A landscape analysis: Investigating restorative features within urban greening

Ellinor Arvidsson

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Department of Landscape Architecture, Planning and Management
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Ellinor Arvidsson

Supervisor: Anna María Pálsdóttir, SLU, Department of People and Society

Examiner: Petra Thorpert, SLU, Department of Landscape Architecture, Planning and Management

Assistant examiner: Matilda Alfengård, SLU, Department of Landscape Architecture, Planning and Management

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Swedish University of Agricultural Sciences

Faculty of Landscape Architecture, Horticulture and Crop Production Science

Department of Landscape Architecture, Planning and Management

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Abstract

Today people are described as an integral component of urban green infrastructure which advocates to study human engagement within the use of nature to develop goals and landscape planning in the purpose of achieving better life conditions for city inhabitants. The connectedness to nature has been described as decisive when exploring possible human psychological restoration derived from nature. Although, a lack of existing research is found concerning any specific amounts or types of restorative features in nature that is preferred when accommodating different health benefits and to serve public health outcomes. This study is comparing restorative environmental qualities within an urban forest as well as an urban planting with the purpose of finding inspiration to future landscape design for urban areas that can support human health and wellbeing. This study was conducted in Jönköping, Sweden by implementing a triangulation of methods using a mood scale that investigated six different categories of mental states, a sensory walk conducted with an introspective approach, as well as applying *Visual Landscape Assessment Tool (VLAT)*. The results showed to be in line with previous research and findings indicated that the urban forest encompassed higher restoration potential than the urban planting. The participant enhanced a happier state of mind within the forest setting in comparison to the urban planting and qualities such as water features and singing birds in the urban forest were argued to redirect focus from city noise and to promote psychological restoration. Limitations and further research are discussed.

Keywords: urban greening, green infrastructure, human restoration, landscape design, environmental psychology, landscape analysis

Preface

In my childhood I spent countless of hours of running around and playing in rural landscapes. Growing up on a farm far away from the nearest city together with different animals, including horseback riding through forests and fields, have throughout life identified and formed me into cherishing nature. The fascination of *why* nature has had a great impact on me was never contemplated until recent years of studying garden design, landscape architecture, and environmental psychology, but foremost when learning to know senior lecturer, my supervisor and friend Anna María Pálsdóttir. Her words telling me *So what?!* has had me questioning different issues into developing a deeper meaning and understanding for our surrounding environment. As my main interest is in landscape design, the significance of understanding nature components far beyond its aesthetic purposes is valuable to me. The choice of comparing an urban forest to an urban planting was important to me as urban areas define most of my current life.

A vast thank you to Anna María who has held my hand through this recent year.
I could have not found a greater support-team than you!

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Abbreviations

VLAT Visual Landscape Assessment Tool

ERI Environmental Response Inventory

BAR Biotope Area Ratio

1.Introduction

As the ongoing densification of cities affect the possibility to experience private or public green spaces (Haaland & Konijnendijk van den Bosch, 2016), it is crucial to raise questions concerning the relationship between urban growth and its impact on the environmental quality where people live and thrives (Erneson et al. 2014). The connectedness to nature has been described as decisive when exploring possible human psychological restoration derived from nature, whereas such restoration is explained to reduce negative emotions affiliated with stress, while also being able to increase positive emotions (Fredricksson, 1998). Research has shown that contact with nature can provide possibilities for restoration (Dolling et al. 2017; Kristjánsdóttir et al. 2020; Pálsdóttir, 2014; Hartig, 2021; Kaplan, 1995; Burns, 2009; Stigsdotter et al. 2017; Nejati et al. 2016), as well as decrease human reactions to stressful events (Hartig et al. 2003; Frumkin et al. 2017; Soga et al. 2020; Grahn & Stigsdotter, 2003; Ottosson & Grahn, 2008; Kuo, 2015).

Nevertheless, there is found to be a lack of research concerning specific amounts or types of restorative features in nature that is required in order to accommodate different health benefits and to serve public health outcomes (Shanahan, 2015; Wyles et al. 2019; Cox et al. 2017). Most research concerning restorative environments have focused on over-aching themes rather than individual experiences (Liu et al. 2021), whereas the need of exploring the role of personal and social aspects has been lifted in order to investigate the effects of psychological restoration (Menatti et al. 2019). As a response to the absence of such significant aspects of the entire field, there is argued to exist a growing body of evidence that aims to reveal these specific elements (Jackson et al. 2013; Keniger et al. 2013).

Nature settings have also been found to improve humans' ability to cope with everyday life (Sonntag-Öström et al. 2014; Unruh, 2004; Vujcic et al. 2017), and is described as directly affecting human mental health (Bratman et al. 2019; Van den Berg et al. 2015; Hartig et al. 2014; Barton & Pretty, 2010), as well as promoting restoration from mental fatigue (Cox et al. 2017). However, to experience psychological restoration for people visiting nature settings one must consider factors such as social, economic, psychological, physiological, behavioral, environmental, and genetic influences (Meyer-Lindenberg, 2014), as these play an important role when analyzing the health outcomes of nature experiences.

1.1 Urban greening

The humanized landscape is explained by Denevan (2011) to aboriginally be modified by hunting, burning, forestry, and planting. Our far most humanized type of landscapes are urban environments built by humans, which are managed through strategies involving sustainability and regeneration (Chiesura, 2004), as well as enhancing development goals and planning in the purpose of achieving better life conditions for city inhabitants (Breuste, 2022). Research has shown that wilderness within an urban context, was beginning to be seen as beautiful and good, so as considered as valuable in terms of advocating and reserving nature, in the mid-19th century due to its innate mythical meaning and protection of its future (Cronon, 1995).

Today, people are described as an integral component of urban green infrastructure (Benedict & McMahon, 2021), which makes it necessary to study human engagement within the use of nature, whether it is man-made or evoked by wild nature. *Urban forestry* and *Urban greening* are two terms which often are recognized in contexts related to city planning, social programs, and sustainable development. During the 1970's, *Urban forestry* first became a recognized discipline (Miller et al. 2015) and was originally defined as a specialized branch of forestry with its purpose to cultivate and manage trees for their present and potential contribution (involving a recreational value) to the physiological, sociological, and economic wellbeing of the urban society (Jorgensen, 1970). A wide range of definitions are to be found with some divergences (Miller et al. 2015). However, they all share a universal explanation that forests located nearby or inside urban areas ought to benefit residents of urban regions.

The term *Urban greening* is defined by Miller (1988) and explained as an integrated, citywide approach to the planting, care, and management of all vegetation, including forest-like areas in a city to secure different environmental and social advantages for urban dwellers. The fundamental purpose by implementing urban greening as a strategy is to simultaneously make cities become more enjoyable, livable, and sustainable, and to integrate many other environmental and social benefits beyond the traditional aim to provide spaces for recreational amenities (Sorensen, 1997).

The implementation of these strategies involves both private and public green spaces and have been argued to serve as promising pathways to sustainable cities including attractive

design and environmental preference, while enhancing possibilities for human restoration (Kowarik et al. 2019; Van den Berg et al. 2003; Staats et al. 2003; Sonntag-Öström et al. 2011; Subiza-Pérez et al. 2021; Nukarinen et al. 2020; Sonntag-Öström et al. 2014; Stoltz et al. 2016), so as to promote spiritual well-being, human advantages, and health and well-being for the world's growing urban population (Cronon, 1995; Freyfogle, 2003; Birch et al. 2020; Shanahan, 2015; van den Berg et al. 1998; McEwan e al. 2020). The human-nature relationship is inevitably influencing the characteristics of cities. However, human development and technological advancements have affected the way's nature is represented within the urban context (Hartsell, 2020).

An opening initiative to the planning of urban nature in Europe emerged at the end of the 19th century and was initiated by Ebenezer Howard, United Kingdom (Richert & Lapping, 1998). It was implemented as a method of urban planning and was called *The Garden City Movement* which aimed to present the primary benefits of a countryside environment together with city environments, while simultaneously avoiding their disadvantages. As a response to this new way of implementing nature in urban areas, new actions all over Europe were developed in the early 21st century in order to meet the growing issues of population density, climate change, and lack of space (Breuste, 2022). By further engagement in systematic and network thinking, the definition and meaning of green infrastructure made its way into urban planning and stakeholders.

The impact of factors such as climate change and densification have raised the importance of environmental qualities in cities (e.g. urban greening) as being more crucial than ever before, which in turn has led politicians, stakeholders, and management to undertake measures during the last decades, in order to attain public health and societal wellbeing. A tool for urban planning, called *Biotope Area Ratio (BAR)* (Lakes & Kim, 2012), also called *Green Area Ratio* (Keeley, 2011), was developed and implemented in Berlin during the 1990s (Delshammar & Falck, 2014). Additionally, the tool has also been used in Seattle under the name *Green Factor* (Abbey, 2008). It was later introduced for the first time in Sweden in the beginning of the 21st century (Stockholms stad, 2015). The fundamental aim with this tool is to promote urban environments with good air quality, local climate, and living environments for city inhabitants. It also provides possibilities to define comparable parameters, where conditions for water management, soil quality, biodiversity and animal life are taken into account (Malmö stad, 2014). In 2014, research

showed that the tool was used in 15 different municipalities within Sweden and that additional municipalities discussed the implementation of using *BAR*, however the number of Swedish municipalities that use it today remains unknown (Delshammar & Falck, 2014).

