



# The natural context of wellbeing: Ecological momentary assessment of the influence of nature and daylight on affect and stress for individuals with depression levels varying from none to clinical



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## ABSTRACT

This paper explores how everyday encounters with two natural phenomena -natural elements and daylight-influence affect and stress levels for people differing in mental health. Nature and daylight exposure both have well-documented beneficial effects on mental health and affect but to what extent their exposure has beneficial effects in daily life is currently under investigated, as is the question whether lower mental health would make one more, or instead, less responsive. To this end, an ecological momentary assessment protocol was employed for a period of 6 days. Fifty-nine participants varying in level of depressive symptoms from none to clinical completed momentary assessments of affect, stress, and their physical environment. Results indicate beneficial effects of nature and daylight on affect and some effects on stress and stress-related outcomes. For nature exposure, but not for daylight exposure, effects were stronger for those in higher need of restoration, stressing the importance of our everyday environment for mental wellbeing.

## 1. Introduction

Our experiences and emotions are situated in the places we encounter throughout the day, thereby inseparably connecting wellbeing with our physical surroundings. It may not be surprising therefore that the [World Health Organization \(2016a\)](#) stresses the importance (amongst others) of environmental factors in the promotion and protection of mental health. Presently, mental health issues present an ever-growing problem. Depression, for example, is the leading cause in sick leave and finding ways to combat depression should have top priority ([WHO, 2016a](#)). Existing therapies are geared towards pharmaceutical interventions and cognitive behavioral therapy, but smaller everyday interventions -such as exposure to restorative environments-could complement the healing process or even help prevent mental illness. The present study therefore investigated how everyday exposure to restorative environmental elements -nature and daylight-influenced affective states and stress levels for both healthy individuals and people suffering from depression and / or anxiety.

Restorative environments represent those places that foster our mental and physical health, improve our affective states and replenish our resources (see, e.g., [Hartig and Staats, 2003](#)). They offer their visitors a place to get away from their daily struggles and provide fascinating scenery (see, e.g., [Kaplan, 1983](#)). The majority of studies in

this domain of research have focused on the restorative effects of nature, but other environmental characteristics may also contribute (see, e.g., [Beute and de Kort, 2014a](#)). In the present study, natural light and natural elements were considered for their restorative potential as well as their omnipresence in everyday life. Exposure to nature and daylight often coincides when one is outdoors, but exposure can also occur indoors in the presence of a window (providing both a view to the outside and daylight entrance) and indoor plants. Besides often going hand in hand ([WHO, 2016b](#)), very similar beneficial effects of these nature and daylight exposure have been reported in separate research domains ([Beute and de Kort, 2014a](#)).

Benefits of nature have been proposed to run through both affective ([Ulrich, 1983](#)) and cognitive pathways ([Kaplan, 1995](#); [Kaplan and Berman, 2010](#)). Natural environments are inherently fascinating and present us the opportunity to get away from our daily hassles and worries (see, e.g., [Kaplan, 1983, 1995](#)). These qualities help boost depleted mental resources ([Kaplan and Berman, 2010](#)). In addition, we may have an evolutionary-based predisposition to respond positively to unthreatening natural environments ([Ulrich, 1983](#)). These positive affective responses have been proposed to be pre-cognitive and contribute to the stress-reducing potential of nature ([Ulrich et al., 1991](#)). Reported beneficial effects of nature include a reduction in stress levels ([Ulrich et al., 1991](#)), improvement of mood ([Beute and de](#)

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Kort, 2014b; Berman et al., 2008; Ulrich et al., 1991), and faster or better physiological recovery after a stress or mental fatigue induction (Beute and de Kort, 2014b; Fredrickson and Lavigne, 1998; Laumann, Gärling, Stormak, 2003; Ulrich et al., 1991). Cognitive benefits include better task performance as well as self-regulatory skills (Beute and de Kort, 2014b; Berman et al., 2008; Ohly et al., 2016). Last, better perceived health (see e.g., Korpela and Ylén, 2007) as well as longer-term health benefits have also been reported (Maas et al., 2006; Mitchell and Popham, 2008).

To what extent such environments do indeed provide restoration and induce more positive affect may vary with the degree to which a person is in need of restoration (Korpela et al., 2008; Roe and Aspinall, 2011). It has been suggested for instance, that people suffering from affective problems and high stress might benefit most from restorative environments. In fact, laboratory research has mainly tested effects of exposure to natural stimuli after first increasing the need for restoration by inducing either stress or attention fatigue (Beute and de Kort, 2014b). At the same time, research also points to a lack in potential to enjoy positive experiences for those suffering from depression (Naranjo et al., 2001). Still, the majority of evidence for beneficial effects of nature on affect stems from laboratory or field research with healthy participants. There are, however, also studies addressing mental health problems directly. One field study investigated the benefits of restorative environments for people with affective problems (Roe and Aspinall, 2011). This study compared restorative effects of healthy individuals versus individuals experiencing mental health issues. Their results indicated that walking in nature was beneficial for both groups, but more so for those in the clinical sample. This suggests that natural environments mattered most for those high in need for restoration. A lack of natural elements in urban environments could also contribute to adverse mental health effects of our surroundings. Ellet et al. (2008) found that walking in an urban environment had detrimental effects on mental health for people suffering from schizophrenia, although it remains unclear whether these effects were due to unfavorable characteristics of urban environments, such as social crowding, or to a lack of nature.

