living room. To validate the

pictures, a two step procedure was applied. First, a focus group ($N = 7$) rated 56 pictures that were pre-selected as examples of the six categories to obtain the most typical exemplar of each category. Then the participants of another focus group ($N = 12$) were asked to spontaneously produce associations to the pictures. After the participants had produced associations, they were asked whether they agreed with the produced associations. Those associations with which more than 50% agreed are reproduced here: The urban environment with people produced the following associations: *outside, street, people, and nice weather*. The classic nature picture: *river, nature, landscape, the mountain, Norway*. And the shopping mall: *shopping mall, city, floors, Oslo City* (a shopping mall), *“lots of people”, glass ceiling, busy*. Urban environment without people: *city, grey, bad weather, downhill, and blocks*. Unsafe (atypical) nature: *forest, evening, dusk*. Living room: *evening, living room, lamp, and reading corner*.

2.3. Measures

The measures used in the two empirical papers were a combination of established and constructed scales. Three different questionnaires were used.

The questionnaire used in the field study (paper II) was constructed with the purpose of measuring restorative outcomes of the nature exposure, emotion regulation in nature, perceived stress, and personality traits. In paper II, the following variables were used:

Demographic variables: *Gender, and age*.

Personality traits: *Extraversion, conscientiousness, and emotional stability* (Engvik & Føllesdal, 2005; John & Srivastava, 1999). There are several ways in which personality could be measured, there is a consensus within psychology that the big five model represents a common framework for personality and several questionnaires measuring the big five traits are available. This means that much research is conducted using the five factors and that there is a motivation to develop valid and reliable measures of these traits. Different questionnaires measuring the big five traits seem to correspond reasonably well with each other (John, Naumann, & Soto, 2008); therefore it may not be

of particular importance what questionnaire one uses. The BFI-44 is one of the shorter instruments and has good psychometric qualities (e.g., Engvik & Føllesdal, 2005; John, Naumann, & Soto, 2008). Three of the five factors were used here.

Stress: The *perceived stress scale* (Cohen, Kamarck, & Mermelstein, 1983), the four item version was used to measure *perceived stress*.

Emotion regulation in nature: *Negative emotion regulation, positive emotion regulation, appraisal of nature, and push motivation*. Several threads came together in the construction of the items comprising these scales. Firstly, a qualitative study was conducted; this was a broad approach that sought to obtain general information on how people might use the environment to regulate their emotions. Secondly, previously published scales on emotion regulation were considered (e.g., Gross & John, 2003). Thirdly, the process model of emotion regulation (Gross, 1998), the environmental self-regulation hypothesis (Korpela, 1995), and emotion theory (e.g., Frijda, 2004; Scherer, 2004) supplied a theoretical background.

Restorative outcomes: The *restoration outcome scale (relaxation, attention restoration, and clearing one's thoughts)* (Korpela, Ylén, Tyrväinen, & Silvennoinen, 2008), and *ego restoration*. The last scale relates to the restoration of willpower, and is an attempt to bring self-control strength into restorative environments research. The inspiration for this comes from research within the ego depletion paradigm (e.g., Baumeister et al., 1998), but it is also a direct consequence of associating ego depletion with directed attention fatigue (see Kaplan & Berman, 2010).

The second empirical paper (paper III) was based on results using two questionnaires. Study 1 applied a questionnaire which included of measures of mood, attentional functioning, and restorative outcomes.

Demographic variables: *Gender*.

Mood: The *positive and negative affect schedule (PANAS)* (Watson, Clark, & Tellegen, 1988), measuring *positive mood*, and *negative mood*.

Attentional functioning: *The attentional function index* (Cimprich, Visovatti, & Ronis, 2011).

Restorative outcomes: *Ego restoration*.

Study 2 applied a questionnaire which included personality, mood, and items relating to pictures of six environments. The following variables were used:

Demographic variables: *Gender*, and *age of birth*.

Personality traits: *Extraversion*, *conscientiousness*, and *emotional stability* (Engvik & Føllesdal, 2005; John & Srivastava, 1999).

Mood: *Positive mood*, and *negative mood* (Watson, Clark, & Tellegen, 1988).

Emotional potential: A scale measuring the perceived emotion regulatory potential of an environment. The theoretical background for this scale was the concept of emotional affordance, but it simply relates to the potential within the environment to reduce sad feelings and increase happy feelings. It is about what people expect.

Intentions to seek the environment: Two single items measured the intention to seek the environment when happy, or sad.

2.4. Procedure

In the field study, the approach was to distribute the questionnaires among the people who were in the vicinity of the mountain lodgings. The people were in the presence of nature, and many had been hiking. A paper box was used to collect the questionnaires.

In the experimental study, the different materials corresponding to the three groups were distributed to the participants in neutral envelopes. The envelopes were in a non-systematic order, and were also distributed to the participant in a non-systematic way. This procedure should, in practice, ensure sufficient randomisation. The envelope

contained one or two pictures and three questionnaires with the date the questionnaire was to be completed, and a unique participant number printed on them.

The survey study using environmental stimuli was conducted on several occasions with several large groups of students attending lectures. A variety of classes and courses were selected as participants, and they were selected in a hap-hazard manner based on convenience, for example whether they had lectures at an appropriate point in time. The pictures the participants viewed were presented in softly lit lecture halls using the image projectors that were available in the lecture halls; in general these projectors were of good quality.

2.5. Statistical methods

Various statistical methods are used in the two empirical papers. Some of these are relatively standard in psychological research and will not be described in any depth here. Methods used to analyse the data, and test hypotheses, in the papers include multiple regression analysis, Pearson's product-moment correlation, t-tests, paired-samples t-tests, analysis of variance (ANOVA), repeated-measures and mixed ANOVAs. Selected issues regarding multiple regression analysis, exploratory factor analysis (EFA), confirmatory factor analysis (CFA) and structural equation modelling (SEM) will be described below.

2.5.1. Multiple regression analysis

Multiple regression analysis is a relatively straightforward statistical analysis and is used extensively in psychology. The analysis is used to test whether several independent variables can be used as predictors for (are associated with) the dependent variable, a regression equation is constructed (1), and coefficient values can be estimated and hypotheses with regards to them tested. In these calculations the variances and

covariances of the (unstandardized) coefficients are accounted for (Tabachnick & Fidell, 2007).

$$y = \beta_0 + \beta_1x_1 + \beta_2x_2 + \dots + \beta_kx_k \quad (1)$$

It is commonly recommended that the fewest number of predictors of the highest relevance should be included in a regression analysis, and the selection of independent variables should be based on theory and research goals (e.g., Tabachnick & Fidell, 2007). It is important to point out that adding a new predictor produces a new regression equation, and sometimes adding a strong predictor can make other predictors, which may have been unrelated, statistically significant. Thus, an independent variable has been found to be a statistically significant predictor in the context of a specific regression equation. This shows that theoretical considerations are extremely important, there should be theory behind the regression equation, and it should be possible to answer the question why this specific equation is believed to be relevant, not only why these predictors are relevant. In many cases, of course, this would be trivial. There is another aspect that may be relevant when judging the appropriateness of multiple regression analysis and it relates to the measures employed. It seems possible that an independent variable could be the most relevant variable associated with a dependent variable, and yet that another variable is the one that turns out to be important in the analysis. When controlling for one variable makes another non-significant does not necessarily mean that the latter variable is not important. It might be that the scales measuring the controlled for variable and the dependent variable are more aligned. This problem is minimized with the use of latent variables in structural equation modelling.

2.5.2. Factor analysis

The purpose of factor analysis is to search for (underlying) dimensionality in the data, for example with the purpose of constructing scales. If there are theoretical reasons to expect a certain structure in the data, confirmatory factor analysis (CFA) can be used. CFA is conducted within the structural equation modelling framework. Traditional recommendations for exploratory factor analysis (EFA) insist on 10 to 1 or 5 to 1 ratio of participants to items, and a minimum of 100 participants. However, even smaller

sample sizes (e.g., 60) may in some cases be acceptable for both EFA and CFA (see Russell, 2002). One methodological study has found that if the communalities are higher than 0.6, population factors may be accurately reproduced by analysing as few as 60 cases, and that sample size may be more relevant to consider when the communalities are lower than 0.4 (MacCallum, Widaman, Zhang, & Hong, 1999).

2.5.3. Structural equation modelling

The purpose of structural equation modelling (SEM) is to test a hypothetical model. It is common to begin by testing the measurement model (i.e., a CFA). A structural model is specified with basis in theory; this can for example be a path model with latent variables.

The procedure fits the sample covariance matrix to a covariance matrix indicated by the structural model, or the measurement model (see, e.g., Byrne, 2010). It is important to consider fit statistics of the models as well as regression weights and error variances. In the case of structural equation modelling, we want the data and the hypothetical model to correspond, accordingly, the χ^2 -test should be non-significant for well-fitting models, and a significant p -value should normally indicate that the model should be rejected.

Besides the χ^2 -test other fit indices should be considered. The comparative fit index (CFI) may be less sensitive to sample size and is important (Russell, 2002).

Recommendations state that the CFI and another index, the Tucker-Lewis Index (TLI), should be between 0.95 and 1.00 (Hu & Bentler, 1999). The root mean square error of approximation (RMSEA) should be lower than 0.06 for well fitting models, and perhaps lower than 0.08 for models with acceptable fit (Hu & Bentler, 1999; MacCallum, Browne, & Sugawara, 1996). It is important that a tested model is firmly grounded in theory (Hayduk, Cummings, Boadu, Pazderka-Robinson, & Boulianne, 2007). This thesis considers that CFIs and TLIs higher than 0.95, RMSEAs of about 0.06 or lower, and non-significant χ^2 -tests would indicate good fit.

Recently one author has suggested rather strict criteria for accepting models, non-significant χ^2 -tests, and sample sizes of two hundred or more (Barrett, 2007). In replies to this, other experts disagreed (Bentler, 2007; Markland, 2007). There may still be an issue on structural equation modelling and sample size. For example, the chi-square test is sensitive to sample size and becomes significant for large samples, which leads to rejection of the hypothetical model even though the discrepancies may be small (Bentler & Bonett, 1980). Small sample sizes can also be problematic, however. Although smaller sample sizes may be more adequate for the chi-square test, if the sample is too small several models may fit equally well (Bentler & Bonett, 1980). Note that there are two separate issues here. One relates to significance testing, while the other relates to sample representability. A hypothetical model should approximate reality. In smaller samples it becomes somewhat more important that the sample at hand accurately represents a specific population in order to ensure that the fitted model will be relevant (see Markland, 2007). In model testing, even sample sizes of about 100 may be acceptable, Gignac (2006), for example, has demonstrated and discussed the use of smaller samples for modelling and has concluded that it may be unproblematic.

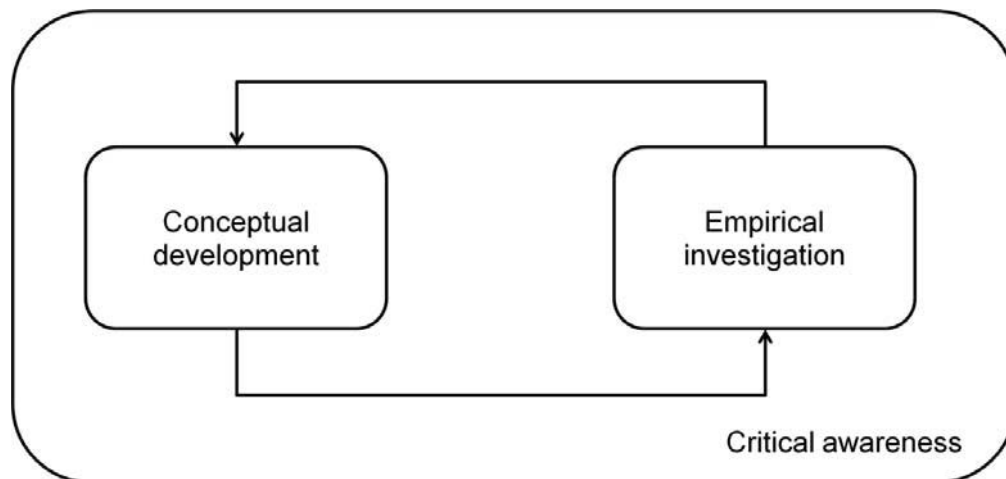
Missing data can be estimated within the structural equation modelling framework, and applying maximum likelihood algorithms for handling the problem of missing data may be superior to common procedures such as listwise deletion (see Enders, 2001).

2.6. General scientific approach

The overall scientific process for the present thesis was to progress by moving between conceptual and theoretical development, and empirical testing or exploration (see Figure 2), using each as foundations for the other. Both of these aspects are present in all three papers; there are conceptual developments in the empirical papers, and empirical results are applied in the theoretical paper. Furthermore, the chosen approach is essentially seen as a continuous process. This may appear to be a combination of the hypothetico-

deductive method and induction. However, on the theoretical side, this approach may have more in common with the abductive method (see Haig, 2005). In abductive reasoning, one begins with the available information (not restricted to empirical observations), and attempts to explain it by constructing a theory (Haig, 2005). It is considered important that this process takes place in a context of critical thinking, or else the process could move in a direction characterized by improper conceptual development, of unwarranted theorizing, and perhaps even failed empirical testing. One way of avoiding such outcomes is to be aware of the pitfalls and biases of thinking, and of the pitfalls of research in general. Of course, knowledge of research methods is important in this regard. In addition to this, potential biases that might threaten the research process in general should also be considered (see Bacon, 2000; MacCoun, 1998).

Figure 2: The scientific approach of this thesis



3. Results

3.1. Paper I: The Use of Nature for Emotion Regulation: Toward a Conceptual Framework

Research and theories on the emotional effects of the natural environment, and developments in emotion theory and research and theorising on emotion regulation appears to have progressed along parallel but somewhat disconnected paths. One purpose of this paper was to bridge these two traditions. To begin with, two, related questions were posed: Firstly, what are the effects of nature on emotion and how might we understand these? Secondly, how might people use nature for emotion regulation? Published research and theory on the effects of nature is subsequently reviewed, and it is concluded that there is reason to assume that nature can be used effectively for emotion regulation. Two main reasons for this are presented. Firstly, nature can influence emotions directly; increasing positive and reducing negative emotions. Secondly, nature can influence emotions indirectly, by counteracting ego depletion and directed attention fatigue. Exposure to nature should reduce any negative side-effects of depletion or fatigue, such as heightened negative emotion, but it should also make it easier to maintain cognition-emotion integration by restoring directed attention and making executive functioning more efficient. It is also argued that there is reason to believe that the restoration of self-control strength which comes from exposure to nature is relevant for emotion regulation in a natural environment. For example, emotional suppression, which can lead to ego depletion, might be a more effective strategy in a natural environment. Moreover, it is indicated how this indirect effect could be relevant with regards to psychopathology, notably by making it easier to resist negative cognitions. Several hypothetical models are also proposed in this paper. The purpose was to suggest a framework that could form a coherent starting point for further empirical and theoretical research. This is only one of several possible ways of looking at this topic. The first model is basically a process model showing the relation between executive functioning, emotion regulation, and attention restoration. The model is not limited to the use of nature, but should be applicable to any form of environmental emotion regulation. However, this model shows how the natural environment can be

used directly and indirectly; a distinction is made between emotion regulation through a beneficial impact on executive functions, and emotion regulation by directly increasing positive emotion and decreasing negative emotion. The second model indicates how (cognitive) resource depletion and emotional distress can both lead to a need for restoration or regulation, and it is indicated that people may not be able to distinguish between these two aspects of environmental emotion regulation. This model also indicates a relation between emotion regulation and stress. The last model attempts to show how mood and personality could be related to the use of nature for emotion regulation. It is proposed that extraversion may not be directly related to the use of nature for emotion regulation, but that neuroticism could be related to the regulation of negative emotion in nature, because high scorers seek outwards for emotional stability. Moreover, it is suggested that it could be adaptive to process more negative information if the environment is restorative. A few research ideas are also discussed.

3.2. Paper II: Exploring the use of nature for emotion regulation: Associations with personality, perceived stress, and restorative outcomes

The aim of this study was to investigate possible relationships between the use of nature for emotion regulation and personality, stress, and restorative outcomes. To some extent this was an empirical exploration of topics addressed in the first paper. A survey was distributed among visitors to two natural environments. The questionnaire comprised several established measures of personality traits, perceived stress, and restorative outcomes. In addition, a few measures were constructed specifically for this study; these were items relating to the use of nature for emotion regulation and items relating to self-control strength. Exploratory factor analysis returned three factors indicating that emotion regulation in nature could be divided into one positive factor, one negative emotion regulation factor, and a factor relating to the rise of negative emotions while not in nature. The negative emotion regulation factor was correlated with perceived stress, and neuroticism. Confirmatory factor analysis was used to test a theoretical three factor model consisting of (positive) appraisal of nature, positive and negative emotion

regulation. The fit statistics of this model were acceptable. Based on theoretical considerations, a path model with personality traits as antecedents to emotion regulation, and the restorative outcome scale was tested using the structural equation modelling approach. The fit of this model was good. In this paper it was also explored whether changes in self-control strength (i.e., willpower) could be considered a restorative outcome. Interestingly, this “ego restoration” scale was positively associated with both neuroticism and perceived stress. In addition, it correlated positively with the scale purportedly measuring the use of nature for negative emotion regulation. Moreover, a traditional mediation analysis showed that negative emotion regulation mediated the relationship between neuroticism and ego restoration.

3.3. Paper III: Active use of the natural environment for emotion regulation

The third paper reports results from two studies. The aim of the first study was to conduct an experimental investigation of the use of nature for (negative) emotion regulation. The participants were randomly assigned to one of three conditions; control, manipulation, or soft manipulation. The control group received a picture of balloons and instructed to look at it (for distraction) each evening, the experimental group received two pictures of nature and instructed to bring the pictures with them and actively use them by looking at them whenever they experienced a negative emotion or needed a distraction, and the experimental group with the soft manipulation received a picture of nature with the same instruction as the control group. Positive and negative mood, and ego restoration was measured before manipulation, after one week, and finally after two weeks. The results were a bit difficult to interpret, but showed that positive mood increased in both experimental groups. In the active use group, positive mood increased but then decreased. It is suggested that it may not be recommended to rely exclusively on this strategy for emotion regulation. After two weeks ego restoration was rated higher in the combined nature group than in the control group indicating a perceived increase in self-control strength. The aims of the second study in this paper were to investigate the perception of the emotion regulatory potential of six different everyday

environments, the emotion-dependent intention to seek the same environments, and relate the perception and intention to personality and mood. Among the six environments were two natural environments; classic nature, showing greenery and water, and unsafe/atypical nature, showing a dark forest. The results showed that the classical natural environment was rated higher on emotional potential than the other environments. In addition, emotional potential was positively correlated with positive mood and conscientiousness. Furthermore, the intention to visit classic nature *when happy* correlated positively with positive mood, while the intention to visit unsafe nature correlated positively with negative mood. The results also showed that there may be gender differences with regards to intentions to seek out classic nature, but not with regards to the perception of the emotional potential of classic nature. Females reported stronger agreement with the items measuring an intention to seek nature overall. The emotional relevance of different types of natural environments was also discussed.