Findings from previous research have shown that green interventions that connects people to nature are increasing in the purpose of tackling mental illness among the population (McEwan et al. 2020), and that the promotion of urban nature enhance a restorative potential (Deng et al. 2020a; Hartig et al. 2014; Grahn & Stigsdotter, 2010; Sonntag-Öström et al. 2014; Qiu et al. 2021), as well as the affordance to optimize city planning, design and management for human well-being and animal wildlife (McEwan et al. 2020; Samuelsson et al. 2020; Paul & Nagendra, 2017; Kabisch et al. 2022).

1.2 Urban forest

The definition of the term *forest* can be perceived as somewhat vague as it can be viewed, defined and assessed differently among people. It is most commonly affiliated with a tree covered land area and can be regarded in several ways such as a source of timber products, a home for indigenous people, a source for multiple ecosystem services, and as social ecological systems (Chazdon, 2016). A forest is also described as incredibly complex due to its affordance to provide invaluable services and products for animals as well as for people (Díaz et al. 2018). Food, medicine, building materials, fibre, shade, recreational space, pollution filtration, and flood risk reduction are some of the benefits acknowledged from forest preservation and production (Di Sacco, 2021). When it comes to the urban forest it is described as the sum of street trees, residential trees, park trees, and green belt vegetation in and around dense human settlements (Millet et al. 2015). According to previous research, areas of green spaces including forests have been found to offer greater benefits such as the promotion of experiencing increased vitality and creativity than those that lack forest attributes (Tyrväinen et al. 2014). Findings have also shown that healing and environmental factors of urban forests can influence city dwellers with healing aspects due to its restorative effects (Kim, 2021; Hauru et al. 2012; Vujcic & Tomicevic-Dubljevic, 2018).

One type of an *urban forest* is a forest conservation. A forest conservation is defined as the practice of maintaining, protecting, and/or restoring forest landscapes in the purpose of conserving biological and cultural values in order to promote sustainable use, as well as to ensure strategic preservation of forest resources for future use (Dudley, 2008). Although the initiate aim with preservation of forests is to achieve goals connected to sustainable development, climate change adaptation, and human- and planetary health (Ihemezie, 2021; Jones et al. 2018), the establishment of these environments are sometimes questioned (Wade et al. 2020; Dimitrakopoulus & Jones, 2021; Dicks, 2021). There are found to be ongoing disagreements between the approaches of nature conservation and the concept of wilderness (Fernández-Llamazares et al. 2020). Conservationists argue that the preservation of wilderness areas play significant roles in protecting endangered biodiversity, ecological functions, as well as providing space for ecological and evolutionary processes to take place under minimal impact of outside interference (Watson et al. 2018; Di Marco et al. 2019).

However, a contradictory argument is that some of the world's foremost conserved forests have been formed and managed by humans over millennia (Levis et al. 2017; Maezumi et al. 2018), which further implies a confusion to the wilderness concept and contradicts the goal to reach a preconceived natural state. Additionally, Cronon (1995) declares the act of preservation as damaging because of the effects humans leave behind in the process of preserving nature.

Forest in Sweden

Sweden is the second most forest dominated country within Europe next after Finland, as the forest land is measured to cover 69 percent of the total land area (Statistics Sweden, 2019). It is constituted by 83 percent coniferous forest, 12 percent mixed forest, and 5 percent deciduous forest (Svenskt Trä, 2022). The high percentage of forest covered land in Sweden together with Swedish legal rights of access to private land (Naturvårdsverket, 2022), enables the accessibility to forests of different kinds easily within reach for all people.

In literature there are found some examples of studies conducted in Sweden on the impact of forest qualities important for humans. A study of the restorative potential in Swedish

forests has shown that participants become more relaxed, happier, harmonious, calmer, and clear-headed than before a forest visit (Lundell & Dolling, 2010). However, participants of the study showed more preference towards pine forests instead of spruce forests (Lundell & Dolling, 2010). Another Swedish study by Lundell et al. (2015) has investigated important factors of which a forest can be seen as rehabilitative. The study concluded five characteristics (*Space, Diversity of species, Serenity, Wilderness, and Cultural history*) to be important when looking into valuable features of forests with the purpose of promoting human health and well-being. Additionally, more studies have investigated the restorative effects on humans in Swedish forest settings (see Sonntag-Öström et al. 2014; Sonntag-Öström et al. 2011; Stoltz et al. 2016).

1.3 Aim

The aim with this thesis is to compare restorative environmental qualities within an urban forest and urban planting with the purpose of finding inspiration to future landscape design for urban areas that can support human health and wellbeing. The following research question are implemented in order to guide the study design and analytical process of this thesis.

- What environmental qualities within various sites of urban greening are perceived as positive in terms of advocating human restoration?

2. Theoretical framework

The perception of the built and natural environment is argued to encounter health-related consequences (Gifford & McGunn, 2012; Seamon, 2000). Research investigating pathways between nature and health has shown that air quality, physical activity, social cohesion, and stress reduction, are some important factors, together with a multiplicity of other mechanisms being intimately connected when exploring the bond between human health and nature presence (Hartig et al. 2014; De vries et al. 2003; Van den berg et al. 2010; Kuo, 2015; Soga et al. 2020). Nature connectedness has also been found being positively related to eudemonic well-being and pro-environmental behaviors (Martin et al. 2020; Pritchard et al. 2020), as well as providing an effective population-wide strategy in prevention of mental ill health for humans (Maller et al. 2005), especially for urban residents (Cleary et al. 2017). In the purpose of further understanding the relationship between landscape features, environmental perception and human health, this theoretical approach will present the *Hypothesis of Biophilia (2.1), Biophilic design (2.2), Naturalistic design (2.3), Human preference (2.4)* including a brief presentation of some interesting theories related to human preference, as well as *Sensory modalities (2.5).*

2.1 Biophilia

The hypothesis of biophilia is originally proposed by Wilson (1986) and proclaims a human dependence that is argued to extend far beyond the simple issues of material and physical sustenance. It suggests that humans respond positively to natural elements partly because of components within our genetic background in addition to craving for aesthetic, intellectual, cognitive, and even spiritual meaning and satisfaction (Kellert & Wilson, 1993). It aims to provide a deeper understanding of *why* and in what circumstances we humans cherish and protect life (Wilson, 1986). The biophilia hypothesis is supported by a number of assertions that suggests that the human relation to life and life-like processes (Kellert & Wilson, 1993) is:

- Inherent (that is biologically based)
- Part of our species' evolutionary heritage
- Associated with human competitive advantage and genetic fitness

- Likely to increase the possibility for achieving individual meaning and personal fulfillment
- Self-interested basis for human ethic care and conservation of nature, most especially the diversity of life

The biophilia hypothesis has also been investigated by Ulrich (1993), whereas he argues that if the biophilic response to natural elements and settings is a part of the human gene pool, it must originate from early humans' exposure to natural occasions associated with fitness or chances for survival. He further discusses the natural stimuli and configurations where *rewards* and *dangers* have been critical during human evolution to favor individuals by learning, remembering, and later creating adaptive responses. This perspective of acknowledging positive (biophilic) and negative (biophobic) affiliations with nature are according to Kellert & Wilson (1993) contributing to an important insight of the biophilia phenomena, which further indicate that the natural habitat of early humans involved dangers as well as advantages (Ulrich, 1993).

Further on, the human response to natural forces and stimuli has been studied by Öhman (1986). Findings from his study revealed a continuous influence of our evolved responses to nature and that these reactions originate in our distant human past. However, an indication of these is predicted to become more insignificant to our survival instincts in today's built and increasingly urban world (Öhman, 1986), and is predicted to atrophy over time (Kellert & Wilson, 1993). Additionally, it is also proclaimed that the promotion of beneficial experiences of nature through contact, often depends on repeated experiences (Kellert & Calabrese, 2015), and that biological tendency needs to be nurtured and developed to become functional (Wilson, 1986).

2.2 Biophilic design

The theory of biophilic design is explained as an attempt to translate the understanding of the hypothesis of biophilia (Wilson, 1986), into designing built environments (Kellert et al. 2011). It is argued to fall under a larger umbrella of restorative design (Gifford & McGunn, 2012), and is defined as the process of basing decisions concerning the built environment on intuition or credible research which is pronounced to be derived from human craving for nature or measurable biological responses in order to achieve the best

possible health outcomes (Meyers, 2018). Basic principles (presented below) have been acknowledged as crucial to implement into planning as these together are argued to achieve the most effective practice of biophilic design (Kellert & Calabrese, 2015).

1. Biophilic design requires repeated and sustained engagement with nature.
2. Biophilic design focuses on human adaptations to the natural world that over evolutionary time have advanced people's health, fitness, and wellbeing.
3. Biophilic design encourages an emotional attachment to particular settings and places.
4. Biophilic design promotes positive interactions between people and nature that encourage an expanded sense of relationship and responsibility for the human and natural communities.
5. Biophilic design encourages mutual reinforcing, interconnected, and integrated architectural solutions.

