UNIVERZA NA PRIMORSKEM

FAKULTETA ZA MATEMATIKO, NARAVOSLOVJE IN

INFORMACIJSKE TEHNOLOGIJE

MAGISTRSKO DELO

(MASTER THESIS)

VNAŠANJE NARAVE V DELOVNA OKOLJA: PERCEPCIJE ZAPOSLENIH O SVOJIH PISARNAH

(BRINGING NATURE INTO WORKSPACES: EMPLOYEES' PERCEPTIONS OF THEIR OFFICES)

MARKO POSAVČEVIĆ

2016

MAGISTRSKO DELO (MASTER THESIS)

MARKO POSAVČEVIĆ

UNIVERZA NA PRIMORSKEM

FAKULTETA ZA MATEMATIKO, NARAVOSLOVJE IN

INFORMACIJSKE TEHNOLOGIJE

Magistrsko delo

(Master Thesis)

Vnašanje narave v delovna okolja: percepcije zaposlenih o svojih pisarnah

(Bringing nature into workspaces: Employees' perceptions of their offices)

Ime in priimek: Marko Posavčević

Študijski program: Biopsihologija, 2. stopnja

Mentor: doc. dr. Katarina Babnik

Delovni somentor: mag. Michael David Burnard

Koper, september 2016

Ključna dokumentacijska informacija

Ime in PRIIMEK: Marko POSAVČEVIĆ

Naslov magistrskega dela: Bringing nature into workspaces: Employees' perceptions of their offices

Kraj: Koper

Leto: 2016

Število listov: 73 Število slik: 3 Število tabel: 7

Število prilog: 3 Št. strani prilog: 8

Število referenc: 133

Mentor: doc. dr. Katarina Babnik

Somentor: mag. Michael David Burnard

UDK: 005.32:331.101.32(042.2)

Ključne besede: naravnost, percepcije, grajeno okolje, pisarna, biofilija, restorativni sonaravni dizajn, strukturno modeliranje

Izvleček: Sodobne smernice gradnje že vključujejo naravo v dizajn grajenega okolja z namenom, da bi to bolje zadostilo potrebam uporabnikov prostorov, ter pozitivno vplivalo na blagostanje le-teh – gre za pristop, imenovan restorativni sonaravni dizajn. Pregled literature na temo restorativnega sonaravnega dizajna je vodil v oblikovanje vprašalnika, ki je nudil vpogled v to, kako uporabniki ocenjujejo svoje pisarne v povezavi s pristonostjo naravnih materialov in elementov ter splošno naravnostjo ter restorativnostjo prostora. Rezultati kažejo, da stanje pisarn glede na principe restorativnega sonaravnega dizajna ni kritično, vendar ostaja prostor za izboljšave. Strukturno modeliranje je pokazalo interakcije med zaznano prisotnostjo elementov narave v pisarni ter njeno zaznano naravnostjo in restorativnostjo, pa tudi z uporabnikovim blagostanjem. Prihodnje raziskovalno delo bi moralo stremeti k dodatni razjasnitvi in razumevanju temeljnih konceptov, ki jih je naslovila ta raziskava, kar bi vodilo do bolj robustnih rezultatov. Kljub temu pa rezultati te študije nakazujejo priložnost za oblikovalce, gradbenike ter proizvajalce, da svoj trud usmerijo v oblikovanje takih notranjih prostorov, ki bi spodbujali blagostanje, pri čemer bi bila zagotovljena tudi raba trajnostnih naravnih virov.

Key words documentation

Name and SURNAME: Marko POSAVČEVIĆ

Title of the master thesis: Bringing nature into workspaces: Employees' perceptions of their offices

Place: Koper

Year: 2016

Number of pages: 73 Number of figures: 3 Number of tables: 7

Number of appendices: 3 Number of appendix pages: 8

Number of references: 133

Mentor: Assist. Prof. Katarina Babnik, PhD

Co-mentor: Michael David Burnard, MSc

UDK: 005.32:331.101.32(042.2)

Keywords: naturalness, perceptions, built environment, office, biophilia, restorative environmental design, structural equation modelling

Abstract: Nature is already being introduced into the built environment through different design attributes and interventions with the intention of improving it to better suit the needs of occupants and to foster well-being – an approach that's commonly referred to as restorative environmental design. In the present work a questionnaire was designed based on a review of relevant literature on the topic of restorative environmental design. The questionnaire allowed insight into how occupants rate their offices with regard to the presence of bio-based materials and elements and the overall naturalness and restorativeness of their office. The results showed that the current adherence of office design to the principles of restorative environmental design in Slovenia is not critical, however there is room for improvement. Structural modelling showed interrelations between the perceived presence of elements of nature in the office and its perceived naturalness and restorativeness, as well as the occupant's well-being. Future research should strive to clarify the concepts addressed in the current study to provide robust measures and conclusions; however, current results already indicate an opportunity for designers, builders, and product manufacturers to direct effort into creating built indoor spaces that foster well-being, while using sustainable resources.

Contents

List of tables

List of figures

List of appendices

ACKNOWLEDGMENTS

First and foremost I would like to express my sincere gratitude to my advisors Dr. Katarina Babnik and Michael Burnard for their invaluable guidance, suggestions, and endless patience throughout the making of this work.

I would like to also extend a special thanks to Dr. Andreja Kutnar for her suggestions, which helped shape this investigation, and for her ceaseless support. I also wish to thank Dr. Anders Q. Nyrud for sharing his knowledge and experience with me, and for his hospitality during my stay at the Treteknisk Institute of Wood Technology in Oslo, Norway. I wish to also acknowledge Dr. Margherita Brondino and Dr. Margherita Pasini for kindly allowing me to use their PRS-11 scale in the present work.

Last but not least, I would like to express my appreciation to my family and friends for their continued support and confidence.

1 INTRODUCTION

In one of his many works, Birthright (2012), Stephen Kellert begins the chapter on design with a sobering estimate: "We now spend on average ninety percent of our time indoors in essentially an artificial, human-designed and –created world" (p.157). For the past 5 millennia human history has been marked by the emergence and rapid development of technology, which led to increasing urbanization and consequently separation of humans from nature – the environment to which most of our emotional and problem-solving processes are adapted to (Kellert, 2008).

The second half of the 20th century brought a progressive paradigm shift. Closely related to prevalent topics and concerns within society, attention began to be directed at the natural environment, both on a local as well as global scale (Clayton & Saunders, 2012). Efforts were made towards raising awareness about problems of natural environment degradation as well as how this damage could be repaired and avoided, leading the way toward a sustainable way of life. This idea of sustainability found its way into the fields of modern design and construction, effectively forming a foundation for what is now known as sustainable design, or green building design (Kitek Kuzman & Kutnar, 2014). The human-built environment is thus already beginning to adhere to the idea of mitigating the adverse effects on nature. The next step would be to include nature into the built environment in a way that would not only prevent negative health outcomes for the users, but would promote health and well-being through catering to the affinity humans have toward nature (Derr & Kellert, 2013; Kellert, 2008). This is the key principle guiding the making of the present work.

By reviewing the existing literature on the topic of including nature into the built environment with the intention of improving it to better suit the needs of occupants, a questionnaire was designed that investigates occupant perspectives of their physical, built environment related to the key findings of current literature on the topic. The study allowed insight into how occupants rate their offices with regard to the presence of bio-based materials and elements and the overall pleasantness and naturalness of their office. One of the key aspects of this study was to determine if the restorativeness of the environment as a psychological concept has a functional role in the context of office spaces, and how bio-based materials contribute to the performance of restorative elements in them. The study provided insight into the current state of office spaces in Slovenia and in what extent they adhere to the principles of restorative environmental design. No similar study was found to have been performed in Slovenia or abroad. This work adds to existing research in the field of environmental psychology, an underrepresented branch of psychology in Slovenia.

1.1 Environmental psychology and the contemporary built environment

The relationship between humans and their environment has been a persisting and reoccurring topic of research within psychological science (Bonnes & Bonaiuto, 2002; Gifford, Steg, & Reser, 2011). However, as Stokols (1995) notes, in the past most psychologists who were interested in the interplay between people and their surroundings did not take the physical environment in its entirety into consideration, but rather relied on the psychological representation of the environment as perceived by the individual, or direct their focus solely on the apprehension of stimuli as specific information received from the environment. This is also known as the distinction between defining the environment as *molecular* instead of as *molar* (Stokols, 1995).

1.1.1 A brief look at the development of environmental psychology

It was only in the 50s and 60s that the study of the complex interrelationship between people and their sociophysical environment increasingly became closer to what we now recognize as environmental psychology, and in the 70s Proshansky, Ittelson and Rivlin (1970) delineated the basic principles of this new field within psychology, thus defining it as a separate and emerging discipline. The importance of this publication, *Environmental Psychology: Man and his Physical Setting* (1970) cannot be overstated since it initiated the rapid development of the discipline that followed – key journals were formed, among others *Environment and Behavior* and *Journal of Environmental Psychology*. For the first time researchers from the fields of environmental and social sciences as well as design were brought together to explore the transactions between people and their environments from an interdisciplinary standpoint and in a joint manner (Uzzel & Räthzel, 2009). What especially separated environmental psychology from other studies of the transactions that occur between people and their surroundings was the attention directed at defining behaviour within a context – that is, seeing how people behave in real-life situations.

1.1.2 From uncertain beginnings to a paradigm of sustainability

The late 1960s were a period when a lot of attention had started to be directed towards the ever more noticeable environmental sustainability problems and issues, such as deforestation, pollution, climate disruption, energy descent, environmental injustice, soil depletion, and other impacts, detrimental to the environment (Steg, van den Berg, de Groot, 2012; De Young, 2013). This was a movement that was apparent in the field of environmental psychology as well, and is commonly referred to as the second period of growth of the field. This movement started with studies exploring the human behaviour that was involved in the creation of said issues, as well as how these environmental changes affected human health and well-being, and then progressed into attempts at

defining factors that influence pro-environmental behaviours in people (Gifford, Steg, & Reser, 2011; Hartig, Kaiser, & Bowler, 2001; Schultz, 2001).

This orientation toward the natural environment is a product of a long-running revolution within both the natural, as well as social and behavioural sciences – an *ecological revolution* (Bonnes & Bonaiuto, 2002). This new approach established a new unit of analysis; the *ecosystem* as a system of interrelationships between living beings and their biotic and abiotic physical environment, observed both locally and globally. It manifested through two distinct approaches, each defining the human-environment interaction within the ecosystem differently. First, *partial* or *natural ecology*, was strongly influenced by biological sciences, and was characterised by the separation of bioecological, "natural" processes from humans and their actions within the environment. The latter were often, if not mainly, perceived as disturbances of the pre-existing balance within the natural ecosystems (Bonnes & Bonaiuto, 2002). However, *full ecology* adopted a different understanding of the human dimension as a central aspect of every ecosystem, and defined the environment as a system of processes which serve as resources for human (and non-human) activities within it. When environmental sciences, along with related social sciences such as environmental psychology started to widely adopt this new full ecology approach the dimension of *sustainability* was necessary to consider. The concept of sustainability can be understood as the equilibrium between the available natural resources and their renewability and the consumption of these resources by living beings in the environment, both human and non-human, broadly defined in terms of both the spatial and temporal dimensions (Bonnes & Bonaiuto, 2002). This concept does not only have environmental implications, but possesses social and economic aspects as well (Steg et al., 2012).

The ever growing influence of the full ecology approach can be observed through the changes that occurred within the field of environmental psychology, most apparently through the emergence of sub-fields and new names of the field itself, as its focus shifted from mainly built environments to natural ones. Giuliani and Scopelliti (2009) illustrate this in their review of the development of the field. These names include "green psychology" (Pol, 1993), "natural psychology" (Gifford, 1995), leading up to an "environmental psychology of sustainable development" (Bonnes & Bonaiuto, 2002), with further sub-fields with narrower scopes such as "conservation psychology" (Clayton & Saunders, 2012).

Ecological issues are still rightfully a priority, and all the attention given to them through research inquiry in the field of environmental psychology is by no means exaggerated. However, some authors (Giuliani & Scopelliti, 2009) see this as a sign of fragmentation of the scientific field and with it a loss of the previously accumulated knowledge of other aspects of the interaction of humans with their socio-physical environments. Others (e.g.

Stokols, 1995) see this as a product of the adaptability of environmental psychology to the issues that are present in society and shared by other environmental sciences; a property that characterised environmental psychology since its emergence as a scientific field. Nonetheless, persistence of several research directions within the field can be observed, natural environmental psychology being one of them (Gifford et al., 2011). Gaining increasing popularity in the last two decades, natural environmental psychology looks at how the presence of nature in various manners (through symbolism, directly, or indirectly) in our environments influences our cognition, emotion, and how that affects our behaviour.

1.1.3 Sustainable construction, green buildings, and occupant health

The concept of sustainability brought forth by the ecological revolution provided an opportunity for advancements in the fields of building design and construction. Sustainable construction can be considered as one of the most important, as well as tangible aspects of sustainability. It strives toward mitigating detrimental environmental impacts both through a responsible use of materials in the construction of the building itself as well as through energy use, and waste production during the operation phase, while providing the user with comfort and minimising negative health outcomes (Kitek Kuzman & Kutnar, 2014; Singh, Syal, Grady, & Korkmaz; 2010). In an effort to objectively assess the adherence of green buildings to the concept of sustainability, several rating systems (environmental rating tools, ERTs) have been developed. Bauer, Mösle, and Schwarz (2010) provide a summary of the criteria that these rating systems specify, namely DGNB (*Deutsche Gesellschaft für Nachhaltiges Bauen*, Germany), BREEAM (*Building Research Establishment Environmental Assessment Method*, Great Britain), LEED (*Leadership in Energy and Environmental Design*, the USA), Green Star (Australia), CASBEE (*Comprehensive Assessment System for Built Environment Efficiency*, Japan), and Minergie (Switzerland). These criteria cover the aspects of the building's site, energy use, material and water consumption, pollution and emissions, and internal environment quality that is linked to the health and well-being of the user (Bauer et al., 2010; Kitek Kuzman & Kutnar, 2014).Sustainable construction and the green building movement have certainly made an important step toward designing the built environment in a way that minimises environmental impacts. At the same time nature is being introduced back into the built environment through the recent renaissance of wood and related bio-based materials as commonly used materials for construction (Bauer et al., 2010).

Kellert (2005; 2012) agrees that while sustainable building design is a step into the right direction, it neglects the human dimension to some degree. Currently, these buildings focus primarily on achieving a low environmental impact and, perhaps to a lesser degree, mitigating negative health outcomes for occupants. This could be described as a 'pathogenic' approach to occupant health. However, this approach is seen as insufficient and lacking – most public health interventions rather adopt what is called a salutogenic (or,

sometimes, biopsychosocial) approach to health (van den Berg, Joye, & de Vries, 2012). This approach defines health as not only the absence of infirmity, but rather a state of complete well-being. We should therefore take advantage of the opportunity presented by the introduction of natural materials and elements into the built environment to promote health and well-being of people who occupy these environments (Kellert, 2005; 2008; Hartig, 2007).

1.2 Exploring the human-nature connection

Contemporary environmental sciences (including social sciences, especially natural environmental psychology) are already tackling the issue of amalgamating nature and the built environment with the aim of creating habitats that are not only designed with nature in mind, but also people, their health, and well-being. The following sections describe a theoretical and empirical basis for the notion that the inclusion of nature into the built environment is a promising intervention to provide the aforementioned benefits.

1.2.1 Reconnecting people with nature

1.2.1.1 Nature as a concept

Before we start the discussion about nature and the natural world, and how our contact with it is involved in our behaviour, well-being and health, we must first define what we mean when using these terms. The broad representation of what is "natural" in culture as well as in science was addressed in the review by Bratman, Hamilton, and Daily (2012). Relying on subjective definitions of what is natural is difficult due to the differences that occur between cultures, individuals and even different periods of time. At the same time, however, objective scientific measures of nature don't overlap with what people generally describe as natural. We thus adopt the definition of "nature" by Bratman and his colleagues (2012) as a foundation: "areas containing elements of living systems that include plants and nonhuman animals across a range of scales and degrees of human management, from a small urban park through to relatively 'pristine wilderness'" (p. 120). This definition does not include elements and attributes of nature that are non-living, yet also important to consider – such as the presence of water and stone. We therefore expand the definition of nature: these are "areas that contain elements of living systems such as plants and non-human animals, as well as non-living elements such as stone and water, across a range of scales and degrees of human management, from a small urban park through to relatively 'pristine wilderness'". We feel that this somewhat broad definition encompasses the concepts and terms used in literature to describe natural environments (e.g., natural landscape, natural area, green space, etc.; van den Berg, Joye, & de Vries, 2012).

1.2.2 Environmental aesthetics and preference

Environmental aesthetics and preferences are a topic discussed in both natural as well as social sciences (Carlson, 1999; Falk & Balling, 2010; Kaplan, 1985). Although environmental preferences seem a difficult phenomenon to research, presenting subjects with representations of different environments in the form of photographs and slides has been proven an effective research design (e.g. Falk & Balling, 2010; Kaplan, 1973; Tang, Sullivan, & Chang, 2015; Ulrich, 1981). Following from these studies it appears people commonly prefer natural environments over built or urban environments (Kaplan & Kaplan, 1989; Kaplan, Kaplan, & Wendt, 1972; Ulrich, 1983; van den Berg, Koole, & van der Wulp, 2003). The preference for these environments, for which there is both anecdotal and scientific evidence, implies there are certain qualitative characteristics of the visual content of natural settings which promote aesthetic appreciation.

In an effort to make this review as comprehensive as possible within the set scope we first turn to environmental aesthetics as a philosophical discipline. In his work, Carlson (1999) explores different views of, or models for the aesthetic appreciation of natural environments, aimed at capturing "the essence of appropriate aesthetic appreciation of nature" (p.5). Based on contemporary views within the philosophical discipline of aesthetics, he describes ten such models (an object model, a landscape model, a natural environment model, an engagement model, an arousal model, a mystery model, a nonaesthetic model, a postmodern model, a pluralist model, and a metaphysical imagination model). Two of these, the natural environment model and the arousal model of nature appreciation, seem to be facing the least conceptual difficulties. The former, the natural environment model, describes our aesthetic appreciation of natural environments as one that is based on the actual object of our observation (as opposed to representations, for instance), and also that this form of appreciation involves knowledge provided by natural, especially environmental sciences. The arousal model, however, replaces the scientific knowledge described in the nature appreciation model with a more common knowledge, present in the general population. While these models seem to defend a very cognitive and rational approach to the psychological process of environment assessment, environmental and social psychology define the process of forming preferences for environments as one guided by affect (Ulrich, 1983). In this case a person's aesthetic response is defined as affect, manifesting on a like-dislike dimension upon viewing a setting (Zajonc, 1980). Zajonc (1980) chose an approach to preference that was drastically different from the then prevalent assumption that cognition preceded affect. To explain how preferences can be formed almost instantaneously, the concept of "preferenda" was introduced – an array of vague and broad characteristics of the setting that elicit an aesthetic response within the observer.