4. Discussion

The main aim of this thesis was to investigate the use of the natural environment for the purpose of emotion regulation. Although this topic has been touched upon in previous research, the use of nature for emotion regulation has not been focused on explicitly. Because of this, the first paper was a theoretical exploration of this topic with the intent to build a framework that might further this area of research. The paper takes a relatively broad approach and several aspects were discussed. However, theoretical and conceptual development did not stop with this paper, and the other two papers, as well as the introduction of this thesis, contain developments that grew out of this first paper. Among the most prominent may be the discussion of emotional affordances and developments relating to the strength model of self-control. In addition, it is suggested in the theoretical paper that emotion theory may benefit from considering the environment more closely. For example, it is common to assume that emotions are elicited by situations of relevance to the well-being of a person. Typically, this is a highly salient situation, for example the loss of a valued object. It is possible to consider emotions as directly connected with the environment along the lines of what Frijda (2004) has suggested; that emotions are states of action readiness, and that they connect us to the environment in a very direct way. For example, angry feelings can be experienced when adapting to an environment in a way that makes one “action ready” to potentially push through a chaotic environment, or a dense forest as one study found (Hull & Harvey, 1989). Similarly, an environment which potentially contains resources could elicit energy and other positive emotions in order to support roaming or exploration, this would also be compatible with the psycho-evolutionary theory (Ulrich, 1993) and the perceptual fluency account (Joye & van den Berg, 2011).

To some extent, the second paper begins where the theoretical paper ends. Several of the proposed models in the theoretical paper were considered, and a slightly modified version of one of the models was empirically tested. Other ideas indicated in the theoretical paper were explored indirectly. For example, correlations were found between neuroticism and negative emotion regulation, and between perceived stress and

negative emotion regulation. This indicates that the model presented in the theoretical paper, showing that antecedents of a need for restoration (and emotion regulation) can be both emotional distress and resource depletion, could indeed be a correct model. Although this may be trivial, it shows that the logic holds.

The third paper begins with the next logical step, an experimental test of the use of nature for emotion regulation. Then another study follows, considering the perception of the potential for emotion regulation inherent in a natural environment, and compares this with various other environments. In addition, the motivational tendency to seek out nature and other environments when one feels happy or sad is investigated. The study of perception takes this research in a slightly different direction to focus on possible antecedents of emotion regulation. But it also shows that people perceive a potential in nature which they do not necessarily make use of.

One contribution of this thesis is that it provides evidence for the benefits of a completely different emotion regulation strategy than those strategies emotion regulation researchers have traditionally focused on (i.e., *suppression* and *reappraisal*).

Beliefs about future events often guide our choices and our behaviours, and are of importance to self-regulation. It is surprising that self-regulation theory is so focused on feedback loops, when feed-forward systems are relatively common in control theory (e.g., Albertos & Mareels, 2010), and anticipation and orientation towards the future is so common among people, for example in relation to allostasis (see, e.g., Ganzel, Morris, & Wethington, 2010; Sapolsky, 2007; Loewenstein, 2007). When it is maintained that psychological functioning is a continuous process that extends over time and consists of several interacting elements making up a larger whole (e.g., Magnusson & Törestad, 1993), self-regulation and perception cannot be seen as static and disconnected but embedded in a person-environment system within a larger context. For example, in real life, perception is a continuous process in context and with

temporality. This point is made with regards to the concept of affordances by Heft (2003), it is further argued that values and sociocultural constraints are contained within the affordances. Self-regulation is connected to the values an individual holds, to psychological processes, to needs and the construction of meaning, but also to movements in space and time. Emotional affordances and emotional potentials indicate the possibilities inherent in different environments and as such supply a continuous framework for emotion regulation.

The association between conscientiousness and appraisal of nature reported in the second paper nicely illustrates how the concept of emotional affordance can be applied. Conscientious individuals orient themselves to a larger extent toward social norms. In the cultural context of the field study reported in paper II, natural environments are probably considered healthy, thus conscientious individuals may perceive a particular niche in this setting. This means that a set of affordances are available to them and that conscientious individuals should perceive higher emotional potential in natural environments. The third paper supports this; emotional potential was found to be positively correlated with conscientiousness. The emotional affordance of nature is embedded in a specific cultural setting, which is particularly relevant for individuals with a higher score on conscientiousness.

A particularly interesting finding was the discovery of a significant, and positive, association between neuroticism and ego restoration. The association was not strong, but it is uncommon to envision that positive experiences can be associated with neuroticism (see, e.g., Lucas & Diener, 2008). Although this may be somewhat controversial, the finding should not be dismissed too quickly because it was in fact argued in the theoretical paper that individuals with higher scores on neuroticism might benefit more from nature than those with lower scores because they enter nature in a depleted state. The relationship with the ego restoration scale indicates that this could be true.

People may perceive nature as an environment that is suitable for emotion regulation, as indicated by the results in the third paper. In fact, people may actually perceive environments they encounter in terms of emotional potential; this is partially supported by the finding that the measures for the different environments were distinct and reliable. People who rated nature higher on emotional potential also indicated that they would seek nature to savour positive emotions and regulate negative emotion – showing, perhaps, that one may perceive what one requires. These findings are relevant for the concept of emotional affordance and in fact all three papers generally point towards the importance of discussing qualities of the person-environment system. There are certain qualities (i.e., emotional affordances) to the person-natural environment system that appears to elicit various beneficial responses. The responses may be specific to a specific person-environment system; the effect may be a form of stabilisation. For example, thinking negatively may be adaptive because it could make a person more aware of threats and more likely to prepare for the future, if the person's surroundings are restorative, thinking negatively may in fact be even more adaptive.

The perception of the unsafe/atypical natural environment is in agreement with previous research documenting that feeling unsafe, or perceiving danger is a relevant factor which can hinder restoration (Gatersleben & Andrews, 2013; Herzog & Rector, 2009). In the present study the perceived emotional potential of this environment and the intention to seek the environment were relatively low, although it cannot be ruled out that other factors may have contributed to this as well. The unsafe/atypical natural environment could also be considered high in refuge and low in prospect reflecting the findings of a previous study (Gatersleben & Andrews, 2013). The intention to visit this environment when sad was associated with negative mood, and emotional potential was associated with emotional stability (neuroticism reversed). If this is considered, for the purpose of discussion, and in the context of negative emotionality, there is something strange happening here. Even though people with higher scores on neuroticism perceive a lower emotional potential in the environment, they still would like to visit it when sad. This probably indicates a congruency perspective. Certain individuals want to seek environments that are compatible with their current state. This makes sense if

maintaining the mood protects psychological integrity and stability. A dynamic systems view is in agreement with this. At some level, what we may call person-environment dissonance will be perceived as too large, and the person may unconsciously or consciously be concerned about disintegration. Dissonance is threatening system stability and emotional self-organization. In this case it may be preferred to remain in a compatible environment, than to seek one eliciting a different emotion, even though this may be considered the healthier option. In addition, the congruency perspective can help explain both why people seek situations that elicit negative emotions, and why they remain in such situations. There are probably several ways of exploring this topic, but let us begin by assuming that it is possible to have higher or lower levels of tolerance for person-environment dissonance. Low tolerance may be related to stability, but also to less seeking of situations that elicit emotion. High tolerance may be related to reactivity, or variability, and to more seeking of both positive and negative emotional situations. Although these are highly theoretical speculations, some support for this view comes from studies showing a relation between neuroticism and affective variability (e.g., Eid & Diener, 1999). Importantly, results from paper III demonstrates that a safe natural environment may be perceived as having higher emotional potential than other environments, and paper II indicates that people with higher scores on neuroticism can use natural environments to support their emotional stability. These findings show how people with higher scores on neuroticism attempt to regulate themselves.

Felt safety is also relevant with regards to psychoanalytic perspectives. Attachment to an undemanding and safe environment is probably a marker of psychological health, because this can allow for potential-space experiences, creative thinking, and the ability to reflect upon one's feelings. Of course, these are very general ideas indeed, but may point towards the relevance of natural environments in modern psychoanalysis.

4.1. Limitations and problems with the use of self-reported data

There are a number of pitfalls in science, and self-reported data can be particularly problematic. One elegant approach to identify biases and potential problems is Francis Bacon's (1561-1626) list of idols (Bacon, 2000, original published 1620). These are essentially tools for evaluating the validity of our research. Idols of the market are problems, or pitfalls, relating to the use of language, for example, we tend to believe in the existence of the concepts we use. Idols of the cave relate to ourselves as individuals; we may have our own idiosyncratic beliefs. Idols of the theatre relates to philosophical dogma, or perhaps dogmatic beliefs of a particular field or subject area. One example here may be the belief that nature is healthy. Finally, idols of the tribe relate to biases due to our human nature (Bacon, 2000). If one attempts to maintain a critical attitude towards science by being aware of these potential pitfalls of thinking it may be possible to arrive at something approximating accurate knowledge. On the other hand, not being aware of these problems could make the research at best simply irrelevant and at worst wrong. The idols would be relevant to consider both with regards to conceptual development, empirical investigations, and the process of moving between concepts and results.

To some extent, measuring emotions is unproblematic because they are subjective in nature, and the argument could be made that we should accept that people feel what they say they feel. On the other hand, we may define how our participants feel by giving them specific emotion items to rate. This limitation is related to the common-methods bias. Many people are used to talking about their feelings and this could make them believe in the existence of their feelings as latent concepts (i.e., idols of the market). Almost everyone uses discrete concepts such as *angry*, or *afraid*, to describe their experiences, and this relates directly to a point made by proponents of the psychological construction approach to emotions: Simply because people recognize their emotions as belonging to a category does not mean that this category exists as an independent entity (e.g., Barrett, 2006). According to this view, valence and arousal are the building blocks of emotional experience (Barrett, 2006). In the present context, however, this was not a

major concern because the emotion words are commonly used as descriptors. In fact, joining them together in sumscores for the purpose of statistical analyses could make the measures more closely aligned with the notion of core affect. On the other hand, it could be a problem that the effects of asking people to regulate (discrete) emotions were measured by lumping together all positive items and all negative items.

Both empirical papers applied a scale measuring perceived changes in willpower, termed *ego restoration*. As it stands, ego restoration is not directly associated with the ego depletion paradigm, pending empirical studies it remains a subjective, albeit reliable measure. It does, however, have some face validity with regards to notions of self-control strength (see, e.g., Baumeister, Vohs, & Tice, 2007). Although it is possible to be too critical, the fact remains that self-control strength is a popular concept within psychology today and the conceptual development may have been influenced by this (i.e., idols of the market and theatre). The up-side is that the empirical results should be relevant even if the relation between perceived willpower and the ego depletion paradigm turns out to be non-existent.

The measures of emotion regulation used in this thesis were mainly about behavioural choices, for example the participants were asked to agree with items stating what they often would do. These items are relatively straightforward. Either this is something you agree with (i.e., “Yes, I use nature in this manner”) or this is something you do not agree with. Some items were about reasons or motivations for seeking nature, and some were about the perceived effects of nature (e.g., emotional potential). These items are dependent upon whether people are aware of their motivations, and it would be relevant whether they accurately perceive what they might feel in the future. Research on the latter aspect indicates that people may to some extent be accurate in judging how an event would make them feel (Loewenstein, 2007). The single items measuring the emotion-dependent intention to visit the depicted environment are more problematic. Firstly, they may be less reliable because they are only single items. Secondly, and more importantly, even though the items themselves are easy to understand, (e.g., If I was sad

I would seek this environment), they contain a double task, first people must picture themselves sad, and then they must decide what they would do. At the very least they would have to decide how feeling sad would impact their desire to seek. This could make the items less valid. Third, the items are used as proxies for emotion regulation. People may not consider this to be their primary motivation to seek the environments; they could answer from the perspective of fit or from a congruency perspective. Although emotion regulation may be the relevant aspect here, directly or indirectly, it seems likely that people's motivations are organized along a continuum, and this continuum may not relate directly to level of agreement with the items. For example, strongly agreeing to seek an environment when happy may be about savouring happy feelings for some people, while for others this might not be important at all. In addition, there is always a possibility that unconscious processes could be relevant.

4.2. Limitations with regards to the samples

The sample with the largest potential for being biased is the experimental study sample (paper III). There may have been a type of self-selection into the study, firstly because not everyone agreed to receive an envelope (and to participate) at baseline, and secondly because there was some dropout from baseline to the next measurement point. Those that participated were probably interested in participating in an experimental study and could potentially belong to a rather specific group of people. This is a threat against the potential of generalising the findings to other populations (i.e. external validity). The groups were of similar sizes so it was not the case that one condition was more popular than another, and therefore the attempted randomisation was not threatened by the dropout (i.e. internal validity).

Steps were taken to avoid any systematic sampling bias in the field study, for example by attempting to approach everyone within an area. It remains a possibility, however, that people may have observed that questionnaires were distributed and because of this may have quickly left the area. Of course, the sample may have been biased to begin with. People visiting these natural environments may share certain characteristics. Of

course, conducting the study in these areas was done intentionally to reach individuals that might have experience with the phenomenon of using nature. Generalisation was not directly an aim of this study, although a conceptual generalisation would be relevant. For example, it is probably not the case that the use of nature for negative emotion regulation is associated with neuroticism in the general population, but the finding indicates a potential in this regard.

The sample used in the survey study using environmental stimuli consisted of students at a Norwegian university college, studying various subjects. The sample was relatively large, and may to some extent be representative of a general student population, but the findings may indicate only how relatively young people feel about the different environments. More experience with different settings may change how one views them and older adults could respond differently to these environments. It is worth mentioning that there are other limitations with the use of student samples as well. For example, there may be less variation than in a sample of the general population, the distribution of individual differences, not limited to personality, may differ. Furthermore, student samples are more homogenous with regards to age and probably also more homogenous with regards to culture than the general population. These limitations apply to both studies in paper III and may threaten the possibility of generalising the results.

In all studies, more females than males participated. This was most pronounced in the experimental study. While this makes generalisation an issue, it could also help explain the findings. Results from the survey study (paper III) indicate that females may to a larger extent use nature to regulate negative feelings, and it was also this aspect that predicted positive mood in the regression analysis. Perhaps if more females had participated, the results would have been stronger. Although at present this is mere speculation, it may be worthy of further study.

4.3. Limitations with regards to the environmental stimuli

With regards to the experimental study, one limitation is that the pictures were only pictures. The pictures were static and the participants may have habituated to them over time, particularly the experimental group who were asked to bring the pictures with them.

It is possible that mediated nature affects us differently than real nature (Kahn, Severson, & Ruckert, 2009). One study compared reactions to a simulated natural environment with a real natural environment. A phenomenological analysis was conducted and showed that when exposed to simulated nature the participants reported experiencing feelings of well-being and positive emotions, but also a great deal of negative experiences were reported, the authors suggest that the lack of a complete scenery was frustrating to the participants. However, physiological measures were also analysed, and both environments were found to be stress reducing (Kjellgren & Buhrkall, 2010).

The survey study reported in paper III used only six pictures to represent six different environments. This is potentially a serious limitation. The findings could be restricted to these specific pictures and not relevant for other similar environments. However, the pictures were validated by two separate focus groups, the first group rated a selection of pictures on category fit, and the second group produced basic associations to the six selected pictures. This procedure demonstrated that at least four of the pictures adequately represented their category. These were the classic natural environment, the shopping mall, the living room, and the urban environment with people. Accordingly, the responses to these four pictures may be relevant for other similar environments as well.

4.4. Other limitations

It is possible that the popularity and impact of the process model of emotion regulation (Gross, 1998), has biased the research presented in this thesis (i.e., the idols of the theatre). For example, the aspect of rising negative emotions when not in nature might have received more attention had it not been for this model. On the other hand, the results of the factor analyses of the emotion regulation items appear to be in agreement with the basic assumptions of the process model. Furthermore, the empirical results presented in this thesis are not dependent upon the validity of this model, and may in fact be compatible with several perspectives on emotion regulation (see Gross & Barrett, 2011).

In the experimental study, the participants were asked to use pictures of nature for emotion regulation. How this was done was up to the participants. Some participants may have followed the instructions more conscientiously than others. It is also possible that the control group and the soft manipulation experimental group used their pictures for emotion regulation.

4.5. Applications and recommendations

People may be encouraged to use nature to regulate themselves. This is likely to be relevant both with regards to the prevention of psychological disorder, and everyday emotional and cognitive functioning. Easy access to nature, for example green spaces indoors and outdoors, at work, and in educational institutions may be beneficial. Indeed, this may be a perspective to consider with regards to societal planning. Using nature for emotion regulation is a strategy which is relatively easy to implement and learn, and may be an alternative for people who utilize unhealthy strategies to regulate their feelings. In a work setting, using nature may support the recovery process, help reduce cognitive fatigue, and perhaps even increase creativity.

4.6. Conclusions and suggestions for further research

This thesis explores the use of nature for emotion regulation. The three papers indicate that such usage may be beneficial. The field study showed that restorative outcomes were associated with the use of nature for emotion regulation. The survey study showed that people perceive nature as an environment that can be used for emotion regulation. Finally, the experimental study showed that using nature to regulate negative emotions can increase positive mood, but also that the strategy may be less effective over time, and perhaps not any more effective than looking at a picture of nature each evening. Independent replications would be extremely valuable, and could strengthen or weaken these conclusions.

Taken together, the studies indicate that it is highly unlikely that the emotion regulation strategy (nature usage) is harmful, and that it probably is beneficial. It is well known that emotion regulation strategies can be both healthy, and unhealthy (e.g., Gross & John, 2003), and therefore it is important to point this out.

Further studies in this area could move in several directions. Researchers could consider the antecedents of emotion regulation, for example studying the long term impact of the emotion regulation strategy explored in this thesis on neuroticism and emotional distress, but also attempt to clarify the impact that nature exposure could have on individuals with higher scores on neuroticism.

It seems possible that nature usage could be integrated with traditional psychotherapy; perhaps emotionally challenging therapies might benefit more from such integration. Although exactly how psychotherapy could be integrated with nature usage needs more research.