Besides these principles, other research has also shown that nature in the built environment can be divided into three categories; *Nature in the Space, Nature Analogues,* and *Nature of the Space,* which in turn can be helpful when forming a structured pattern language for biophilic design, as well as to support dissemination and conceptualization of biophilic experiences within built environments (Browning & Ryan, 2020). *Nature in the Space* is explained as direct experiences with nature within the built environment, and could be a view out of a window, a smell of potted herbs, or a breeze through a room. *Nature Analogues* are described as indirect or representational experiences of nature which could be floral pattern pillows, a fractal pattern in flooring, or textured wood on a door handle, and lastly, *Nature of the Space* is described as encompassing four-dimensional characteristics of common spatial experiences in nature, which could be a window at the end of a corridor, and the transition from a low entry into a high-ceiling lobby (Browning & Ryan, 2020). Kellert & Calabrese (2015) are also considering three similar experiences of nature in their framework of biophilic design but choose to explain them as; *Direct experience of nature, Indirect experience of nature,* and *Experience of space and place*. They argue that these biophilic design qualities can be experienced through all of our human senses, including movement, and that the visual sense is undoubtedly the most dominant way people perceive and respond to the natural world (Kellert & Calabrese, 2015).

Today, the theory of biophilic design serves as a tool to meet the prevailing approach in design for modern urban environments as previous ways of designing have for a long time contributed to a degradation of natural systems, climate change, major biodiversity loss, resource consumption, and separation between humans and the natural world (Kellert et al. 2020; Gillis & Gatersleben, 2015; Africa et al. 2019; Wijesooriya & Brambilla, 2021; Söderlund, 2019; Mazuch, 2017; Modi & Parmar, 2020) . Kellert et al. (2011) demonstrate that by using this theory of biophilic design, we can design our way to reconciliation, or at its best, harmonization with nature again. Also, today's use of the biophilic design approach is explained in research as a *social movement* and is rapidly expanding around the world through local champions, collaborations, and education (Söderlund, 2019).

2.3 Naturalistic design

Naturalistic landscape design emerged in landscape planning during the 19th century as landscape parks and "wild gardens" became popular among urban planners and garden enthusiasts (Simonič, 2003). Although, natural forms have served as inspiration for design, art, and architecture throughout ancient history (Perry et al. 2008). During the last few decades, a professional interest in naturalistic landscapes has grown expansively within northern Europe which has led to a spread of more natural landscape environments within urban contexts (Özgüner, 2006).

The current practice of implementing the relationship between art and nature into landscape design has been discussed in research and explained as complicated in ways of both linguistic meaning and the issue of defining where the limit between *ecological* stops and *informal* starts (Dunnett & Hitchmough, 2004). However, the basic concept behind naturalistic design can be interpreted as the incorporation of native plant communities into the designed landscape together with an understanding of how native plants operate in nature in order to create a successful planting design (Weaner, 1996). To easier separate different planting styles and to make a complex set of philosophies understandable, Dunnet & Hitchmough (2004) suggests some assertions to consider when analyzing the relationship between nature, art, and the use of locally native plants:

- The degree of taxonomic diversity in a planted area
- The degree allowed for dynamism or spatial mobility of a taxa over time

- The repetition of taxa across an area
- The intermingling of taxa

Additionally, six positions can be evaluated in order to measure the degree of *naturalness*; *1) Formality 2) Mass planting 3) Conventional informal planting 4) Stylised nature 5) Biotope planting 6) Habitat restoration* (Dunnett & Hitchmough, 2004). Beyond previously mentioned strategies on how to define *naturalistic design*, there are three basic considerations to include when practicing this theory, and those can be divided into three categories: *Aesthetic*, *Managerial*, and *Environmental* (Weaner, 1996). These imply the accomplishment of bringing art and nature with nature as a guide together. The promotion of natural processes when incorporating native plants in order to decrease management intensity, and the promotion of naturally designed landscapes to serve as functioning ecosystems, capable of providing food and shelter for animals and insects (Weaner, 1996). However, there is found to be a lack of research about human preferences for different naturalistic landscape designs in contrast to the preference of natural landscape types or geometrical design types (Simonič, 2003; Coburn et al. 2019).

2.4 Human preference

When doing research of human behavior, it is important to always respect each individual's peculiarity regarding for instance; former experiences and knowledge, in order to understand one's preferences. The term preference is explained as *the act of choosing one alternative over others* (APA, 2020), and when referring to peoples' preferences for landscape settings it most commonly suggests decorative features rather than the essential, and the favored opposed to the necessary (Kaplan & Kaplan, 1989). It is also mentioned that a landscape not only enhances numerous things, but it ought to be regarded as an organization of different components that creates organizational patterns, which conclusively play an important role when studying our preferences for natural settings (Kaplan & Kaplan, 1989).

The study of Falk & Balling (2010) presents some theoretical frameworks that aim to investigate landscape preferences into predictive variables. Ulrich (1977) identified five variables considered as important: focality (coherence, unity), ground surface texture, depth, mystery (the sense that more information can be gained at low risk), and

complexity. Another theory is the Prospect refuge theory by Appleton (1975), which proposes that a savannah-like landscape offers an attractive combination of features where the combination between low shrubs and clumps of trees divided by open spaces can provide satisfaction because of being surrounded with complementary strategic components. However, this theory is explained in general manners as humans have varying requirements at different times, which in turn affect the interaction with the surrounding environment (Falk & Balling, 2010). Lastly, a framework developed by Kaplan (1987) considered that two aspects were decisive when analyzing human preference in regard to landscape settings, and those were 1) information-processing implications, and 2) their evolutionary significance. The framework also suggested that visual content of natural landscape designs is of greater significance (Kaplan, 1987).

Numerous attempts have been made in differential psychology throughout time for the purpose of developing systems that relate the personality of the individual to reactions toward the surrounding environment, (see studies of Witkin et al. (1954); Zuckerman et al (1964); Mehrabian & Russell (1974). A framework called *Environmental Response Inventory*, was developed by McKechnie (1970) and aims to define environmental subscales such as environmental trust, antiquarianism, urbanism, environmental adaptation, stimulus seeking, pastoralism, need for privacy, and mechanical orientation. However, it is argued that in order to understand a person in its environment, they need to be considered as one constellation of interdependent factors (Lewin, 1951; Küller, 1991).

3. Method

The data collection of this study includes a triangulation of methods such as a mood scale, a sensory walk, and the use of *Visual Landscape Assessment Tool (VLAT).* The study is conducted through an introspective approach, whereas introspection in this matter means the act of observing oneself (Gustavsson, 2004). All observations for this study are perceived solely by the author and the purpose of implementing this method is to describe, interpret, and condense the meaning of what has been experienced. An introspective approach aims to describe in more detail why one reacts as one does while using the researcher self as the object of study (Ottosson, 1997, 2001). The results are also chosen to be presented from a third person perspective as it is argued to create a certain distance for the author when narrating the results (Ottosson, 2007). No statistical analyzes were performed due to the choice of methods that only serve as observations from one person.

3.1 Place description

Place descriptions of each site are used in order to properly present the material which later is investigated through a triangulation of methods. It aims to provide spatial information in terms of environmental features in addition to the relations between them (Khan et al. 2013; Kim et al. 2017). They can be fruitful for spatial learning, problem solving, and decision support when exploring large-scale environments (Khan et al. 2013). For this study, it was by importance to include detailed descriptions of each site in order to convey an honest and unbiased presentation of the two places investigated. The purpose of using place descriptions was also to allow people disconnected to the sites to become as intimate with the environmental features as possible, which further aims to create a deeper understanding of the later result.

Place descriptions for this study includes a list of plants from the urban forest and pictures from each site in order to provide a two-dimensional perception. A list of plants from the urban planting was asked for, however no answers were given concerning the choice of species from the designers of the urban planting. Due to seasonal concerns the inventory of vegetative features was difficult to conduct as the study was implemented in the

beginning of March. However, considerations that were deliberated when choosing sites were:

1. Their closeness to the author's neighborhood, so as to each other.
2. Different appearances in the physical environment so that the comparison could be as rich as possible.
3. Free access to visit at any time.

3.1.1 Informal interviews

In terms of properly understanding each site it was imperative to include background information about historical aspects of each site, conclusive decisions, as well as underlying ambitions. The information was later used in the presentation of each site (3.1.2).

Urban forest

Six questions concerning the forest site were written in an email to two employees working as nature reserve managers at the technical, park- and forest planning department within the municipality of Jönköping (Fogelberg, 2022, personal communication, 7 March). Answers from one nature reserve manager were received on 7th of March 2022 at 11:30 am.

1. How old are the trees within the coniferous forest?
2. Does there exist any list of plants to take part of concerning the specific location?
3. What measures are taken regarding the management of the forest?
4. Who is in charge of management?
5. Would you call the forest "natural"?
6. Is this a place you call primeval forest?

Additional background information was retrieved from Länsstyrelsen (2014) in order to understand further decisions and ambitions regarding forest areas within the nature reserve.

Urban planting

Six questions were also asked over telephone to the operation manager at the management unit of Jönköping's county, who also was one of the designers of the urban planting (Burman, 2022, personal communication, 28 February). Answers from the operation manager were received the 28th of february 2022 at 1:30 pm.

1. When was the planting completed?
2. Who was in charge of the design?
3. What was the purpose with the planting?
4. Does the designer think that predicted needs are met?
5. Has any follow-up been accomplished regarding the function of the place?
6. Is it created to serve any specific target group?