Observing a scene and assigning preference to it implies a set of features that elicit an affective response, not unlike the concept of "preferenda" by Zajonc (1980) – several attempts have been made to understand and define the elements of the content within these scenes that foster preference. One of the earliest aspects of the visually perceived scene, argued to play a role in preference, was the *visual complexity* of the scene (Kaplan, 1973; Rapoport, 1994; Ulrich, 1983). Complexity, defined as the "number of independently perceived elements in a scene" (Ulrich, 1983, p. 95), was expanded upon after failing to explain the preference of natural over urban environments (Kaplan & Wendt, 1972). However, in the context of preference for buildings, intermediate complexity did indicate the highest preference among architecture and engineering students (Akalin, Yildirim, Wilson, & Kilicoglu, 2009).

Kaplan and Wendt (1972) developed a "tentative model" to explain the preference for natural settings, which consisted of two main variable categories. The first category, *legibility*, relates to the ease of information transmission and involves two components: *identifiability* (making sense of the observed) and *coherence* (fluidity and connectedness of the observed scene). The other variable category was named *predicted information*, dealing with information that the scene 'promises', but is harder to access. It contains the components of *mystery* (the impression that the scene could offer more information should it be further explored) and *complexity* (promise of information upon further inspection of the scene) (Kaplan & Wendt 1972, Kaplan, 1987).

Further studies introduced elements and aspects of visual setting perception and preference that were generally in agreement with earlier models (Kaplan, 1972), but provided elaborations of the concepts they described. Ulrich (1983) provided an overview of these elements: high to moderate *complexity*; the presence of a *focal point* and *observable structural patterns*; moderate to high level of *depth* in the setting; presence of a *ground texture* that invites locomotion and activity; presence of a *deflected vista*; perceived *threat levels* are insignificant, negligible.

1.2.2.1 An evolutionary approach to environmental preference

To explain the consistency found in studies that explore human preferences for environments – especially the observation that people prefer natural to urban environments (van den Berg, Jorgensen, & Wilson, 2014) and, even further, that some natural environments are preferred over others (Falk & Balling, 2010), several authors subscribe to the hypothesis that these processes are a product of evolution and possess adaptive value. The human form is arguably suited for thriving in savannah-like environments – like the ones our prehistoric ancestors roamed for almost two million years. Due to this, savannah-like environments are commonly referred to as environments of evolutionary adaptation (EEA) in evolutionary sciences – prototypical environments the characteristics of which

are reflected through our adaptive traits (Orians & Heerwagen, 1992). Evolutionary psychologists agree that our cognitive and emotional processes, much like our bodies, are adapted to these ancient milieus, thus guiding our affect and preferences for environments (Orians & Heerwagen, 1992).

Indeed the prevalent theories about our preference for viewing (or other forms of experiencing) natural settings are based on the presumption that our species is not adapted to life in urban environments and that this – consciously or not – drives us to seek out nature, which in turn grants benefits to our well-being and health (Kaplan & Kaplan, 1989; Ulrich, 1981). Furthermore, Ulrich (1983, 1993) hypothesises that Zajonc's (1980) concept of preferenda does not apply to the elements of visual settings such as complexity, a focal point etc., but instead claims we are sensitive to meaningful stimuli that implies the presence of important resources our predecessors needed to survive, such as water, shelter, and greenery (Heerwagen, 2009; Orians & Heerwagen, 1992; Ulrich, 1983).

Some authors, however, criticize the general agreement that these processes stem from our evolutionary needs, arguing that many, if not most of the studies that explore the topic are performed on samples of the Western population, in many cases recruiting students (Joye & van den Berg, 2012). However, cross-culture studies continue to be performed, adding to the validity of the assumption that our environmental preferences and benefits gained from nature contact may in fact be evolutionary in origin (Falk & Balling, 2010).

1.2.2.2 Biophilia – the connection between people and nature

In one of his many publications, but perhaps one that is essential for the present work, biologist Edward O. Wilson (1984) described the elation and fascination he felt as he observed the natural landscape while on one of his research journeys. He named this sentiment 'biophilia', further defining it as »the innate tendency to focus on life and lifelike processes« (p. 1); an »urge to affiliate with other forms of life« (p. 85). Though the posed thesis that this tendency is innate, and evolutionary (Heerwagen, 2000, 2009), and thus present in all of us might seem bold, Wilson (1984) continues to elaborate this by presenting manners in which nature is present in the human culture. Themes of nature appear in cultures more or less vicariously, through symbolism or factual content, providing a plethora of well-presented cases – the anecdotal nature of which adds weight to the notion of how deeply nature is woven into our culture. An aspect of the human-nature connection Wilson (1984) also addresses are the environments we choose to dwell in, seeking underlying mechanisms that guide our aesthetical appraisals of environments.

We now spend the majority of time indoors, in an environment that is mostly built, and therefore mostly devoid of nature (Kellert, 2012). A look at how the modern urban environments are built shows a trend of not only the progressive degradation of natural environments and systems, but also the disconnection of humans from nature (Kellert,

2008). Through the exclusion of nature from our urban dwellings we have willingly given up the opportunity to satisfy our biophilic needs and the benefits that come with it – mainly health and well-being (Derr & Kellert, 2013).

This, as Kellert (2008) asserts, is not an inevitable consequence of modernisation, but an avoidable flaw in design instead. However, the occurrence of this trend calls the evolutionary nature of biophilia as a tendency to connect to nature into question. Kellert (2005, 2008) humbly explains this by describing biophilia as a weak tendency – one that needs sufficient nurture to fully manifest as a system of biophilic values (Kellert, 2008); which could explain our persisting attraction to nature despite our isolation from it through urbanisation. Biophilia as a weak tendency is related to people's perceptions and other cognitive constructs. Strong evolutionary tendencie, which are more deeply rooted in our biological needs, manifest in more explicit forms across cultures – an example often used is our taste for sweet and fatty foods, which are saturated with calories and therefore provide more energy upon consumption (Orians & Heerwagen, 1992).

The evolutionary component of the biophilia hypothesis assumes that the absence of nature in the physical environments we occupy guides us to seek out nature through aesthetic responses; the reconnection with it in turn fosters benefits to our health and well-being. We take a look at these in the following section.

1.3 Linking nature to health

To continue answering the question why people tend to prefer natural environments and why it is important to allow people the opportunity to interact with nature on a daily basis, even in the built environment, we look at research into the connection between human-nature interaction and emotional states, cognitive abilities, and mental health in general. We will use the umbrella term 'restorative benefits' here to refer to the beneficial effects nature has on our health and well-being, referring to Hartig's (2007) definition of restoration, describing it as 'the process of renewing physical, psychological and social capabilities diminished in ongoing efforts to meet adaptive demands' (p. 2).

The modern way of life, especially in urban environments, can subject the individual to a lot of psychological wear and tear: fast pace of life, stressful jobs, pressures imposed by media and society (De Young, 2010). People are left to face these stressors in an environment that generally does not support our adaptive needs, therefore stripping us of an important coping resource (Heerwagen, 2009). Coping with stressors leaves us fatigued and in need of cognitive, emotional and physiological restoration – we will look at evidence that addresses the role of nature contact in restorative processes.

The benefits of human-nature contact as recognized in literature can be assigned into two broad categories: those that apply to our cognitive processes (Berman, Jonides, & Kaplan,

2008) and those that apply to our affective responses and related psychophysiological pathways (van den Berg, Hartig, & Staats, 2007). Research in both of these directions is guided by a corresponding theory: ART (Attention Restoration Theory, Kaplan, 1995) and SRT (Stress Reduction Theory, Ulrich, 1993), respectively. Both of these theories draw from an evolutionary explanation of our attraction to nature (Kaplan, 1987, Ulrich, 1983). Some studies suggest other mechanisms involved in our attraction to nature and the benefits it fosters – such as conscious preference (Hartig & Korpela, 1997); we briefly discuss those as well.

The research presented below addresses the benefits of being in contact with nature in general – we discuss applications in the built environment in later sections.

1.3.1 Directed attention and psychological restoration

The first of the two main theories on the benefits that contact with nature provides, ART (Kaplan, 1995), focuses predominantly on the human cognitive processes. The Attention Restoration Theory as defined by Rachel and Stephen Kaplan (1989; S. Kaplan, 1995) describes the cognitive state of the person seeking restoration as one of attentional fatigue. This concept is drawn from the two types of attentional processes described by William James (1984). Our attention may be drawn *involuntarily*, which occurs when we are presented with information that is interesting to us. This captivates our focus in an attempt to gather more information and gain insight into what is going on. The other kind of attention James (1984) described as *voluntary*, now commonly referred to as *directed attention* (Kaplan & Berman, 2010). This is the attention we consciously direct to process weak, ambiguous stimuli despite the lack of fascination or interest it evokes in us. Consequently, this directed attention requires mental effort; not to enhance the retention of the stimuli within our focus, but to inhibit other (more interesting) stimuli from drawing our attention away (Kaplan, 1995). Directed attention is the psychological resource involved in neurological functions such as self-regulation and executive functioning, and is subject to depletion (Kaplan & Berman, 2010). This depletion or attentional fatigue is supposed to be a consequence of prolonged periods of directed attention. Directed attention fatigue results in several adverse symptoms, such as reduced performance and errors, reduced ability to plan actions, irritability, aggression, and lack of inhibition in social interaction, resulting in interpersonal behaviours that are less socially acceptable (Herzog, Ouelette, Rolens, Koenigs, 2010; Kaplan, 1995; Kuo & Sullivan, 2001). These symptoms are important especially in the context of the workplace since these environments often require directed attention, and directed attention fatigue can have serious effects on not only the productivity of workers, but also their well-being (Bringslimark, Hartig, & Patil, 2011; Kaplan, 1993). These environments should therefore offer opportunities for restoration and replenishment of directed attention.

ART presumes there are conditions that facilitate the replenishment of the potential to maintain directed attention. Restoration of this potential takes place in the absence of the need to direct attention; therefore, in environments that evoke involuntary attention, or fascination (Kaplan, 2001). However, mere fascination does not yet imply restoration. Firstly, Kaplan (1995) places the concept of fascination on a continuum from 'soft' to 'hard'. Hard fascination as an extreme occurs when a certain stimuli unwillingly occupies the entirety of our capacity to process information, which does not offer restoration. In contrast, 'soft' fascination is proposed to occur when we're immersed in certain natural settings – our attention is drawn to the innately interesting and exciting elements of the setting while allowing us to still reflect and contemplate (Kaplan, 1995; Kaplan & Kaplan, 1989). For a setting to provide restoration, it should include four main aspects or components. Beside *fascination* – the presence of exciting stimuli – the feeling of escape, or *being away* allows the person to forget the stressors they were faced with in the previous environment. The aspect of *extent* is described as the notion of scope within the setting, with features that seem to extend into the distance. Finally, *compatibility* provides the observer with the sense of belonging and opportunity to function in line with his or her inclinations at ease (Kaplan, 1995).

1.3.1.1 Studies on attention restoration

Of course, many environments can possess these characteristics. However, a prototypical setting, believed to satisfy all of these requirements to provide restoration, is a natural one. The restorative potential of natural settings has been researched extensively, with findings generally supporting the hypothesis that natural settings are more restorative than urban. These studies however used different methodologies to assess the restorativeness of urban versus natural settings and imagery. Several studies measured restoration through the participants' performance on cognitive tasks that demand directed attention, such as the backwards digit-span task (Berman et al., 2008), sustained attention – SART test (Berto, 2005), or variants of the Stroop colour-word test (Hartig, Evans, Jamner, Davis, Gärling, 2003) – in the latter, the Stroop test was used as a pretest condition to deplete directed attention capacity, while the Necker Cube Pattern Control task (NCPCT) was administered in different stages of the experiment to assess cognitive restoration. The NCPCT test was shown to be sensitive to changes in directed attention capacity (Tennessen & Cimprich, 1995). These studies unanimously showed better performance on cognitive tasks when administered after viewing or being physically present in natural (restorative) environments.

Other studies used self-reported measures of restorativeness, thus testing whether can perceive the restorative value of natural settings. One of these measures is the Perceived Restorativeness Scale that aims to itemize the four theoretical factors of attention restoration, fascination, being away, extent, and compatibility. The development of the

scale began in the late 90s (Hartig, Evans, Korpela, & Gärling, 1996) and proved useful in discerning environments that were hypothesized as less restorative from those that were higher in restorative value (again both through field experiments as well as visual representations), however these studies struggled with the confirmation of a four-factor structure as suggested by ART (Hartig, Korpela, Evans, & Gärling, 1997; Hartig, Kaiser, Bowler, 1997). Purcell, Peron, and Berto (2001) continued with the development of the PRS. This tool again proved useful in separating natural and urban environments (Chang, Hammitt, Chen, Machnik, & Su, 2008; Purcell et al, 2001). A further validation yet improved the robustness of the tool (Pasini, Berto, Brondino, Hall, & Ortner, 2014). The development of the PRS scale continues with the aim to create a universal and robust measure of perceived restorativeness of environments (M. Brondino & M. Pasini, personal communication, 2 February, 2016). A measure similar to the PRS was developed by Laumann, Gärling, and Stormark (2001), yielding a factor structure in accordance with the ART, and subsequently successfully used in other studies on restorativeness of natural environments (Cole & Hall, 2010).

Some other measures of self-reporting perceived restorativeness of environtments were used in research, using very descriptive items to rate the variables of attention restoration (PRP; Herzog, Chen, & Primeau, 2002; Herzog, Maguire, & Nebel, 2003). These also showed some success, although the PRS and related measures are represented in literature in a higher degree, perhaps because of their relative simplicity and practical value.

1.3.2 Stress and psychophysiological restoration

The other main branch of research on restorative effects of natural environments is aimed at studying the moderating effects of natural settings on psychological arousal, mood and the physiological mechanisms that accompany these changes (Ulrich, 1983; Wohlwill, 1983).

Ulrich (1984, 1993) based his work on the ideas within affective psychology that contrasted the previous assumptions held by cognitive psychologists, accepting the view that our affective responses precede cognitive processes. At the same time, emotional responses were proving to be culturally consistent (Bratman et al., 2012). Ulrich (1993) suggested that viewing a setting that contains water or vegetation would elicit positive affect and reduce stress. This is in accord with the instantaneity of affective responses as supported by affective psychology of the 70s and 80s. The cross-cultural consistency of affective responses also supports the evolutionary approach to the aesthetics and preferences for natural environments. Natural settings that contain elements such as vegetation and water also suggest important resources (food, water, shelter), reacting to these scenes in an instantly positive manner thus suggests adaptive value. Levels of stress and accompanying affective states (positive or negative mood) are linked to their specific

physiological correlates: psychological arousal linked to stress decreases the presence of alpha waves in the electromagnetic activation of the brain and causes changes in blood pressure (Chang et al., 2008), as well as heart rate (Ulrich, 1981), and increases in saliva cortisol levels. Ulrich's (1993) proposed theory on the role of nature contact in stress, affect and related physiological changes came to be known as Stress Reduction Theory (SRT) in literature (Bratman et al., 2012).

1.3.2.1 Studies on stress reduction and mood

Again, stress-reducing and mood-improving effects of experiencing nature were, as is the case with ART, explored using different measures. Stress and psychological arousal were measured with physiological measures discussed earlier and self-report measures. Ulrich (1981) showed preference for natural photographs containing vegetation and water through slight increases of heart rate as well as alpha wave levels – both indicating arousal and interest. At the same time, participants expressed different affective states depending on the observed scenes with the Zuckerman Inventory of Personal Reactions (ZIPERS) – most noticeable being the decrease of Fear Arousal when viewing scenes that contained water and vegetation, whereas the score increased for the urban scenes. However, the study was performed on a small sample (18 participants), so strong implications cannot be drawn from it. Similar results were obtained on a larger sample of 46 students, who again were shown slides of natural and urban settings – ZIPERS scores showed a similar pattern of affective responses when observing natural settings. A later study performed by Ulrich et al. (1991) involved 120 individuals, who were exposed to videos of natural and urban settings. The group that was shown natural scenes reported more positive affective states and faster stress recovery was inferred from physiological measures such as heart rate, skin conductance, systolic blood pressure and muscle tension. Newer studies that employ both psychological as well as physiological measures show results in favour of natural scenes on the former, while physiological responses often do not show obvious signs of stress recovery when exposed to natural scenes (Stigsdotter & Grahn, 2011; Tyrväinen et al., 2013; Chang et al., 2008). There is some methodological discord regarding physiological measures. Laumann, Gärling, and Stormark (2003) observed decreased heart rate when participants watched a video depicting natural scenery, which they assigned to a lower degree of physiological arousal, while other studies explained the observed higher levels of physiological arousal as excitement or interest toward natural imagery (Ulrich, 1981; Ulrich et al., 1991). Self-reported mood and restorative state, however, show a preference for natural environments over urban when it comes to restoration from a stressful experience (van den Berg et al., 2014).

1.3.3 Other approaches to the restorative benefits of experiencing nature

Many studies measure psychological as well as affective, psychophysiological restoration at the same time (e.g. Chang et al., 2008; Cole & Hall, 2010; van den Berg et al., 2014). The results generally show high correlation between the two modalities, implying that these restorative mechanisms tend to work in unison, however any causal relationships remain to be explored (Bratman et al., 2012).