Declines in depression scores during horticultural therapy have been reported (Gonzalez, Hartig, Patil, Martinsen, & Kirkevold, 2010). One possible explanation for such findings is that horticultural therapy, and other nature based therapies, capitalize on the emotion regulatory properties of nature. Perhaps a more direct focus on emotion regulation in such therapeutic approaches might increase their effectiveness.

Environment-focused emotion regulation in general could be extensively investigated. One might begin by gathering studies that have touched upon the topic already.

In modern society it seems that people are still searching for ways of clearing their minds and handling their everyday emotions and stress. It seems unlikely that people are any less stressed today than in previous ages. Granted, stressors such as famine and epidemics may have become less relevant, but modern life continuously bombards us with irrelevant noise, distractors, and tempting offers of goods and experiences. Entertainment is constantly available. Many of the constraints that were in place in previous ages have been removed while more temptations appear to have been added. This situation only benefits those of us with high levels of self-control. Ego restoration becomes a necessity in modern society. Environments that are undemanding are too far between, and should be made available, without such environments people are likely to become more stressed and less creative. People probably rely extensively on distractions or intrapsychological strategies for handling their emotional burdens, whereas using the natural environment is a different way of achieving psychological stability. Perhaps having a quiet moment in a natural environment actually allows a person to solve an emotional problem rather than be continuously distracted from it.

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Papers I - III

Paper I

The Use of Nature for Emotion Regulation: Toward a Conceptual Framework

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Abstract

The intention of this work is to explore the concept of emotion regulation in nature. Natural environments can potentially have direct and indirect effects on emotional processes—directly by activating or reducing emotions, and indirectly by influencing other important processes related to emotions or emotion regulation. Executive functioning and certain aspects of self-regulation are fundamental for emotion regulation, and research indicates that exposure to nature may have a beneficial impact on these functions, for example, by making it easier to think about feelings. Research also demonstrates that exposure to nature may increase positive emotions and decrease negative emotions. In general, people may be more or less aware of the effects of nature and more or less inclined to regulate emotion in nature. However, natural environments can be used instrumentally to achieve emotional effects, and there is reason to believe that some people do so. The regulation of emotion in nature can be considered as belonging to the situation selection and situation modification stages in the process model of emotion regulation. Individual differences in how environments are perceived, and in strategies for regulating emotions, indicate that for some people the presence of nature may be central to psychological health.

In comparison to urban and synthetic environments, spending time in nature may be more beneficial to emotional processes. Experimental evidence indicates that positive emotions increase and negative emotions decrease when participants are exposed to

natural environments (Hartig et al., 1991, 2003; van den Berg et al., 2003). Natural environments are also reported as being better suited for reflection (Herzog et al., 1997; Kaplan & Kaplan, 1989). A recent review of 25 published studies concluded that natural environments may have positive effects on well being (Bowler et al., 2010). However, the topic of emotion regulation in nature has not been adequately explored. A search using the PsycInfo database limited to “emotion regulation and natural environment” returned only seven citations, and arguably, only one relevant item. The purpose of the current work is to conceptually explore the regulation of emotions in nature. The literature will be systematically examined in an attempt to build a bridge between theory and research on emotion regulation, and natural environmental psychology.

Research indicates that natural environments have specific and measurable effects on everyone, that is, objective effects. However, people may be more or less aware of these effects and may turn to nature to varying degrees and for various reasons, that is, subjectively. A conceptual discussion on emotion regulation and natural environments, therefore, needs to address two related questions:

1. What are the effects of nature on emotional processes, and how can we understand them?
2. How might people use the environment for emotion regulation?

What Is Nature?

It is difficult to exactly delineate what a natural environment is. For example, one might ask how many and what kind of natural elements should be present for an area to be regarded as nature. A small park with vegetation and some trees could be considered a natural environment in the sense that it may offer at least some of the potential benefits of nature. The potential for restoration is most likely central to the use of nature, and natural environments are perhaps the most typical example of a restorative environment (Kaplan, 1995; Kaplan & Kaplan, 1989) (see next section). For many of us, going out into nature would mean seeking an environment that

is different from an urban environment, dominated by natural elements, and sufficiently large for us to experience some level of absorption in this environment. A prototypical example could be a green landscape with trees, hills, and perhaps a stream, with limited or minimal human impact.

The notion of a natural environment is not unitary in the research literature. About a third of the studies on health effects and nature focused on comparing natural and urban environments (Velarde et al., 2007). Within environmental psychology, research on the effects of natural environments is often synonymous with research on restorative environments. Research may be conducted in the field (e.g., Berman et al., 2008; Hartig et al., 2003) by using films (e.g., Laumann et al., 2003; van den Berg et al., 2003) or with pictorial stimuli (e.g., Berto, 2005). Some relevant studies also have considered favorite places, where natural environments may be overrepresented or form an important category (e.g., Korpela, 2003; Korpela & Hartig, 1996). For an environment to be categorized as natural, it may be sufficient that it includes some natural elements (Korpela, 2003; Kuo & Sullivan, 2001). Related to this issue are questions regarding level of exposure: how much nature and for how long is it necessary for there to be a detection of effects? Here, the results are mixed. Mediated nature, for example, films of scenery, may not have the same effects as real nature (Kahn et al., 2009), but even pictorial stimuli of rather short durations may have positive effects on attentional resources (Berto, 2005). One study that has investigated wilderness experiences indicates that longer exposure can be related to a greater degree of restoration; the wilderness areas in this study were mountainous terrains with forests, meadows, and lakes (Cole & Hall, 2010). On the whole, it appears that more research is needed regarding the effects in relation to the level of exposure.

Restorative Environments and Emotions

Environments can influence emotional processes both directly and indirectly. One example of a direct influence could be a specific environment that tends to activate certain emotions. Indirectly, environments may influence other processes that could, in turn, be relevant for emotional processes. For example, it may be difficult to concentrate in noisy environments, which, in turn, makes it difficult to process emotions. Some environments might have similar effects on almost everyone, but there may also be individual variations. This points toward the importance of considering the transaction between an individual and the environment, as not all individuals are affected by the environment in the same way. Let us consider two persons who both become angry in noisy environments: one of them is able to concentrate and self-regulate, whereas the

other cannot. Theoretically, restorative environments make it easier for us to concentrate.

Researchers often rely on two theoretical frameworks when investigating restorative environments: attention restoration theory (Kaplan, 1995; Kaplan & Kaplan, 1989) and a psychophysiological theory of stress reduction (Ulrich, 1993). These theories can be seen as complementary and are similar in that both regard natural environments as offering the potential for recovery from a depleted state, such as stress or directed attention fatigue.

Attention restoration theory considers directed attention, that is, an effortful and voluntary ability to focus and inhibit distractions (Kaplan, 1995), to be a limited resource which can become fatigued by sustained effort. Natural environments are one typical example of settings that restore this resource (Kaplan, 1995). According to Kaplan & Kaplan (1989), restorative environments have four factors or qualities which contribute to the restoration of attention: *being away* from your normal surroundings; *compatibility* between what you want to do and what the environment affords; an environment of sufficient coherence and scope, termed *extent*; and, finally, restoration is more likely to happen when attention is directed toward something that is interesting and yet undemanding, a concept termed *fascination* (Kaplan & Berman, 2010).

In general, empirical findings offer support for attention restoration theory (Kaplan, 1995; Kaplan & Berman, 2010). For example, two groups of students were tested on the digit-span backward task before and after a walk in a natural and urban environment. Research participants first performed a task designed to fatigue their attentional resources and then went for a walk either through a natural park or downtown in a city. The researchers concluded that only the walk in the natural environment restored attentional resources (Berman et al., 2008). In another study, two groups of participants were exposed to a series of pictures of nonrestorative or restorative environments. A continuous performance test, which was itself fatiguing, was used to measure sustained attention, and those exposed to restorative environments improved their performance significantly on three measures. Interestingly, performance on one measure also improved after exposure to the nonrestorative environment (Berto, 2005). The study also investigated between-group differences, and the group exposed to restorative environments scored significantly better on a reaction time measure, but differences between groups on the other measures were nonsignificant (Berto, 2005).

According to Ulrich's (1993) theory, we are to some extent genetically predisposed to prefer certain natural environments, typically environments that have been particularly important with regard

to survival, food, water, and safety for early humans. Further, being able to relax and be restored in nonthreatening environments may have offered certain advantages. Due to this, human beings have innate and adaptive responses to natural environments that lead to their recovery from psychophysiological stress (Ulrich, 1993). When the environment itself was not dangerous, it may have been adaptive to respond with feelings of safety and restoration. There is also some logic in feeling safe in an environment of high survival value, because it could increase the likelihood of remaining there. An exposure to restorative environments will elicit a range of responses: increased positive emotions, reduced negative emotions, reduced physiological arousal, and decreased stress responses (Ulrich, 1993). This could also be considered a theory of emotion regulation, because it specifies the effects of natural environments on emotional processes, and because it includes preferences.

Research indicates that the exposure to natural environments may lead to reduced physiological arousal. In one study, two groups of research participants watched a film of a natural or urban environment while their cardiac inter-beat interval was measured, and lower heart rates were found in the group exposed to nature (Laumann et al., 2003). The study by Hartig et al. (2003) also supports the stress-reducing effects of nature. Although significant differences in blood-pressure readings could not be established in a comparison of those who had taken a walk through a natural environment with those who had taken a walk in an urban environment, there, nevertheless, appeared to be an effect of the environment. Further, they have found that sitting in a room with a window that affords a view of nature (trees and hillsides) reduced blood pressure more than sitting in a room without a window (Hartig et al., 2003).

Although the effects of nature on physiological measures may not be that large, the effects on self-reported emotional states appear to be greater (Bowler et al., 2010). A number of studies have demonstrated that going for a walk in a natural environment reduces negative emotions and increases positive emotions (Berman et al., 2008; Hartig et al., 1991, 2003). One study has explored emotional restoration in natural and urban environments. The research participants viewed a frightening film followed by a filmed walk through either a natural or an urban environment. The self-reported emotions before and after the film demonstrated that the viewing of the nature film increased happiness and reduced negative emotions. Some degree of emotional restoration could also be inferred from the reports by those viewing the urban film (van den Berg et al., 2003).

Kaplan & Kaplan's (1989) four components of restorative environments may be relevant to emotional responses. Research participants in one study imagined themselves in three different places (a

city centre, their favorite place, and an unpleasant place), then rated their emotions, and completed the Perceived Restorativeness Scale (Hartig et al., 1997; Korpela & Hartig, 1996). All factors except coherence significantly correlated with positive affect for all three environments. Coherence, which should be closely related to *extent*, significantly and negatively correlated with anger/aggression (Korpela & Hartig, 1996); in other words, environments lacking in coherence may make us angry.

Emotion Regulation in Natural Environments

Emotion regulation has not been a primary focus in research on effects of natural environments, although some relevant perspectives can be found in research on favorite places (e.g., Korpela, 2003). The purpose of this section is to integrate some relevant results from environmental psychology with the concept of emotion regulation, as it is used in other areas of psychology.

At first glance, the literature on emotions and feelings may appear confusing. For example, different researchers use the same terms for different phenomena. However, Gross (1998) appears to have identified a consensus: emotions are responses to events that we evaluate to be relevant to us (by offering us challenges or opportunities), for example, losing or finding something of value, and emotions tend to lead to experiential, behavioral, and physiological changes. This is quite similar to Frijda (1988), who considers emotions to be responses to events that are important to us. These responses are subjective experiences, often overt behavior, a specific state of action readiness, and physiological changes that can support action, including hormonal and autonomous activation. Izard (2007) distinguishes between basic emotions, that is, rapid and partially nonconscious responses, and emotion schemas, which are a more complex and organized integration of cognition and emotion. These definitions could be considered as belonging to an emotions-as-entities approach. See Barrett (2006) for an important discussion on this view and on basic emotions. See also Scherer (2004) for an interesting approach where subjective experience or feelings are considered as a monitoring component that integrates all other responses. What we mean by emotions and how they are necessarily defined influence our views of emotion regulation. If feelings are seen as readouts that integrate all other responses, then they would be considered more important than if they are seen as more peripheral or epiphenomenal.

Although this may seem somewhat academic, emotion and emotion regulation can be distinguished from mood and mood regulation by differences in duration and intensity. Moods are typically longer in duration, forming something such as a background feeling (Gross, 1998; Larsen, 2000).

The environmental perspective may not have been adequately explored in emotion theory. As was stated earlier, environments that lack coherence may make us angry. Changes in emotional arousal may be needed to operate efficiently in different environments. These changes can be related to the physiological responses that support a state of action readiness (Frijda, 1988). Speculatively, a certain level of arousal may be needed to operate efficiently in a noisy environment, and this arousal could be interpreted as anger. For example, one study has demonstrated that arousal increases when undergrowth is heavier (Hull & Harvey, 1989). Emotions and environments appear to be tightly coupled.

Emotion regulation can be more or less automatic, and a more or less conscious or unconscious process (Gross & Thompson, 2007). We can choose to put ourselves in situations where we know we shall feel good, or we can choose to do something about those situations that do not have the emotional outcomes we want. We can choose to do this consciously because of previous learning, or we can do this without thinking about it. Emotion regulation can dampen, increase, or sustain an emotion, and it comprises processes that influence the experiential, physiological, and behavioral components of emotions (Gross & Thompson, 2007). A process model of emotion regulation has been proposed encompassing five families of strategies: *situation selection*, *situation modification*, *change of attentional focus*, *cognitive change*, and *response modulation* (Gross, 1998). The strategies take place at different stages in the emotion-generating process; the first four have been termed *antecedent focused*, and *response modulation* has been termed *response focused* (Gross, 1998; Gross & Thompson, 2007). Strategies may influence the onset, duration, or intensity of emotion. *Situation selection* involves choosing situations that make it more likely to experience the emotions one wants, but it can also be about avoiding situations. *Situation modification* involves changing situations once they are selected. The two other antecedent-focused strategies relate to changing what one attends to in a situation, and changing what one thinks about a situation, for example, a reappraisal. Suppression of emotional response is an example of *response modulation*. It is important to note that *response modulation* also involves behavior that may influence the situation and lead to *situation modification* (Gross, 1998; Gross & Thompson, 2007).

During a day, one moves through different environments and different emotions, and one may experience a need to consciously seek suitable environments and situations for regulating emotions. These processes may also operate subconsciously. For example, after a particularly stressful day, one may find oneself walking a slightly different route home than usual without having thought about it, or

one might visit a particular restaurant. Investigating both the conscious and subconscious processes that are activated could be very fruitful research.

Theoretically, one factor from Kaplan & Kaplan's (1989) attention restoration theory could share features with Gross' (1998) process model of emotion regulation. *Being away* comprises elements of *situation selection* and *situation modification*, but where situation selection is about choosing a setting, being away is about how the setting is perceived. By employing situation selection, people may choose to put themselves in restorative environments. This point will be returned to in a later section.

There is reason to believe that antecedent-focused strategies are more effective. In addition, they appear to be positively related to psychological well being. The greater use of reappraisal has been found to be related to higher levels of psychological well being, higher levels of positive emotions, and lower levels of negative emotions (John & Gross, 2007). Schutte et al. (2009) included all antecedent-focused strategies in their study and have demonstrated correlations with psychological well being and emotional intelligence. Experimental studies indicate that emotional suppression, a response-focused strategy, does not reduce the subjective experience of negative emotion, and may even increase it. On the other hand, it appears to be possible to suppress positive emotions (John & Gross, 2004). Further, emotional suppression appears to be taxing. An increase in physiological activation similar to stress responses was found when participants suppressed their responses, but not when they used reappraisal (John & Gross, 2004). This may also apply to interpersonal regulation. When interaction partners suppressed their emotions, increased physiological activation could be observed in the (nonsuppressing) participants (John & Gross, 2004). It is important to point out that all strategies for emotion regulation can be adaptive or maladaptive; for example, with the latter, they can serve to maintain psychopathology (Campbell-Sills & Barlow, 2007). A longitudinal study followed students for almost 2 years and concluded that emotional suppression was an important strategy. Those who had the ability to use this strategy reported lower levels of distress by the end of the study. The flexible use of different strategies may be important (Bonanno et al., 2004). Several studies have demonstrated that suppressing emotions is a cognitively demanding type of regulation. Suppressing emotions increases the cognitive load so that less is remembered from conversations or pictures shown (John & Gross, 2004). Although suppressing emotions may not be beneficial in general, there may be situations where it would be more sensible to suppress an emotion, at least for a while, in order to maintain social relations or to act in accordance with what is socially acceptable.

Having the ability to use several strategies is probably advantageous (see also the section on personality).

Let us return to the idea that an environment can have direct and indirect effects on emotional processes. An environment has the potential to directly increase or decrease our emotional responses. One example is the emotional effects of specific natural environments in Ulrich's (1993) theory. Indirect effects of an environment invoke other mental processes such as attentional processes, executive functions, self-regulation, or other cognitive functions, which, in turn, have an effect on emotions or emotional processes. The important factor here is that environments have an effect on these processes.

If it can be shown that, for example, executive functioning is important for emotion regulation, and executive functioning is more efficient in natural environments, then this would be an example of an indirect effect. See Figure 1 for an illustration of the ideas discussed next.

Emotion regulation can be considered a problem-solving activity where one evaluates the current emotional state, defines a goal state, formulates a plan for achieving this state, executes the plan, and evaluates the outcome. Accordingly, it is dependent on executive functioning (Zelazo & Cunningham, 2007).

Kaplan & Berman (2010) have proposed that both self-regulation and executive functioning depend on a common resource, namely, directed attention. An important element of self-regulation is the ability to apply effort in order to achieve one's goals, although this ability appears to be limited and may become fatigued with use (Gailliot et al., 2008). This fatigued state has been termed *ego depletion*, and it has, for example, been demonstrated that emotional

suppression can lead to ego depletion (Baumeister et al., 1998). According to Kaplan & Berman (2010), there is a considerable overlap between directed attention fatigue and ego depletion. Further, although the empirical evidence for linking these concepts may be somewhat limited, as indicated by Kaplan & Berman (2010) themselves, they, nevertheless, present a convincing case for their relatedness.

The developmental literature has also employed a similar concept. Executive attention refers to the volitional control of attention and includes the focus of attention on targets, resisting interference, and resolving conflicts among processes by, for example, the inhibition of inappropriate responses (Rueda et al., 2005). Individual differences in executive attention have been linked to effortful control, which is a temperamental concept and refers, among other things, to how well this ability functions (Rueda et al., 2005). A higher level of effortful control is probably related to social competence, general adjustment, and more efficient emotion regulation (Eisenberg et al., 2007). However, the concept of effortful control appears to include more than just a limited resource for self-regulation. Interestingly, a task often used in developmental literature to study effortful control and executive attention is a children's version of the task used by Berman et al. (2008) to demonstrate how exposure to nature restores attentional resources (Fan et al., 2002; Rueda et al., 2004).