3.1.2 Presentations of the urban forest and the urban planting

The case study was conducted in the city of Jönköping in Sweden, where two different sites were chosen due to their different appearances. They were compared in order to recognize restorative environmental qualities in each site with a further purpose to inspire future landscape design that can support human health and wellbeing.

Figure 1. Overview of where the city of Jönköping is located within Sweden (Google maps, 2022).

One is located in a coniferous forest within the nature reserve Bondberget and is referred to as *Urban forest* (see *A* in *Figure 2*). The other site is located in the adjacent area of the hospital Ryhov and is referred to as *Urban planting* (see *B* in *Figure 2*). The distance between the two sites is 5.2 kilometers and it takes approximately 1.15 hour to walk between them.

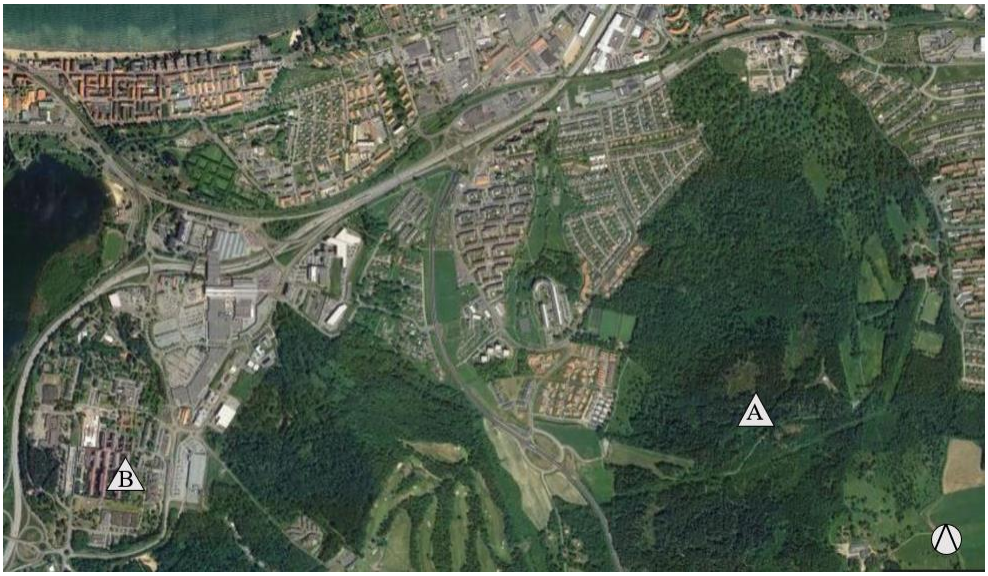

Figure 2. Overview of where the sites are located in relation to each other within the city of Jönköping, (A) Urban forest, and *(B) Urban planting, with 5.2 kilometers distance between (Google maps, 2022).*

Urban forest

The chosen site is a limited area of 2000 m2 in a coniferous forest managed by the municipality of Jönköping, located within the nature reserve *Bondberget*. It includes 65-year-old spruces, in addition to conifers highly regarded worthy of protection due to their age of being over 200 years old. It is dominated by planted trees that aim to provide visitors with large old trees, sun opened glades and nature values through rich variation of species. Ongoing measures of maintenance are among others to thinning self-sown spruces in order to promote stability and variation in dimensional development, so as to promote the development of large old trees. The chosen site was last thinned in 2014 and is not considered as natural.

Figure 3. Overview of the urban forest, circled in red, in relation to the rest of the nature reserve Bondberget (Google maps, 2022).

The surrounding area includes a 37-hectare forest mixed with deciduous trees, alder carr, and swamp forest, that together forms a natural forest-like biotope, which however lacks continuity. This setting is mentioned as being frequently visited by roe deers and people using the adjacent exercising tracks and is also described as a place with high recreational value due to stands constituted by spruce including a ground covered by moss. In addition to these stands, other species are also recognized (see *Table 1*.), though with indulgence to the possibility of neglecting certain species due to weather and season, as well as to the divergences between certain places surrounding the limited area.

Botanical name	English name	Swedish name
Actaea spicata	Eurasian baneberry	Trolldruva
Betula pendula	Silver birch	Vårtbjörk
Chaenotecha phaeocephala	Chaenotecha	Brun nållav
Deschampsia flexuosa	Wavy hair-grass	Kruståtel
Dryopteris filix-mas	The male fern	Träjon
Galium odoratum	Sweet woodruff	Myskmadra
Hylocomium splendens	Splendid feather moss	Husmossa
Hypnum cupressiforme	Cypress-leaved plait moss	Cypressfläta
Hypogymnia physodes	Monk's-hood lichen	Kvistlav
Luzula sylvatica	Great wood-rush	Skogsfryle
Mercurialis perennis	Dog's mercury	Skogsbingel
Neckera sp.	Feathery Neckera moss	Fjädermossa
Oxalis acetosella	Sorrel	Harsyra
Picea abies	Spruce	Gran
Plagiotechium latebricola	Alder silk moss	Alsidenmossa
Pleurozium schreberi	Red-stemmed feather moss	Väggmossa
Ptilium crista-castrensis	Knights plum moss	Kammossa
Schoenoplectus lacustris	Lakeshore bulrush	Säv
Vaccinium myrtillus	European blueberry	Blåbär

Table 1. List of plants found in the urban forest within the nature reserve Bondberget.

The urban forest visit took place 2022-03-06 at 11:00 AM and it was four plus degrees outside. It was a sunny day with some clouds on the sky and some areas were covered in snow. Before visiting the urban forest, a 30-minute walk was taken from the student's home to the chosen site. To reach the nature reserve, it was necessary to walk on both paved walkways, gravel walkways and inside the coniferous forest on moss-covered ground. During the walk some distant cars and people were recognized, however no communication with other people occurred. Different types of vegetation were also recognized while passing pastures and open fields, deciduous forest while eventually reaching the coniferous forest. The chosen site was entered from the east side of the nature reserve (from the right in *Figure 4*.) and was investigated by walking around in the limited area, taking pictures from different angles when standing up and sitting down. The visit lasted approximately 45 minutes.

Figure 4. Pictures from the visit to the urban forest with connecting arrows showing the location of where the picture was taken from (Arvidsson, 2022).

Urban planting

The planted garden is a rooftop sand-planting located in connection to the hospital of Ryhov and is about 1800 m2. The squared planting, circled in red (see *Figure 5.*), includes an entrance made out of concrete and organic walkways of gravel that stretch through the garden in a kidney-shaped pattern. The intention of creating dynamic patterns together with drought-resistant plants was to provide the opportunity for people to stroll around and to experience the feeling of wilderness, in contrast to the flat, dead surface it was before. The aim was also to create an unpretentious place rich in species, that could be perceived as the opposite to well-cleaned.

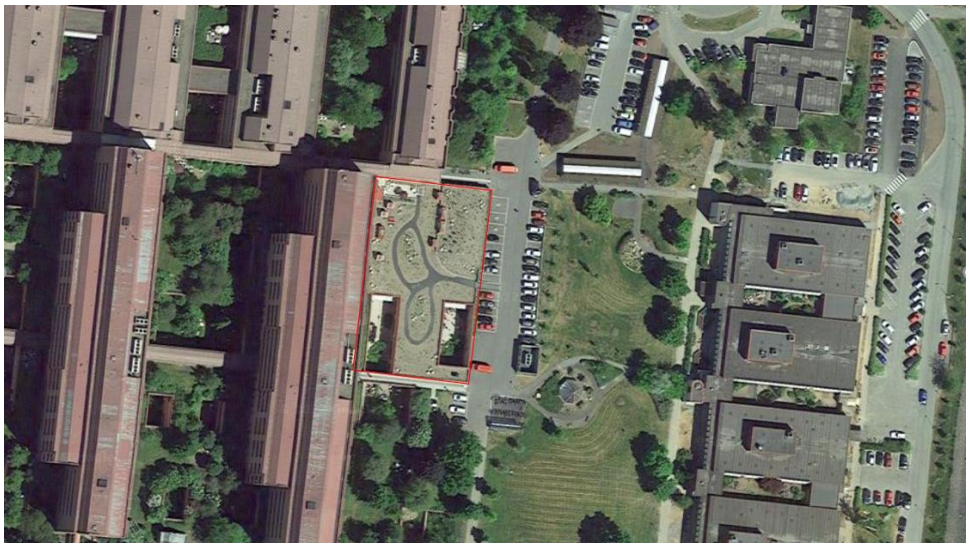

Figure 5. Overview of the urban planting, circled in red, and its adjacent neighborhood including buildings of the hospital, a small park, and parking lots (Google maps, 2022).

Within the squared area of 1800 m2, there are two immersions where it is possible to look down on two courtyards connected to the floors below. In these courtyards there are seating areas and planted trees and shrubs, which can be seen from standing in the garden. The building on the left side of the garden has over five floors, and one of the purposes of having the garden at this specific location was to provide an attractive green space seen from every floor, including the hospital entrance. In the northern part of the plantation there are small, red houses that belong to the hospital, and in the northwest corner there is a patio available for employees of the hospital. In the adjacent neighborhood there are buildings connected to the hospital, a parking lot, and a park area with open green surfaces. The garden is perceived as not serving its full potential and purpose due to its low visitor number. The garden is also mentioned being appreciated by employees working inside the building, but no people are recognized walking around in the garden although it is open for everyone.