Cognitive benefits of being in natural settings for people suffering from affective disorder have been demonstrated by Berman et al. (2012). They report that, just as healthy individuals, people with depression benefit from exposure to nature. Memory span improved after a 50-min walk in nature. In addition to cognitive benefits, the walk also yielded significant improvements in affect. Last, longitudinal studies have yielded evidence for protective benefits of exposure to greenery on mental health (for an overview, see e.g., Annerstedt et al., 2015; Gascon et al., 2015). For example, proximate greenness has been found related to a decreased risk for anxiety and depression (Beyer et al., 2014; Maas et al., 2009).

Beneficial effects of daylight, on the other hand, are often attributed to biological processes; the so-called non-image forming effects of light. These non-image forming effects are driven mainly by intrinsically photoreceptive retinal ganglion cells in the eye that feed information directly to central parts of the brain, thereby entraining the biological clock (e.g., influencing sleep quality) as well as acutely affecting human functioning (Cajochen, 2007). These effects depend on the brightness and spectral composition of the light as well as the duration and timing of light exposure. Light therapy (therapeutic bright light exposure) is a promising treatment option for multiple forms of depression (Terman and Terman, 2005). In addition, the synthesis of vitamin D in response to exposure of the skin to sunlight has also been related to beneficial affective (Landsdowne and Provost, 1998) as well as health-protective effects (Kauffman, 2009). It goes beyond the scope of this paper to discuss these pathways in detail, please consult (Boyce, 2014) for an overview of biological effects of light.

Importantly, little research in this field has focused on the psychological experience of daylight exposure, whereas this is also likely to play a role (Beute and de Kort, 2014a; Boyce et al., 2003; de Kort and Veitch, 2014). After all, apart from being very bright – much brighter than

electric lighting indoors – it is also strongly associated with naturalness, outdoors, health and related positive phenomena (Haans, 2014; Veitch et al., 1993; Veitch and Gifford, 1996). Especially potential affective benefits of daylight appear a promising candidate (Beute and de Kort, 2014a). Indeed, people show a consistent preference for the presence of windows (see, e.g., Collins, 1975) as well as sunny and bright as opposed to overcast and dark scenes (Beute and de Kort, 2013).

Whereas restorative effects of nature have mainly been tested for healthy individuals, evidence of beneficial effects of daylight exposure on affective problems has since long been collected in clinical research. Perhaps the most direct link between daylight exposure and mental health is illustrated by Seasonal Affective Disorder (Rosenthal et al., 1984). A shorter photoperiod in winter is seen to play an important role in the etiology of “winter depression”, but also causes (milder) symptoms in the healthy population (Rosenthal et al., 1984). Bright Light Therapy is often the remedy for Seasonal Affective Disorder (Terman and Terman, 2005). In fact, it has also proven successful in treating non-seasonal depression (Terman and Terman, 2005) as well as other mental health issues such as burnout (Meesters and Waslander, 2010). In tandem, field studies have indicated positive effects of sunlight exposure in patient rooms on recovery from depression (Beauchemin and Hays, 1996; Canellas et al., 2016) and spending time outdoors in daylight could improve depressive symptoms in elderly as well as improve their cognitive functioning (Caldwell et al., 2014). A daily walk outdoors proved beneficial for individuals with seasonal affective disorder, an effect the authors attributed to daylight exposure (Wirz-Justice et al., 1996). Notably, walking outdoors not only means exposure to daylight but also potentially to nature, as well as an increase in physical activity (Beute and de Kort, 2014). Not only individuals with mental health problems appear to benefit from daylight exposure as, for instance, a 30-min exposure to daylight has been found to improve mood (Kaida et al., 2007) for healthy individuals as well.

As the previous sections illustrate, both nature and daylight can have profound positive affective benefits. These phenomena are naturally available and can vary widely between different environments.

### 1.1. Ecological momentary assessment of context and affect

While the amount of nature and daylight can vary substantially throughout the day, affective states and stress levels also show dynamic diurnal patterns (e.g., Murray et al., 2009; Takano and Tanno, 2011). Ecological Momentary Assessment (EMA; Shiffman, and Stone, 1998), or Experience Sampling Methodology (ESM; Csikszentmihalyi et al., 1977), allows capturing these dynamics in environmental conditions and affective states in concurrence by probing participants multiple times per day to fill in short questionnaires. This methodology has high ecological validity – capturing behavior and cognition in everyday life – and is especially suitable to capture contextual effects (Beute et al., 2016; Reis, 2012). This methodology has recently flourished due to rapid advancements in mobile and sensor technology. EMA provides restorative environments researchers a tool to gain a wealth of new insights and the ability to advance restoration theory, for instance because it allows capturing multiple environmental factors at the same time (Beute et al., 2016). EMA studies typically employ Hierarchical models to test for beneficial effects of nature exposure. Hierarchical models can deal well with the nested nature of the data (i.e., multiple measurements per person over multiple days) as well as with missing data (i.e., participants not responding to beeps). Another advantage is the ability to create your own model tailored to the particular dataset and research question. For instance, one can compare fixed with random effects of the independent variable, to see whether effects are the same for all individuals or differ between individuals.

Some related research has already been conducted employing ESM/EMA protocols. Being in a natural environment was found related to happiness (Mackerron and Mourato, 2013) as well as vitality (Ryan et al., 2010). These studies used either geographical location

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