One example can serve to illustrate the relevance of this for emotional processes. If one's preferred strategy for emotion regulation is emotional suppression, then an exposure to natural environments may help one from becoming too fatigued. The indirect route may also have some relevance with regard to depression. It has been

shown that thought suppression may be exerted by people vulnerable to depression in order to avoid negative thinking, and since this activity is effortful, depressive episodes may occur when people are mentally fatigued, or conversely, when the cognitive load is high (Wenzlaff et al., 2002). Hypothetically, exposure to nature could also make it easier to use an inefficient strategy. Kuo & Sullivan (2001) have investigated whether the proximity to natural surroundings might have any impact on anger and aggression, because irritability can be a consequence of directed attention fatigue (Kaplan, 1995). The sample consisted of women living in a relatively poor area of a city, whose close proximity to natural elements

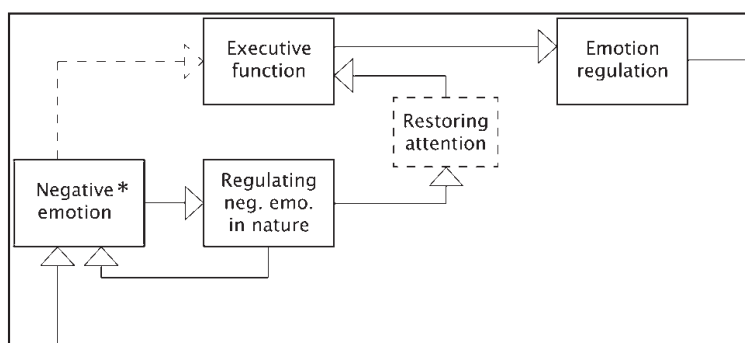


Fig. 1. Regulation of emotion in nature (* or anticipated emotion).

appeared to have a significant impact on anger and aggression. The connection to directed attention fatigue was supported as well (Kuo & Sullivan, 2001). The exposure to nature not only directly impacts emotion, but may also impact other relevant processes for emotion regulation (Fig. 1). People who make use of nature for emotion regulation may not be able to distinguish between the two.

Place Attachment and Emotion Regulation

Processes of attachment and emotion regulation are highly related. Feeling safe is the goal of the attachment system, and in a well functioning dyad, emotion is regulated, for example, to support exploration (Sroufe, 1996). Morgan (2010) discusses how place attachment may develop from a child's movements between caregiver and place: positive emotions arise in connection to the mastery and exploration of a specific place, but distress leads to the seeking of the caregiver. The possible next step may be to experience safety in the place, and feelings of security did indeed emerge as a theme in the narratives reported by Morgan (2010). It may even be possible to speak of the place as a secure base, and even nature itself as a secure base, as indicated by Jordan (2009). Although an interesting idea, this stretches the concept of the secure base. However, should we follow this line of thinking, despite having some reservations, people may enter into relationships with specific natural places, feel safe, and feel soothed by being in a specific place. The use of favorite places for self-regulation may not be that uncommon as discovered by Korpela (1995): retrospective essays written by adolescents were analyzed, they seemed to indicate that people use their favorite places for self-regulatory purposes, including emotion regulation (Korpela, 1995), and so there may be some merit to this idea. Positive emotions related to mastery should be an important part of people's emotional experiences in nature.

Perceiving Emotional Affordances?

Following the evolutionary informed logic of Ulrich (1993), many of us should perceive specific natural environments as being better suited for creative thinking and reflection on feelings. Some environments may be implicitly perceived as suitable for emotional expression, whereas others are not. Thus, there may be important individual differences. For example, not everyone would feel comfortable expressing anger while standing in line waiting, but some do. In addition, some environments may be perceived as risky and dangerous and not at all suitable environments for reflecting on feelings. To some extent, a situation may afford the expression of a certain emotion. Gibson's (1986) theory of affordances considers the relation between an individual and the environment; that is to say,

the fit between what the environment provides and some behavior is immediately perceived. One part of this fit is termed *affordance*, and it refers to the properties of the environment in relation to this behavior (Gibson, 1986; Greeno, 1994). Emotional affordance would then refer to aspects of the environment that allow for the expression of certain emotions. Although some feel free to express themselves in any environment, many of us may experience today's hectic environments as unsuitable for the expression of emotional feelings. So, an environment can not only activate certain emotions, but also afford the expression of certain emotions to varying degrees. This factor can be considered to be related to the concept of compatibility as well (Kaplan & Kaplan, 1989). Some may perceive natural environments as being better suited for thinking about important events, for deeper reflection, and perhaps for experiencing or regulating emotions. When experiencing a negative emotion, some may perceive an incompatibility with their normal environment, and seek natural environments instead. Studies by Korpela (1995, 2003) offer some support to this view, as the respondents tended to report that negative feelings or life events often preceded their visits to favorite places, and after their visits, they reported less negative and more positive feelings.

Activating Positive Emotions Is One Path to Restoration

Manipulations that elicit mild positive emotions have beneficial effects on thinking, motivation, and social perception [see Isen (2004) for a review]. Attempting to increase positive emotions can be a strategy for reducing negative emotions. Then, there is reason to believe that positive emotions can have this restorative effect, for example, with beneficial impacts on the physiological effects of negative emotions (Fredrickson, 1998; Fredrickson & Levenson, 1998). In addition, according to Fredrickson's (1998) broaden-and-build theory, positive emotions may influence thinking so that it becomes more flexible and creative. Moreover, Ulrich (1993) links this to the possibly adaptive value of being creative in specific natural environments. Thus, activating positive emotions may reduce negative emotions and benefit cognition. It has also been shown that positive emotions may, to some extent, counteract ego depletion (Tice et al., 2007).

Using Nature for Emotion Regulation

As human beings, we adapt and use our surroundings in various ways. The idea explored here is that different environments could be used as a means in order to achieve emotional ends. Specifically, the central idea here is that some people may utilize the natural

environment as an environment conducive to emotion regulation. Another example of this view can be found in research by Korpela (e.g., 1995, 2003). This depends on their knowing something about the effects of nature. This kind of knowledge is an important component of effective emotion regulation (Wranik et al., 2007). It is not necessarily the case that people are completely aware of all the effects that nature has on them, nor of the processes that lead them to spend time in nature. All the same, some level of knowledge should be an important part of an environmental usage perspective on emotion regulation. In addition, proximity to nature may be relevant.

We like some environments better than others. The motivations for approaching certain environments and avoiding others may, at least in part, be based on preferences. Speculatively, an organism may construct these preferences based on needs. Accordingly, environmental preferences may be one example of how we become aware of a need for environmental change. How could this occur? Research on environmental preferences and attentional fatigue illustrates this point. Students reported preferences for a walk in a natural and an urban environment early in the morning and in the afternoon after a lecture, with low and high conditions of attentional fatigue, respectively. Although natural environments were highly preferred in both conditions, the difference in preferences was significantly larger in the high-fatigue condition. Preferences for the urban environment were also significantly lower in the high-fatigue condition than in the low-fatigue condition (Hartig & Staats, 2006). Intentional change of environment could be considered a strategy for restoring attentional resources, as well as a strategy for regulating emotions. Negative emotion appears to influence self-regulation negatively (Baumeister et al., 2007), and directed attention fatigue leads to less effective thinking and self-regulation (Kaplan, 1995), possibly creating a negative spiral. People who use environmental strategies may not necessarily distinguish between impaired thinking caused by emotional distress and impaired thinking because of directed attention fatigue, particularly so if they are in a negative mood. Further, the need for nature may arise in both conditions (see Fig. 2 for an illustration). The preference for nature should be particularly strong when directed attention is fatigued and the presence of negative emotion is strong. We obtain information about the environment through our emotional reactions and adapt accordingly. In a modern urban environment, it may be difficult to benefit from adaptive responses, as these may not be activated. Even though there may be a preference for nature, this particular environmental option may not be available. The negative spiral just mentioned could clearly be exacerbated in an urban environment. Conversely, if available and used, nature could remedy this. Some support for the beneficial effects of using nature for emotion regulation comes from one recent ecotherapy program (see Mind Ecoterapy Report, 2007).

Environmental strategies for emotion regulation, such as using nature for emotion regulation, may in general be considered to belong to the families of situation selection and situation modification. Regulation of positive emotion in nature should be considered a variant of situation selection, because we seek nature in order to experience positive emotions, that is, to activate them. However, it could also be the case that one wants to upregulate or maintain an already activated positive emotional state, and, thus, in this case, the strategy would belong to the family of situation modification. Regulation of negative emotion in nature should be considered a variant of situation modification, because we seek nature in order to reduce negative emotions, that is, to reduce them once they have been activated. For example, if one were to suggest a relocation of a discussion to the park in order to reduce tensions, this would be an example of situation modification.

Theoretically, people could try to use natural environments to upregulate negative emotion and to downregulate positive emotion; but, in practice, people probably expose themselves to nature in order to upregulate positive emotion and downregulate negative emotion.

Of course, emotion regulation in nature could also be about pure avoidance, that is, running away before an unwanted situation arises. However, in this case, many situations could hypothetically suffice, and it may not necessarily be about nature. However, it is important to consider that we may feel pushed from our normal environments into natural environments not because of the benefits of nature but because of unwanted aspects of our normal environments. We could

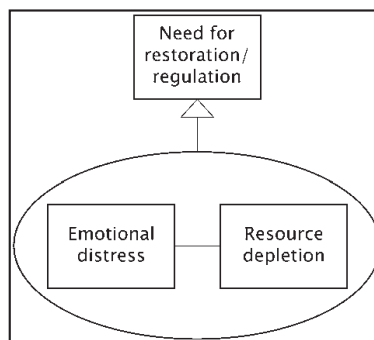


Fig. 2. Antecedents of regulation and restoration.

also consider this in terms of push and pull motivations. If we are pushed toward natural environments because of some aversive event, such as emotional distress, then emotion regulation in nature would be considered a modulation of response that leads to situation modification. If we are pulled toward nature because we believe it will have positive emotional effects, then emotion regulation in nature would be considered as situation selection. All of these strategies, to some extent, depend on the proximity to nature.

Personality May Influence Strategy Choices

Several studies have documented a relationship between mood and personality traits. Positive affect has been associated with extraversion, whereas negative affect has been associated with neuroticism (e.g., Costa & McCrae, 1980; Watson et al., 1999). This may be not only because of general differences in mood, but also because individuals high in neuroticism react more strongly to negative emotional stimuli and those high in extraversion react more strongly to positive emotional stimuli (Gross et al., 1998). Personality traits may be relevant for emotion regulation as well. Gross & John (2003) have found that emotional suppression was negatively related to extraversion, whereas reappraisal was negatively related to neuroticism. Further, it has been demonstrated that persons high in extraversion maintain a positive mood better than low scorers do (Lischetzke & Eid, 2006). The use of nature to increase positive emotion could be more common among those high in extraversion. On the other hand, people low in extraversion may be more comfortable in expressing emotions when alone. In addition, if your preferred strategy for emotion regulation is suppression, then this may be easier to do in nature through the indirect route (Fig. 1). Those who are high in extraversion probably perceive very different emotional affordances compared with those who are low in extraversion. Some might regard social situations as an opportunity for emotional expression, whereas others opt for suppression in such circumstances.

It seems likely that personality can impact mood by acting as a set-point stabilizer or by influencing strategic choices, and subsequently emotion and mood (Fig. 3). John & Gross (2007) have predicted that neuroticism is negatively related to nearly all emotion regulation strategies. However, people high in neuroticism may to a larger extent rely on environmental strategies, thus seeking outside themselves the emotional stability they lack. For example, a recent study has found a positive association between neuroticism

and the use of music for emotion regulation (Chamorro-Premuzic & Furnham, 2007). In earlier times when natural environments were more immediately available, the time spent processing negative emotional information may not have been as taxing as it can be today. Speculatively, it may even make evolutionary sense to process a lot of negative information given that safe natural environments have emotionally restorative effects. One idea that could be further researched is that there is a positive relationship between neuroticism and the regulation of negative emotion in nature.

A Few Suggestions for Further Research

There are several possible avenues for research based on what has been discussed here, as well as some unanswered empirical questions. The similarities between ego depletion and directed attention fatigue need to be experimentally explicated. Spending time in a natural environment appears to be beneficial, but the most relevant environmental components and what duration is necessary to experience gains merit research. Further, the functional elements of ecotherapy could also be more closely examined.

More studies on the emotional restorative effects of nature would strengthen this research area. One example may be the use of emotion induction procedures, and it would also be interesting to consider combining this with directed attention fatigue. If this is found to be detrimental, then one might wonder about the long- and short-term consequences of combining negative emotion and directed attention fatigue. What happens to emotion regulation when restoration is difficult?

Research in this area might also be relevant for psychotherapy. In psychotherapy, the ability to tolerate experiences without becoming too disorganized is often an important task; some level of

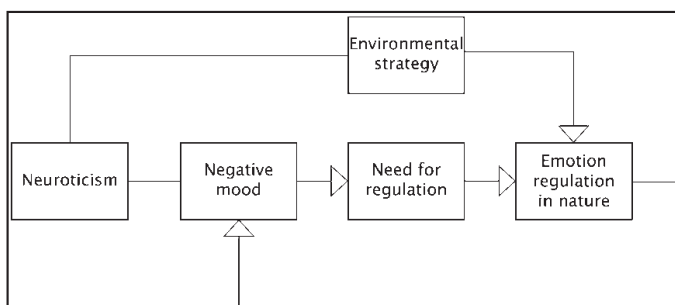


Fig. 3. Personality and emotion regulation.

exposure to the natural environment may be beneficial in this regard. The dynamic integration of cognition and emotion may be more easily achieved by increasing the restorativeness of a typical therapeutic environment. As such, integration may be desirable; clinical researchers might find it rewarding to consider the physical environment as well.

The idea that those of us with higher scores on neuroticism may benefit more from nature should perhaps be explored further. However, it is important to note that this is not about neuroticism *per se*. Visiting a natural environment should have beneficial effects on many types of stress and emotional challenges. Another empirical question is whether people with easy access to nature are psychologically healthier than others. Given what has been discussed here, it is possible that for some people being deprived of nature may be particularly detrimental to psychological health. Access to nature may operate as a moderator variable. For example, there may be a lower incidence of symptoms and psychopathology among those with a higher score on neuroticism with access to nature than among those without access to nature. However, since an element of neuroticism is symptomatic, one might also suspect a lower incidence of neuroticism in areas with nature more immediately available.

Environmental strategies for emotion regulation, of which the use of nature for emotion regulation is one example, should be researched further. Perhaps, initially, the use of experimental methods, but also survey methods and interviewing could be employed. Finally, the models proposed here could also offer a starting point for research.

Conclusions

How we choose to regulate our emotions may be central to our psychological health. The use of nature for emotion regulation should be highly effective in increasing positive emotions and decreasing negative ones. Natural environments' role in restoring attentional resources should also have beneficial effects on emotional processes. Consequently, people who choose to spend time in nature in order to regulate their emotions should find it effective. Some may even use nature strategically for emotion regulation. More research is needed both into how people use nature for emotion regulation and into what long-term effects this strategy may have. Research is also needed to investigate the association between ego depletion and directed attention fatigue. A first step would be to investigate whether the exposure to nature can counteract ego depletion. Individual differences in the choice of strategies for emotion regulation indicate that in practice some may benefit more from exposure to nature than others. For example, if your preferred strategy for emotion regulation

is mentally taxing, then spending time in nature would be helpful. Further, people vulnerable to depression may benefit highly from exposure to nature, because it should increase their ability to resist negative cognitions. Associations between emotional distress and self-regulation also indicate that there may be individual differences in the effects of natural environments that have not yet been sufficiently investigated. Individual differences in the perception of emotional affordances also indicate that nature may affect us differently. Although most of us may perceive nature as a setting suitable for reflection, some of us may, in fact, need nature in order to reflect. Moreover, although almost everyone can experience the benefits of nature, some of us may actually need these benefits to a higher degree than others. Spending time thinking about negative emotional information may have been more adaptive when human beings spent most of their time in natural environments. This clearly points toward the advantage of having natural environments readily accessible.

Author Disclosure Statement

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Paper II

Exploring the use of nature for emotion regulation: Associations with personality, perceived stress, and restorative outcomes

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Abstract

The purpose of this study was to assess associations among personality constructs, the use of nature for emotion regulation, and restoration outcomes. Visitors ($N = 142$) to two popular wilderness or natural areas in Norway received a questionnaire. The participants reported on their use of nature for emotion regulation, personality, stress, and restorative outcomes from their exposure to nature. The results showed that self-reported positive and negative emotion regulation in nature was related to restorative outcomes of the exposure to nature, and that emotion regulation could predict restorative outcomes. The results also demonstrated that the regulation of negative emotion in nature was related to perceived stress and neuroticism. This study also developed an alternative scale to measure restoration based on “willpower.” This “ego restoration” scale correlated with other measures of restorative outcomes. Individuals with higher levels of stress and higher scores on neuroticism reported higher levels of ego restoration. The relation between neuroticism and ego restoration was mediated by emotion regulation.

Keywords: emotion regulation, nature, restoration, personality, stress, recovery

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Introduction

People use physical environments for various purposes. At times we may want to withdraw to a quiet location to think more clearly about some issue, and sometimes we may seek a particular environment simply because being there makes us happy. Moreover, these two aspects can be combined. An individual might seek an environment that reduces negative emotion whenever high negative emotion is detrimental to mental functioning. If effective, this usage should be relevant to health and well-being. In addition, personality factors are likely to influence how an environment is experienced and how an individual behaves in relation to the environment. For example, it has been demonstrated that personality can predict affective experience over long periods of time (Costa & McCrae, 1980). Furthermore, in the interactionist view, persons, situations, and behavior are interwoven, and one should be able to predict behavior based on knowledge of the person and the situation (Funder, 2006).

The notion that natural environments can be used for emotion regulation is an articulated foundation for several approaches in environmental psychology. Researchers have applied the concept of emotion regulation as a foundation for studies on restoration (in nature) and favorite places (Korpela et al., 2001; Korpela & Hartig, 1996), and to place preference specifically (Korpela, 2003). Furthermore, there are studies that have considered daily demands and hassles in relation to visits to nature (e.g., Korpela & Kinnunen, 2011; Korpela et al., 2008, 2010). But emotion regulation is often considered implicitly and not explicitly. There has been no attempt to measure the use of nature for emotion regulation, and we do not know how explicit usage is related to restoration and other aspects. It may be possible to connect the cognitive and emotional effects of nature by relating emotion regulation to restoration. This article attempts to expand on previous research by developing a scale to measure the concept of emotion regulation in nature, and exploring how it may be related to restoration and personality.