The urban planting visit took place 2022-03-08 at 2:00 PM and it was six plus degrees outside. There was a clear-blue sky and full sun during the visit and no snow-covered areas were to be found. Before visiting the urban planting, a 20-minute walk was taken from the student's home to the chosen site. To reach the urban planting, it was necessary to walk on paved walkways along a highway, and heavily trafficked roads. Some trees and plantings were recognized on the way to the chosen site and other people as well as cars

were seen and heard in the immediate surroundings before and during the visit, however no communication with other people occurred. The site was entered from east side (from the right in figure 7.) and it was investigated by walking around within the limited area, taking pictures when standing up and sitting down. The visit lasted approximately 45 minutes.

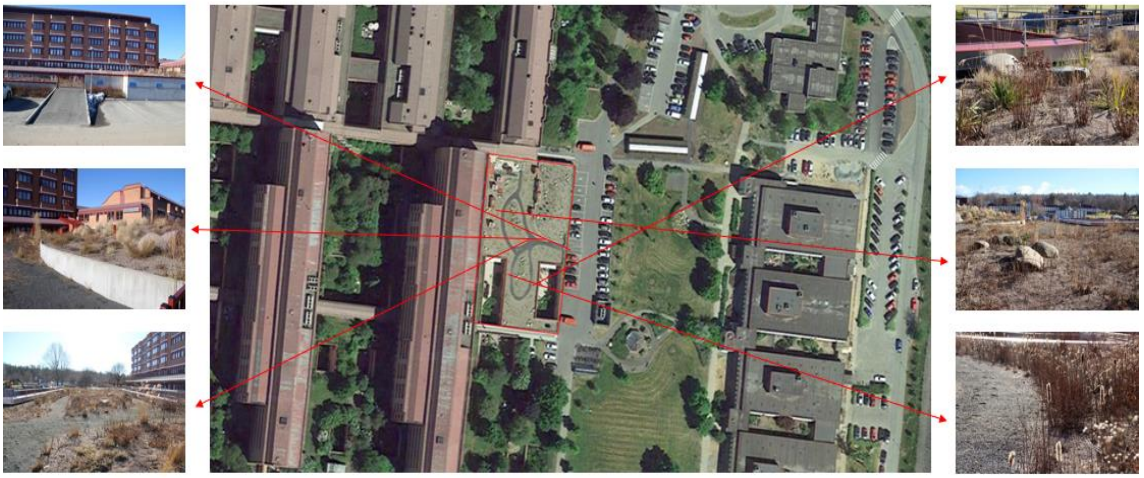

Figure 6. Pictures from the visit to the urban planting with connecting arrows showing the location of where the picture was taken from (Arvidsson, 2022).

3.2 Triangulation method

The settings were analyzed in a triangulation encompassing a mood scale described and developed by Sonntag-Öström et al. (2011), a sensory walk involving the sensational experiences of the visits used with an introspective approach, together with the framework *Visual Landscape Assessment Tool (VLAT)* developed by Tveit et al. (2006) in order to investigate the perception of each site. The purpose of using a triangulation of methods was to provide knowledge that went beyond the knowledge made possible by only one approach. Using multiple methods could contribute to a promotion of quality in research (Flick, 2007).

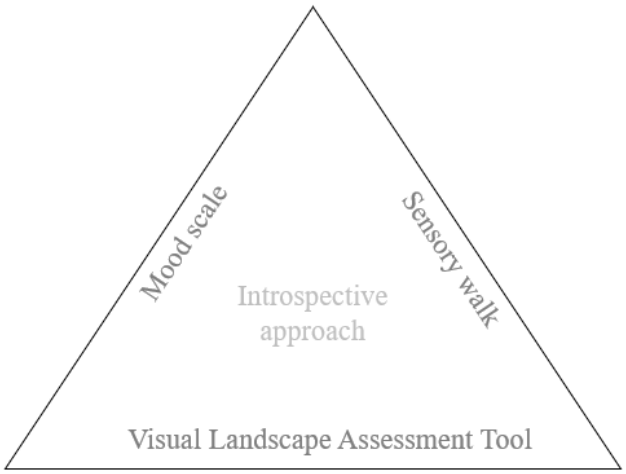

Figure 7. A triangulation model of methods implemented in this introspective landscape analysis.

3.2.1 Mood scale

The intention with using the mood scale developed by Sonntag-Öström et al. (2011), was to investigate the psychological effects of visiting each site. It enhances the possibility to evaluate changes within a person's mental state and are supposed to be applied before and after performing any type of nature -or animal-oriented rehabilitation or activity promoting human wellbeing (Sonntag-Öström et al. 2011). It includes six different categories with contrasting words, where a 10-point-scale is presented as a range from 1 (most negative nuances) to 10 (most positive nuances). Similar or same method was found in other studies (Kristjánsdóttir et al. 2020; Dolling et al. 2017; Kanelli et al. 2021) and the mood scale for this study include following categories: tension (tense/relaxed), fatigue (exhausted/alert), happiness (sad/happy), irritability (irritated/harmonious), restlessness (restless/peaceful) and clear-headedness (mentally divided/clear-headed).

3.2.2 Sensory walk

The sensory walk was implemented with the purpose of describing sensational experiences of each site. Notes were taken during each walk at the settings with the purpose of capturing contemporary impressions of the site while all five of our human senses were considered. However, when describing features with the help of using natural language it was significant to consider the possible ambiguity that could emerge from

linguistic complexity. Language confusion was important to regard when promoting successful human communication. To apply equal prerequisites for both settings during the analyzing process one open-ended question created by Kanelli et al. (2021) was answered. The question followed:

Please describe any details you found interesting during the urban/ nature exposure. In order to properly answer this question please consider any visual, auditory, olfactory, gustatory or tactile stimulus that you experienced and provoked either euphoria or discomfort. Please describe that particular stimulus as well as the way it affected you.

This part is suggested by Kanelli et al. (2021) to focus on the gaps of green space research where it enables the possibility to detect any prevailing sense during natural experiences and further exploration regarding the possibility to relate to any positive or negative physiological and psychological state of the participant.

Sensory modalities

The human mind and body have through evolution been developed in a mainly sensory world dominated by environmental features such as light, sound, odor, wind, weather, water, vegetation, animals, and landscapes (Kellert et al. 2011). In an evolutionary context, human survival has been argued to depend on a continuous sensory input as it enables the possibility to survive an environment full of challenges, acquiring information and creating reactions (Mather, 2011). Although many categorizations of the human sensory system exist, dominating definitions between five sensory modalities have been drawn: visual, auditory, olfactory, gustatory, and tactile (Proctor & Proctor, 2021), whereas the latter designates the senses of temperature, pain, and pressure (Allen & MacDonald, 1927).

The sensory modality regarding human vision is explained as the most important human sense (Thorpert, 2019) as it embraces 80 percent of our information intake (Haupt & Huber, 2008). Light is fundamental in order to attain visual experiences as it is light that circulates between interior and exterior, creating divisions between the viewing subject and the landscape that is perceived (Edensor, 2017). Research has shown that the effects of light via retinal and extra-retinal routes, not only can impact the significant phenomena

of vision, but also mood, behavior, autonomic arousal, as well as our hormones (Küller et al. 2006). After light, the human color vision is perceived to act as the second most basic reaction when it comes to visual qualities (Mather, 2016). Findings have shown that colors impact within an interior space might influence the psychological mood of individuals (Küller & Mikellides, 1993).

The auditory sense is a system that senses complex fluctuations in loudness, pitch, and timbre, while its amplitude is measured in terms of compression, rarefaction, as well as changes in pressure waves (Mather, 2016). Experiential qualities of the sonic world have seemed to be neglected concerning environmental design (Cerwén, 2016). However, previous research has divided different types of sounds into categories, such as: *natural*, *technological*, and *human* sounds (Cerwén et al. 2016). Findings have shown that the sound of nature elements was perceived as positive, the sound of technological sounds was perceived as negative, and that the impact of human sounds were the most complex to evaluate as it seemed to vary depending on the individual, mood, and health state (Cerwén et al. 2016).

Our sense of smell is argued to be important for our social and emotional life as it appears to modulate human behavior and interpersonal relationships while having a major influence on personal preferences and personality (Sarafoleanu et al. 2009; Boesveldt & Parma, 2021). The olfactory sensory modality is not perceived as vital for human survival, but is explained as crucial when adding quality, consistency, and emotions to our visual sensations (Zador & Mombaerts, 2007). Although this sense is portrayed as diminished, leaving vision and hearing to be the most important senses (Sarafoleanu et al. 2009), it is stated to be instrumental to the achievement and maintenance of human wellbeing (Boesveldt & Parma, 2021; Parma et al. 2017).

To maintain a physical and mental wellbeing, the gustatory sense is stated as being crucial in terms of supporting a sufficient, balanced and nutrient supply, as well as to avoid potential toxins (Ohla, 2021). The gustatory sensation is closely related to the perception of flavours which are defined by the combination of olfactory, gustatory, and trigeminal sensations (Pallante, 2021). Taste is often characterized through qualities such as sweet, umami, bitter, salty, and sour, and while they can be evaluated according to intensity (i.e chemical concentration) and hedonics (i.e pleasantness), more dimensions are stated to be unexplored (Breslin, 2013).