Some authors studied the restorative potential of environments as a phenomenon that is under influence of conscious cognitive processes, such as conscious preference. Herzog et al. (2010) studied the restorative potential of houses of worship, finding that the perceived spiritual component of visiting these environments corresponds with the theoretical model of ART. Hartig and Korpela (1997) also studied the relationship between conscious preference for favourite places and the perceived restorativeness of these places – PRS scores were the highest for these places, while the neutral environment (a town square) and a disliked place (as assigned by the participants) had significantly lower scores. These results show some involvement of conscious cognitive processes in the perception of restorative value of different environments. This aspect was revisited in a study by Korpela, Hartig, Kaiser and Fuhrer (2001), who on a sample of university students (n=199) again showed that favourite places scored high on the PRS scale; however natural settings were represented in a higher degree among favourite places and to a lower degree among unpleasant places.

Restorativeness was also linked to the concept of livability – the presence of elements that make urban spaces attractive and vibrant, such as sitting areas, focal attraction point, the presence of trees, daylight, and water. Self-report measures of restorativeness were linked to a moderate amount of elements of livability in the urban built environment (Abdulkarim & Nasar, 2014).

1.3.4 Biophilia and children

Although not explicitly linked to the present work, we find it important to include the aspect of children in the built environment, as they have a unique and specific role in this context, especially when it comes to the inclusion of nature into the spaces and dwellings they use and are a part of.

Children certainly have the most to gain, but also the most to lose from their surroundings (Derr & Kellert, 2013). There is an extensive body of literature describing the effects that different aspects of the physical environment (pollution, toxins, crowding, noise, overall quality, etc.) have on children's cognitive, social and emotional development (Ferguson, Cassells, MacAllister & Evans, 2013), as well as on their physical development and health.

Investigations into the effect of exposing children to natural environments have emerged later, but show promising results.

Children have, now perhaps more than ever, a lot of reasons to stay indoors. Parents often prefer seeing their children stay inside because of dangers presented by traffic and presence of crime (Faber Taylor & Kuo, 2006). Video games, computers and other forms of entertainment also come into play as convenient pastime, but at the cost of increasing incidence of illnesses as a result of prevalently sedentary lifestyles – the most apparent being childhood obesity (Pretty et al., 2009; Eksioglu Cetintahra & Cubukcu, 2015). Kellert (2005) categorized 3 ways children come into contact with nature: directly, indirectly, and vicariously (symbolic). This is of course true for adults as well, however research directed toward children's contact with nature aims mostly at providing children with a direct and indirect contact with nature, not so much the vicarious presence of nature in the built environment (Moore & Cooper Marcus, 2008; Louv, 2008; Chawla, 2015). Actual contact with nature often involves physical activity, which is beneficial for children, and thus receives more attention. Moore and Cooper Marcus (2008) review an extensive body of literature that provides evidence of benefits of nature exposure for children, such as improved attention functioning, improved immune system, cognitive development and learning, as well as benefits stemming from increased physical activity.

Finally, we need to look back on the rationale on making sustainability in design truly sustainable, expressed by several authors (Derr & Kellert, 2013; Kellert, 2002, 2005, 2008; Heerwagen, 2006). Complementing the existing paradigm of sustainable building design with elements of biophilic design does not only promote healthy development as well as health and well-being in children. Implementing nature into the built environment serves to equip children with a respect for nature, to cater to and to develop their sense of affinity towards nature, life and life-like processes. We would thus invest into the future generations, making them the stewards of the endeavour to create not only a sustainable economy, but a sustainable society.

1.4 Bringing nature into the built environment

After discussing the human attraction towards nature and the benefits this contact fosters, we take a look at how we can effectively reconnect man and nature through the design of built environments. These beneficial effects and processes are important to consider in the context of not only the built environment, but also the context of the physical workspace. Many studies have addressed the implementation of nature into urban landscapes in forms of parks, recreational areas, green roofs, gardens etc. (Heerwagen, 2009; Grahn & Stigsdotter, 2010; Peschardt & Stigsdotter, 2012; Tenngart Ivarson, & Hagerhall, 2008). Urban green spaces are indeed an important aspect of reintroducing natural elements and attributes into the design of urban, built environments; these studies provide evidence that

not only shows people's preference for such forms of landscape and architecture design, but also suggests positive effects on health and well-being of the occupants. We will however limit our scope to the design of interior built environments.

In the field of environmental psychology of the workspace three factors are recognized to contribute to lower levels of stress: physical, functional, and psychological (Vischer, 2007). The physical comfort commonly relates to thermal, acoustic, visual comfort and indoor air quality (Frontzak & Wargocki, 2011). These needs are addressed through building codes and standards, although sometimes the additional costs that accompany these considerations lead to workspace conditions that do not cater to the basic biophysical needs of the employee (Fox, Jackson, & Barondess, 2003). Functional comfort relates to the support the physical environment offers the employee to perform work-related tasks and duties, while psychological comfort relates to psychosocial factors such as territoriality, belonging, privacy, and control (Vischer, 2007). The environmental comfort model supposes that a non-supportive (uncomfortable) environment requires energy for coping, thus depleting these cognitive resources which could otherwise be directed at completing tasks at hand (Vischer, 2007). While classic models do not contain nature contact as a factor that could improve the comfort of the workspace, contemporary models in environmental psychology of the workspace are beginning to be complemented with findings from natural environmental psychology (Veitch, 2011). In this work we are focusing primarily on offices, but the attributes and elements presented below can be used to improve any form of the built indoor environment, unless specific conditions prevent the implementation of any of them.

1.4.1 Restorative environmental design

In light of the insufficient attention placed on the occupant health and well-being by the current sustainable building design paradigm, Kellert (2008; Derr & Kellert, 2013) proposes a new design paradigm that is interchangeably called 'restorative environmental design' and 'biophilic design' in literature. This design would merge the low-environmental-impact benefits of sustainable design while taking advantage of the building and landscape design to foster the connection between humans that inhabit these buildings, and nature. To be able to effectively implement the concept of biophilia into our built environments we must understand which aspects of nature and natural settings can be translated into building design elements, and how to do it.

Kellert (2008) provides a system of design interventions, drawn from relevant research within environmental psychology, which contains 72 elements. We will not describe the system here in detail; the design attributes and elements are presented in Table 1.4.1.1. Biophilic design and the corresponding design elements are separated into two distinct dimensions: a naturalistic dimension involving elements that directly, indirectly or

symbolically reflect nature in the built environment; the other dimension – vernacular or place-based – includes design characteristics that tap into the more spiritual and value-based aspects of biophilia. These include designs that resonate with the history of the area and its geographical properties (Kellert, 2008). McGee and Marshall-Baker (2015) used this system to design a tool to help designers and architects identify and quantify biophilic elements of interior spaces. We must still however consider the practical aspect of implementing these design elements and attributes into the built environment, either with new construction or by retrofitting these elements into existing buildings. A way of doing that is by investing effort into creating a solid body of robust empirical evidence that would serve as a reference for builders, developers and governments.

Table 1.4.1.1.
Elements and attributes of biophilic design (Kellert, 2008).

Environmental features	Natural shapes and forms	Natural patterns and processes
Colour	Botanical motifs	Sensory variability
Water	Tree and columnar supports	Information richness
Air	Animal (mainly vertebrate) motifs	Age, change, and the patina of time
Sunlight	Shells and spirals	Growth and efflorescence
Plants	Egg, oval, and tubular forms	Central focal point
Animals	Arches, vaults, domes	Patterned wholes
Natural materials	Shapes resisting straight lines and right angles	Bounded spaces
Views and vistas	Simulation of natural features	Transitional spaces
Façade greening	Biomorphy	Linked series and chains
Geology and landscape	Geomorphology	Integration of parts to wholes
Habitats and ecosystems	Biomimicry	Complementary contrasts
Fire		Dynamic balance and tension
		Fractals
		Hierarchically organized ratios and scales
Light and space	Place-based relationships	Evolved human-nature relationships
Natural light	Geographic connection to place	Prospect and refuge
Filtered and diffused light	Historic connection to place	Order and complexity
Light and shadow	Ecological connection to place	Curiosity and enticement
Reflected light	Cultural connection to place	Change and metamorphosis
Light pools	Indigenous materials	Security and protection
Warm light	Landscape orientation	Mastery and control
Light as shape and form	Landscape features that define building form	Affection and attachment
Spaciousness	Landscape ecology	Attraction and beauty

Spatial variability	Integration of culture and ecology	Exploration and discovery
Space as shape and form	Spirit of place	Information and cognition
Spatial harmony	Avoiding placelessness	Fear and awe
Inside-outside spaces		Reverence and spirituality

1.4.2 Evidence-based design

The findings from the field of environmental psychology, specifically those pertaining to the restorative benefits of nature, are already finding their way into the practice of building design. However, to justify the potential interventions in building design, especially indoor built environments, we must draw conclusions from robust scientific findings (Hartig, 2007). Implementation of restorative design elements has already begun in healthcare settings through evidence-based design (Joye & van den Berg, 2012; Ulrich, 2008), where restorative benefits such as stress reduction and positive affect (Ulrich, 1984) are important for patient recovery and well-being. This is well illustrated by a significant study performed on postoperative gallbladder patients who were granted window views on either a brick wall or a group of trees showed significant effects with the latter condition such as shorter hospital stay duration, fewer negative evaluations from nurses, decreased doses of analgesic medications, as well as fewer postsurgical complications (Ulrich, 1984).

Frumkin (2008) points to the involvement of anecdotal experience and our common sense in assigning beneficence to contact with nature. Restorative environments research and biophilic design include many ‘soft’ concepts, which is why scientific rigor must be employed when building the evidence base to support the translation of findings into guidelines to be used in practice (Frumkin, 2008; Ulrich, Quan, Zimring, Joseph, & Choudhary, 2004). It is therefore vital to direct efforts into forming definitions and measures as objectively as possible, and perform research on large, well defined samples.

1.4.3 Elements of nature in the indoor built environment

To provide structure for this section we refer to the extensive and rigorous review by A. E. van den Berg (2005), who examined clinical and non-clinical studies on the benefits of design elements and attributes that reflected or introduced nature into the built environment. Her review yielded a list of six general design elements: allowing views of nature; the inclusion of gardens; presence of indoor plants; presence of daylight; fresh air; and quiet (van den Berg, 2005). We will exclude gardens in this work as these do not apply strictly to design elements of the built indoor environment. We will however address material choice and the inclusion of natural or bio-based materials due to the extensive literature on the topic. Wood as such an element was included in the review on studies that involve indoor nature exposure by McSweeney et al. (2015).

The inclusion of elements of nature in interior design can also improve interior environment quality (IEQ) as measured by constructs such as Sick Building Syndrome (SBS) (Engvall, Norrby, & Sandstedt, 2004), characterized by occupant health complaints and symptoms such as respiratory and eye irritation, fatigue, and headaches, often caused by poor air quality, insufficient lighting and thermal conditions. Many of these issues are already relatively successfully regulated through building guidelines such as LEED (Lee & Guerin, 2009); however, the inclusion of natural elements might foster occupant well-being to a greater extent (Heerwagen, 2009).

1.4.3.1 Views of nature

Perhaps the most known study on this topic is the one performed by Ulrich (1984), showing significant decrease of time spent recovering from surgery with the group of patients who were granted a window view of trees. Windows in the office are an important resource for allowing restoration to occur, if they allow a view of nature, which was demonstrated by several studies performed in a workplace (Chang & Chen, 2005), residential buildings (Kaplan, 2001; Tennessen & Cimprich, 1995), and in classrooms (Benfield, Rainbolt, Bell, & Donovan, 2015). Not all indoor spaces have windows, and not all windows allow a 'natural' view. Drawing from the previously discussed studies that involved viewing photographs of nature (McSweeney et al., 2015) it isn't unreasonable to predict that decorative elements that depict nature would offer restoration in the office setting. Kweon, Ulrich, Walker, and Tassinary (2008) found that the presence of posters with natural landscapes resulted in significantly lowered states of anger and stress with male participants. A study in Norway showed that office workers decorated their offices with plants and pictures of nature when they didn't have access to a window with a view (Bringslimark et al., 2011).

1.4.3.2 Presence of plants

As an easy element to implement into the physical workspace, plants were often a subject of research. The presence of plants indoors was linked to lower anxiety (Chang & Chen, 2005) and stress recovery (Russell, 1999), a limited effect was found on improved performance on cognitive tasks and creativity (Shibata & Suzuki, 2002). Plants in the office were also associated with lower rates of sick leave and higher productivity (Bringslimark, Hartig, & Patil, 2009), as well as lower incidence of self-reported health and discomfort symptoms, such as fatigue or headache (Fjeld, 2000) – therefore addressing health problems that are generally a sign of poor interior environment quality, commonly . In some cases, however, plants did not show any results on the occupant stress levels (Fell, 2010), and sometimes mixed results were obtained (van den Berg, 2005), indicating the necessity for further research in this area.

1.4.3.3 Presence of daylight

Both van den Berg (2005) and McSweeney et al. (2015) reviewed evidence that in most cases supported beneficence of sunlight in the indoor environment. In modern construction daylight is often used as a means to reduce energy consumption for lighting and heating, however positive health outcomes of daylight presence include reduced length of stay in hospitals, lower medication intake and lower incidence of depression (van den Berg, 2005). In the context of the workplace, daylight showed limited results on measures of comfort and performance, merely implying positive effects on mood and cognition (Heschong, 2003). This area of research is hardly conclusive as the presence of window views often causes an overlap in the studied effects on health and well-being, while artificial lighting that mimics daylight has not yielded positive results on health or well-being (Beute & De Kort, 2013; van den Berg, 2005). Interstingly, artificial lighting solutions that mimic daylight have not shown positive effects, again suggesting that the studied benefits of daylight presence are complemented with the benefits of having a window view and often access to fresh air (van den Berg, 2005). This overlap is pointed out in the review by Beute and De Kort (2013), who looked at empirical evidence of the health benefits of daylight indoors.

1.4.3.4 Fresh air

In many cases, access to fresh air may be facilitated by the presence of windows. In health settings air is often filtered through High Efficiency Particulate Air (HEPA) filters for safety reasons; office buildings also often don't allow access to fresh air through windows – hence ventilation quality is important. Both van den Berg (2005) and Frontczak and Wargocki (2011) examined studies on fresh air access to the occupant health and found evidence supporting lower rates of self-reported SBS symptoms and sick leave. Ventilation quality also has a limited effect on improved worker performance (Heschong, 2003).

1.4.3.5 Quiet and the absence of noise

Unpleasant noise is a common stressor in the built environment (Vischer, 2007). In the context of interior spaces noise may be produced by the activities of others (van den Berg, 2005), traffic and other noise-producing elements outside the building (Gou, Lau, & Shen, 2012). Research on the effects of noise on health and well-being in healthcare settings is still very scarce (van den Berg, 2005). In offices, unpredictable, unnecessary and uncontrollable noises generate stress in workers (Rashid & Zimring, 2008). Meaningful, predictable auditory stimuli tend to be less unpleasant (Heerwagen, 1998), and a pleasant soundscape might even foster restoration. Payne (2013) developed the Perceived Restorativeness Soundscape Scale, which – although only partially validated and partially standardised – successfully showed higher degrees of perceived restorative value of rural soundscapes compared to urban soundscapes.

1.4.3.6 Natural and bio-based materials

Material choice in designing buildings is a well-researched topic. As natural materials are regaining their popularity as materials for construction through the green building movement, a look at other, ancillary benefits of using natural materials is reasonable. Despite the presence of opportunities for the use of wood in construction, several barriers still impede the implementation of this material – e.g., building codes regarding fire hazard, prices compared to other materials, and insufficient training for designer, builders, as well as wood tradespeople (O'Connor, Kozak, Gaston, & Fell, 2004).

Nyrud, Bringslimark, and Bysheim (2014) found that intermediate quantities of wood furnishing in a healthcare setting yielded the highest preference ratings by the hospital staff. Presence of wood is therefore preferred over lack of visible wooden surfaces, however lowest ratings of preference were found to be assigned to the photo of the room that had pine wood on all surfaces. Even though the aesthetic appreciation of wooden surfaces has been assigned to its wood-grain figures (Masuda, 2004), pine is quite a structured wood with visible knots and grain patterns. Such a structured wood surface could convey an overwhelming amount of information – a high number of knots in wood surfaces is, for example, commonly found as unattractive (Broman, 1995; Nakamura & Kondo, 2007). Rice, Kozak, Meitner, and Cohen (2006) looked at the link between visible wooden surfaces and psychological well-being. They found that participants believed that the use of wood in the interior could create healthful environments. Wood was also commonly described with positive adjectives such as being warm, relaxing, natural, inviting, and comfortable. This and other studies on the psychological benefits of using wood in interior design were reviewed by Nyrud and Bringslimark (2010); their summary of results indicate that wood as an indoor design element shows high preference among people – being described as "warm", "natural", "inviting", and "calming", and often implies stress reduction as measured through psychophysiological responses. Perceptions of the naturalness of materials used in construction and building design, such as wood and stone, are important to consider. A study performed in Finland, Norway, and Slovenia showed that people's perceptions of material naturalness decrease with greater degrees of processing – solid wood, stone, and brick were therefore perceived as most natural (Burnard et al., 2015). This is an important aspect to consider when selecting building materials.

1.5 Aims and goals

The aim of this Master's thesis was to perform a survey to assess how employees in Slovenia perceive their offices with regard to the presence of bio-based materials and elements, and how the employee's perceived naturalness of their office spaces is linked to their well-being and preferences.

To do this, we have set the following goals. Firstly, we wished to assess to what extent office spaces in Slovenia adhere to the principles of restorative environmental design. Secondly, we wished to examine whether offices with a higher presence of bio-based materials and elements, reflective of nature, are also perceived as more "natural". Lastly, we tested the concept of restorativeness within the context of offices to see if the concept is applicable in these surroundings and to assess whether the rated presence of bio-based materials and elements influences the perception of the office as more restorative.

1.6 Research hypotheses

Based on our literature review and the empirical evidence it includes, we have formed these hypotheses to guide our research:

- *The presence of bio-based materials and elements in the workplace positively correlates with employees' subjective wellbeing*.

Introducing elements and materials into the indoor built environment has been proven to decrease stress (Ulrich, 1984) and promote well-being (Nyrud & Bringslimark, 2010; van den Berg, 2005)

- *Workplaces with a higher presence of bio-based materials and elements reflective of nature are perceived as more "natural".*

We predict that participants who perceive a higher presence of "natural" elements as assessed by our questionnaire will rate their workplace as more "reflective of nature" as a whole.