Personality

In the five-factor model of personality, extraversion and neuroticism are the traits that have been most strongly associated with positive and negative affects, respectively (e.g., Costa & McCrae, 1980; Steel, Schmidt, & Shultz, 2008). People with higher levels of neuroticism may experience more cognitive noise, as studies on reaction time variability have indicated (Robinson & Tamir, 2005). They have higher levels of negative emotion, which can place demands on cognitive resources, and they appear to experience lower levels of self-control (Tangney, Baumeister, & Boone, 2004).

Individuals with a higher score on extraversion may both experience more happiness and to a larger extent believe in the happiness-producing aspects of nature and, concomitantly, have more positive appraisals of nature. But there is no reason to believe that only people *high* in extraversion use nature to up-regulate positive emotion.

A meta-analysis has demonstrated that the trait of conscientiousness is strongly associated with quality of life and positive affect (Steel, Schmidt, & Shultz, 2008). John and Gross (2007) have predicted that conscientiousness will be related to situation selection and situation modification. Accordingly, this trait may be related to emotion regulation in nature. On the other hand, conscientiousness involves goal-orientation and abilities such as planning and organizing (John & Srivastava, 1999), and, for individuals with a higher score on conscientiousness, the use of nature may depend on whether this activity is perceived to be

relevant to their goals or not; for example, if the natural environment is irrelevant to happiness, then nature may not be used to achieve happiness. This could indicate that the appraisal of nature by individuals with a higher score on conscientiousness may influence whether or not they use nature to regulate emotion. Given that this trait involves an orientation toward what is socially prescribed (John & Srivastava, 1999), conscientiousness should be related to positive appraisals of nature (in cultures where nature is considered positive).

Theories of restoration

Attention restoration theory (ART; Kaplan & Kaplan, 1989; Kaplan, 1995) assumes that attention can be effortless or directed. Directed attention refers to the ability to maintain focus and inhibit distractions. With use, this ability may become fatigued, termed directed attention fatigue. Effortless attention is used when the task does not require sustained mental effort. The use of effortless attention allows directed attention to rest and be restored. One way this can be achieved is through an exposure to a restorative environment. This would involve, on some level, the enervated person's leaving the fatiguing environment and seeking another environment that is sufficiently extensive so that immersion is possible. This environment, by being fascinating to look at, should induce a resting of directed attention so that effortless attention will be used instead, and finally, the environment should be compatible with what the person wants to do. The presence of these four qualities – being away, extent, fascination, and compatibility – makes an environment restorative (Kaplan & Kaplan, 1989).

ART predicts that natural environments will be rated higher than urban environments on all of the restorative qualities, and that an exposure to a natural environment will restore attentional resources. Research results offer support for both of these predictions (e.g., Berman, Jonides, & Kaplan, 2008; Herzog, Maguire, & Nebel, 2003; Laumann, Gärling, & Stormark, 2001; Purcell, Peron, & Berto, 2001).

In an alternative view, Ulrich (1993) has proposed a psychoevolutionary theory of restoration in the natural environment. This framework suggests that an exposure to specific natural environments both reduces stress and negative emotions and increases positive emotions, predictions which research results also support (e.g., Berman, Jonides, & Kaplan, 2008; Hartig et al., 2003).

The restorative experience involves moving from a depleted state to a restored state. Thus, there may be three relevant aspects to restoration: a depleted state, a restored state, and the restorative process. Kaplan and Kaplan (1989) have carefully researched these phenomena and may have discovered a process model of restoration. The more time one spends in a restorative environment the more benefits one may experience. First, a clearing of the head of lingering thoughts may occur. Second, directed attention may be restored. Next, further restoration may lead to cognitive tranquility, and finally, to a state of deeper reflection on one's life and future (Kaplan & Kaplan, 1989). Herzog et al. (1997) have divided the benefits into attentional recovery and reflection. In contrast, Korpela et al. (2008) have focused on a slightly different set of restorative experiences, namely relaxation, clearing one's thoughts, and attention restoration. Thus, it would seem that previous research has discovered and focused on a few key restorative outcomes that people may experience when visiting nature.

Directed attention fatigue may also lead to less effective self-regulation (Kaplan, 1995). Research demonstrates that the ability to engage in certain self-control tasks (e.g., inhibiting a dominant response) may depend on a resource that can become depleted with use, and the

term “ego depletion” refers to a reduction in this ability following use (Baumeister et al., 1998). Kaplan and Berman (2010) have proposed that directed attention is the common resource on which executive functioning and self-regulation both rely, which indicates that directed attention fatigue shares important features with ego depletion. If there is a depleted state specifically related to the strength model of self-control, then there should also be a restored state. Ego restoration could be defined as the experience of recovering from ego depletion. In lay theory, self-control is often referred to as “willpower” and although more research is needed, “willpower” may be another way to measure attentional fatigue and restoration (see Baumeister et al., 2008; Tice & Bratslavsky, 2000).

The use of nature for emotion regulation

It is important to distinguish between emotion regulation and the purported emotional effects of nature. Simply because nature can be used to regulate emotion does not mean that people use nature in this manner.

An exposure to natural environments may have direct effects on emotional processes, for example, the reduction of negative emotions and the increase of positive emotions (e.g., Berman, Jonides, & Kaplan, 2008; Hartig et al., 2003; van den Berg, Koole, & van der Wulp, 2003). But natural environments may also have an indirect effect on emotional processes by restoring attentional resources and have beneficial influences on executive functioning or self-regulation for example (e.g., Berman, Jonides, & Kaplan, 2008; Kaplan & Berman, 2010; Berto, 2005). Individuals who spend time in nature to regulate their emotions may not distinguish between the two effects, but should nevertheless find the approach effective (Johnsen, 2011). Because of these effects, individuals may use nature instrumentally to regulate emotions, and this is the central idea here. People may engage with nature in order to regulate their emotions. For example, people may do this to maintain psychological stability or to reflect upon their feelings. Korpela (1995) has proposed a similar argument for favorite places, and the hypothesis of environmental self-regulation (Korpela, 1995) provides a foundation for the present study.

Spending time in nature in order to experience positive emotions should be considered as situation selection, while spending time in nature in order to regulate negative emotion should be considered primarily as situation modification (Johnsen, 2011). Stated briefly, situation selection may involve inserting oneself in a situation that one believes will lead to positive emotions, while situation modification may involve changing a situation either before or after an emotion has been activated (Gross & Thompson, 2007). Regarding the use of nature, this is not merely about positive and negative emotions because, hypothetically, one could seek out nature to increase or maintain negative emotions, which would be a form of situation selection, and, perhaps more likely, one may seek nature to maintain or increase an already activated positive feeling. In this case, the regulation of positive emotion in nature should be considered as an occurrence of situation modification and not situation selection. In general, however, we can assume that people want to down-regulate negative emotion and up-regulate positive emotion (John & Gross, 2007). There is evidence that suggests that individuals higher in negative mood may choose natural environments as favorite places and, perhaps, visit them in order to regulate emotion (Korpela, 2003). Individuals may also seek nature to avoid or get away from their normal environments, an aspect which could be called a “push motivation” (Johnsen, 2011), and which may involve the experience of rising negative emotion when one is not in nature. Such experiences should be closely related to a need for nature.

Finally, appraisal processes may be relevant to emotion regulation in nature. Efforts to regulate emotions may directly involve appraisals, in addition to reappraisals (see Tugade & Fredrickson, 2007). To some extent, appraisals may be antecedents to situation selection and modification because some evaluation of the situation must necessarily occur in relation to selection or modification, but appraisals or reappraisals also appear to occur later in the process. It may be worthwhile noting that some models do not distinguish between emotion generation and emotion regulation (Gross & Barrett, 2011).

The present study

In order to study a phenomenon, it may be most relevant to focus on a group of people who are likely to manifest the phenomenon. The purpose of this study was to explore the relations between the uses of nature for emotion regulation and personality, stress, and restorative outcomes. By conducting this research with people visiting a natural environment, it was expected that two important aspects would be present: (1) the participants were exposed to nature and might experience restoration and (2) people who use nature to regulate emotions might be present within this group.

It was expected that emotion regulation in nature would be organized into positive and negative emotion regulation (i.e., situation selection and situation modification, respectively).

It was also assumed that, to some extent, processes of appraisal would be relevant to the regulation of emotion in nature. These may be influenced by beliefs, knowledge, and prior experiences, and, to some extent, be related to personality. Above all, an appraisal of the relevance of nature for one's emotional well-being would be significant in this context.

Persons in depleted or fatigued states should have restorative experiences when exposed to nature. The purported presence of negative emotion (e.g., Costa & McCrae, 1980) and cognitive noise (Robinson & Tamir, 2005) in neuroticism may lead to ego depletion or directed attention fatigue. Accordingly, it was expected that higher levels of neuroticism would be related to higher levels of restoration. Stressful events might similarly lead to fatigue (and stress), and it was also anticipated a positive relation between stress and restoration.

The use of nature to regulate emotions may reduce negative emotion and increase positive emotion and should be related to restorative experiences. It was therefore hypothesized that more agreement with items suggesting a use of nature for emotion regulation would be related to more agreement with measures of restoration (Hypothesis 1).

Furthermore, it was expected that neuroticism would be positively related to the regulation of negative emotion in nature (Hypothesis 2). Individuals with a higher score on neuroticism may use the physical environment to support emotional stability (which they lack) or may perceive a greater need to regulate emotion. Because not everyone will necessarily use nature in this manner, it was hypothesized that emotion regulation would mediate the relation between neuroticism and restoration (Hypothesis 3).

To further explore this topic, a hypothetical structural model was constructed. Proposing and testing a larger conceptual model served several purposes here. The hypotheses could be tested within a larger framework, it could be investigated whether emotion regulation might predict restoration, and finally, the fit of the proposed conceptual model could be investigated.

A conceptual model

In its essence, emotion regulation involves attempts to increase or decrease the experience, the expression or the physiological aspects that may accompany or comprise an emotion (Gross, 1998; Gross & Thompson, 2007). In the process model of emotion regulation, regulatory efforts can take place both before and after an emotion is activated, termed antecedent- and response-focused regulation, and regulation may influence several aspects of emotions, for example, duration and intensity (Gross, 1998; Gross & Thompson, 2007). Research shows that emotion regulation may be relevant for psychological well-being (e.g., Gross & John, 2003) and may help to reduce stress (Sapolsky, 2007). Furthermore, antecedent-focused regulation may be associated with a healthier profile than response-focused regulation (Gross & John, 2003; Schutte, Manes, & Malouff, 2009). As indicated in the section on the use of nature for emotion regulation, using the environment to regulate emotion may be divided into situation selection and situation modification, mirroring positive and negative emotion regulation.

Fundamental to the present study is the idea that actively using natural environments for emotion regulation will improve mental functioning (i.e., restore mental resources). Furthermore, it is maintained that personality has an impact both on the choices one makes and one's experiences. For example, individuals with higher scores on extraversion may be motivated to seek positive experiences and individuals with higher levels of negative affect may be motivated to regulate negative emotions. And moreover, that one's experiences may, at least in part, be mediated by one's choices or behavior. Personality traits will influence emotion regulation, which in turn will influence restoration (see Figure 1). A similar model has been proposed for emotional experiences (see Ng & Diener, 2009).

Method

Participants

The sample consisted of visitors and hikers in the vicinity of mountain lodgings in two wilderness areas in Norway. The visitors to these areas are likely to represent both the more extreme hikers and climbers and the leisurely wanderers, perhaps with a higher representation of the latter.

A very high percentage wanted to participate in this study; of those approached only 16 declined, and accordingly more than 90% agreed to participate. In total, 146 completed questionnaires were collected. Of these, four questionnaires were deemed to be unusable because they were blank or only partially completed. The final sample used for the analyses reported here consisted of the completed questionnaires from 142 participants. The sample comprised 74 females (52.1%) and 54 males (38%). Furthermore, the participant ages were between 16 and 79 years and the median age range was 40–49 years.



Figure 1: A conceptual model.

Location

The study areas for this cross-sectional design were two Norwegian wilderness areas, at the entry and exit points to the mountain areas of Trollheimen and Jotunheimen. In both study areas, mountains are visible. There are also inland waters and large areas with green hills. Although both areas are very green, Trollheimen is probably perceived as being rather greener, while Jotunheimen has the more typical mountain terrain. These areas in particular were chosen because they to some extent represent the range of popular Norwegian wilderness areas.

Procedure

The data were collected during the summer, from mid-July to mid-August, and on days with sunny weather. Data collection took place later in the day, when wilderness visitors were returning from their hikes. It was attempted to approach everyone present in the areas. The visitors received a short presentation of the research project and a questionnaire and a pen if they agreed to participate. The participants themselves put completed questionnaires into a cardboard box.

Data analysis

Pearson product-moment correlations were calculated to investigate the relations between the different measures. Factor analyses were used to explore the dimensionality of restorative experiences and emotion regulation and to test theoretical structures. Exploratory factor analysis (EFA) was performed by the method of principal axis factoring with promax rotation. To test the hypothetical factor structures against the observed data (confirmatory factor analysis), the structural equation modeling approach was used. In addition, this approach was used to test the fit of two conceptual models. In structural equation modeling, several fit statistics are considered. A significant p -value of the χ^2 test normally indicates that a model should be rejected. In addition, other fit indices are important to consider, and Russell (2002) has recommended paying more attention to the comparative fit index (CFI) because it may be less sensitive to sample size. The CFI should be between 0.95 and 1.00 (Hu & Bentler, 1999), and similarly for the Tucker-Lewis coefficient (TLI). For well-fitting models, the root mean square error of approximation (RMSEA) should preferably be lower than 0.06 (Hu & Bentler, 1999; MacCallum, Browne, & Sugawara, 1996).

Measures

Personality traits and perceived stress

This study measured conscientiousness, extraversion, and neuroticism by using the Norwegian version of the big five inventory (BFI-44) (Engvik & Føllesdal, 2005; John & Srivastava, 1999), the Norwegian version is rated on a 7-point scale. The Cronbach's α were acceptable: extraversion ($\alpha = 0.79$), conscientiousness ($\alpha = 0.70$), and neuroticism ($\alpha = 0.78$).

Perceived stress was measured with the four-item version of Cohen, Kamarck, and Mermelstein's (1983) scale, the items of this scale are rated *how often have you felt this way* from (1) *never* to (5) *very often*. Cronbach's α for this scale was 0.68.

Emotion regulation

The 11 items measuring emotion regulation were rated on a 7-point scale from "highly disagree" to "highly agree." EFA (principal axis factoring with promax rotation) of these items clearly

indicated the expected structure of situation selection (positive emotion), situation modification (negative emotion), and a push-motivation factor (rising negative emotion when not in nature). Table 1 shows items and factor loadings. Three factors accounted for 60.2% of the variance. Cross loadings were low, and all items loaded heavily on the expected factor. Interestingly, one item assumed to measure the maintenance of positive emotion loaded on both the positive emotion factor and the situation-modification factor, as might be expected theoretically. The situation-selection factor also contained a few knowledge or appraisal related items, for example, "Whenever I am outdoors in nature I feel happiness." It should be noted that the Norwegian word for happiness is closer in meaning to well-being than the English word, and in addition, a literal translation of the word used here would be happiness-like. Because there were theoretical reasons to expect a certain factor structure, a confirmatory factor analysis (maximum likelihood) was attempted. Push motivation is not about emotion regulation per se, but rather about the experience of being away from nature, therefore a three-factor model was tested (appraisal, positive emotion regulation, and negative emotion regulation). The fit statistics of this model were acceptable ($\chi^2 = 17.2$, $df = 11$, $p = 0.101$, $TLI = 0.97$, $NFI = 0.97$, $CFI = 0.99$, $RMSEA = 0.063$). In addition, a model with a latent variable reflecting an appraisal of nature as a determinant for the two emotion-regulation factors was tested, which also resulted in an acceptable fit ($\chi^2 = 17.3$, $df = 12$, $p = 0.140$, $TLI = 0.97$, $NFI = 0.97$, $CFI = 0.99$, $RMSEA = 0.056$). Cronbach's α for the four scales were as follows: positive emotion regulation, 0.56; negative emotion regulation, 0.83; push motivation, 0.83; appraisal, 0.94.

Restorative outcomes

Korpela et al. (2008) have developed the restoration outcome scale (ROS) to measure restorative outcomes people might have when visiting their favorite place. This scale was adapted to the present context to tap participant's experiences after visiting the natural areas chosen for this study. The participants indicated their restorative experiences on a 7-point scale, from "not at all" to "a very high degree." Korpela et al. (2008) have indicated that ROS measures three aspects

Table 1: Factor analysis of the emotion regulation items (pattern matrix factor loadings)

Item	Negative	Positive	Push
I often go out into nature when I am angry	0.93	-0.16	0.02
I often go out into nature when I am sad	0.85	0.05	-0.09
I go out into nature to process my feelings	0.60	0.15	0.04
When I am happy I feel a need to be outdoors in nature	0.36	0.21	0.19
Whenever I am outdoors in nature I feel happy ^a	0.04	0.88	-0.01
Outdoor life makes me happy ^a	0.06	0.86	0.01
I go out into nature to experience positive feelings	-0.18	0.60	0.07
I go out into nature to experience joy	0.15	0.49	-0.06
When I have been away from nature for some time, I become irritable	0.04	-0.03	0.98
When I have been away from nature for some time, I feel sad	-0.16	0.16	0.71
When I have been away from nature for some time, I feel angry	0.27	-0.12	0.62

^aNorwegian: lykkelig, see 'Method' section.

of restoration: "relaxation," "attention restoration," and "clearing one's thoughts." However, the factor analysis reported in the article yielded a one-factor solution (Korpela et al., 2008). Using the data in the present study, ROS was submitted to EFA, specifically principal axis factoring with promax rotation; this yielded a two-factor solution, which appeared to consist of "relaxation" and "clearing one's thoughts," and the attention restoration item loaded primarily on the relaxation factor. A confirmatory factor analysis was performed to evaluate whether ROS could be said to consist of three aspects. A model with ROS as a higher-order factor and three sub-factors was evaluated. The fit of this model was not acceptable ($\chi^2 = 21.5$, $df = 7$, $p = 0.003$, $TLI = 0.91$, $NFI = 0.94$, $CFI = 0.96$, $RMSEA = 0.123$). However, sometimes a measurement model can be misspecified (see Byrne, 2010), and inspecting the modification indices made it clear that the fit could be substantially improved by correlating the error terms of the "attention restoration" item and the third "relaxation" item. This may be theoretically justified as well because of item overlap. The respecified model was clearly an improvement ($\chi^2 = 9.5$, $df = 6$, $p = 0.150$, $TLI = 0.98$, $NFI = 0.98$, $CFI = 0.99$, $RMSEA = 0.065$). The Cronbach's α for the scales "relaxation" and "clearing thoughts" were 0.86 and 0.72, respectively.