The last sensory modality revealed in this study is our tactile sense caused by tactile impressions. It interprets the material characteristics of surfaces and objects, and is argued to be an uncharted territory thus far (Chun et al. 2018). Nevertheless, research has shown that humans perceive the texture of objects using the kinesthetic and tactile information acquired by several receptors in the human body (Lederman et al. 1982; Holliins et al. 1993). Two definitions of tactile perception are recognized, and those are *active touch*, which can be described as stroking a surface in order to experience roughness or slipperiness, as well as *passive touch*, which is pursued by just pressing an object and contributing to the tactile experiences of stiffness and thermal feel of objects (Asaga et al. 2013). The tactile sense is explained as important for human function as it provides the affordances to recognize pain, temperature and weight, independently of the nature of the source (Schifferstein, 2006).

3.2.3 Visual Landscape Assessment Tool

Visual Landscape Assessment Tool (VLAT) developed by Tveit et al. (2006) was employed with the intention of analyzing the visual character of the two settings. It presents a framework based on four levels of abstraction which are: *concepts*, *visual dimensions*, *landscape attributes*, and *potential visual indicators*. The framework aims to increase the understanding of the connection between theory and visual expression within landscapes and is described as useful when wanting to quantify, measure and compare landscapes (Tveit et al. 2006). It includes nine key concepts such as: *Stewardship, Coherence, Disturbance, Historicity, Visual scale, Imageability, Complexity, Naturalness*, and *Ephemera.* These nine key concepts will be evaluated in terms of rating the character as low, medium, or high within the setting, with consideration to the definition to each concept explained by Tveit et al. (2006).

	Concepts	**Dimensions**	**Landscape attributes**	**Potential indicators**
Stewardship	Sense of order and care, perceived accordance to an "ideal" situation reflecting human care	sense of order; sense of care; upkeep	signs of use/non-use; vegetation succession; buildings, linear features (fences, paths etc.) management detail; drainage; waste.	percentage of abandoned land and stage of succession; status of maintenance of buildings; management type and frequency; length and

	through active and careful management.			condition of linear features (for example fences and walls); presence of waste; wet areas in crop fields; presence of weed.
Coherence	Unity of a scene, repeating patterns of color and texture, correspondence between land use and natural conditions.	harmony; unity/holistic; land-use suitability	land use; water; pattern.	percentage land use in correspondence with natural conditions; water presence and its spatial location; repeating colours and patterns.
Disturbance	Lack of contextual fit and coherence, constructions, and interventions.	lack of contextual fit; lack of coherence	extraction; natural disturbance (for example: fire and windfall); constructions (for example: motorway; infrastructure; urban elements; temporary constructions)	number of disturbing elements; percentage area impacted by disturbance, visibility of disturbing elements.
Historicity	Historical continuity and historical richness, different time layers, amount, and diversity of cultural elements.	historical continuity; historical richness.	visible time layers; cultural elements (for example, historical agricultural buildings, grave mounds, ruins, cairns, signs of earlier cultivation, fences, stone walls, historical roads and paths); traditional agricultural structures.	presence of cultural elements; shape and type of linear historical elements; age of historical elements; number of time layers; percentage area of historic continuity; presence of traditional land use and pattern
Visual scale	Landscape rooms or perceptual units: their size, shape and diversity, degree of openness.	visibility; openness; grain size.	topography; vegetation; man made obstacle	viewshed size; viewshed form; depth of view; degree of openness; grain size; number of obstructing objects.
Imageability	Special features, both natural and cultural, making the landscape create a strong visual image in the observer, and making landscapes distinguishable and memorable.	spirit of place; genius loci; uniqueness/distinctiveness; vividness.	spectacular elements; panorama; landmarks; water; iconic elements.	viewpoints; presence of spectacular, unique or iconic elements and landmarks; presence of historic elements and patterns, presence of water bodies, percentage area of moving water.
Complexity	Diversity, richness of landscape elements and features, interspersion of pattern.	diversity; variation; complexity of patterns and shapes.	linear features; point features; land cover; land form.	number of objects and types; evenness index; dominance index; diversity indices; shape diversity; size variation indices; heterogeneity indices; edge density; aggregation indices.

Naturalness	Closeness to a preconceived natural state.	intactness; wilderness; natural; ecologically robust.	natural feature; structural integrity of vegetation; vegetation/land-cover type	fractal dimension; vegetation intactness; percentage area with permanent vegetation cover; presence of water; percentage area water; presence of natural feature; lack of management; management intensity (type and frequency), naturalism index, degree of wilderness
Ephemera	Change with season and weather.	seasonal change (human imposed and natural); weather related changes.	land cover/vegetation; animals; land use (ploughing, etc.); water (colour reflections and waves); weather.	percentage of land cover with seasonal change; presence of animals; presence of cyclical farming activities; percentage area water; projected and reflected images; presence of weather characteristics.

Table 2. An overview and definition of Visual Landscape Assessment Tool's (VLAT) nine key concepts, in relation to the framework's four levels of abstraction (Tveit et al. 2006)

3.3 Triangulation of analysis

As the collection of data is pursued in a triangulation of methods, it is perceived as natural to the structure of this thesis to also analyze the results in a triangulation. The main findings are discussed together with own experiences and previous research in the following order:

- Mood scale
- Sensory walk
- *Visual Landscape Assessment Tool (VLAT)*

Triangulating the analysis helps to reveal what specific results that emerged from each specific method, and to further assist future studies with inspiration on different ways to collect quantitative as well as qualitative information based on these specific methods. The use of triangulation is argued to enable a more profound understanding to emerge (Ottosson, 2007) and to allow the researcher to combine different theories and methods where he/she is not limited by the respective weaknesses of the theories/methods, but benefits of their respective strengths, which further suggests that they can reinforce one another's result (Risjord et al. 2002; Williamsson, 2005).

After analyzing the main findings from each method solely, a comparison between the findings can easily be conducted and to further lead to an overall conclusion.

4. Results

This chapter includes quantitative results from the mood scale implementation both before and after the visits to the urban forest (4.1), qualitative results from the sensory walk within the urban forest (4.2) and findings revealed from the implementation of *Visual Landscape Assessment Tool (VLAT)* from the urban forest (4.3). A summary of the revealed main findings from the three different methods are merged together and presented in (4.4). Additionally, quantitative results from the mood scale implementation both before and after the visit to the urban planting are presented in (4.5), as well as qualitative results from the sensory walk (4.6), together with findings revealed from the implementation of *VLAT* (4.7). Conclusively a summary of the revealed man findings from the urban planting is merged together and presented in (4.8).

4.1 Mood scale – urban forest

A comparison between the mental state before and after the urban forest visit concluded in overall higher scores after the visit *(see Figure 8)*.

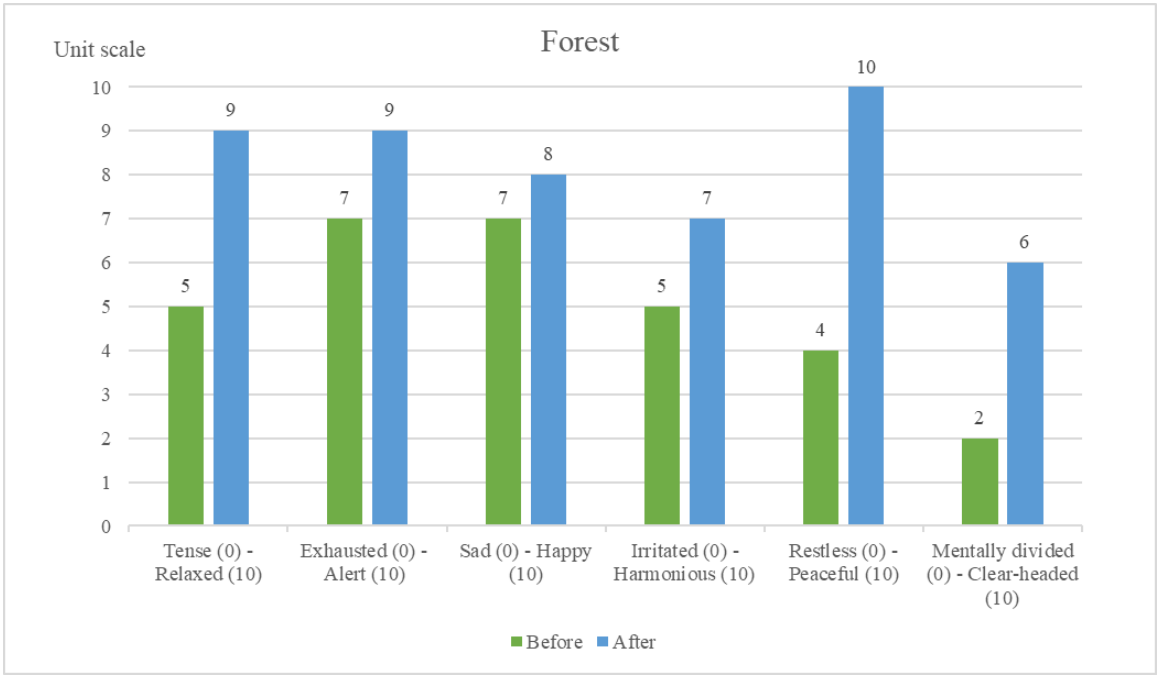

Figure 8. Results from implementing the mood scale before and after the urban forest visit, showing overall higher scores after visiting the forest in comparison to before.