- *Perceived restorativeness of the workplace correlates positively with the perceived naturalness of the space.*

The Kaplans (1989; Kaplan, 1995) have dedicated their research work to the concept of restorativeness. They suggest that certain environments possess qualities which facilitate the restoration of attentional fatigue, which occurs after longer periods of performing tasks that require directed attention. Empirical evidence points to nature and natural scenes as those that promote restoration in the highest degree.

- *Perceived restorativeness of the workplace correlates positively with the rated presence of bio-based materials and elements in the office.*

Workspaces can be made to reflect nature in a higher extent through the introduction of bio-based materials (mainly visible wooden surfaces) and elements that are generally reflective of nature. These are, for example, access to fresh air, sunlight, presence of plants, a view through the windows and absence of noise.

2 METHODS

2.1 Participants

For the present study we wished to recruit individuals whose primary workspace (i.e. the working environment in which they spend the majority of their work day) is an office. A sample of white collar, office (administrative and professional) workers employed in different businesses in Slovenia was recruited. Large and medium sized businesses were selected based on their number of employees by consulting web portals SloExport (SloExport, 2016) and the PIRS Business Directory of the Republic of Slovenia (PIRS, 2016). A nonprobability (convenience) sampling method was employed. Respondents were not recruited directly – rather, invitations containing the link to the survey were sent to PR and HRM representatives of the selected companies, who then distributed the invitations among the employees who met the criteria. Due to this form of respondent recruitment a response rate is impossible to define exactly. The final sample consisted of 401 employees, 71.3% of which were female. The mean age of respondents in the sample was 43.08 years (SD = 9.64). The majority of participants had completed a master's degree, were employed in a non-managerial position, and had a job tenure of up to 23 years (mean = 13.52, SD = 10.55).

2.2 Instruments

Following a literature review we have gathered relevant empirical findings and theoretical background on the topic of introducing aspects of nature (elements and materials) into the built indoor environment. These findings were then itemised to form a questionnaire in Slovene, the content of which can be separated into several sections. We describe these in detail below. To ensure that the items are not confusing and to reduce the need to shift mental frames to a minimum, focus was placed on unifying the item scales as much as possible. Most of the items are therefore rated on a 5-point Likert-type scale (1 – Strongly disagree; 5 – Strongly agree).

The questionnaire (Appendix A) is included in the Appendix section of this work, where the variable labels for each item are included. For the sake of clarity and simplicity, these labels are used to refer to their corresponding items in the following sections.

- ***Presence of nature:***

The first section addresses the aspect of the "presence of nature" in the physical environment. Items in this section were designed to allow the participants to rate their offices on the perceived "naturalness" as a general, broad appraisal of how natural the physical office space "feels" (*Naturalness1* through -*3*). Other items in this section of the questionnaire address the elements of healthful interior design that reflect nature as

described by van den Berg (2005) and McSweeney *et al*. (2015). These items were designed to assess the presence of plants (variable *Plants*), the presence of fresh air (*FreshAir*) and sufficient sunlight (*Sunlight1* and *Sunlight2*), the presence of visible wooden surfaces (*VisWoodSurface*) and the haptic pleasantness of working surfaces in the office (*SurfacesPleasingHaptic*), as well as the absence of unpleasant noise (*Noise1* and *Noise2*). The item that inquires about the presence of windows in the office (*WindowsView1*) is complemented with items that allow the participant to rate the pleasantness of the view (*WindowsView2*) and whether the window offers a view of a natural setting (*WindowsView3*). In a similar fashion two items address decorative elements: one allows rating the presence of decorative items in the office (*Decor1*) while the other allows participants to rate the contribution of these decorative items to their well-being (*Decor2*).

When designing these items we avoided prompting the respondent to rate the presence of these elements with an objective measure – the items were instead formed to measure the presence of these attributes as perceived by the respondent.

- ***Perceived restorativeness of the environment:***

As a subscale in our questionnaire the newest version of the PRS-11 scale was used (M. Brondino & M. Pasini, personal communication, 2 February 2016), an update to the one developed by Pasini et al. (2014). The original scale is designed to be used for rating photographs of natural and urban settings. The PRS-11 consists of 11 items rated on a scale from 0 to 10; the lowest and highest values are complemented with descriptors "Completely disagree" and "Completely agree", respectively. To be used in our questionnaire the scale was first translated to Slovenian through forward- and back-translation. Mismatches in the translated scale were fixed to produce a satisfactory translation, which was followed by minor adjustments to the items in the scale to adapt it for application in the context of an office environment (e.g. "Places like this-" was changed into "Places like my office-"). The PRS-11 measures restorativeness on four factors: Being away (*Restor1, Restor4, and Restor8*), Coherence (*Restor2, Restor5, and Restor10*), Scope (*Restor3* and *Restor7*), and Fascination (*Restor6, Restor9*, and *Restor11*), which correspond with the theoretical elements of ART (Kaplan, 1995).

Using the obtained responses a factor analysis was performed on the PRS-11 scale (principal components method, varimax rotation). The analysis suggested two factors, which is not in accordance with the four *a priori* components as defined by the ART. Only one item loaded on the second factor, which is why we can't treat it as an individual construct. The PRS-11 was therefore treated as a scale of overall perceived restorativeness in the present study. The reliability of the instrument as a single-factor scale was calculated using the Cronbach Alpha reliability coefficient. Recommended Cronbach Alpha values

range between .70 and .90 (Tavakol & Dennick, 2011). The 11-item scale yielded a satisfactory coefficient of .89.

- ***Sick Building Syndrome:***

To form a self-report measure for well-being, linked to the comfort of the office environment we looked at symptoms of the sick building syndrome (SBS), a term used in literature to describe common health issues (and other complaints about the physical environment) caused by unsatisfactory indoor environment quality – ocular, nasal, throat, and dermal symptoms (mainly irritation), as well as symptoms of the central nervous system: headaches and fatigue (Engvall et al., 2004). We have included items that inquire about the presence of these symptoms as well as the presence of noise. Presence of noise was included in this section as well – out of the factors of IEQ within the theory of SBS, the issue of noise was addressed to a greater degree through the inclusion of elements of nature in the built indoor environment. We excluded dermal issues from our list of symptoms as complaints regarding these symptoms are not as common (Engvall et al., 2004). Items in this section with corresponding variable codes: *SBS1*, *SBS2*, *SBS3*, *SBS4*, and *SBS5* allow rating of the presence of headaches, fatigue, eye irritation, respiratory irritation, and unpleasant noise, respectively. Since the items in this section are related in their content, Cronbach's Alpha was calculated to assess the reliability of this section as a scale. The analysis produced a Cronbach Alpha coefficient of .79. Factor analysis was performed (principal components method, varimax rotation) which indicated a single factor – the array of SBS items was therefore treated as a unidimensional scale.

- ***Well-Being Index:***

To implement a control for bias in responses to the items that address office environment perceptions we have chosen to use the WHO-5 Well-Being Index. The WHO-5 scale allows participants to rate their well-being on 5 items in a time frame of two weeks. A sum of scores on these items is a measure of the respondent's mental well-being; a high score implies a more positive state of well-being (WHO, 2001). The items in the WHO-5 scale are labelled with codes *WHO1-5*.

Reliability of this scale was again calculated using Cronbach's Alpha coefficient and showed a satisfactory result ($\alpha = .9$).

- ***Environmental preferences:***

To assess what types of physical office environments people prefer, and to see whether the current offices satisfy these preferences, we formed a scale that consists of 16 non-repeated pairs of semantically opposite descriptors, therefore forming an ipsative, or "forced-choice" measure. In each of the 16 pairs of descriptors the participants had to pick the one

that best describes their current physical office environment. This was then repeated for their imagined "ideal" office. The items were selected from semantic scales previously used as well as qualitative studies in natural environmental psychology research – the main criteria guiding our choice was selecting descriptors that were associated with natural materials (such as wood) and design elements that reflect nature. When possible, we tried to refrain from selecting pairs of descriptors that bear a very apparent positive or negative semantic value.

- ***Demographics:***

The demographic section of the questionnaire contains general demographic items, items that address patterns of office use, as well as items that inquire about the respondents work and organization. The two latter categories serve as a measure of bias; testing for the participants existing knowledge about using natural materials in the built environment by being involved in the forest sector or related fields, as well as any differences in perception due to cultural context. The general demographic items inquire the respondents about their age, sex, and education. Items regarding the patterns of office use ask for information about the amount of time spent in the office and interacting with a computer, frequency of leaving the office, and whether the respondent shares their office with co-workers. The respondents are also inquired about whether their position in the company is managerial, how long their tenure in the company is, in which region the company is located, and what is the company's main activity according to the Standard Classification of Activities (SKD 2008) as defined by the Statistical Office of Slovenia (AJPES, 2016), and whether the company's ownership is public, private or mixed.

2.2.1 Variable grouping

Based on our understanding of key theoretical concepts and empirical findings we have grouped variables in our questionnaire into several latent variables, namely Elements of nature, Perceived naturalness, Perceived restorativeness, Fulfilment of needs, Well-being, and Mood. The variable Elements of nature consists of the group of items or variables that are related to design elements and attributes that create a healthful indoor environment through the introduction of nature: presence of plants (*Plants*), presence of windows (*WindowsView1*) and presence of a window view of a natural setting (*WindowsView3*), decorative items (*Decor1*), fresh air (*FreshAir*), sunlight (*Sunlight1* and *Sunlight2*), absence of noise (*Noise1* and *Noise2*), visible wooden surfaces (*VisWoodSurfaces*) and the haptic pleasantness of working surfaces in the office (*SurfacePleasingHaptic*). The Perceived naturalness variable measures the participant's overall perception of their office space as either reflective or nature or artificial. It consists of variables *Naturalness1* through -*3*. Perceived restorativeness consists of all the items in the PRS-11 scale, while Fulfilment of needs addresses the participant's general satisfaction with their physical

work environment, including variables *WorkplaceSat1* through *-5*. The latent variable Well-being relates to the factors of the physical office setting that contribute to the individual's well-being. We included items that relate to symptoms of SBS (*SBS1* through *-5*), physical relief on departure (*ReliefOnLeave*), and variables that address the pleasantness of several design elements (*WindowsView2* and *Decor2*). The naming of the variable Mood might be slightly misleading here: it consists of the WHO-5 scale, and serves as a moderator variable. Besides being related to the Well-being variable, we predicted that the baseline affective state of the respondent would interact with their perception of the office's naturalness and the specific design elements we're inquiring about in the questionnaire, the office's restorativeness, as well as its ability to satisfy the respondent's physical needs at the workplace.

2.3 Procedure

Following a literature review, several key findings regarding the use of natural materials and elements that reflect nature in the interior were identified and itemised to form the questionnaire that was used in the present study, along with the scales that were included in it: namely, the PRS-11 (M. Brondino & M. Pasini, personal communication, 2 February 2016) and the WHO-5 Well-Being Index (WHO, 2001). The questionnaire was then implemented as an online survey, accessible via a dedicated link. Businesses' contact information was gathered through web portals SloExport (SloExport, 2016) and the PIRS Business Directory of the Republic of Slovenia (PIRS, 2016). Not all of the listed businesses included a contact; the final number of contacted businesses was 457. Where possible, the businesses' HR and PR offices and representatives were contacted directly – in other cases the general e-mail address was used. The email cover letter contained a brief description of the current study and its aims, which employee profiles were appropriate for the study, details about filling out the survey, and a web link to the survey itself. Details about anonymity were included as well; responses were collected in a way that prevents the possibility of linking individuals or even individual companies to specific responses.

2.3.1 Analysis

After reaching a sample of 401 responses statistical analysis was performed. Only full responses were used. To analyse the relatively complex system of interrelationships between variables in the questionnaire structural equation modelling was used. Structural equation modelling was performed using the R software environment for statistical computing (version 3.3.1) with the Lavaan package (version 0.5.20). IBM SPSS 20 software was used to perform chi-square analysis. Before the structural equation modelling itself some variables were recoded. Several items (variables *WorkplaceSat4* and *-5*, *Naturalness2*, *Sunlight1*, *Noise2*, *Restor10*, *SBS1* through *-5*, *ReliefOnLeave*) were phrased in such a way that a lower score implied a positive effect on selected measures of well-

being – these scores were reversed. The item "Please rate the presence of decorative items in your office" (variable *Decor1*) was rated on a 5-point scale with labels 1 – Too little, 3 – OK as is, and 5 – Too much. This variable was recoded so that a score of 4 was counted as 2, and a score of 5 as 1.

The next step was defining the model in R with the Lavaan structural equation modelling package. The model was defined to represent relationships between variables in the questionnaire as suggested by the theoretical concepts addressed in the literature review. After defining all the latent variables and regressions between them, all of the predicted residual covariances between items/variables that were related or addressed a similar concept were entered. The structural modelling was performed with the maximum likelihood estimator, more specifically the "MLM" estimator as defined by the Lavaan structural equation modelling package. This estimator employs robust standard errors and uses the Satorra-Bentler (Satorra & Bentler, 1994) scaled test statistic. We used this estimator for our analysis because we worked with a complete dataset, and this estimator is robust against non-normality. Model fitting was an iterative process – after defining the initial model in Lavaan and examining the results, modification indices were inspected to see whether any parameters could be included in the model to better fit it to the data. Modification indices are provided after every model fitting as a list of parameters (regressions, residual covariance, or latent variable definitions) that are estimated to improve the goodness-of-fit should they be introduced into the model. During this process only parameters that adhere to the theoretical background of our model were included. This resulted in a model that better fit the data.

Chi-square analysis was performed to examine whether descriptor choices differed significantly between the current and ideal physical office settings. To do that, expected frequencies were calculated and then compared with observed values.

3 RESULTS

3.1 Demographics

The variables presented in Tables 3.2.1 and 3.2.2 below address the nature of the participants' employment as well as their office use patterns. These were intended as indicators whether a response bias due to professional, academic, or cultural background as well as the specifics of office use could be assumed. The majority of the respondents stated they are not involved with the forest based sector (N=362), some own a forest (N=26), a small number are either employed in the sector directly (N=6) or in a related field (N=5), or have a formal education related to the forest based sector (N=2).

Table 3.1.1
Demographic information describing employees' job-related characteristics and office use patterns.

Job and office use variables	Number
Education	
Less than high school degree	1
High school graduate, diploma or equivalent	0
Trade, technical or vocational training	3
Some college credit, no degree	54
Bachelor's degree	61
Master's degree	192
Professional degree	83
Doctorate degree	7
Position type	
Managerial	92
Non-managerial	309
Job tenure (years)	
0 – 11	201
12 – 23	128
24 – 35	60
36 – 47	11
48 – 60	1
Hours spent in office (weekly)	
< 31	17
31 – 35	25
36 – 40	133
41 – 45	184
> 45	42

Hours spent interacting with a computer (weekly)	
< 31	36
31 – 35	116
36 – 40	170
41 – 45	64
> 45	15
Frequency of leaving the workstation	
Very rarely	10
Rarely	74
Occasionally	207
Frequently	72
Very frequently	38
Shared office	
With no one	43
With one other person	25
With two other people	34
With three other people	143
With more than 3 other people	156

We have collected demographic information about the organisations the participants were employed in; we present those in Table 2.1.2. The vast majority of respondents were employed in the Central Slovenia region; and companies with main activities related to public administration, defence, and compulsory social security were represented in our sample with the highest frequency.

Table 3.1.2
Business characteristics.

Demographic variable	Number
Region	
Mura (Pomurska)	17
Drava (Podravska)	33
Carinthia (Koroška)	15
Savinja (Savinjska)	31
Central Sava (Zasavska)	1
Lower Sava (Posavska)	8
Southeast Slovenia (Jugovzhodna Slovenija)	17
Central Slovenia (Osrednjeslovenska)	210
Upper Carniola (Gorenjska)	37
Littoral-Inner Carniola (Primorsko-notranjska)	6

Gorizia (Goriška)	11
Coastal-Karst (Obalno-kraška)	15
Company type	
Private	157
Public	223
Mixed	21
Main company activity category	
A - Agriculture, forestry and fishing	19
B - Mining and quarrying	3
C - Manufacturing	69
D - Electricity, gas, steam and air conditioning supply	7
E - Water supply, sewerage, waste management and remediation activities	19
F - Construction	5
G - Wholesale and retail trade, repair of motor vehicles and motorcycles	6
H - Transportation and storage	20
I - Accommodation and food service activities	5
J - Information and communication	6
K - Financial and insurance activities	6
L - Real estate activities	0
M - Professional, scientific and technical activities	13
N - Administrative and support service activities	10
O - Public administration and defence, compulsory social security	139
P - Education	6
Q - Human health and social work activities	23
R - Arts, entertainment and recreation	1
S - Other service activities	44
T - Activities of households as employers, undifferentiated goods- and services-producing activities of households for own use	0
U - Activities of extraterritorial organizations and bodies	0

3.2 Descriptive statistics – Elements of nature and Well-being

One of the goals set to guide the making of the present work is to assess to what degree the offices in Slovenia adhere to the principles of restorative environmental design. To address

this we present mean scores and standard deviations for variables in the groups Elements of nature and Well-being in Tables 3.1.1 and 3.1.2.

Table 3.2.1
Descriptive statistics for variables in the group Elements of nature.

Variable label	Item	M	SD
Plants[a]	*There are plants in my office.*	3.54	1.44
SurfacePleasing-Haptic[a]	*Working surfaces in my office are pleasant to the touch.*	3.45	1.05
WindowsView3[a]	*Windows in my office allow a direct view of a natural setting.*	2.85	1.44
Decor1[b]	*Please rate the presence of decorative elements in your office.*	2.33	.96
VisWoodSurfaces[a]	*Please rate the presence of visible wooden surfaces in your office.*	3.39	1.04
Sunlight1[a]	*Light sources in my office are mostly artificial.*	2.39	1.17
Sunlight2[a]	*Sunlight illuminates my office during the day.*	3.81	1.15
FreshAir[a]	*My office allows easy access to fresh air.*	3.88	1.08
Noise1[a]	*My workspace allows me to work in peace and quiet.*	2.96	1.24
Noise2[a]	*Ambient sounds in my office are bothersome.*	2.96	1.22
		Yes (%)	No (%)
WindowsView1[c]	*My office has one or more window(s).*	97.8	2.2

Note: [a], measured on a 5-point scale Completely agree-Completely disagree; [b], measured on a 5-point scale Too little-OK as is-Too much; [c], binary response Yes-No; M, mean; SD, standard deviation. Means and standard deviations were calculated for non-recoded variables.