Because Kaplan and Berman (2010) have argued that directed attention is a resource for self-regulation, it was assumed that natural environments would also counteract ego depletion, and accordingly that a restorative outcome that people might experience would be *ego restoration*. Three items were included to measure this concept. The items in this scale were "I have gained more self-control," "I have gained more willpower," and "I feel more able to resist temptations if I want to." These items were rated on a 7-point scale, from "not at all" to "a very high degree," and the context was indicated by the headline: "After visiting this natural area, how do you feel?" Cronbach's α for this scale was 0.88.

In order to evaluate whether the ego restoration scale would be a relevant aspect of restorative experiences and differentiated from the ROS, an EFA was conducted. Including this scale resulted in a three-factor solution in which ego restoration appeared as one of the factors.

Summary statistics for all scales and t scores for the personality measures are shown in Table 2.

Results

Gender was not related to any of the restoration scales (all $ps > 0.18$), which is in agreement with the findings of Korpela et al. (2008).

It was expected that neuroticism, because of a relative relation to depletion, would be positively related to restoration. To investigate the relation between personality and the restorative outcomes, correlations between neuroticism and ego restoration, attention restoration, relaxation, and clearing one's thoughts were calculated (Table 3). The results demonstrated that neuroticism was significantly related only to ego restoration. Furthermore, correlations were calculated between the restorative outcomes and the perceived stress scale in order to investigate the possibility that stress is related to restoration; this analysis demonstrated that stress was significantly related only to ego restoration. As expected, extraversion was not related to any of the restorative outcomes. It was interesting to observe, however, that conscientiousness was related to relaxation.

Hypothesis 1 was supported by the analyses; positive emotion regulation and negative emotion regulation were positively related to the restorative outcomes (Table 3), in particular negative emotion regulation was strongly related to several of the restorative outcomes.

Table 2: Means and standard deviations, item ranges, and number of items of summarized scales

	Mean	Standard deviation	Items in scale
Negative emotion regulation	3.79	1.47	3
Positive emotion regulation	6.17	0.82	2
Push motivation	3.90	1.51	3
Appraisal of nature	6.03	0.94	2
Ego restoration	4.12	1.34	3
Relaxation	5.44	0.97	3
Extraversion	51.11	8.92	8
Conscientiousness	51.15	9.01	9
Emotional stability ^a	52.15	8.24	8
Perceived stress	2.13	0.68	4
Attention restoration	4.82	1.19	1

^a Neuroticism reversed.

The results also demonstrated that neuroticism was positively related to negative emotion regulation in nature. Although it has been suggested that conscientiousness may be related to situation selection and modification, this was not found. Conscientiousness was not significantly correlated with positive and negative emotion regulation (Table 3).

To investigate whether individuals higher in extraversion had a more positive appraisal of nature, a correlation between the appraisal scale and extraversion was calculated. The analysis showed that appraisal of nature was significantly, and positively, correlated with extraversion. It was suggested in the introduction that conscientiousness would be related to appraisals, and the results demonstrated a significant correlation between conscientiousness and the appraisal scale.

According to Hypothesis 3, emotion regulation should mediate the relationship between neuroticism and restoration. The mediation hypothesis was tested with the approach suggested by Baron and Kenny (1986). Starting with relaxation, a mediation could not be established because neuroticism did not predict relaxation ($\beta = 0.09$, $p = 0.296$). Moreover, neuroticism could not be used to predict either attention restoration ($\beta = 0.06$, $p = 0.499$) or clearing one's thoughts ($\beta = -0.03$, $p = 0.730$). However, neuroticism did predict ego restoration ($\beta = 0.20$, $p = 0.021$). Furthermore, neuroticism predicted negative emotion regulation in nature ($\beta = 0.28$, $p = 0.001$), and, finally, the inclusion of both neuroticism and emotion regulation in a regression analysis to predict ego restoration confirmed that emotion regulation mediated the relation between neuroticism and ego restoration by showing that the impact of neuroticism was reduced (negative emotion regulation, $\beta = 0.52$, $p = 0.000$; neuroticism, $\beta = 0.05$, $p = 0.561$). These results support Hypothesis 3.

This study constructed and tested a structural model to investigate further the relations between personality, appraisal, emotion regulation, and the restorative experience. The hypothetical model was constructed on the basis of the theoretical considerations presented in the introduction and the hypotheses. The confirmatory factor analyses of emotion regulation in nature and restorative outcomes supplied the latent variables that were used in the models. The model attempted to explain restoration in a natural environment with positive and negative emotion regulation as antecedents, and with neuroticism predicting negative emotion

Table 3: Correlations between scales and measures

	1	2	3	4	5	6	7	8	9	10	11
1. Positive emotion regulation	–										
2. Negative emotion regulation	0.25**	–									
3. Push motivation	0.26**	0.52**	–								
4. Appraisal of nature	0.53**	0.40**	0.43**	–							
5. Extraversion	0.18*	0.03	0.01	0.20*	–						
6. Conscientiousness	0.07	–0.02	0.23*	0.25**	–0.05	–					
7. Neuroticism	–0.05	0.28**	0.15	–0.04	–0.02	–0.37**	–				
8. Perceived stress	–0.01	0.30**	0.13	0.03	–0.02	–0.33**	0.45**	–			
9. Ego restoration	0.21*	0.53**	0.30**	0.35**	0.01	0.06	0.20*	0.19*	–		
10. Relaxation	0.30**	0.35**	0.26**	0.49**	0.12	0.26**	0.09	–0.02	0.44**	–	
11. Clearing thoughts	0.25**	0.14	0.16	0.32**	0.15	0.13	–0.03	0.02	0.43**	0.46**	–
12. Attention restoration	0.13	0.41**	0.40**	0.38**	0.09	0.25**	0.06	0.12	0.51**	0.64**	0.40**

Note: * $p < 0.05$, ** $p < 0.01$.

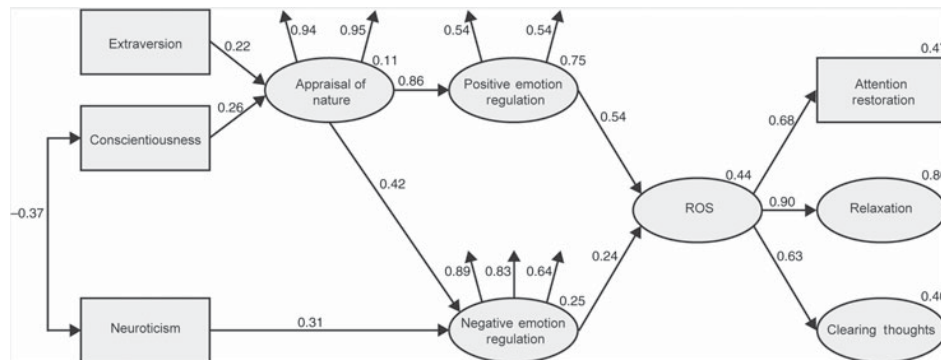


Figure 2: Structural model of emotion regulation in nature with the ROS as outcome.

regulation, conscientiousness, and extraversion predicting appraisal of nature, and appraisal of nature predicting positive and negative emotion regulation, the ROS was used as the outcome variable. The fit statistics for this model were excellent ($\chi^2 = 106.1$, $df = 96$, $p = 0.225$, $TLI = 0.98$, $NFI = 0.90$, $CFI = 0.99$, $RMSEA = 0.027$). All paths were significant and the model accounted for 44% of the variance in restoration (see Figure 2). This model supports Hypotheses 1 and 2, and to some extent Hypothesis 3.

Discussion

This study demonstrates the relevance of emotion regulation with respect to the uses of nature. The results suggest that antecedents to emotion regulation in nature may include a depleted state and that personality is relevant in this perspective. There is also an indication that people will experience restoration following emotion regulation. Furthermore, this study supports other studies that have indicated that people may seek nature to maintain emotional stability (e. g., Korpela, 2003). It is noteworthy that people who report that they come to natural environments with the intention of regulating negative emotions also report restorative experiences. This adds to our knowledge of how nature is used and indicates what effects an exposure to the natural environment can have in relation to psychological stability and well-being. Moreover, it shows the close relation between emotion regulation and restoration that may exist in real-life situations. Emotion regulation in nature clearly separated into positive and negative emotion regulation, which was expected.

Korpela et al. (2008) have used several different variables to predict restoration, including length of stay, frequency of visits, and nature or urban "orientedness." The predictors used could account for 19–31% of the variance in the ROS. In the model presented here, emotion regulation accounted for as much as 44% of the variance in the joint variable of restoration. However, the values are difficult to compare because the R^2 statistic is not calculated the same way as in traditional regression analysis. These results further illustrate the relevance of emotion regulation with respect to restorative experiences.

The confirmatory factor analysis of the ROS and items supported the theoretical structure that Korpela et al. (2008) have proposed, and the ROS was found to be an acceptable measurement

model. In addition, the present study contributes to the literature by introducing a new restorative concept, namely ego restoration. This concept was introduced with a theoretical discussion, the reporting of results from an EFA, and the establishment of its relation to other measures. Further studies should attempt to relate this concept to the ego depletion paradigm and investigate the concept of ego restoration experimentally.

As mentioned in the introduction, it may be difficult to register a restored state, and it may involve a preceding depleted state. It is interesting to note that neuroticism was related to ego restoration. We may speculate that this could indicate a return to normal (i.e., a nondepleted version of themselves) for individuals higher in neuroticism, as they may enter natural environments with low willpower and leave with higher.

Personality did not appear to have a large impact on emotion regulation, which indicates that this is not primarily an issue related to differences in personality. Individual differences in the use of nature for emotion regulation may have their roots in experience and knowledge, and could be related to cultural differences.

An appraisal of nature as being relevant to one's happiness appeared to mediate the relation between extraversion/conscientiousness and emotion regulation, while neuroticism appeared to be more directly related to negative emotion regulation. Recent research results have demonstrated that emotion regulation may mediate the relation between personality and emotional experience (Ng & Diener, 2009), a finding which may have its counterpart in the present study with regard to restoration. However, in the present context, it indicates a beneficial outcome of this strategy for individuals higher in neuroticism, a result which might be fruitful to consider in a general mental-health perspective.

The present study considers nature as a condition that supports psychological stability, and not as a one-shot treatment. Further research might consider whether the use of nature to regulate emotions is related to health and well-being over longer periods. A useful question, for example, is whether people who repeatedly use nature in this manner are psychologically healthier than others.

Further research might focus on the role that natural environments can play with respect to the regulation of negative emotion. Experimental studies might investigate whether the detrimental influence that emotion regulation can have on other forms of self-regulation (Tice & Bratslavsky, 2000) can be counteracted in a natural environment, an outcome which the present results seem to suggest.

The model tested here showed acceptable fit with the data. The considered indices of fit were indicative of a good or an excellent fit. This analysis was somewhat explorative; however, given that the results indicated acceptable fit with what might be a representative sample, the model was judged to be a highly relevant model of emotion regulation in nature. Still, this should be considered a somewhat tentative conclusion because not all measures were based on established scales.

Implications

This study connects the emotional and cognitive benefits of nature and it shows that using nature to regulate emotion can buffer against the detrimental effects of negative emotion. For example, people high in negative affect can use nature to achieve some balance in their emotional life. Accordingly, using nature to regulate negative emotion may help prevent depression, anxiety, and stress. In the larger perspective, having nature available may be

essential to psychological health. This study also indicates that actively using nature to regulate emotion may be essential to experience some benefits of nature. Finally, the environmental perspective has so far been neglected in research on emotion regulation; this study shows the potential of environment-focused emotion regulation.

Limitations

First, it should be noted that some caution is warranted with regard to causal conclusions due to the cross-sectional nature of this study.

Furthermore, the notion that nature is health-promoting is ubiquitous in Norwegian culture, and so it is entirely possible that these results may not generalize to other populations. It might even be relevant to speak of a Norwegian subculture, although this study took some care when selecting the locations to avoid such selection bias.

Although this study takes the present sample to be highly representative of visitors to these two natural areas during the summer, there may still be some limitations due to sampling characteristics. First, the reader should not consider the statement that 90% agreed to participate to be a statement about response rate. Although one may attempt to ask everyone present in an area, this may not be possible in practice for various reasons; for example, some persons may move very quickly through an area. Second, this study did not randomly draw this sample, and so there may be some selection bias.

Conclusions

Emotion regulation may be an important motive for seeking out nature. People who seek out nature to regulate emotions appear to experience benefits. We may divide emotion regulation in nature into two strategies: (1) to increase positive emotions and (2) to decrease negative emotions. Both strategies are related to the experience of restorative outcomes. People who experience stress and high negative emotion may both experience and perceive nature as an environment that supports emotion regulation.

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Paper III

Research Reports

Active Use of the Natural Environment for Emotion Regulation

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Abstract

Two studies on the use of nature for emotion regulation were conducted. Study 1 ($N = 35$) ran over two weeks and was an experimental investigation. Participants in the experimental condition were asked to use a picture of nature actively as environmental stimuli for emotion regulation in their everyday life, while two control groups simply looked at a picture of nature or a picture of balloons each evening. A significant effect of the manipulation was found on positive mood, but the effect was complex with an initial increase and then a decrease. There were no findings on negative mood. Study 2 ($N = 473$) explored the motivational tendency to seek out nature when the participants were happy or sad. A novel concept (expectancy construct) was introduced to measure the perception of the emotion regulatory potential of different environments. The classical natural environment was rated highest on emotional potential of all environments tested here. Perceiving a higher emotional potential in nature was related to a higher intention to seek out nature when happy or sad. Personality and mood were also related to these concepts. Higher positive mood was related to the intention to seek out nature when happy. Conscientiousness was related to a more positive perception of nature. The studies support the notion that using nature may be an effective strategy for regulating one's emotions.

Keywords: nature, emotion regulation, self-regulation, environment, mood, person-environment studies

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Introduction

In contrast to many other strategies, actively using the environment for emotion regulation does not focus directly on altering the cognitive or emotional processes of the individual. Historically, however, research in this area has been more focused on intrapsychological characteristics than on the environmental usage perspective. It may be timely to ask how important the environment really is in relation to cognitive and emotional processes; perhaps it is all too easy to forget this perpetual ground to the figure of mental life. Related to this, philosophers have argued that cognitive operations may extend into the environment in ways that make the role of the environment a more active one (Clark & Chalmers, 1998). There is reason to believe that adaptive emotion regulation is beneficial to health and well-being (DeSteno, Gross, & Kubzansky, 2013), and strategies that involve the environment are particularly interesting because they may be considered strategies that take place earlier in the emotion generative process (Gross & Thompson, 2007). In addition, environmental emotion regulation strategies have the advantage that they may be easier to implement. But we need to know more about how such strategies are related to psy-

chological health. One promising example of environment-focused emotion regulation entails seeking out or using nature (e.g., Johnsen, 2011; Korpela, 1995).

The present work draws on two theoretical perspectives: Firstly, the environmental self-regulation hypothesis, which states that one's favourite places, may be, and in fact are, used for the purpose of self-regulation (Korpela, 1995, 2003). The central idea is that favourite places have attributes that support self-regulation. The second theoretical perspective applied in this study, the process model of emotion regulation, states that emotion regulation may occur prior to or subsequent to the activation of an emotion, termed antecedent- and response-focused regulation, respectively. In the process model of emotion regulation, environment-focused regulation would primarily be antecedent focused, and occur within the stages of situation modification and situation selection (Gross, 1998; Gross & Thompson, 2007). Emotion regulation can involve attempts to alter the magnitude, duration, onset, and offset of emotional responses (Gross, 1998). One may regulate one's emotions by manipulating the situation, or one may choose to seek out situations that increase or reduce certain emotions. Using nature for emotion regulation would involve situation modification, but there may also be some overlap with another antecedent focused strategy, attentional deployment (i.e., distraction; see Gross & Thompson, 2007).

Equally important to the present study are theories and empirical findings about the relevance of the natural environment for emotion regulation. Ulrich's (1993) psycho-evolutionary theory states that human-beings have evolved restorative responses to nature. An exposure to nature, according to this theory, will reduce negative emotions and increase positive emotions (affective restoration). And research supports this; being exposed to a natural environment after watching a frightening movie has been shown to improve mood more than being exposed to a built environment (van den Berg, Koole, & van der Wulp, 2003). Attention restoration theory states that exposure to natural environments will restore cognitive function (Kaplan & Berman, 2010; Kaplan & Kaplan, 1989). In fact, it has been shown that pictures of nature presented for 15 seconds may restore attentional capacity (Berto, 2005). Recently the theory has been expanded to include the ego depletion perspective, indicating that an exposure to nature may also counteract ego depletion effects (Kaplan & Berman, 2010). The concept of ego depletion refers to the idea that the exercise of self-control on a task will reduce the resources for self-control one has available to use on a following task (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Baumeister, Sparks, Stillman, & Vohs, 2008). This means that an exposure to nature should restore cognitive resources more quickly, and in turn enabling the processing of emotional information.

Although several studies have been able to demonstrate the positive effects on mood and attention of an exposure to nature (e.g., Berman, Jonides, & Kaplan, 2008; Bowler, Buyung-Ali, Knight, & Pullin, 2010; Hartig, Evans, Jamner, Davis, & Gärling, 2003; van den Berg et al., 2003), research has focused less on the everyday uses of nature in relation to emotion regulation. However, a few relevant studies have been conducted. The use of favourite places for self-regulation is highly similar to the use of nature for emotion regulation, and one experimental study showed positive effects (on restorative experiences) of prescribing visits to a favourite place once per day, although only one third of the visits in this study were to natural environments (Korpela & Ylén, 2009). There are a few non-experimental studies that have studied the environmental usage perspective (e.g., Korpela, Hartig, Kaiser, & Fuhrer, 2001), but especially germane to the present work are two studies. One studied teachers' place choices in relation to their levels and sources of stress, and the results indicated that teachers who experience higher levels of vocational stress may cope by seeking nature in order to get away (Gulwadi, 2006). In the second study, Korpela (2003) showed that negative feelings often precede people's visits to their favourite places (mostly natural places) and positive feelings dominate after the visits.

The purpose of Study 1 was to test whether using the natural environment to regulate emotions is an effective strategy, in particular that it can increase positive mood and decrease negative mood. In Study 2, we wanted to investigate the perception of different environments (among them natural environments) with regards to emotion regulation, and the emotion-dependent motivational tendency to visit different environments.