The results showed that the forest visit contributed to some changes in the mood of the author. Tense/relaxed showed an increase from 5<9, exhausted/alert showed an increase from 7<9, sad/happy showed an increase from 7<8, irritated/harmonious showed an increase from 5<7, restless/peaceful showed an increase from 4<10, and mentally divided/clear-headed showed an increase from 2<6. The mental state of sad/happy resulted in being the least affected by visiting the forest as it scored one number higher than before, while the mental state of restless/peaceful resulted in being the most affected by the visit as it scored six numbers higher than before. No indication of impairment of any mental state was recognized when evaluating the results between the mood scales.

4.2 Sensory walk – urban forest

In order to present findings from the sensory walk, all five senses were regarded and evaluated in terms of describing particular stimulus and the way it affected the author. Both regular and intermittent features have been considered when including each sense.

Visual

The visual stimuli were described as being highly affected by dark in contrast to light. As the sun was shining through spruces, finding its way through the tree trunks and reflecting light on green moss that covered the ground, it created distinct contrasts between glades and shadows from tall spruces. Some snow-covered areas were found within the area and was argued to increase the feeling of comfort as the white patches of snow contributed to making the area lighter. Another prominent aspect according to the author, was the influence of topography. Due to differences in altitude at the site, it was explained as creating feelings of safety and versatility of space. The tall spruces were also mentioned to enhance a feeling of safety as it makes humans feel physically small in consideration to the surroundings.

The coniferous forest was found to allure both pleasant feelings, but also discomfort concerning the visual impact. The ground covered by green moss, and broken twigs were interpreted as making the forest soft and pleasant. It was also described as positive to recognize birds and squirrels at the site, in order to feel less lonely and to observe signs of other living beings. Within the chosen area, a small water stream was passing through. According to the author, the water entailed both positive and negative effects on the visual

stimuli. As the water mirrored the blue sky, it was explained as creating further depth in the perception of the environment, but it was also described as a disturbance due to its vague limits and the possibility of accidentally stepping into the water.

Auditory

According to the author, the site involves both disturbing and appreciated sounds. City noise is argued to be far most represented considering the auditory stimuli, as the highway is located 3 kilometers away from the forest. Except the sound from driving cars, other sounds such as birds of different species singing, water rippling, and twigs cracking while walking around, are recognized. Feelings of annoyance and frustration are mentioned as an outcome of listening to the sound of highway noises, but feelings of comfort, happiness and hope are proclaimed by the author being allured when listening to vivid water features and birds. It is described as inducing a hopeful feeling when recognizing movement and life in the surrounding environment. The author mentions how these features show the liveliness within one ecosystem that is ongoing during all time, independent of human effort. These sounds are also indicated to redirect focus and to take away unwanted noises by helping the author to concentrate on the present.

Olfactory

Small hints of spruce and wet moss are recognized at this site, but no pervasive smell is mentioned being found. However, different types of scents are found in different areas within the site. The author implies that one type of smell can be perceived right beside the water stream, and another standing away from the water surrounded by mostly spruces and moss. The smell recognized nearby the water was described by the author to emit a hint of mire, close to a musty scent. The smell recognized among the spruces, away from the water stream, is mentioned as being perceived as more fresh and acidulous. This type of smell is also perceived by the author to be more inviting and enjoyable. The interpreted feelings when analyzing this place considering the olfaction were described as calmness and neutrality. All smells recognized at the setting were already familiar to the author before the visit, and instead of being surprised, the author describes how they awoke positive memories and thoughts connected to previous experiences.

Gustatory

During the sensory walk, no experiences of taste were available due to seasonal factors as this study was performed in March. However, common edible vegetation species were found at the site, such as blueberry and sorrel, which could challenge the gustatory stimuli at another time and season visiting the site.

Tactile

The tactile stimuli were described as being affected by several different features within the coniferous forest. Hard tree trunks, soft and wet moss, sharp fir needles, and cold snow, were some of the characteristics that were discovered. The feeling of being cautious was argued to play a significant role when walking around in this landscape, not risking to trip over or walk into tree branches, which hence promoted the feeling of being in the present and motivating the author to pay attention to the surroundings. The author also describes how the soft moss contributed with a permissive and pleasant environment to bodily functions as the moss, compared to hard ground such as asphalt or concrete, were satisfying to walk on.

4.3 Visual Landscape Assessment Tool – urban forest

The results from the employment of *Visual Landscape Assessment Tool (VLAT)* are presented in a gradient showing the presence of each key concept set out from low to high *(see Figure 9.)*. The placement of each concept is later motivated and evaluated in the same following order as presented in the gradient.

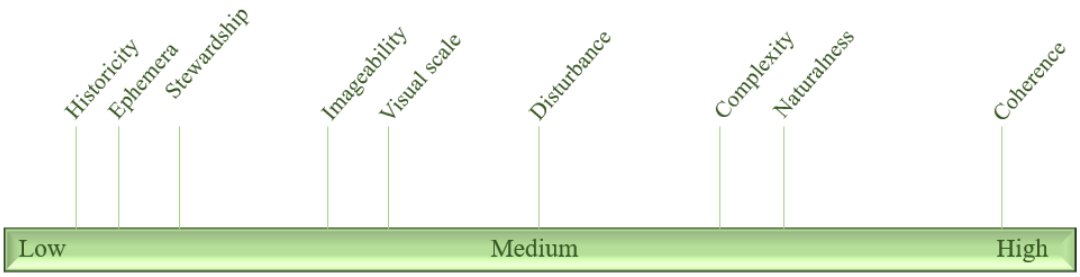

Figure 9. A gradient presenting the presence of each key concept of Visual Landscape Assessment Tool (VLAT), within the forest setting from low presence to the left, to high presence to the right.

Historicity

The *historicity* was perceived as *Low* in the forest environment due to the lack of cultural elements such as, buildings, grave mounds, ruins, cairns, signs of earlier cultivations, fences, stone walls, or historical roads or paths. However, the concept is not perceived as completely *Low* as some historical aspects have been noticed. The plantation of the 65-year-old spruces can be perceived as representing a traditional land use, as spruce is one of Sweden's' most common domestic species. The original purpose of preserving this type of coniferous forest within a nature reserve, indicates the historical value of this place.

Ephemera

Ephemera was also placed as mainly *Low* at this site because of the number of evergreen plants dominating in this coniferous forest. Spruces, and different species of moss, are two factors that maintain their visual character regardless of season. Periods of heavy rainfalls, drought, or wind are taken into account whereas these are unavoidable factors that can disturb qualities of the site, hence the placement on the right side of *Low*.

Stewardship

The concept *Stewardship* is placed closer to the middle between *Low* and *Medium* as the lack of linear features and the feeling of wilderness are evoked by recognizing wild animal life, natural water streams, and fallen trees on the ground. Nevertheless, a sense of order and care are present in this environment as it is managed by humans and controlled in terms of thinning out spruce shoots with the purpose of promoting the growth of older trees. The level of stewardship is also recognized as human impact is revealed through recognizing trees that have been felled with chainsaws.

Imageability

This concept was placed in the middle between *Low* and *Medium* as this type of site can be found in many locations within Sweden. It is not perceived as unique or special in features, but it is perceived as memorable and iconic. The site provides a strong visual image as contrasts between tall spruces and a ground layer of moss can be described as distinguishable and memorable. The small water stream that runs through the site is also contributing to the *imageability* of this place.

Visual scale

The degree of openness can be discussable concerning this place, hence the placement to the left side of *Medium*. It is open due to the lack of any shrub layer, and the depth of view can be found between the tree trunks. However, the topography of an undulating ground makes the visibility less fortunate while the roof of treetops can be perceived as contributing to a reduced visibility and openness.

Disturbance

This key concept is placed as *Medium* because this site is regularly exposed to human impacts such as visitors of the nature reserve or management, and accessible for anyone at any time. It is also disturbed from city noise as it is located nearby the city of Jönköping and E4 highway. At the same time as disturbing elements are present, it is perceived as disconnected from daily interference with human activity, so as located in solitude away from the city. While the nature reserve as one entity can be perceived as lacking a contextual fit within the urban context, the chosen area is perceived as natural in consideration to its immediate surroundings.

Complexity

Complexity is placed closer to the middle between *Medium* and *High* due to the complexity of landscape type and biological diversity. This place is supporting a wide range of different species such as humans, different animals, and vegetation, and includes different patterns which in turns contribute to shape diversity found within the site, as well as size variation. Tall spruces, hard stones, soft moss, sharp fir needles, sticky cones, are a few characteristics that together create the complexity of this site.

Naturalness

This key concept is placed in the middle between *Medium* and *High* as it is perceived as ecologically robust and aims to provide a perception of a preconceived natural state. The presence of natural features is high, although not entirely due to qualities that indicate management intensity. The perception of wilderness is recognized, though with the indulgence to the fact that it is not wild.

Coherence

Coherence is perceived as *High* due to the repeating patterns, colors, and texture that can be recognized within the area. The link between land use and natural conditions can be noticed as the vegetation habitat is repetitive and a feeling of harmony among qualities are present. No features that can be perceived as disconnected to forest contexts are found.