Table 3.2.2
Descriptive statistics for variables in the group Well-being.

Variable label	Item	M	SD
SBS1[b]	*(Frequency in past two weeks) Headaches*	2.01	1.12
SBS2[b]	*(Frequency in past two weeks) Fatigue*	3.11	1.16
SBS3[b]	*(Frequency in past two weeks) Eye irritation*	3.00	1.26
SBS4[b]	*(Frequency in past two weeks) Respiratory irritation*	1.98	1.14
SBS5[b]	*(Frequency in past two weeks) Unpleasant noise*	2.80	1.27
ReliefOnLeave[a]	*I feel a physical relief after leaving my office space.*	3.04	1.12
WindowsView2[a]	*The view through the window(s) is pleasant.*	3.20	1.35
Decor2[c]	*Please rate the contribution of your office's decorative items to your well-being.*	2.85	1.10

Note: [a], measured on a 5-point scale Completely agree-Completely disagree; [b], measured on a 5-point scale At no time – All of the time; [c], measured on a 5-point scale Very low – Very high; M, mean; SD, standard deviation. Means and standard deviations were calculated for non-recoded variables.

Descriptive statistics for variables in the groups Elements of nature and Well-being show no surprising results. The mean values are close to scale centres, which is the value of 3 on 5-point scales. Some of the elements are however represented to a higher degree in our sample: respondents indicated a slightly higher presence of plants in their offices, presence of visible wooden surfaces and the pleasantness of working surfaces to touch, as well as the presence of sunlight and access to fresh air.

Only 9 respondents indicated their office had no windows, which makes using the presence of windows as a grouping variable in subsequent statistical analyses impossible.

3.3 Environmental preference

To complement the findings obtained through structural equation modelling and see whether respondents' current physical office settings match their imagined ideal physical office space, frequencies for all the descriptor choices in both the current and ideal condition were examined. The significance of the change in frequency distribution was tested using the chi-square test. We present these results in Table 3.1.

Table 3.3.1.

Frequencies and chi-square statistics for descriptor choices between current and ideal office.

	Current	Ideal	Chi-Square	p
Warm	297	373	52.38	<.000
Cool	104	28		
Natural	234	396	194.24	<.000
Artificial	167	5		
Homey	**191**	**373**	197.91	<.000
Industrial	**210**	**28**		
Confusing	147	7	157.52	<.000
Coherent	254	394		
Plain	350	263	52.40	<.000
Ornate	51	138		
Confined	144	7	153.13	<.000
Spacious	257	394		
Open	264	366	77.00	<.000
Closed	137	35		
Inspiring	**146**	**394**	348.64	<.000
Uninspiring	**255**	**7**		
Exciting	**172**	**227**	15.09	<.000
Calming	**229**	**174**		
Simple	348	369	5.80	0.016
Complex	53	32		
Fascinating	**167**	**390**	292.26	<.000
Unattractive	**234**	**11**		
Rustic	**245**	**134**	61.64	<.000
Sophisticated	**156**	**267**		
Cluttered	125	9	120.56	<.000
Clean	276	392		
Bright	319	397	79.24	<.000
Dark	82	4		
Casual	251	330	38.98	<.000
Formal	150	71		
Modern	**184**	**358**	172.31	<.000
Old-fashioned	**217**	**43**		

Note: Bold values indicate where the prevalence of the selected descriptor shifted between the current and ideal office conditions.

Having compared the frequencies of descriptor choice between the current and ideal office spaces we have observed that all of the descriptor pairs show significant differences in

choice at the 1% level with 1 degree of freedom, except for the descriptor pair Simple-Complex, where the change is significant at the 5% level. We have marked the frequencies where the descriptor choice prevalence changed between the current and ideal conditions – in the descriptor pair Homey – Industrial, for example, "industrial" was used prevalently by participants to describe the current office setting, whereas "homey" was a preferred descriptor for the participants' ideal office setting. A somewhat surprising observation is the preference for the ideal physical office setting to convey "excitement", while the current office settings were prevalently described as "calming" by the respondents.

3.4 Structural equation modelling

Structural equation modelling was employed to address the system of interrelationships that occur between the latent variables, represented by the items in the questionnaire. Our hypotheses are:

- the presence of bio-based materials and elements in the workplace positively correlates with employees' subjective wellbeing;
- workplaces with a higher presence of bio-based materials and elements reflective of nature are perceived as more "natural";
- perceived restorativeness of the workplace correlates positively with the perceived naturalness of the space;
- perceived restorativeness of the workplace correlates positively with the rated presence of bio-based materials and elements in the office.

These hypotheses are addressed by consulting different aspects of the linear model as obtained through structural equation modelling. The direction of the relationship in the model can be interpreted as: "*latent variable Y is predicted by X*", if the arrow pointed from Y to X.

The initial model, defined based on our understanding of the concepts involved and the relationships between them, was fitted to the data and resulted in the diagram presented in Figure 3.1.1. Values marked with "**" are significant at the .001 level and those marked with "*" are significant at the .05 level. All of these values are fully standardised estimates.

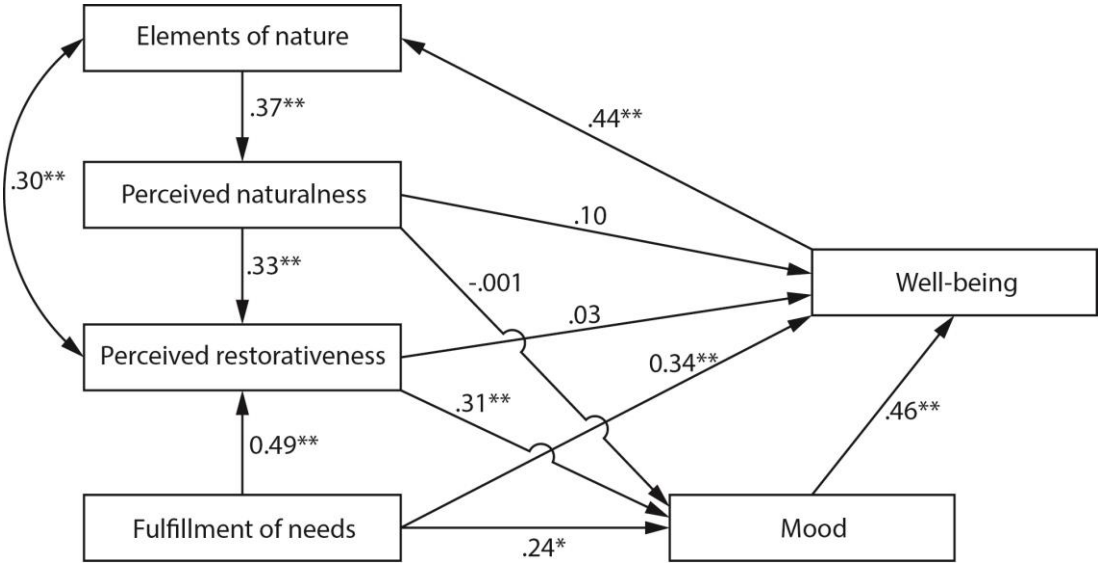


Figure 3.4.1. The initial model of latent variable interrelationships (**; significant at .001 level, *; significant at .05 level.

Fitting the model to the data returned several coefficients that show the goodness of fit. The standard coefficients that provide information about goodness of fit are Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI). A fourth indicator of whether the predicted model fits the data is the ratio between the chi-square statistic and degrees of freedom (χ^2/df) (Dion, 2008). After fitting the first model no new regressions were indicated that would significantly improve the model fit. After proving to be virtually non-existent in the initial model, the regression between Perceived naturalness and Mood was removed. We treated the PRS-11 scale as a single-factor scale in the present study, so initially covariance between the *a priori* factors (Being away, Coherence, Scope, and Fascination) and their corresponding items were not included – residual covariances between PRS-11 items (along with several other covariance parameters) were added as indicated by the modification indices, but these did not reflect the ART factor structure. A corrected model was then fitted to the data again, this time showing better results on the indices that show goodness of fit. Model fitting results for both models are presented in Table 3.1.1. The corrected model is presented in Figure 3.1.2. Again, the regression values marked with "**" are significant at the .001 level and those marked with "*"at the .05 level.

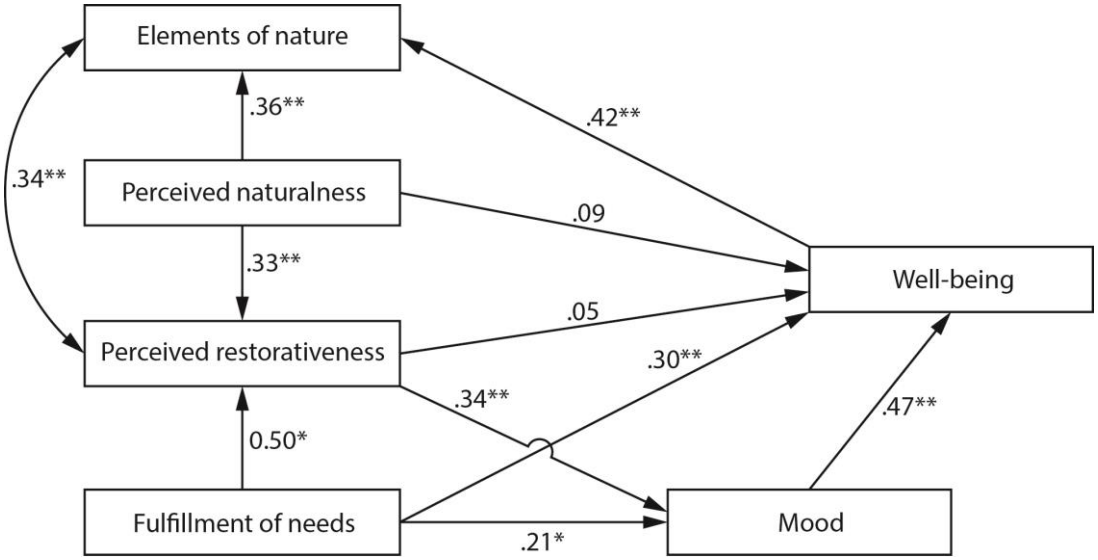


Figure 3.4.2. The corrected model of latent variable interrelationships (**; significant at .001 level, *; significant at .05 level).

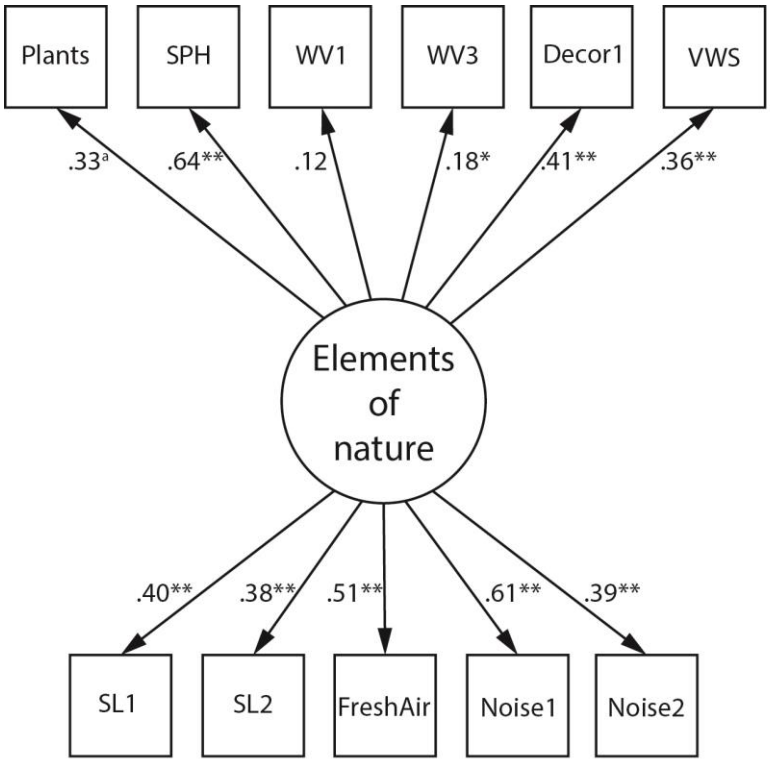
Table 3.4.1
Model fitting results for initial and corrected model, along with recommended values.

Index	Initial model	Corrected model	Recommended values
χ^2/df ratio	2.72	2.04	< 3
RMSEA	.07	.05	≤ .05
CFI	.83	.90	≥ .9
TLI	.82	.89	≥ .9

Note: RMSEA, Root Mean Square Error of Approximation; CFI, Comparative Fit Index; TLI, Tucker-Lewis Index.

The corrected model shows a good fit on both RMSEA as well as χ^2/df ratio indices, while TLI is slightly below the recommended value for assigning a good fit (Dion, 2008; McDonald & Ho, 2002). The TLI index is, however, relatively close to the recommended threshold. This is the model that fits the data obtained in the current study best; however it must be noted that most of the regressions between latent variables are very modest, and insignificant in some cases. This is the case with the initial model as well – only goodness-of-fit indices improved after new parameters were introduced into the model, the strength of relationships between latent variables, however, did not. The relationships between Elements of nature on one end and Well-being, Perceived naturalness and Perceived restorativeness on the other all show significance. The detailed parameters of the corrected model that was used to interpret data are included in the Appendix section (Appendix B).

A detailed look at the components of the latent variable Elements of nature shows that the majority of predicted elements load on the latent variable significantly (at the .001 level – "**"; and .05 level – "*"), with the exception of WindowsView1.



Note: [a]; Plants has a factor loading of 1.000 because it is the first entered component.
SPH, SurfacePleasingHaptic; WV, WindowsView; VWS, VisWoodSurfaces; SL, Sunlight.

Figure 3.4.3. A detailed view of standardised estimates of component factor loadings.

4 DISCUSSION

The demographic information, including office use information, is examined first to see if any patterns that would indicate bias are apparent. The majority of respondents in our sample are not in any way affiliated with the forest based sector, so bias due to educational or professional background is unlikely. Unfortunately the distribution of companies throughout the statistical regions of Slovenia is unbalanced with the majority of respondents working in the Central Slovenia region, thus preventing us from effectively exploring if and to what extent location influences perceptions.

Respondents indicated they spend most of their work week in their office, with a moderate amount of time spent interacting with a computer and mostly rated the amount of their departures from the office during workdays as "occasional". This indicates the patterns of office use as observed in this sample would provide enough exposure to the physical environment at work to expect it to influence the employees' health and well-being. An interesting observation was that the majority of employees in our sample share their office with 3 (N=143) or more (N=156) people. This could mean that participants work in either bigger closed offices or open-plan offices – at the same time this information implies there could exist a strong psychosocial factor that influences perceptions of the physical environment; an aspect we did not address in the current work. A look at the mean scores on variables included in the groups Elements of nature and Well-being shows that the overall state of offices in Slovenia is not concerning regarding their adherence to the key principles of restorative environmental design which recommends the inclusion of design attributes and elements that reflect nature (Derr & Kellert, 2013). Only 9 respondents (2.2%) indicated their offices lacked windows. Some key design elements already show a higher occurrence in Slovenian offices: presence of plants, presence of visible wooden surfaces and the pleasantness of working surfaces to touch, the presence of sunlight and access to fresh air. The observation that the mean scores showed a central tendency of values near 3 does imply that improvements can be made to transform workplaces into more comfortable work environments.

We continue this section by looking at the results of the current study to address the hypotheses we defined earlier.

4.1 The presence of bio-based materials and elements in the workplace positively correlates with employees' subjective wellbeing

To either confirm or reject this hypothesis we looked at the existing literature on the topic of implementing bio-based materials and elements reflective of nature into the indoor built environment. These findings were itemised and grouped into what became latent variables in our model: Elements of nature, Perceived naturalness, Perceived restorativeness,

Fulfilment of needs, Well-being (in the physical environment), and Mood. To examine the interrelationships between these variables in a coherent, non-reductionistic way we used structural equation modelling. This was an iterative process, involving corrections to the model – the final model showed an acceptable fit to the data using all of the predicted variables. The model that fits the data best does show a significant relationship between the perceived elements of nature in the physical office setting and well-being as measured in the questionnaire – the final model did however show an inverse relationship than predicted, implying that in this case a measure of well-being predicts the perception of natural elements in the built environment. This result can be explained by emphasising the fact that participants' perceptions were being addressed. Our environmental perceptions rarely, if ever, occur on the level of cognitive elements of perceptions – i.e., descriptive meanings (Mandler, 1982). In reality these descriptive cognitions are complemented by perceptions of a higher order; evaluative meanings that involve assessing whether our values are present in the environments that are being perceived (Mandler, 1982). Assigning evaluative meanings evokes an emotional response, which in turn has a reciprocal relationship with perceptions. It can be therefore assumed that well-being can be expected to affect our environmental perception as much as our environmental perceptions can influence our emotional states and well-being.

Both perceived naturalness as well as perceived restorativeness showed no significant relationship with well-being, despite being theoretically related to design elements in the built environment that reflect nature (Kellert, 2008). Perceived restorativeness did however show a significant relationship with the score on the WHO-5 scale (variable Mood) – this shows there does exist a relationship between restoration and the employee's well-being in some form. A detailed look at the predicted components of the latent variable Elements of nature (van den Berg, 2005; McSweeney et al., 2015) indicates that the design elements that present a manner of implementing nature into the built indoor environment do play a role in the occupant's well-being.

These results imply there exists a positive correlation between the presence of bio-based materials and elements in the physical workspace and the employee's well-being. It is however still too soon to draw firm conclusions from the current results – further research must be directed at identifying the mechanisms that underlie these effects in greater detail, as well as designing a more robust tool for measuring these effects and the relationships between them.