Study 1

The purpose of Study 1 was to investigate whether everyday use of nature for emotion regulation would be effective, and subsequently have an impact upon emotions and cognitive functions. An experimental design was used to investigate this. If this strategy for emotion regulation is effective we expected the following (within subjects) changes over time for those in the experimental group(s): reduced negative mood (Hypothesis 1a), increased positive mood (Hypothesis 1b), and a beneficial impact upon cognitive functions (Hypothesis 2). In addition, over time, this might lead to between group differences, and accordingly we expected that the nature group would at end of treatment experience lower negative mood (Hypothesis 3a), higher positive mood (Hypothesis 3b), and higher cognitive functioning (Hypothesis 4) than the control group.

Method

Participants — Participants in this study were sixty four (mainly second year) psychology students at a Norwegian college and 69% were females. Most participants were recruited in the lecture hall during mandatory coursework, but a few were approached in the library. All participants gave their informed consent, and agreed to participate in the study. They received no monetary compensation or course credit for participating. Sixty four questionnaires were handed in on the first day (at baseline). After one week, forty one participants handed in the questionnaire and at two weeks, thirty five participants handed in the questionnaire. There were no significant differences between those who dropped out after baseline and those that did not on positive mood, negative mood, or ego restoration (p s > .05).

Measures — To measure mood, we used the Norwegian version of the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). This measure has also previously been used in studies of exposures to nature (e.g., Berman et al., 2008). The participants were instructed to rate, on a 1-5 scale, how they had been feeling the last couple of days, including today. The reliabilities (Cronbach's α) for time one, two, and three were PA: .83, .88, and .88, and NA: .75, .76, and .77.

For this study we also used the most recent version of the Attentional Function Index (AFI; Cimprich, Visovatti, & Ronis, 2011). This scale measures perceived cognitive functioning in everyday activities that require working memory and executive attention. People are asked to rate their level of functioning on 13 items relating to remembering, planning, and maintaining focus, for example: "Getting started on activities (tasks, jobs) you intend to do". Cimprich et al. (2011) conducted exploratory factor analyses with the scale, and divided it into three sub-scales, effective action (1), attentional lapses (2), and interpersonal effectiveness (3). Previous versions of this scale have been used to study the cognitive effects of an exposure to nature (e.g., Duvall, 2011). The instrument was translated into Norwegian, back translated by a native English speaker (who is fluent in Norwegian and has a degree in psychology), and then both translations were evaluated against the original. At baseline ($N = 64$), the reliabilities of the three part-scales of the AFI were .78, .30, and .71, making factor one and three acceptable, and factor two unacceptable.

We also used the Ego Restoration Scale (Johnsen, 2012) to investigate possible effects of the nature exposure on cognitive functions. This three item scale is assumed to measure changes in the strength aspect of self-regulation (see Baumeister et al., 1998). In theory, the restoration of attention should also restore self-regulatory strength (Kaplan & Berman, 2010), and the scale attempts to measure such changes through perceived changes in willpower. The scale is measured on a 1-7 scale (*not at all - to a high degree*). Previous research has found the scale to be highly related to the use of nature for emotion regulation and the concept has been termed ego restoration (Johnsen, 2012). The reliability of this scale was good, the Cronbach's α 's for start, end, and middle were .90, .88, and .90.

Procedure — The study investigated whether using the natural environment for self- and emotion regulation would have any impact on mood and cognition. To this end, we included three conditions (N s at mid-point): One control group ($N = 14$), one experimental group ($N = 14$), and one experimental/control group with a softer manipulation ($N = 13$). The participants received envelopes which contained instructions, three questionnaires with dates of completion printed on them, and environmental stimuli in the form of A4 size pictures. The envelopes were in random order, unknown to the experimenter, and the envelopes were also distributed among the participants in a non-systematic way. The experiment ran over two weeks and the three questionnaires were identical, the first questionnaire was filled out on the first day, the second on the same weekday one week later, and the third one week after that. The instructions stated that the questionnaires should be completed approximately mid-day.

The experimental group envelope contained two pictures of natural environments (Figures 1 and 2). The instruction read: *In this project we are interested in the use of art and pictures as distractions – and whether this has any effect. We want you to bring these pictures with you and use them actively in your daily life. If you need to think about something, reflect upon something that has happened, or if you are a bit sad/angry/annoyed or similar, then use these pictures actively. Look at them while you are reflecting. Or let your thoughts wander. We ask that you do this instead of what you would normally do if you need a distraction. Common distractions may include watching TV, playing computer games, or using the internet. Look at the pictures for as long as you feel you need to.*

The envelope for the experimental group (2) with the softer manipulation contained one of the pictures of a natural environment (Figure 1). And the instruction read: *In this project we are interested in the use of art and pictures as distractions – and whether this has any effect. Bring this picture home with you, hang it in your room and look at it at least once every evening.*

The control group received an envelope which contained a picture of balloons, this was chosen among several alternatives, first because it was clearly not about nature, and second because it was a neutral picture, and yet somewhat positive (Figure 3). The instructions were the same as the one for the second experimental group.

This study was conducted during the spring, since during the summer the quality of the environment where the college is located in terms of greenness is very high, and during the winter we assumed that the large discrepancy between the environmental stimuli and the outdoor environment might have an impact in itself. We used pictorial stimuli to achieve some measure of control over the environments used. The participants were told not to discuss the study with anyone before the study had ended.

Results

There were no significant findings (using between and repeated measures ANOVAs, $ps > .05$) with the two reliable sub-scales of the Attentional Function Index. Summary statistics of the outcome measures are shown in Table 1.



Figure 1. Experimental group and nature control group picture used in Study 1.



Figure 2. Experimental group picture used in Study 1.

To investigate whether using nature for emotion regulation had any impact on mood, we conducted two mixed between-within (3×3) repeated measures ANOVAs. The three groups (experimental conditions) were entered as a between-group factor, and the mood measures (PANAS) at three time points (start, middle, and end) were entered as within-group factors. There was a main effect (of time) on negative mood, $F(2,64) = 4.571$, $p = .014$, $partial \eta^2 = 0.125$, which we did not expect. The decrease in negative mood can be observed for all groups in Table 1. In addition, the interaction was non-significant $F(4,64) = 0.821$, $p = .517$, $partial \eta^2 = 0.049$. There was no main effect on positive mood, $F(2,64) = 0.415$, $p = .662$, $partial \eta^2 = 0.013$. However, the group \times time interaction was significant, $F(4,64) = 3.314$, $p = .016$, $partial \eta^2 = 0.172$. This last result supports Hypothesis 1b; there was an increase in positive mood in the experimental group(s). Relative to baseline, positive mood increased in both



Figure 3. Control group picture used in Study 1.

experimental groups, while in the control group, positive mood decreased (see Table 1). It was also tested whether this effect on positive mood held when comparing the experimental group against the nature control group only, to compare the nature exposure effect with the use of nature effect. This analysis indicated a significant main effect of time (positive mood increased in both groups), $F(2,44) = 3.239$, $p = .049$, $partial \eta^2 = 0.128$, but also a significant group \times time interaction was found, $F(2,44) = 3.543$, $p = .037$, $partial \eta^2 = 0.139$. That is, there was a main effect of nature exposure on positive mood, but there was also a difference between the two nature groups. In order to investigate this difference specifically, we considered the within-subject contrasts in an analysis of the experimental group alone. This analysis yielded a non-significant linear component, but a significant quadratic component for the main effect, $F(1,11) = 11.421$, $p = .006$.

We also conducted a mixed ANOVA with the ego restoration scale. The Mauchly test showed that the assumption of sphericity was violated; therefore the Greenhouse-Geisser values are reported. The results indicated a non-significant main effect, $F(1.557, 46.701) = 1.571$, $p = .221$, $partial \eta^2 = 0.050$. And the group \times time interaction was non-significant as well, $F(3.113, 46.701) = 1.304$, $p = .284$, $partial \eta^2 = 0.080$.

In order to investigate between group differences, the groups must be similar at baseline. The results demonstrated no significant differences between the groups at baseline: Negative mood: $F(2,38) = 1.67$, $p = .202$; Positive mood: $F(2,38) = 1.96$, $p = .155$; Ego restoration $F(2,38) = 0.20$, $p = .823$). But there were no differences between the groups at end of treatment either: Negative mood: $F(2,32) = 0.49$, $p = .618$; Positive mood: $F(2,32) = 0.27$, $p = .763$; Ego restoration: $F(2,32) = 2.61$, $p = .089$. We also conducted analyses with the combined nature group compared with the control group; the groups were similar at baseline: Ego restoration: $F(1,39) = 0.17$, $p = .679$; Negative mood: $F(1,39) = 1.11$, $p = .298$; Positive mood: $F(1,39) = 3.96$, $p = .054$. At end of treatment, there were no differences on mood ($F_s < 1$, $p_s > .05$), but a significant difference between the groups on ego restoration: $F(1,33) = 4.795$, $p = .036$. This last result supports Hypothesis 4, but we found no support for Hypothesis 3.

Table 1

Summary Statistics Over Time for Experimental Study

	Summary statistics over time					
	Start of treatment		Middle of treatment		End of treatment	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Experimental group						
PA	3.30	0.55	3.59	0.65	3.42	0.69
NA	1.81	0.58	1.49	0.37	1.51	0.37
Ego restoration	4.64	1.18	4.39	0.82	4.44	0.87
Experimental group 2						
PA	3.35	0.58	3.43	0.72	3.60	0.64
NA	1.55	0.35	1.48	0.44	1.40	0.34
Ego restoration	4.41	1.18	4.51	1.30	4.83	1.32
Control group						
PA	3.70	0.60	3.46	0.64	3.55	0.52
NA	1.53	0.36	1.44	0.30	1.37	0.35
Ego restoration	4.36	1.45	3.62	1.87	3.58	1.74
Combined nature group						
PA	3.33	0.56	3.52	0.68	3.51	0.66
NA	1.69	0.49	1.48	0.40	1.45	0.35
Ego restoration	4.53	1.16	4.45	1.06	4.64	1.11

Discussion

The results gave a partial support for the idea that actively using nature for emotion regulation is an effective strategy. We found support for one of our hypotheses regarding active usage; using nature for emotion regulation had an effect on positive mood. In addition, the analysis of the combined nature group indicated that nature exposure in general may have an effect on positive mood.

The effect on positive mood of using nature appears to be rather complicated. After the first week we observed an increase in positive mood, but towards the end of the experiment positive mood decreased (although remaining above the baseline level). One explanation is that the manipulation was too invasive; the participants were told *not* to do what they normally would do when experiencing negative emotions. In addition, the contrast analysis showed that the effect may be quadratic. Accordingly, the present study indicates that relying exclusively on this strategy for emotion regulation is not recommended.

While the experimental group reported slightly higher negative mood than the other two groups at baseline, the groups were not significantly different in mood at any time point. The higher negative mood in the experimental group at baseline may explain why there were no group differences at middle or end.

Low power (small number of participants) may explain why there were no between group differences when comparing the experimental group and the two control groups. Moreover, we did not monitor whether the participants followed the instructions given, and some may have adhered less strongly to them. In addition, it is possible that the participants in the two control group used their pictures for emotion regulation as well, although this option would have been time-constrained. Finally, as indicated above, the experimental instruction may also have been

too invasive, because the participants were urged to exclude other strategies (effective or ineffective ones), which could contribute to statistical noise.

Using nature for distraction, or emotion regulation, may influence cognitive functioning. The results showed that the combined nature group experienced higher levels of willpower, termed ego restoration, at end of treatment, when compared with the control group. A tentative conclusion may be that indirect representations of nature have a beneficial impact on restoration of willpower.

This study raises two important questions. First, what is the role of the other environments in which people find themselves? How important is the environment one moves away from when one seeks nature? Environmental deprivation may play a role here. The present study was conducted during springtime and environmental deprivation may have been a factor, although it is difficult to say how important this was because nature was still present in the everyday environment of the participants. Perhaps the results would have been stronger if the participants were living in an urban environment. A related question is whether the discrepancy between the two environments is important. Within attention restoration theory, environmental change is acknowledged, but it is only indicated that the restorative environment should be in some way *different* from one's everyday environment (Kaplan & Kaplan, 1989). The second question raised is whether using nature for emotion regulation becomes less effective over time. People may habituate to nature, and people may certainly habituate to still images of nature. Nevertheless, it seems possible that nature exposure over time could have an effect on positive mood. Although the *active use* of nature may not be a necessary condition in this regard. On the other hand, a clinical population might benefit more from this approach, because it is possible that using nature is more effective for those higher in negative mood, and/or those with some sort of cognitive fatigue (Johnsen, 2011).

Strictly speaking, this study cannot answer the question of whether using a picture of nature to regulate one's emotions is more effective than using any other picture. We can only conclude that after one week the experimental group seemed to benefit emotionally from using nature to regulate their everyday emotions.

Study 2

The purpose of Study 2 was to investigate the perception of nature with regards to emotion regulation, and the intention to use nature for emotion regulation. Specifically, we wanted to explore whether nature is perceived as an environment suitable for emotion regulation, and whether the intention to use nature for emotion regulation would have any impact on mood/affectivity. In addition, the relevance of individual differences (personality and gender) in this regard was explored.

Emotional Potential and Emotion Regulation

That some environments are better suited for certain activities is not a new idea. Research on favourite places takes at its starting point that one can choose to spend time in environments that are well suited for reflecting upon (negative) feelings (e.g., Korpela, 1995, 2003). Korpela (2003) has found that individuals with higher levels of negative mood tend to choose natural environments as their favourite places, and that these favourite places may support emotion regulation.

We suggest a relatively straightforward concept to measure the perceived relevance of an environment for emotion regulation. This concept is called the *emotional potential* of an environment. Emotional potential may be defined as an expectancy construct, *i.e.*, to what extent one expects emotional effects from (being exposed to) an envir-

onment. An environment with the emotional potential to increase positive and reduce negative emotions could actively be used for this very purpose.

Within the process model of emotion regulation, environment-focused emotion regulation would be viewed as a variation of situation selection and situation modification (see Gross, 1998; Gross & Barrett, 2011). The essential point here is that one can choose to spend time in environments one believes will increase, reduce, or maintain a feeling (situation selection). And one may modify a situation once a feeling already has been activated (or if one anticipates a feeling). For example, one may engage the children in a game when stuck in traffic. Expectancy constructs should be highly relevant in both cases because they guide our emotion regulatory choices.

Personality and Emotion Regulation

Meta-analytic and longitudinal studies have demonstrated the relevance of personality traits such as extraversion and neuroticism, but also conscientiousness, for positive and negative affect¹ (e.g., Costa & McCrae, 1980; Steel, Schmidt, & Shultz, 2008). And personality traits may be related to both emotions and moods (e.g., Costa & McCrae, 1980; Larsen & Ketelaar, 1991) and strategies for emotion regulation (see John & Gross, 2007 and Ng & Diener, 2009). The relationship between personality, environment, and mood may be highly complex. Over time, personality could influence one's mood by influencing what environments one seeks out, but it may also influence the emotional significance (impact) of these chosen environments (see Diener, Larsen, & Emmons, 1984; Lucas & Diener, 2008). It is easy to envision self-affirming circles through the seeking of environments that are congruent with one's personality. But it also seems likely that repeated exposure to "healthy" environments should have an impact upon one's mood. Summing up, personality traits may, to varying degrees, moderate the emotional impact of an environment, and mood and emotional well-being over time. In addition, environmental choices may, if they are systematic over time, partially mediate the effect of personality on mood, but this, and any direct effects of seeking environments on mood, must be an accumulation of emotional experiences. To conclude, given the relations between personality and affect, it is important to account for the variance in mood due to personality. Similarly, gender differences in mood and emotion are also relevant to consider (e.g., Grossman & Wood, 1993), that is, emotion regulatory choice is likely to be influenced by type and intensity of experience.

In this study, we developed a scale to measure the perceived emotional potential of nature (and other environments). It seems likely that this kind of scale, measuring the expected emotional effects of different environments, may be of interest and relevance in a variety of other contexts as well. For example, this scale could be used when emotional processes and well-being (in an environment) are relevant to consider, and not merely immediate reactions. Previous research has demonstrated that natural environments receive higher ratings of positive affect than urban environments (e.g., van den Berg et al., 2003; White et al., 2010). Accordingly, we hypothesized that nature would be rated higher on emotional potential than the other environments (H1a), and moreover, that perception would be related to intention; those perceiving a higher emotional potential in nature should also be more inclined to seek out nature (H1b). In addition, we studied the intentions to seek out different environments (motivational tendencies), in order to explore the participants' tentative orientation towards specific environments. We hypothesized that the motivational tendency to seek out nature when experiencing a negative emotion would be related to a more positive and less negative mood (the regulation Hypothesis, H2), and that the motivational tendency to seek nature when experiencing a positive emotion would be related to higher positive mood and lower negative mood (the savouring Hypothesis, H3).

To explore these hypotheses we analysed the participants' reactions to a small sample of environments. In similar research, studies often compare natural environments with urban environments (Velarde, Fry, & Tveit, 2007). The present study stands within this tradition, but we wanted to include a few indoor environments and one atypical natural environment as well.

Method

Participants — The participants in Study 2 were 473 college students (17% studied psychology). 66.2% were female and the mean age of the participants was 22.6 years old. By using lists of active enrolled students we calculated that 57.4% of the population of students at this college participated in this study.

Environmental Stimuli — We started with fifty six pictures in total that represented six different everyday environments: urban environments with people, urban environments without people, "unsafe or scary" natural environments, living rooms, shopping malls, and classical natural environments. A panel ($N = 7$) rated the pictures on the degree to which they were the typical examples of their environmental categories, and based on this six picture were selected (see Figures 4-9). A focus group was recruited to check the validity of the six pictures, essentially to ascertain whether people think of these categories when seeing the pictures. The focus group ($N = 12$, six women) was asked to give their most basic associations to the six selected pictures. Specifically, the participants were asked to give the first association that came to mind, and the researcher asked for more associations several times until it appeared that no new associations were reported. After the list for each picture had been produced the participants were asked to raise their hand if they agreed with each of the associations. The agreements on these associations were counted. In general, the results confirmed the original categories, but the highest concordance was for classic nature, urban environment with people, and the shopping mall. Only the associations agreed upon by 50% or more are reported. The "urban environment with people" produced the following associations and number of people agreeing: *outside* (12), *street* (11), *people* (12), and *nice weather* (12). The "classic nature" picture produced the following associations: *river* (9), *nature* (12), *landscape* (12), *the mountain* (6), *Norway* (12). And the "shopping mall" produced the following associations: *shopping mall* (12), *city* (12), *floors* (12), *Oslo City* (a shopping mall) (9), *lots of people* (12), *glass ceiling* (10), *busy* (11). "Urban environment without people": *city* (11), *grey* (8), *bad weather* (8), *downhill* (11), and *blocks* (10). "Unsafe (atypical) nature": *forest* (12), *evening* (9), *dusk* (10). "Living room": *evening* (12), *living room* (10), *lamp* (12), and *reading corner* (7).



Figure 4. Urban environment with people (Study 2).



Figure 5. Urban environment without people (Study 2).



Figure 6. Unsafe/atypical nature (Study 2).



Figure 7. Classic nature (Study 2).



Figure 8. Living room (Study 2).



Figure 9. Shopping mall (Study 2).

Measures — Extraversion and neuroticism was assessed with the Norwegian version of the big five inventory (BFI-44; Engvik & Føllesdal, 2005; John & Srivastava, 1999). Positive and negative mood were measured using the Positive and Negative Affect Schedule (PANAS) (Watson et al., 1988), with the instruction to indicate *how you generally feel*. The intention to seek out nature was measured with two questions: “I would seek this environment if I was sad” and “I would seek this environment if I was happy”. The questions were verbally anchored from 1-7,

highly disagree to *highly agree*. It was assumed that these two items indicated a motivational tendency or an *intention* to seek out nature when happy or sad, and that this intention should be closely related to savouring happy feelings, and regulating negative feelings.

Emotional potential was measured by four items: "Being in these surroundings would make me happier"; "Being in these surroundings would make me less happy"; "Being in these surroundings would make me sadder"; "Being in these surroundings would make me less sad". These items were submitted to exploratory factor analysis (principal axis factoring with promax rotation). The factor analysis extracted a total of seven factors, but the last factor seemed to be the result of over-factorisation, for example, most items loaded lightly on this factor, and unsystematically. In addition, it was apparent that the items that related to the six different environments (pictures) organised into the first six factors (one for each environment). Therefore, a six factor solution was used which accounted for 55.16% of the variance (the seven factor solution accounted for 59.85%). The six factors consisted of items relating to the same picture. Pattern matrix cross loadings were very low, typically below 0.10 (max 0.14), and factor loadings were typically very high, about 0.70 (min 0.43). Moreover, the six factors formed a bipolar organisation, with negative loadings for the items "...less happy" and "...sadder", and positive loadings for the items "...happier" and "...less sad". Thus, we reversed the negative items and calculated mean emotional potential scales for each environment. The reliabilities (Cronbach's α) of these scales were good. See Table 2 for means, standard deviations, item ranges, and Cronbach's α 's for all measures.

Procedure — The pictures of the six different environments were presented in softly lit lecture halls using an image projector. The participants viewed the pictures and indicated their immediate reactions to them on the questionnaire.

Results

Pair wise comparisons were conducted using paired samples *t*-tests and all environments were tested against the classical natural environment on emotional potential and the intention to seek out the environments when happy/sad. Hypothesis 1a stated that nature would be rated highest on emotional potential. The results supported this: *classic nature* obtained significantly higher score on emotional potential than the other environments: compared with the urban environment with people: $t(465) = 11.197, p < .001, d = 0.71$; urban environment without people: $t(463) = 30.400, p < .001, d = 2.00$; unsafe nature: $t(462) = 34.566, p < .001, d = 2.15$, living room: $t(464) = 24.047, p < .001, d = 1.58$; shopping mall: $t(464) = 11.422, p < .001, d = 0.76$. Cohen's *d* was computed by dividing the difference in means by the pooled standard deviation, as recommended for repeated measures designs (see Dunlap, Cortina, Vaslow, & Burke, 1996). According to Hypothesis 1b, the perception of the emotional potential of nature should be associated with the intention to seek out nature. The results supported this, emotional potential correlated with the intention to seek nature when happy ($r = .62, p < .01$), and sad ($r = .21, p < .01$).

The participants seemed to prefer seeking classic nature when happy (savouring) over the other environments. Compared with urban environment with people: $t(464) = 11.823, p < .001, d = 0.71$, urban environment without people: $t(463) = 25.165, p < .001, d = 1.61$, unsafe nature: $t(461) = 30.948, p < .001, d = 1.86$, living room: $t(463) = 16.272, p < .001, d = 1.04$, shopping mall: $t(461) = 3.836, p < .001, d = 0.25$. In general, the participants did not report a particularly strong motivational tendency to seek any of the environments when sad (see Table 2). However, classic nature was rated higher than most environments on the intention to regulate sadness. Compared with urban environment with people: $t(461) = 13.641, p < .001, d = 0.78$, urban environment without people: $t(458) = 7.538, p < .001, d = 0.46$, shopping mall: $t(462) = 10.530, p < .001, d = 0.62$, unsafe nature: $t(461) = 0.892, p = .373, d = 0.06$, living room: $t(462) = -0.838, p = .403, d = 0.05$.

Table 2

Means, Standard Deviations, and Item Ranges of Measures

	Mean	Standard deviation	Item range	Cronbach's α
Extraversion	4.64	0.91	1-7	.78
Emotional Stability (N)	4.52	1.08	1-7	.81
Conscientiousness	4.62	0.88	1-7	.78
Negative mood	1.83	0.49	1-5	.78
Positive mood	3.53	0.52	1-5	.78
Urban env. w/ people				
Would seek if happy	4.26	1.46	1-7	-
Would seek if sad	2.67	1.65	1-7	-
Emotional potential	4.96	1.04	1-7	.76
Urban env. w/o people				
Would seek if happy	3.08	1.36	1-7	-
Would seek if sad	3.26	1.52	1-7	-
Emotional potential	3.69	1.01	1-7	.76
"Unsafe" nature				
Would seek if happy	2.59	1.51	1-7	-
Would seek if sad	3.93	1.76	1-7	-
Emotional potential	3.19	1.31	1-7	.86
Classic nature				
Would seek if happy	5.24	1.32	1-7	-
Would seek if sad	4.04	1.81	1-7	-
Emotional potential	5.67	0.96	1-7	.83
Living room				
Would seek if happy	3.82	1.41	1-7	-
Would seek if sad	4.12	1.46	1-7	-
Emotional potential	4.09	1.05	1-7	.81
Shopping mall				
Would seek if happy	4.87	1.64	1-7	-
Would seek if sad	2.94	1.80	1-7	-
Emotional potential	4.78	1.35	1-7	.85

There were gender differences in intention, but not in the perception of nature. Seek out if sad, males ($M = 3.81$, $SD = 1.77$), females ($M = 4.17$, $SD = 1.82$), $t(460) = 2.009$, $p = .045$, $d = 0.20$. Seek out if happy, males ($M = 4.93$, $SD = 1.42$), females ($M = 5.40$, $SD = 1.25$) $t(460) = 3.620$, $p < .001$, $d = 0.36$. Emotional potential, males ($M = 5.66$, $SD = 0.97$), females ($M = 5.68$, $SD = 0.96$), $t(461) = 0.234$, $p = .815$, $d = 0.02$.

We conducted regression analyses to test whether the motivational tendency to seek nature when sad or happy (emotion regulation) could predict positive and negative mood. Personality traits (extraversion, emotional stability, and conscientiousness) and gender were entered in the first step, and the intention items (happy/sad) with regards to classic nature were entered in the second step. The dependent variable was positive mood (PA from the PANAS scale). This resulted in a significant R^2 -change ($F = 5.114$, $p = .006$). All predictors were significant at the .05 level, except the "would visit if sad" item ($p = .066$). Using negative mood (NA) as dependent variable did not result in a significant R^2 -change ($F = 1.015$, $p = .363$). We assumed there might be gender differences and con-

ducted separate regression analyses with males and females. As before, we entered conscientiousness, extraversion, and emotional stability in the first step and the intention items in the second. The results from these analyses, with PA as dependent variable, are shown in Tables 4 and 5. For males, the “would seek if happy” item was a significant predictor of PA, while for females, the “would seek if sad” item was a significant predictor of PA. Summing up, the motivational tendency to seek the natural environment when happy was correlated with positive mood (see Table 3), and predicted positive mood for males (see Table 5). The intention to seek the natural environment when sad was found to be a significant predictor of positive mood for females (see Table 4), but it was not correlated with positive mood (Table 3).

Table 3

Correlations Between Emotional Potentials and Intentions to Seek Different Environments, and Mood/Personality

	PA	NA	Emotional Stability	Extraversion	Conscientiousness
Classic nature					
Would seek if sad	.02	.07	-.05	-.10*	.02
Would seek if happy	.13**	.02	-.03	.01	.22**
Emotional potential	.15**	-.09*	.08	.03	.17**
Urban w/ people					
Would seek if sad	.04	.07	-.00	.05	.03
Would seek if happy	.02	.06	-.13**	.06	-.04
Emotional potential	.04	-.08	-.01	.13**	.00
Shopping mall					
Would seek if sad	.01	-.01	-.01	.04	.03
Would seek if happy	-.05	.12**	-.23**	.08	.03
Emotional potential	-.06	-.00	-.14**	.09	.11*
Urban w/o people					
Would seek if sad	.00	.12*	-.06	-.15**	.00
Would seek if happy	-.02	-.05	.03	-.01	-.05
Emotional potential	-.07	-.12**	.09*	-.04	-.09
Unsafe nature					
Would seek if sad	-.02	.17**	-.11*	-.09	-.05
Would seek if happy	.05	.00	.12**	-.06	.03
Emotional potential	.04	-.01	.21**	-.05	-.03
Living room					
Would seek if sad	.01	.03	-.07	.01	-.07
Would seek if happy	.05	-.01	-.02	.02	-.05
Emotional potential	.07	-.07	.04	.05	-.05

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

There were no significant differences in mood between the groups that reported that they would seek nature when sad/happy (agreement 5-7 on the Likert-type scale) and the groups that did not (agreement 1-4), all $ps > .15$. However, when endorsement of savouring (positive emotion regulation) was higher (6-7), there was a significant difference between the high intention group and the low intention group (agreement 1-5) on positive mood (PA): high intention ($M = 3.63$, $SD = 0.54$), low intention ($M = 3.45$, $SD = 0.49$), $F(1,463) = 13.688$, $p < .001$, $d = 0.35$. But there was no difference on negative mood (NA), high intention: ($M = 1.81$, $SD = 0.45$), low intention ($M = 1.84$, $SD = 0.52$), $F(1,463) = 0.628$, $p = .428$, $d = 0.06$. And interestingly, positive mood was higher among those with

Table 4

Hierarchical Multiple Regression of Positive Mood (PA) onto Personality and the Use of Nature for Emotion Regulation (Females, $N = 313$)

	Model 1			Model 2		
	β	t	p	β	t	p
Extraversion	.46	9.974	<.001	.47	10.211	<.001
Emotional Stability	.15	3.228	.001	.15	3.226	.001
Conscientiousness	.28	6.221	<.001	.27	5.909	<.001
Seek if happy				.04	0.776	.438
Seek if sad				.10	2.185	.030
R^2	.44			.45		
F change	78.877**			3.419*		

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

Table 5

Hierarchical Multiple Regression of Positive Mood (PA) Onto Personality and the Use of Nature for Emotion Regulation (Males, $N = 155$)

	Model 1			Model 2		
	β	t	p	β	t	p
Extraversion	.49	7.079	<.001	.49	7.080	<.001
Emotional Stability	.05	0.699	.486	.06	0.891	.374
Conscientiousness	.31	4.732	<.001	.28	4.245	<.001
Seek if happy				.16	2.310	.022
Seek if sad				-.01	-0.125	.901
R^2	.37			.40		
F change	29.019**			2.860		

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

higher endorsement of the negative emotion regulation item, although the difference was not significant, high intention ($M = 3.62$, $SD = 0.55$), low intention ($M = 3.51$, $SD = 0.51$), $F(1,463) = 3.438$, $p = .064$, $d = 0.21$. The high endorsement group also reported higher negative mood, but the difference was not significant, high intention ($M = 1.87$, $SD = 0.54$), low intention: ($M = 1.81$, $SD = 0.47$), $F(1,463) = 1.187$, $p = .276$, $d = 0.12$.

Of course, this may not be about nature at all; any environment could be sought for the purpose of emotion regulation or self-regulation, and be effective. In order to test for this possibility, we compared responses to the classic natural environment with responses to all six environments. We conducted the same hierarchical regression analyses as with the natural environment, adding gender and personality traits in the first step and the intention items in the second. The results showed that adding the intention items resulted in a significant R^2 -change only in one analysis. For the "unsafe" natural environment, seeking if sad predicted negative mood ($\beta = .11$, $p = .004$), that is seeking this environment positively predicted negative mood when controlling for personality and gender. Moreover, three of the intention items correlated positively with negative mood (see Table 3).

Discussion

The present study introduced a novel concept, emotional potential, to measure the perceived relevance of an environment for emotion regulation. This *expectancy construct* refers to the belief that an environment will increase positive and decrease negative emotions. Emotional potential seems to be a reliable and coherent measure. The

perceived emotional potential of nature appears to be high. This supports previous research findings on the association between nature and positive affect (e.g., van den Berg et al., 2003; White et al., 2010). However, this may not be true for all natural environments; the picture of the unsafe natural environment was rated significantly lower on emotional potential than the classical natural environment.

We found some support for both the savouring and the regulation hypotheses. Positive mood was associated with the intention to seek nature when happy (savouring). This could indicate that the strategy is effective in increasing or maintaining positive mood. On the other hand, it may be that people higher in positive mood are more outgoing, more oriented towards seeking environments in general. Of course, then such associations should also be found with the other environments. Both intentions, to seek out nature when happy, and sad, could predict positive mood in the regression analyses, but there was a gender difference here. For males, the intention to seek out nature when happy was a significant predictor of positive mood, while for females, the intention to seek out nature when sad predicted positive mood.

The intention to seek nature was not associated with negative mood. This could indicate that the impact upon negative mood is more indirect (see below). When the participants were divided into groups based on endorsement of the items, perhaps indicating a stronger tendency to *actually* seek out nature when happy or sad, we found a higher level of positive mood among those showing a tendency towards savouring, and this difference was statistically significant. In addition, positive mood was higher among the participants showing a tendency towards negative emotion regulation. This difference was close to being statistically significant. The fact that this group also reported slightly higher negative mood indicates that people with higher negative mood may seek out nature to undo the impact of negative feelings, that is, they may perceive a need to use nature to buffer against their negative mood, and as a result may heighten their positive mood. This fits well with the broaden-and-build theory of positive emotions, where the activation of positive emotions is thought to undo the sequelae of negative emotions (Fredrickson, 1998). This could explain a hypothetical indirect effect on negative mood.

There are two main objections that could be raised against this study; the choice to study only a small number of environments, and the choice to include only two emotions. One important reason for making these choices was the attempt to avoid fatigue among the participants. Two common examples of emotions were selected, one positive and one negative. With regards to the selection of environments there was an additional reason for our approach. Rather than controlling some relevant aspect of the environment, we opted for a more holistic approach and selected a few common *everyday* environments. We were looking for a representation of environments that people might be exposed to daily or weekly. To be useful, the environments should be representative exemplars of their category, and the focus group confirmed this representativeness. Overall, the classical natural environment, the shopping mall, the living room, and the urban environment with people may be judged to be adequate exemplars.

The *type* of natural environment one seeks may be relevant. In the present context, a natural environment showing water and greenery was rated more positively than a natural environment showing a dark forest. The responses to the atypical natural environment could indicate a congruency perspective. That is, seeking a darker natural environment could be a way of validating one's negative mood. And furthermore, this could indicate that it may be easier to project emotions onto nature, both positive and negative, than onto other environments. But it is also possible that we respond more readily to different natural environments, that is, the underlying relevance of natural environments may be clearer to us, as evolutionary analyses have suggested (e.g., Ulrich, 1993).

The relation between the perception of the emotional potential of nature and conscientiousness confirms a previous finding that individuals with a higher score on conscientiousness may appraise nature as highly relevant for their well-being (Johnsen, 2012). This is also in accordance with the idea that conscientious individuals orient themselves towards that which is socially prescribed (see John & Gross, 2007), and have emotional responses accordingly.

The finding that savouring happy feelings in an *urban environment* is weakly related to negative mood might indicate that this is an inefficient strategy. On the other hand, it could simply mean that people with a more negative mood want to avoid public settings even when they are happy. Nevertheless, the finding is intriguing and should be researched further. Generally speaking, the relations between personality, the seeking of affect-congruent and affect-incongruent environments, and emotional responses, should be researched further. There may be some interesting findings here, for example, seeking mood-congruent environments could moderate or mediate the relationship between mood and personality.

Only single items were used to measure intention in this study, it is possible that by using scales, and by including more emotions, the relations will be stronger. It should also be noted that the intentions only referred to a specific picture as a proxy for nature. While our approach made it possible to gather more immediate, and perhaps visceral, reactions to the different environments, asking about these environments in general would probably produce stronger associations.

General Discussion

We have reported results from one experimental and one cross-sectional study of the use of nature for emotion regulation. Taken together, the results from these two studies show that the use of nature for emotion regulation may have real and beneficial consequences for people employing this strategy. The evidence for an effect on positive mood from this strategy seems convincing, at least to some extent. The experimental study showed an initial increase in positive mood for the active usage group and a main effect on positive mood for the combined nature group, and the cross-sectional study showed that more usage of nature for emotion regulation was related to higher positive mood. It was more difficult, however, to demonstrate that this strategy has an effect on cognitive functions. The only finding of relevance was that, at the end of the experiment, ego restoration, which is assumed to measure an increase in willpower, was rated higher in the combined nature group than in the control group. This shows that being exposed to nature may over time have an effect on one's perceived willpower.

Future studies might focus on whether using nature to regulate emotion is effective in increasing positive mood over longer periods of time, and whether this approach may be relevant in a clinical perspective. For example, using nature may be particularly effective for people who cope with their depression by seeking mood-congruent environments. Moreover, further research might also consider the appropriateness of using different environments (e.g., the shopping mall) for emotion regulation.

Emotional potential may be a relevant concept to consider when studying relations between the physical environment (e.g., buildings and neighbourhoods) and well-being. In fact, the present findings indicate that people may perceive nature as highly relevant for emotion regulation. And therefore, taking steps that make the option of visiting nature available to people may contribute to increased well-being and better psychological health in the population.

The results reported here show that it may be of importance which environmental stimuli one chooses for distraction. Given this, one should take a closer and more specific look at what environmental distractions people use, or

prefer. This may be particularly relevant in our modern society where environmental stimuli designed to distract is the rule rather than the exception.

Notes

i) We use the term affect as a general term referring to both emotions and moods. And distinguish between emotions and moods in terms of duration and situational relevance. Mood is a more lasting (days, months) emotional reaction.

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