4.1.1 Environmental preferences – current and ideal office space

As a means of addressing the participants' environmental preferences in the context of the presence of "natural elements" in the built indoor office environment, we discuss the results of descriptor choices here. As observed in the Results section of the current work,

the participants describe their ideal physical office setting as "warm", "natural", "homey", "coherent", "plain", "spacious", "open", "inspiring", "exciting", "simple", "fascinating", "sophisticated", "clean", "bright", "casual", and "modern". Many of these can be linked to empirical results regarding semantic descriptors of visible wooden surfaces indoors ("warm", "natural", and "homey"; Nyrud & Bringslimark, 2010). The importance of using natural or bio-based materials indoors is implied by results of structural equation modelling as well, considering the relatively strong factor loadings of components such as SurfacePleasingHaptic and VisWoodSurfaces on Elements of nature. Chosen descriptors such as "coherent", "inspiring", and "fascinating" coincide with theoretical implications of the Attention Restoration Theory (Kaplan, 1995), again implying these preferences could be satisfied through an increased inclusion of elements reflective of nature into the office. Caution should be exercised when considering design interventions, as participants preferred their office be "exciting", but also "plain", "simple", "casual", "sophisticated", and "modern" – suggesting that these design elements should not be overwhelmingly ornate (strongly figured wood surfaces, intricate natural décor or an overwhelming presence thereof; Nyrud et al., 2013). The indicated desire for openness and space suggests a parallel with Heerwagen's (1998) and Ulrich's (1993) promotion of an evolutionary approach in transforming the built environment into "habitats" for people by catering to their adaption to savannah-like environments, of which openness is a key characteristic.

All of the choices for the "ideal" condition were significantly different from choices for the "current" condition. In most cases the majority of respondents described their current offices with a similar set of descriptors – the frequencies merely increased in the "ideal" condition. In some cases, however, the descriptor choice showed a qualitative shift between conditions; meaning that the current offices were described in majority with one descriptor in the pair, the ideal office with the other. The majority of respondents chose "industrial" (52.4%) for their current office, but chose "homey" (93%) for the ideal. The same applies to the differences between "uninspiring" (63.6%) to "inspiring" (98.3%), "calming" (57.1%) to "exciting" (56.6%), "unattractive" (58.4%) to "fascinating" (97.3%), "rustic" (61.1%) to "sophisticated" (66.6%), and "old-fashioned" (54.1%) to "modern" (89.3%). These differences imply dissatisfaction with the current workspaces and need to be considered when designing interventions. Taking these observation into account when deciding on design interventions could prove to be a step toward making office environments restorative.

4.2 Workplaces with a higher presence of bio-based materials and elements reflective of nature are perceived as more "natural"

We addressed this hypothesis by looking at the relationship between the latent variable Elements of nature and Perceived naturalness. The standardised estimate value is .36,

which is significant at the .001 level; however the relatively small value implies a need for caution when interpreting these results. Considering the relative complexity of the model used in the present study and the strength of other relationships in it this result strongly suggests there is indeed a correlation between the presence of natural elements in the built indoor environment (such as daylight, quiet, visible wooden surfaces, etc.), and the perceived naturalness of said space. Several studies found that participants enjoyed tactile contact with wood surfaces more than other materials (Nyrud & Bringslimark, 2010), while fresh air, window views of natural settings, a pleasant soundscape and the lack of noise, as well as the presence of decorative items are well-recognised as methods of introducing nature into the built environment (Bringslimark et al., 2011; Chang & Chen, 2005; Gou et al., 2012; Heschong, 2003; Payne, 2013; van den Berg, 2005) – the results of the present study are in line with these observations.

4.3 Perceived restorativeness of the workplace correlates positively with the rated presence of bio-based materials and elements in the office

The final model showed a significant relationship between the latent variables Elements of nature and Perceived restorativeness, comparable to that between Elements of nature and Perceived naturalness. Despite the relatively weak relationship it is possible to assume these results propose that making the built environment more "natural" by introducing specific design elements also positively affects the restorative potential of the environment. A stronger relationship appeared between Perceived restorativeness and Fulfilment of needs, a measure of the general physical comfort of the indoor environment. Perhaps in the context of the office environment the general physical comfort, i.e. the compatibility of the employee's physical needs at work and the ability of the environment to satisfy them has a more explicit relationship with restorativeness than the presence of nature indoors. The inability of the environment to provide comfort to the occupant increases the load on the occupant's physical as well as cognitive resources – effort must be exerted to perform tasks and cope with the lack of comfort simultaneously (Vischer, 2007). These results do suggest that representations of nature indoors do influence the perceived restorativeness of the physical space as predicted, however further determination of underlying mechanisms is necessary.

4.4 Perceived restorativeness of the workplace correlates positively with the perceived naturalness of the space

The model again showed a moderate regression of .33, $p = .001$, between Perceived naturalness and Perceived restorativeness. This coincides with the relationship between Perceived restorativeness and Elements of nature – it can be assumed these constructs are

interrelated as predicted by the model used in the present work. The relatively modest strength of the relationship can be again assumed a consequence of the model's complexity – the constructs in the model that address its naturalness (Elements of nature, Perceived naturalness, and Perceived restorativeness) do show a cluster of significant interrelationships that show these are related by latent psychological processes. We can therefore confirm the hypothesis. This finding is in accordance with the ART (Kaplan, 1995), on which the PRS-11 scale is based; as well as with other empirical evidence gathered with the use of self-reported measures of perceived restorativeness (e.g. Laumann et al., 2001; Pasini et al., 2014; Purcell et al, 2001) which have shown that natural environments are perceived as more natural – it appears the same is true with the built indoor environment.

5 CONCLUSIONS

The aim of the present study was to form a questionnaire that addresses the positive effects of including nature into the indoor built environment and with it perform a survey to assess how employees in Slovenia perceive their offices with regard to the presence of bio-based materials and elements, as well as how the ratings of perceived naturalness of the office spaces is linked to the employees' well-being and preferences. We set four hypotheses to guide the present work: the presence of bio-based materials and elements in the workplace positively correlates with employees' subjective wellbeing; workplaces with a higher presence of bio-based materials and elements reflective of nature are perceived as more "natural"; perceived restorativeness of the workplace correlates positively with the rated presence of bio-based materials and elements in the office; perceived restorativeness of the workplace correlates positively with the perceived naturalness of the space. These hypotheses were addressed through the examination of different aspects of the model fitted to the data. Structural equation modelling showed a satisfactory fit to the data, although not all of the fit indices showed a good fit ($\chi 2$/df ratio = 2.04, RMSEA = 0.05, CFI = 0.90, TLI = 0.89). Despite the relatively modest strength of the observed relationships between variables we can confirm these hypotheses, although with a certain degree of caution. The present study involved perceptions which are characterised by their reciprocal relationship with emotional responses – perceptions evoke an emotional response, but are in turn also affected by the emotional state in which perceptions are being formed (Mandler, 1982). This explains the difficulties in fully defining all of the relationships that can be assumed to occur in the system of constructs that the present model includes.

Involvement of natural design elements in employees' preferences for their workspace environments was indicated through their choices of descriptors for an "ideal" office – preferred descriptors matched those used in previous studies on preferences for natural settings and materials. This is an observation that complements our model; adding an extra dimension to the array of design elements that can be implemented to include nature into the built environment and contribute to the occupants' well-being.

Solid conclusions are hard to be drawn from the results of the present study; however, in light of other research work performed on the topic of including nature into the built environments and the benefits to health and well-being of the occupants such interventions bring, the present work should serve as an implication to encourage designers as well as builders and developers to pursue progress in building design by considering the design elements and attributes that are already part of evidence-based design in healthcare (Ulrich, 2008) and are a practical demonstration of what could essentially be considered restorative environmental design (Derr & Kellert, 2013; Kellert, 2008). Both the structural equation modelling results, as well as semantic descriptor scale results suggest material production and product design should direct effort into using bio-based materials. The preferences for

the visual and tactile characteristics of these materials (Nyrud & Bringslimark, 2010; Nyrud et al., 2013) ensure a market for such products – at the same time the opportunity for sustainable resource use is present.

5.1 Implications for future research

As demonstrated by the results in the current work the mechanisms and processes that underlie the beneficence of nature exposure in the built environment as displayed by an ever growing body of empirical evidence still need to be explored in detail. Effort must be directed at providing explicit definitions of concepts involved in these processes, and robust measures should be developed and used on well-defined populations. Building a convincing evidence base is not only vital for our full understanding of these phenomena, but is necessary for facilitating the transferral of knowledge into practical design interventions for transforming cities and buildings into healthful, biophilic environments.

These same steps could improve the results of the current study. A better designed sample with objectively defined control and experimental groups (offices that are objectively assessed as more adherent to restorative design principles) should be recruited, with specific, reliable and robust measures to evaluate perceptions, restoration and well-being.

6 POVZETEK

V 60. letih prejšnjega stoletja se je pozornost pričelo v vedno večji meri posvečati okoljskim problemom, dejavnikom njihovega nastanka in možnostim reševanja. Prisotnost tega trenda je bila očitna tudi na področju okoljske psihologije (Steg, van den Berg, de Groot, 2012). Posledica preusmeritve pozornosti na ohranitev naravnih ekosistemov je bila definicija dimenzije trajnosti – to lahko razumemo kot ravnovesje med dostopnimi naravnimi viri in njihovo obnovljivostjo ter porabo teh virov s strani živih bitij, na lokalni in globalni ravni hkrati (Bonnes & Bonaiuto, 2002). Koncept trajnosti se je prenesel tudi na področje gradnje. Trajnostna gradnja in z njo povezana *zelena gradnja* v prvi meri stremita k čim manjšemu vplivu na okolje (Kitek Kuzman & Kutnar, 2014). Kellert (2005; 2012) zagovarja stališče, da bi morali uporabo naravnih materialov v gradnji izkoristiti kot priložnost, da so tudi v grajenih okoljih ljudem ponujeni možnost stika z naravo in pozitivni učinki na zdravje in blagostanje, ki izvirajo iz tega stika (Hartig, 2007). Privlačnost, ki jo ljudje čutimo do narave, Wilson (1984) imenuje biofilija – gre za evolucijsko težnjo po povezovanju z naravo in naravnimi procesi (Heerwagen, 2009). Naše preference in estetika pa niso edina vrednost vključevanja narave v grajeno okolje – raziskave so pokazale pozitivne učinke stika z naravo na naše kognitivne zmožnosti, pa tudi lajšanje stresa. Kellert (2008) predpostavlja, da lahko te učinke dosežemo s prilagojenim dizajnom grajenega okolja, ki ga poimenuje sonaravni restorativni dizajn. Načela restorativnega sonaravnega dizajna so v določeni meri že prisotna v tako imenovanem na dokazih temelječem dizajnu, ki ga najpogosteje najdemo v zdravstvu. Ta vključuje elemente, kot so prisotnost rastlin (Bringslimark, Hartig in Patil, 2013), oken z razgledom na naravo in dekorativnih elementov z naravno vsebino (Kweon, Ulrich, Walker in Tassinary, 2008), prisotnost dnevne svetlobe (Beute in DeKort, 2013), odsotnost hrupa (Payne, 2013), ter prisotnost naravnih materialov, posebno vidnih lesenih površin (Nyrud in Bringslimark, 2013). Na podlagi obstoječe literature smo zastavili naslednje hipoteze, ki so vodile oblikovanje tega dela: prisotnost naravnih materialov in elementov v delovnem prostoru pozitivno korelira s subjektivnim blagostanjem zaposlenih; delovni prostori z višjo prisotnostjo naravnih materialov in elementov so zaznani kot bolj „naravni“; zaznana restorativnost prostora pozitivno korelira z zaznano „naravnostjo“ prostora; zaznana restorativnost prostora pozitivno korelira z ocenjeno prisotnostjo naravnih materialov in elementov v pisarni.

Po pregledu literature na temo implementacije elementov narave v dizajn grajenega okolja – posebno notranjih prostorov – smo oblikovali vprašalnik, ki preverja percepcije zaposlenih glede prisotnosti teh elementov v njihovih pisarnah ter sorodnih konceptov: v tem primeru zaznane naravnosti in restorativnosti prostora, ter kako se ti koncepti povezujejo z blagostanjem zaposlenih. V vprašalnik je bila vključena še semantična lestvica parov pridevnikov, s pomočjo katere so udeleženci opisali svoj trenutni ter idealni fizični delovni prostor. Zbrani so bili tudi demografski podatki glede narave dela udeležencev z namenom preverjanja morebitne pristranskosti odgovarjanja na anketo zaradi vzorcev rabe pisarne ali področja, na katerem so udeleženci zaposleni ali šolani. V

raziskavo so bili povabljeni strokovni in administrativni delavci, zaposleni v različnih srednje velikih in velikih podjetij v Sloveniji. Končni vzorec je vključeval 401 udeleženca. 71.3% udeležencev v vzorcu je bilo ženskega spola, povprečna starost udeležencev pa je znašala 43.08 let (SD = 9.64). Demografski podatki niso kazali na prisotnost dejavnikov, ki bi vplivali na pristranskost odgovorov. Glavnega dela analize podatkov smo se lotili s strukturnim modeliranjem v programskem okolju R, s programskim paketom Lavaan. Postavke v vprašalniku smo združili v skupne latentne spremenljivke, na podlagi razumevanja teorije na področju restorativnega sonaravnega dizajna smo napovedali tudi povezanost med temi spremenljivkami. Po iterativnem procesu prilagajanja parametrov smo oblikovali model, ki je kazal ustrezno prileganje podatkom, zbranim v raziskavi. Semantično lestvico s pridevniki smo analizirali z metodo hi-kvadrat, ki je pokazala da so razlike med ocenami trenutnih in idealnih prostorov statistično značilne.

Rezultati kažejo, da stanje pisarniških prostorov v Sloveniji glede na upoštevanje načel restorativne sonaravne gradnje ni slabo – videti je, da so od merjenih elementov dizajna udeleženci najpogosteje poročali o prisotnosti rastlin, sončne svetlobe, dostopa do svežega zraka, vidnih lesenih površin in prijetnosti površin na dotik. Strukturni model kaže, da prisotnost elementov narave in naravnih materialov v prostoru pozitivno vpliva na zaznavanje prostora kot bolj naravnega, pa tudi kot restorativnega. Opaziti je moč tudi povezanost med zaznanimi elementi narave ter merami blagostanja, ki smo jih v vprašalniku uporabili. Preference zaposlenih glede izgleda idealnega pisarniškega prostora se ujemajo s pridevniki, ki so jih v predhodnih študijah udeleženci uporabili za opis naravnih materialov in grajenih prostorov, ki so bili z njimi opremljeni. Na podlagi dobljenih rezultatov lahko torej zastavljene hipoteze potrdimo, vendar z določeno mero previdnosti. Razmeroma šibke moči povezav med spremenljivkami lahko pripišemo kompleksnosti raziskovanih procesov in potrebi po nadaljnih raziskavah, ki bi te mehanizme podrobneje razložile. Izpostaviti gre tudi dejstvo, da je raziskava obravnavala percepcije, kar nekoliko oteži raziskovanje odnosa s čustvi in blagostanjem – saj so ti pojavi povečini v recipročnem odnosu (Mandler, 1982).

Kljub temu pa rezultati te študije nakazujejo priložnost za oblikovalce, gradbenike ter proizvajalce, da svoj trud usmerijo v oblikovanje takih notranjih prostorov, ki bi spodbujali blagostanje, pri čemer bi bila zagotovljena tudi raba trajnostnih naravnih virov.

7 REFERENCES

Abdulkarim, D. & Nasar J. L. (2014). Are livable elements also restorative? *Journal of Environmental Psychology, 38*, 29-38.

AJPES (2016). Standard classification of activities (SKD). Retrieved 1 June, 2016, from http://www.ajpes.si/Registri/Drugo/SKD/.

Akalin, A., Yildirim, K., Wilson, C., & Kilicoglu, O. (2009). Architecture and engineering students' evaluations of house facades: Preference, complexity and impressiveness. *Journal of Environmental Psychology, 29*(1), 124-132.

Bauer, M., Mösle, P., & Schwarz, M. (2010). *Green building: Guidebook for sustainable architecture*. Berlin, Heidelberg: Springer-Verlag.

Benfield, J. A., Rainbolt, G. N., Bell, P. A., & Donovan, G. H. (2015). Classrooms with nature views: Evidence of differing student perceptions and behaviors. *Environment and Behavior, 47*(2), 140-157.

Berman, M. G., Jonides, J., & Kaplan, S. (2008). The cognitive benefits of interacting with nature. *Psychological Science, 19*(12), 1207-1212.

Berto, R. (2005). Exposure to restorative environments helps restore attentional capacity. *Journal of Environmental Psychology, 25*(3), 249-259.

Beute, F. & de Kort, Y. A. W. (2013). Salutogenic effects of the environment: Review of health protective effects of nature and daylight. *Applied Psychology Health and Well-Being, 6*(1), 67-95.

Bonnes, M. & Bonaiuto, M. (2002). Environmental psychology: From spatial-physical environment to sustainable development. In R. B. Bechtel & A. Churchman (Eds.), *Handbook of environmental psychology* (pp. 28-54). New York, NY: John Wiley and Sons.

Bratman, G. N., Hamilton, J. P., & Daily, G. C. (2012). The impacts of nature experience on human cognitive function and mental health. *Annals of the New York Academy of Sciences, 1249*, 118-136.

Bringslimark, T., Hartig, T., & Patil, G. G. (2009). The psychological benefits of indoor plants: A critical review of the experimental literature. *Journal of Environmental Psychology, 29*(4), 422–433.

Bringslimark, T., Hartig, T., & Patil, G. G. (2011). Adaptation to windowlessness: Do office workers compensate for a lack of visual access to the outdoors? *Environment and Behavior, 43*(4), 469-487.

Broman, O. (1995). Visual impressions of features in scots pine wood surfaces: A qualitative study. *Forest Products Journal, 45*(3), 61-66.

Browning, W.D., Garvin, C., Ryan, C.O., Kallianpurkar, N., Labruto, L., Watson, S., & Knop, T. (2012). *The economics of biophilia: Why designing with nature in mind makes financial sense*. New York, NY: Terrapin Bright Green, LLC.

Browning, W.D., Ryan, C.O., Clancy, J.O. (2014). *14 Patterns of Biophilic Design*. New York, NY: Terrapin Bright Green, LLC.

Burnard, M. D., Nyrud, A. Q., Bysheim, K., Kutnar, A., Vahtikari, K., & Hughes, M. (2015). Building material naturalness: Perceptions from Finland, Norway and Slovenia. *Indoor and Built Environment, 0*, 1-16. doi:10.1177/1420326X15605162

Carlson, A. (1999). *Aesthetics and the environment: The appreciation of nature, art and architecture.* London, UK: Routledge.

Chang, C. Y., Hammitt, W. E., Chen, P. K., Machnik, L., & Su, W. C. (2008). Psychophysiological responses and restorative values of natural environments in Taiwan. *Landscape and Urban Planning, 85*(2), 79-84.

Chang, C.Y. & Chen, P. K. (2005). Human response to window views and indoor plants in the workplace. *HortScience, 40*(5), 1354-1359.

Chawla, L. (2015). Benefits of nature contact for children. *Journal of Planning Literature, 30*(4), 433-452.

Clayton, S. D., & Saunders, C. D. (2012). Introduction: Environmental and conservation psychology. In S. D. Clayton (Ed.). *The Oxford handbook of environmental and conservation psychology* (pp. 1-7). New York, NY: Oxford University Press.

Cole, D. N. & Hall, T. E. (2010). Experiencing the restorative components of wilderness environments: Does congestion interfere and does length of exposure matter? *Environment and Behavior, 42*(6), 806-823.

De Young, R. (2010). Restoring mental vitality in an endangered world: Reflections on the benefits of walking. *Ecopsychology, 2*(1), 13-22.

De Young, R. (2013). Environmental psychology overview. In A. H. Huffman & S. Klein (Eds.), *Green organizations: Driving change with IO Psychology* (pp. 17-33). New York, NY: Routledge.

Derr, V. & Kellert, S. R. (2013). Making children's environments "R.E.D.": Restorative environmental design and its relationship to sustainable design. In E. Pavlides & J. Wells (Eds.), *Proceedings of the 44th Annual Conference of the Environmental Design Research Association.* Providence, RI: The Environmental Design Research Association.

Dion, P. A. (2008). Interpreting structural equation modelling results: A reply to Martin and Cullen. *Journal of Business Ethics, 83*(3), 365-368.

Eksioglu Cetintahra, G. & Cubukcu, E. (2015). Do parents' evaluations of physical environment influence childhood obesity and children's physical activity? *Procedia – Social and Behavioral Sciences, 202*, 24-30.

Engvall, K., Norrby, C., & Sandstedt, E. (2004). The Stockholm Indoor Environment Questionnaire: A sociologically based tool for the assessment of indoor environment and health in dwellings. *Indoor Air, 14*(1), 24-33.

Faber Taylor, A. & Kuo, F. E. (2006). Is contact with nature important for healthy child development? State of the evidence. In C. Spencer & M. Blades, (Eds.), *Children and Their Environments* (pp. 124-140). Cambridge, UK: Cambridge University Press.

Falk, J. H. & Balling, J. D. (2010). Evolutionary influence on human landscape preference. *Environment and Behavior, 42*(4), 479-493.

Fell, D. R. (2010). *Wood in the human environment : restorative properties of wood in the built indoor environment* (T). Electronic Theses and Dissertations (ETDs) 2008+. University of British Columbia. Retrieved 5 November, 2014, from https://open.library.ubc.ca/cIRcle/collections/24/items/1.0071305

Ferguson, K. T., Cassells, R. C., MacAllister, J. W., & Evans, G. W. (2013). The physical environment and child development: An international review. *International Journal of Psychology, 48*(4), 437-468.

Fjeld, T. (2000). The effect of interior planting on health and discomfort among workers and school children. *HortTechnology, 10,* 46–52.

Fox, D. M., Jackson, R. J., & Barondess, J. A. (2003). Health and the built environment. *Journal of Urban Health, 80*(4), 534-535.

Frontczak, M. & Wargocki, P. (2011). Literature survey on how different factors influence human comfort in indoor environments. *Building and Environment, 46*(4), 922-937.

Frumkin, H. (2008). Nature contact and human health: Building the evidence base. In S. Kellert, J. H. Heerwagen, & M. L. Mador (Eds.), *Biophilic Design* (pp. 107-118). Hoboken, NJ: Wiley and Sons.

Gifford, R., Steg, L., & Reser, J. P. (2011). Environmental psychology. In P. R. Martin, F. M. Cheung, M. C. Knowles, M. Kyrios, L. Littlefield, J. B. Overmier, & J. M. Prieto (Eds.), *The IAAP handbook of applied psychology* (pp. 440-470). Oxford, UK: Wiley-Blackwell.

Giuliani, M. V., & Scopelliti, M. (2009). Empirical research in environmental psychology: Past, present, and future. *Journal of Environmental Psychology, 29*(3), 375-386.

Gou, Z., Lau, S. S., & Shen, J. (2012). Indoor environmental satisfaction in two LEED offices and its implications in green interior design. Indoor and Built Environment, 21(4), 503-514.

Grahn, P. & Stigsdotter, U. K. (2010). The relation between perceived sensory dimensions of urban green space and stress restoration. *Landscape and Urban Planning, 94*(3), 264-275.

Hartig, T. & Korpela, K. M. (1997). Restorative qualities of favorite places. *Journal of Environmental Psychology, 16*(3), 221-233.

Hartig, T. (2007). Three steps to understanding restorative environments as health resources. In C. W. Thompson & P. Travlou (Eds.), *Open Space: People Space* (pp. 199). London, UK: Taylor & Francis.

Hartig, T., Evans, G.W., Jamner, L.D., Davis, D.S., & Garling, T. (2003). Tracking restoration in natural and urban field settings. *Journal of Environmental Psychology, 23*(2), 109-123.

Hartig, T., Kaiser, F. G., & Bowler, P. A. (1997). *Further development of a measure of perceived environmental restorativeness* (Working Paper No. 5). Gävle, Sweden: Uppsala University, Institute for Housing Research.

Hartig, T., Kaiser, F. G., & Bowler, P. A. (2001). Psychological restoration in nature as a positive motivation for ecological behavior. *Environment and Behavior, 33*(4), 590-607.

Hartig, T., Korpela, K. M., Evans, G. W., & Gärling, T. (1996). *Validation of a measure of perceived environmental restorativeness* (Göteborg Psychological Reports, 26:7). Göteborg: Department of Psychology, Göteborg University.

Hartig, T., Korpela, K. M., Evans, G. W., & Gärling, T. (1997). A measure of restorative quality in environments. *Scandinavian housing and Planning Research, 14*(4), 175-194.

Hartig, T., Mang, M., and Evans, G.W. (1991). Restorative effects of natural environment experience. *Environment and Behavior, 23*(1), 3-26.

Heerwagen, J. H. (12. 3. 1998). Design, productivity and well-being: What are the links? *Proceedings of the AIA Conference on Highly Effective Facilities*.

Heerwagen, J. H. (2000). Green buildings, organizational success, and occupant productivity. *Building Research and Information, 28*(5), 353-367.

Heerwagen, J. H. (2006). Investing in people: the social benefits of sustainable design. *Proceedings of the conference Rethinking Sustainable Construction.*

Heerwagen, J. H. (2009). Biophilia, health, and well-being. In L. Campbell & A. Wiesen (Eds.), *Restorative Commons: Creating health and Well-being through urban landscapes*. Newtown Square, PA: USDA Forest Service.

Herzog, T. R., Maguire, C. P., & Nebel, M. B. (2003). Assessing the restorative components of environments. *Journal of Environmental Psychology, 23*(2), 159-170.

Herzog, T. R., Ouelette, P., Rolens, J. R., & Koenigs, A. M. (2010). Houses of worship as restorative environments. *Environment and Behavior, 42*(4), 395-419.

Herzog, T.R., Chen, H.C., & Primeau, J. S. (2002). Perception of the restorative potential of natural and other settings. *Journal of Environmental Psychology, 22*(3), 295-306.

Heschong, L. (2003). *Windows and offices: A study of office worker performance and the indoor environment.* Fair Oaks, CA: California Energy Commission.

James, W. (1984). *Psychology: A briefer course.* Cambridge, MA: Harvard University Press.

Joye, Y. & van den Berg, A. E. (2012). Restorative environments. In L. Steg, A. E. van den Berg, & J. I. M. de Groot (Eds.), *Environmental psychology: An introduction*. Oxford, UK: Wiley-Blackwell.

Kaplan, R. (1973). Predictors of environmental preference: Designers as clients. In Preiser, W. (Ed.), *Environmental Design Research*. Stroudsburg: Dowden, Huchinson, & Ross.

Kaplan, R. (1985). The analysis of perception via preference: A strategy for studying how the environment is experienced. *Landscape Planning, 12*(2), 161-176.

Kaplan, R. (2001). The nature of the view from home: Psychological benefits. *Environment and Behavior, 33*(4), 507-542.

Kaplan, S. & Berman, M. G. (2010). Directed attention as a common resource for executive functioning and self-regulation. *Perspectives on Psychological Science, 5*(1), 43-57.

Kaplan, S. & Wendt, J. S. (1972). Preference and the visual environment: Complexity and some alternatives. In W. J. Mitchell (Ed.), *Environmental design: Research and practice.* Proceedings of the Environmental Design Research Association Conference Three, Los Angeles.

Kaplan, S. (1987). Aesthetics, affect, and cognition: Environmental preference from an evolutionary perspective. *Environment and Behavior, 19*(1), 3-32.

Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology, 15*(3), 169-182.

Kaplan, S., & Kaplan, R. (1989). *The experience of nature: A psychological perspective.* New York, NY: Cambridge University Press.

Kaplan, S., Kaplan R., and Wendt, J. S. (1972). Rated preference and complexity for natural and urban visual material. *Perception and Psychophysics, 12*(4), 354-356.

Kellert, S. R. (2002). Experiencing nature: affective, cognitive, and evaluative development in children. In P. H. Kahn & S. R. Kellert (Eds.), *Children and nature: Psychological, sociocultural, and evolutionary investigations.* Cambridge, MA: Massachusetts Institute of Technology.

Kellert, S. R. (2005). *Building for life: Designing and understanding the human-nature connection*. Washington, DC: Island Press.

Kellert, S. R. (2012). *Birthright: People and nature in the modern world*. New Haven, London: Yale University Press.

Kellert, S., (2008). Dimensions, Elements, and Attributes of Biophilic Design. In S. Kellert, J. H. Heerwagen, & M. L. Mador (Eds.), *Biophilic Design* (pp. 3-20). Hoboken, NJ: Wiley and Sons.

Kitek Kuzman, M. & Kutnar, A. (2014). *Contemporary Slovenian timber architecture for sustainability*. Springer International Publishing.

Korpela, K. M., Hartig, T., Kaiser, F. G., & Fuhrer, U. (2001). Restorative experience and self-regulation in favorite places. *Environment and Behavior, 33*(4), 572-589.

Kuo, F. E. & Sullivan, W. C. (2001). Environment and crime in the inner city: Does vegetation reduce crime? *Environment and Behavior, 33*(3), 343-367.

Kweon, B., Ulrich, R.S., Walker, V.D., and Tassinary, L.G. (2008). Anger and stress: The role of landscape posters in an office setting. *Environment and Behavior, 40*(3), 355-381.

Laumann, K., Gärling, T., & Stormark, K. M. (2001). Rating scale measures of restorative components of environments. *Journal of Environmental Psychology, 21*(1), 31-44.

Laumann, K., Gärling, T., & Stormark, K. M. (2003). Selective attention and heart rate responses to natural and urban environments. *Journal of Environmental Psychology, 23*(2), 125-134.

Lee, Y. S. & Guerin, D. A. (2009). Indoor environmental quality related to occupant satisfaction and performance in LEED-certified buildings. *Indoor and Built Environment, 18*(4), 293-300.

Louv, R. (2008). Children and the success of biophilic design. In S. Kellert, J. H. Heerwagen, & M. L. Mador (Eds.), *Biophilic Design* (pp. 205-212). Hoboken, NJ: Wiley and Sons.

Mandler, G. (1982). The structure of value: Accounting for taste. In M. S. Clark in S. T. Fiske (Eds.), *Affect and cognition: The Seventeeth Annual Carnegie Symposium on Cognition* (pp. 3-36). Hillsdale, NJ: Lawrence Erlbaum Associates.

Masuda, M. (2004). Why wood is excellent for interior design? From vision physical point of view. Proceedings 8th World Conference on Timber Engineering. Lahti, Finland, 102-106.

McDonald, R. P. & Ho, M. R. (2002). Principles and practice in reporting structural equation analyses. *Psychological Methods,7*(1), 64-82.

McGee, B. & Marshall-Baker, A. (2015). Loving nature from the inside out: A biophilia matrix identification strategy for designers. *Health Environments Research & Design Journal, 8*(4), 115-130.

McSweeney, J., Rainham, D., Johnson, S. A., Sherry, S. B., & Singleton, J. (2015). Indoor nature exposure (INE): A health-promotion framework. *Health Promotion International, 30*(1), 126-139.

Moore, R. C. & Cooper Marcus, C. (2008). Healthy planet, healthy children: Designing nature into the daily spaces of childhood. In S. Kellert, J. H. Heerwagen, & M. L. Mador (Eds.), *Biophilic Design* (pp. 153-204). Hoboken, NJ: Wiley and Sons.

Nakamura, M. & Kondo, T. (2007). Characterization of distribution pattern of eye fixation pauses in observation of knotty wood panel images. *Journal of Physiological Anthropology, 26*(2), 129-133.

Nyrud, A. Q. & Bringslimark, T. (2010). Is interior wood use psychologically beneficial? A review of psychological responses toward wood. *Wood and Fiber Science, 42*(2), pp. 202-218.

Nyrud, Q. A., Bringslimark, T., & Bysheim, K. (2014). Benefits from wood interior in a hospital room: A preference study. *Architectural Science Review, 57*(2), 125-131.

O'Connor, J., Kozak, R., Gaston, C., & Fell, D. (2004). Wood use in nonresidential buildings: opportunities and barriers. *Forest Products Journal, 54*(3), 19-28.

Orians, G. & Heerwagen, J. (1992). Evolved responses to landscapes. In J. Barkow, L. Cosmides, & J. Tooby (Eds.), *The Adapted Mind: Evolutionary psychology and the generation of culture* (pp. 555–579). New York, NY: Oxford University Press.

Pasini, M., Berto, R., Brondino, M., Hall, R., & Ortner, C. (2014). How to measure the restorative quality of environments: The PRS-11. *Procedia – Social and Behavioral Sciences, 159*, 293-297.

Payne, S. R. (2013). The production of a Perceived Restorativeness Soundscape Scale. *Applied Acoustics, 74*(2), 255-263.

Peschard, K. K. & Stigsdotter, U. K. (2013). Associations between park characteristics and perceived restorativeness of small public green spaces. *Landscape and Urban Planning*, *112*(1), 26-39.

PIRS (2016). Business directory of the Republic of Slovenia. Retrieved 3 June, 2016, from http://www.pirs.si/.

Pretty, J., Angus, C., Bain, M., Barton, J., Gladwell, V., Hine, R., Pilgrim, S., Sandercock, G., & Sellens, M. (2009). *Nature, childhood, health and life pathways.* Colchester: University of Essex.

Proshansky, H. M., Ittelson, W. H., & Rivlin, L. G. (1970). *Environmental psychology: Man and his physical setting.* New York, NY: Holt, Rinehart & Winston.

Purcell, T., Peron, E., & Berto, R. (2001). Why do preferences differ between scene types? *Environment and Behavior, 33*(1), 93-106.

Rapoport, A. (1994). *The meaning of the built environment: A nonverbal communication approach*. Tucson: The University of Arizona Press.

Rashid, M. & Zimring, C. (2008). A review of the empirical literature on the relationships between indoor environment and stress in health care and office settings: Problems and prospects of sharing evidence. *Environment and Behavior, 40*(2), 151-190.

Rice, J., Kozak, R. A., Meitner, M. J., & Cohen, D. H. (2006). Appearance wood products and psychological well-being. *Wood and Fiber Science, 38*(4), 644-659.

Russel, H. (1999). The psychological effects of plants on people in offices. *Interiorscape*, 19-21.

Satorra, A. & Bentler, P. M. (1994). Corrections to test statistics and standard errrors in covariance structure analysis. In A. von Eye & C. C. Clogg (Eds.), *Latent variables analysis: Applications for development research*. Thousand Oaks, CA: Sage Publications.

Schultz, P. W. (2001). The structure of environmental concern: Concern for self, other people, and the biosphere. *Journal of Environmental Psychology*, *21*(4), 327-339.

Shibata, S. & Suzuki, N. (2002). Effects of the foliage plant on task performance and mood. *Journal of Environmental Psychology*, *22*(3), 265-272.

Singh, A., Syal, M., Grady, S. C., & Korkmaz, S. (2010). Effects of green buildings on employee health and productivity. *American Journal of Public Health, 100*(9), 1665-1668.

SloExport (2016). Database of Slovenian exporters. Retrieved 3 June, 2016, from http://www.sloexport.si/.

Steg, L., van den Berg, A. E., & de Groot, J. I. M. (2012). Environmental psychology: History, scope and methods. In L. Steg, A. E. van den Berg, & J. I. M. de Groot (Eds.), *Environmental psychology: An introduction*. Oxford, UK: Wiley-Blackwell.

Stigsdotter, U. K., & Grahn, P. (2011). Stressed individuals' preferences for activities and environmental characteristics. *Urban Forestry & Urban Greening, 10*(4), 295-304.

Stokols, D. (1995). The paradox of environmental psychology. *American Psychologist, 50*(10), 821–837.

Tang, I. C., Sullivan, W. C., & Chang, C. Y. (2015). Perceptual evaluation of natural landscapes: The role of the individual connection to nature. *Environment and Behavior, 47*(6), 595-617.

Tavakol, M. & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, 2, 53-55.

Tennessen, C. M., & Cimprich. B. (1995). Views to nature: effects on attention. *Journal of Environmental Psychology, 15*(2), 77–85.

Tenngart Ivarsson, C. & Hagerhall, C. M. (2008). The erceived restorativeness of gardens – Assessing the restorativeness of a mixed built and natural scene type. *Urban Forestry & Urban Greening, 7*(2), 107-118.

Tyrväinen, L., Ojala, A., Korpela, K. M., Lanki, T., Tsunetsugu, Y., & Kagawa, T. (2014). The influence of urban green environments on stress relief measures: A field experiment. *Journal of Environmental Psychology, 38*(1), 1-9.

Ulrich R. S., Simons, R., Losito, B., Fiorito, E., Miles, M., and Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology, 11*(3), 201-230.

Ulrich, R. S. (1981). Natural versus urban scenes: Some psychophysiological effects. *Environment and Behavior, 13*(5), 523-556.

Ulrich, R. S. (1983). Aesthetic and affective response to natural environment. In Altman, I. and Wohlwill, J.F. (Eds.). *Behavior and the Natural Environment* (pp. 85-125). New York: Plenum.

Ulrich, R. S. (1984). View Through a Window May Influence Recovery From Surgery. *Science, 224*, 42-421.

Ulrich, R. S., Quan, X., Zimring, C., Joseph, A., & Choudhary, R. (2004). *The role of the physical environment in the hospital of the 21st century: A once-in-a-lifetime opportunity*. Concord, CA: Center for Health Design.

Ulrich, R.S. (1993). Biophilia, biophobia and natural landscapes. In S. R. Kellert & E. O. Wilson (Eds.), *The Biophilia Hypothesis* (pp. 73–137). Washington, DC: Island Press.

Ulrich, R.S. (2008). Biophilic Theory and Research in Healthcare Design. In S. Kellert, J. H. Heerwagen, & M. L. Mador (Eds.), *Biophilic Design* (pp. 87-106). Hoboken, NJ: Wiley and Sons.

Uzzell, D, & Räthzel, N. (2009). Transforming environmental psychology. *Journal of Environmental Psychology, 29*(3), 340–350.

van den Berg, A. E. (2005). *Health impacts of healing environments: A review of evidence for benefits of nature, daylight, fresh air, and quiet in healthcare settings.* Groningen: Foundation 200 years University Hospital Groningen.

van den Berg, A. E., Hartig, T., & Staats, H. (2007). Preference for nature in urbanized societies: Stress, restoration, and the pursuit of sustainability. *Journal of Social Issues, 63*(1), 79-96.

van den Berg, A. E., Jorgensen, A., & Wilson, E. R. (2014). Evaluating restoration in urban green spaces: Does setting type make a difference? *Landscape and Urban Planning, 127,* 173-181.

van den Berg, A. E., Joye, Y., & de Vries, S. (2012). Health benefits of nature. In L. Steg, A. E. van den Berg, & J. I. M. de Groot (Eds.), *Environmental psychology: An introduction*. Oxford, UK: Wiley-Blackwell.

van den Berg, A. E., Koole, S. L., & van der Wulp, N. Y. (2003). Environmental preference and restoration: (How) are they related? *Journal of Environmental Psychology, 23*(2), 135-146.

Veitch, J. A. (2011). Workplace design contributions to mental health and well-being. *Healthcare Papers (special issue), 11,* 38-46.

Vischer, J. C. (2007). The effects of the physical environment on job performance: Towards a theoretical model of workspace stress. *Stress and Health, 23*(3), 175-184.

Wilson, E. O. (1984). *Biophilia*. Cambridge: Harvard University Press.

Wohlwill, J. F. (1983). The concept of nature: A psychologist's view. In I. Altman, & J. F. Wohlwill (Eds.), *Behavior and the Natural Environment* (pp. 85-125). New York: Plenum.

World Health Organization - WHO (2001). WHO Well-being scale (WHO-5). Retrieved march 2015 from http://www.who-5.org/.

Zajonc, R. (1980). Feeling and thinking: preferences need no inferences. *American Psychologist, 35* (2), 151-175.

APPENDICES

APPENDIX A

Questionnaire as used in the present study, with added variable labels.

1) Perception of current office space

……Items are answered on a 5-point Likert-type scale (Strongly Agree – Strongly Disagree)* *……Items are answered on an 11-point Likert-type scale (1-10; Completely Agree – Completely Disagree)* *BIN……..Items are answered either Yes or No.*

1) [WorkplaceSat1] My office is comfortable to work in. **
2) [WorkplaceSat2] I am pleased with my physical environment at work. **
3) [WorkplaceSat3] My physical environment at work is satisfying to me. **
4) [WorkplaceSat4] I would prefer working in a different physical environment. **
5) [WorkplaceSat5] I find my workplace to be stressful. **
6) [Naturalness1] The design of my office looks/feels reflective of nature. **
7) [Naturalness2] The design of my office looks/feels artificial. **
8) [Naturalness3] There are physical elements here I would describe as "natural". **
9) [Plants] There are plants in my office. **
10) [SurfacePleasingHaptic] Working surfaces in my office are pleasant to the touch. **
11) [WindowsView1] My office has one or more window(s). BIN

(Items 11a and 11b: If previous item was answered with 'yes')

11a) [WindowsView2] The view through the window(s) is pleasant. **

11b) [WindowsView3] Windows in my office allow a direct view of a natural setting. **

12) [Decor1] Please rate the presence of decorative elements in your office. *(5-point Likert, Too little – OK as is – Too much)*
13) [Decor2] Please rate the contribution of your office's decorative items to your well-being. (*5-point Likert Very low – Very high)*
14) [VisWoodSurfaces] Please rate the presence of visible wooden surfaces in your office. *(5-point Likert, Very low – Low – Moderate – High – Very high)*
15) [Sunlight1] Light sources in my office are mostly artificial. **
16) [Sunlight2] Sunlight illuminates my office during the day. **
17) [FreshAir] My office allows easy access to fresh air. **
18) [Noise1] My workspace allows me to work in peace and quiet. **
19) [Noise2] Ambient sounds in my office are bothersome. **

20) [Restor1] Places like this are a refuge from everyday worries. ***

21) [Restor2] In place like this it is easy to see how everything fits together. ***

22) [Restor3] Places like this allow exploration. ***

23) [Restor4] To get away from things that usually demand my attention I like to be in places like this. ***

24) [Restor5] In places like this everything seems to have its proper setting. ***

25) [Restor6] Places like this are fascinating. ***

26) [Restor7] In places like this I can move around freely. ***

27) [Restor8] To stop thinking about the things that I must get done I like to be in places like this. ***

28) [Restor9] In places like this my attention is drawn to many interesting things. ***

29) [Restor10] Places like this are chaotic. ***

30) [Restor11] In places like this it is hard to be bored. ***

31) *(SBS Symptoms – mark frequency in the past two weeks:)* *(5-point Likert, At no time – All of the time)*

- Headaches [SBS1]
- Fatigue [SBS2]
- Eye irritation [SBS3]
- Respiratory irritation [SBS4]
- Unpleasant noise [SBS5]

32) [ReliefOnLeave] I feel a physical relief after leaving my office space. **

2) Description of ideal, desired office space

Please read the pairs of descriptors below and in each pair pick the word that describes your current/ideal office space best.

Descriptors				
Warm	Cool		Exciting	Calming
Natural	Artificial		Simple	Complex
Homey	Industrial		Fascinating	Unattractive
Confusing	Coherent		Rustic	Sophisticated
Plain	Ornate		Cluttered	Clean
Confined	Spacious		Bright	Dark
Open	Closed		Casual	Formal
Inspiring	Uninspiring		Modern	Old-fashioned

Demographics and Patterns of office use

33) Age: _____

34) Sex: *Male / Female*

35) Highest level of education completed:

1. Less than high school degree
2. High school graduate, diploma or equivalent
3. Trade, technical or vocational training
4. Some college credit, no degree
5. Bachelor's degree
6. Master's degree
7. Professional degree
8. Doctorate degree

36) Hours per week in office: < 31 | 31 – 35 | 36 – 40 | 41 – 45 | 46 >

37) How frequently do you leave your workstation during the day? *(5-point Likert, Hardly ever – Very often)*

38) Hours per week interacting with a computer: < 31 | 31 – 35 | 36 – 40 | 41 – 45 | 46 >

39) I share my office *(Select: No, With 1 other person, With 2, With 3, With more)*

40) My position in the company is: Managerial/Non-managerial. *(Please select)*

41) [Tenure] Tenure in company:_____ years

42) Please mark the region in Slovenia where the organization you work in is located. *(Please select)*

□ Mura (Pomurska)
□ Drava (Podravska)
□ Carinthia (Koroška)
□ Savinja (Savinjska)
□ Central Sava (Zasavska)
□ Lower Sava (Posavska)
□ Southeast Slovenia (Jugovzhodna Slovenija)
□ Central Slovenia (Osrednjeslovenska)
□ Upper Carniola (Gorenjska)
□ Littoral-Inner Carniola (Primorsko-notranjska)
□ Gorizia (Goriška)
□ Coastal-Karst (Obalno-kraška)

43) The company I'm employed at is: Private/Public/Mixed *(Please select)*

44) Please mark the main activity of the organization you work in (as defined by the Standard Classification of Activities - SKD_2008). *(Please select)*

A - Agriculture, forestry and fishing	L - Real estate activities
B - Mining and quarrying	M - Professional, scientific and technical activities
C - Manufacturing	N - Administrative and support service activities
D - Electricity, gas, steam and air conditioning supply	N - Administrative and support service activities
E - Water supply, sewerage, waste management and remediation activities	P - Education
F - Construction	Q - Human health and social work activities
G - Wholesale and retail trade, repair of motor vehicles and motorcycles	R - Arts, entertainment and recreation
H - Transportation and storage	S - Other service activities
I - Accomodation and food service activities	T - Activities of households as employers, undifferentiated goods- and services-producing activities of households for own use
J - Information and communication	U - Activities of extraterritorial organizations and bodies
K - Financial and insurance activities	

45) Please state your level of involvement with the forest based sector.

- ☐ I am employed in the forest based sector directly
- ☐ I am employed in a field related to the forest based sector (e.g., construction, transportation, logistics)
- ☐ I have a formal education related to the forest based sector (e.g., currently enrolled, or past enrolment in a forest related field, e.g., wood science, forestry)
- ☐ I own a forest
- ☐ I am not involved with the forest based sector
- ☐ I have other involvement with the forest based sector:_____

46) Do you or your family receive any income from forestry and/or the forest based industry? [BIN]

Mood WHO-5

Please indicate for each of the five statements below which is closest to how you have been feeling over the last two weeks.

47) [WHO1] I have felt cheerful and in good spirits. *(5-point Likert, At no time – All of the time)*

48) [WHO2] I have felt calm and relaxed. *(5-point Likert, At no time – All of the time)*

49) [WHO3] I have felt active and vigorous. *(5-point Likert, At no time – All of the time)*

50) [WHO4] I woke up feeling fresh and rested. *(5-point Likert, At no time – All of the time)*

51) [WHO5] My daily life has been filled with things that interest me. *(5-point Likert, At no time – All of the time)*

APPENDIX B

Detailed parameters of the final, corrected model as defined in R software, Lavaan package.

```
#Final model
      model.corrected <- '
#Regressions
      wel ~ res + nat + fon + who
      res ~ nat + fon
      who ~ res + fon
      eon ~ nat + res + wel
#Latent variables
      nat =~ Naturalness1 + Naturalness2 + Naturalness3
      eon =~ Plants + SurfacePleasingHaptic + WindowsView1 +
             WindowsView3 + Decor1 + VisWoodSurfaces + Sunlight1 +
             Sunlight2 + FreshAir + Noise1 + Noise2
      res =~ Restor1 + Restor2 + Restor3 + Restor4 + Restor5 + Restor6 +
             Restor7 + Restor8 + Restor9 + Restor10 + Restor11
      wel =~ SBS1 + SBS2 + SBS3 + SBS4 + SBS5 + ReliefOnLeave + Decor2 +
             WorkplaceSat5 + WindowsView2
      who =~ WHO1 + WHO2 + WHO3 + WHO4 + WHO5
      fon =~ WorkplaceSat1 + WorkplaceSat2 + WorkplaceSat3 +
             WorkplaceSat4
#Covariances
#covariances in PRS scale (single-component)
      Restor1 ~~ Restor4
      Restor1 ~~ Restor5
      Restor4 ~~ Restor8
      Restor9 ~~ Restor10
      Restor9 ~~ Restor11
      Restor10 ~~ Restor11
#covariances in Nat
      Naturalness1 ~~ Naturalness3
#covariances in EON
      SurfacePleasingHaptic ~~ VisWoodSurfaces
      WindowsView1 ~~ WindowsView2 + WindowsView3 + FreshAir
      WindowsView2 ~~ WindowsView3
      Decor1 ~~ Decor2
      Sunlight1 ~~ Sunlight2
      Noise1 ~~ Noise2 + SBS5
      Noise2 ~~ SBS5
#covariances in WHO
      WHO1 ~~ WHO2 + WHO3 + WHO4 + WHO5
#covariances in SBS
      ReliefOnLeave ~~ SBS1 + SBS2 + SBS3 + SBS4 + SBS5
'
```

APPENDIX C

Detailed fitting results of the final corrected model. A covariance or correlation matrix cannot be added here due to the large number of variables in our study.

Table 1
Latent variable factor loadings.

	Estimate	Std.Err	Z-value	P(>|z|)	Std.lv	Std.all
nat =~						
Naturalness1	1				0.963	0.903
Naturalness2	0.94	0.056	16.852	0	0.905	0.799
Naturalness3	0.552	0.052	10.607	0	0.532	0.537
eon =~						
Plants	1				0.47	0.327
SurfcPlsngHptc	1.429	0.217	6.573	0	0.672	0.639
WindowsView1	0.038	0.021	1.799	0.072	0.018	0.121
WindowsView3	0.532	0.177	3.003	0.003	0.25	0.18
Decor1	0.726	0.133	5.444	0	0.341	0.408
VisWoodSurfacs	0.799	0.165	4.833	0	0.375	0.361
Sunlight1	0.993	0.197	5.039	0	0.467	0.398
Sunlight2	0.926	0.193	4.808	0	0.435	0.38
FreshAir	1.177	0.199	5.91	0	0.553	0.511
Noise1	1.543	0.241	6.401	0	0.725	0.607
Noise2	0.978	0.202	4.85	0	0.46	0.388
res =~						
Restor1	1				1.81	0.694
Restor2	1.197	0.076	15.844	0	2.166	0.809
Restor3	1.08	0.082	13.157	0	1.955	0.715
Restor4	1.074	0.073	14.751	0	1.944	0.72
Restor5	1.264	0.09	14.078	0	2.289	0.829
Restor6	1.258	0.081	15.551	0	2.278	0.848
Restor7	0.992	0.087	11.422	0	1.796	0.615
Restor8	1.016	0.067	15.26	0	1.839	0.7
Restor9	1.09	0.083	13.135	0	1.973	0.752
Restor10	0.592	0.103	5.765	0	1.072	0.358
Restor11	0.568	0.09	6.317	0	1.029	0.34
wel =~						
SBS1	1				0.738	0.663
SBS2	1.132	0.085	13.248	0	0.836	0.724
SBS3	1.132	0.091	12.383	0	0.836	0.664
SBS4	0.873	0.082	10.711	0	0.645	0.569
SBS5	0.895	0.087	10.249	0	0.661	0.541
ReliefOnLeave	1.196	0.097	12.331	0	0.883	0.796
Decor2	0.104	0.087	1.193	0.233	0.077	0.07
WorkplaceSat5	0.551	0.073	7.588	0	0.407	0.391
WindowsView2	0.431	0.09	4.786	0	0.318	0.242
who =~						
WHO1	1				0.964	0.878
WHO2	1.063	0.055	19.464	0	1.025	0.861
WHO3	1.126	0.057	19.613	0	1.086	0.921
WHO4	1.033	0.065	15.825	0	0.996	0.756

WHO5	0.825	0.057	14.451	0	0.795	0.664
fon =~						
WorkplaceSat1	1				0.931	0.858
WorkplaceSat2	1.107	0.042	26.37	0	1.03	0.965
WorkplaceSat3	0.98	0.046	21.208	0	0.912	0.892
WorkplaceSat4	0.921	0.067	13.755	0	0.857	0.682

Note: Std.Err, standard error; Std.lv, standardised estimates for latent variables; Std.all, stadardised estimates for observed and latent variables.

Table 2

Covariance parameters in the model and their standardised estimates.

	Estimate	Std.Err	Z-value	P(>|z|)	Std.lv	Std.all
Restor1 ~~						
Restor4	0.784	0.241	3.258	0.001	0.784	0.223
Restor5	-0.63	0.181	-3.475	0.001	-0.63	-0.217
Restor4 ~~						
Restor8	1.117	0.247	4.528	0.000	1.117	0.318
Restor9 ~~						
Restor10	-1.538	0.261	-5.884	0.000	-1.538	-0.318
Restor11	1.184	0.289	4.101	0.000	1.184	0.24
Restor10 ~~						
Restor11	-2.164	0.429	-5.041	0.000	-2.164	-0.271
Naturalness1 ~~						
Naturalness3	0.036	0.041	0.856	0.392	0.036	0.093
SurfacePleasingHaptic ~~						
VisWoodSurfacs	0.132	0.055	2.395	0.017	0.132	0.169
WindowsView1 ~~						
WindowsView2	0.026	0.021	1.225	0.221	0.026	0.139
WindowsView3	0.021	0.019	1.08	0.280	0.021	0.105
FreshAir	0.024	0.01	2.338	0.019	0.024	0.18
WindowsView3 ~~						
WindowsView2	1.341	0.092	14.608	0.000	1.341	0.767
Decor1 ~~						
Decor2	0.051	0.046	1.106	0.269	0.051	0.06
Sunlight1 ~~						
Sunlight2	0.689	0.072	9.53	0.000	0.689	0.605
Noise1 ~~						
Noise2	0.365	0.066	5.537	0.000	0.365	0.353
SBS5	0.439	0.061	7.222	0.000	0.439	0.451
Noise2 ~~						
SBS5	0.561	0.064	8.714	0.000	0.561	0.501
WHO1 ~~						
WHO2	0.051	0.045	1.151	0.250	0.051	0.162
WHO3	-0.028	0.044	-0.634	0.526	-0.028	-0.116
WHO4	-0.072	0.042	-1.736	0.083	-0.072	-0.159
WHO5	0.011	0.039	0.289	0.773	0.011	0.024
SBS1 ~~						
ReliefOnLeave	-0.169	0.049	-3.436	0.001	-0.169	-0.301
SBS2 ~~						
ReliefOnLeave	-0.097	0.061	-1.585	0.113	-0.097	-0.182

SBS3 ~~ ReliefOnLeave	-0.132	0.064	-2.055	0.040	-0.132	-0.208
SBS4 ~~ ReliefOnLeave	-0.171	0.054	-3.149	0.002	-0.171	-0.273
SBS5 ~~ ReliefOnLeave	-0.119	0.046	-2.591	0.010	-0.119	-0.172
nat ~~ fon	0.603	0.057	10.629	0.000	0.673	0.673

Note: Std.Err, standard error; Std.lv, standardised estimates for latent variables; Std.all, stadardised estimates for observed and latent variables.