4.4 Main findings

This chapter presents a summary of findings from the urban forest environment. They revealed that all suggested mental states concluded in higher scores after the visit than before, whereas the mental state of sad/happy resulted in being the least affected and the state of restless/peaceful resulted in being the most affected. By conducting a sensory walk, findings showed that the visual stimuli were described as being highly affected by dark in contrast to light as well as differences in altitude that created feelings of safety and versatility of space. The affordance of being able to observe signs of other living beings contributed to feeling less lonely in addition to induced positive, as well as negative effects of being near water.

Feelings of annoyance and frustration were outcomes of listening to the sound of highway noises, but the sound of water features and birds contributed to a redirection of focus as it promoted feelings of comfort, happiness and hope. Results also showed that the forest site awoke positive memories as familiar smells were recognized from previous experiences of the author. Features found within the forest also enhanced the feeling of being in the present and motivating increased attention to the surroundings. Finally, by employing *VLAT,* the concept of historicity revealed to have least qualities in the forest and the concept *coherence* revealed to have predominant qualities.

4.5 Mood scale – urban planting

A comparison between the mental state before and after the urban nature visit concluded in both higher and lower scores after the visit compared to before *(see Figure 10.)*.

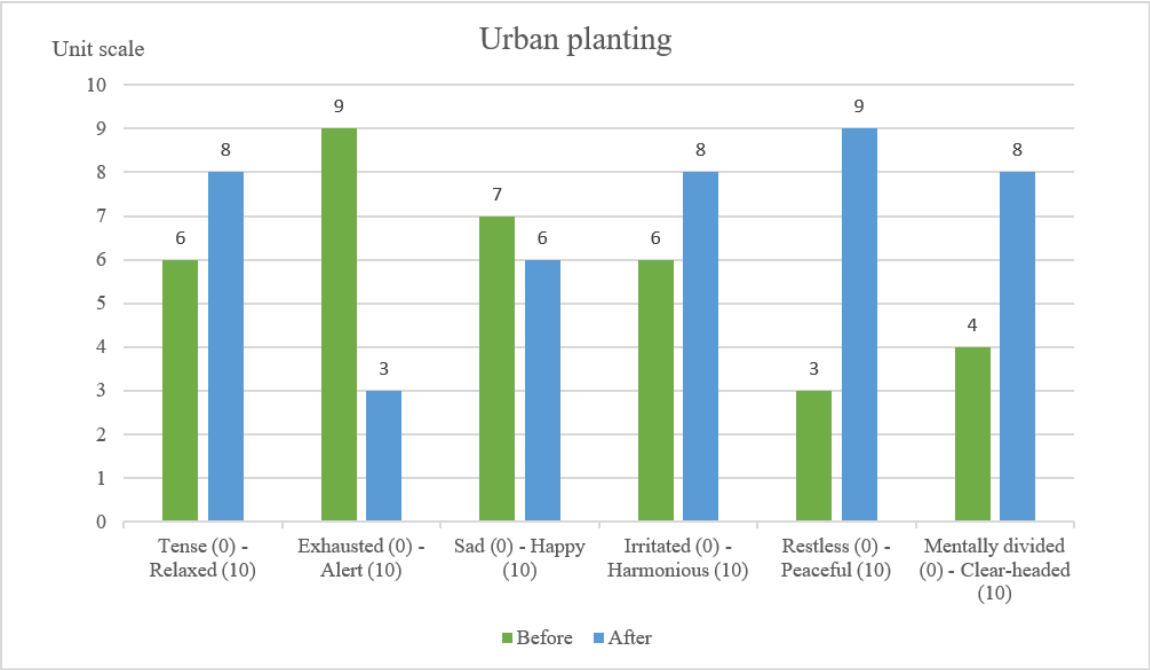

Figure 10. Results from implementing the mood scale before and after the visit to the urban planting, showing both higher and lower scores after the visit in comparison to before.

The results showed that the urban planting visit contributed to changes in the mood of the author. Tense/relaxed showed an increase from 6<8, exhausted/alert showed a decrease from 9<3, sad/happy showed a decrease from 7<6, irritated/harmonious showed an increase from 6<8, restless/peaceful showed an increase from 3<9, and mentally divided/clear-headed showed an increase from 4<8. The mental state of sad/happy resulted in being the least affected by visiting the urban planting as it scored one number lower than before, while the mental states that showed being most affected by the visit was exhausted/alert and restless/peaceful, both an alteration of six numbers, though both higher and lower than before the visit. Exhausted/alert and sad/happy showed indication of impairment when evaluating the results between the mood scales before and after the visit.

4.6 Sensory walk – urban planting

In order to present findings from the sensory walk, all five senses were regarded and evaluated in terms of describing particular stimulus and the way it affected the author. Both regular and intermittent features have been considered when including each sense.

Visual

According to the author, the visual stimuli was challenged within this garden in terms of providing contrasts between brown withered plants and evergreen plants. The low evergreen shrubs and perennials are argued to direct the focus of disturbance surrounding the garden, and to further help the visitor to concentrate on the ground beneath, than to be distracted from movement or buildings in the adjacent area. However, this is considered by the author as certainly connected to the specific time of the year of this study as the characteristics of the garden are inconsistent depending on seasonal changes.

The different levels of plantings are also described as creating a feeling of safety and intimacy as it creates visual rooms within the garden and helps to decrease the feeling of being exposed, which can be induced by being close to several hospital windows along the western side of the garden. The organic placement of stones among the plantings is mentioned by the author to create a feeling of coherence and dynamics as it contributes to a nature-like scenery. According to the author, the serpentine-like gravel-paths promote a positive feeling of freedom as no distinct boundaries between substrate of paths or plantings differ more than grain size, and a slight color shift. This place is described as promoting a sense of excitement, a feeling of new and invigorating due to the choice of drought-resistant plants and exotic touch.

During the visit, no other people are recognized visiting the area within the garden than the author. Nevertheless, other people, dogs, cars, and buses are seen in motion surrounding the planting. The ongoing movement in the immediate area is described as being distracting.

Auditory

The auditory stimuli were explained as being negatively affected concerning the perception of the environment. Sounds from construction work, machines, cars, and doors closing were recognized by the author during the entire visit, although other sounds such as people talking, dogs barking, and birds singing were sounds more positively acknowledged. All sounds surrounding the garden are explained as inducing a feeling of tiredness which further helped to portray the place as unharmonious. Being able to hear other humans conversing awoke a feeling of security according to the author, though a slightly unrelaxed feeling emerged, as it felt less lonely but at the same time unprivate.

The sound from walking on the gravel covered ground is described as positive as it helped to direct the attention towards the garden and to keep out other auditory distractions. Something in the sound of hearing footsteps onto the gravel is also described as reassuring and promoting the author to feel safe in terms of making other beings of any kind aware of one's presence.

Olfactory

No pervasive smell was detected within this site according to the author. Though, some hints of warm sand, gravel and concrete could emerge from standing still in some areas within the garden. This smell is described as sweet and musky, awakening sentimental memories of the author as it reminds her of spring and playing around in a sandbox as a child.

Gustatory

No edible features were found during the sensory walk within the area.

Tactile

This site is explained challenging the tactile sense in various ways as different materials were found at the site. The author describes how gravel contributed to a feeling of a soft ground in contrast to concrete walls, as well as to the entrance made out of asphalt. The combination between soft and hard, or edgy materials were also found in other features at the site, for instance the smooth sand, contra hard stones, or thorny plants contra soft panicles from different species of grass, enhanced various ways to challenge the tactile sense.

4.7 Visual Landscape Assessment Tool – urban planting

The results from the employment of *Visual Landscape Assessment Tool (VLAT)* are presented in a gradient showing the presence of each key concept set out from low to high *(see Figure 11.)*. The placement of each concept is later motivated and evaluated in the same following order as presented in the gradient.

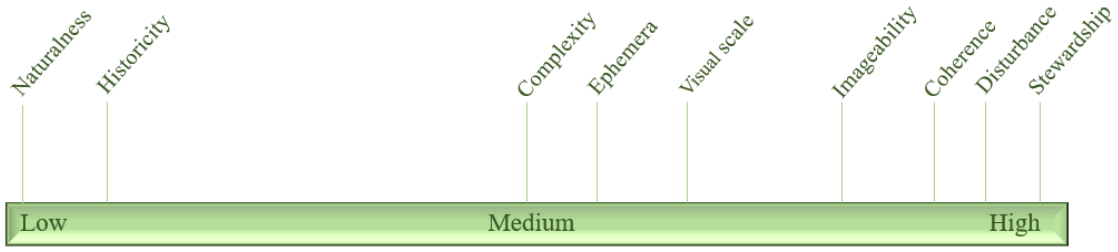

Figure 11. A gradient presenting the presence of each key concept of Visual Landscape Assessment Tool (VLAT), within the urban planting from low presence to the left, to high presence to the right.

Naturalness

The *naturalness* was perceived as *Low* due to the lack of intactness, wilderness, and the high level of management intensity. Although the garden enhances natural features such as different species of vegetation, and stones, all qualities of the area are highly managed and designed by humans. The combination of plants is also far from any preconceived natural state, whereas these would not be possible to find together as wild elsewhere in Sweden.

Historicity

The *historicity* is placed on the right side of *Low* in order to explain how some features found within the chosen area can indicate cultural elements. The enclosure and concrete walls can be perceived as cultural elements as these show signs of constructions built by humans, and the choice of drought-resistant plants can show a tendency of modern plant-design. However, this site is perceived as having a low historical value due to its lack of different time layers.

Complexity

This key concept is placed as *Medium* because of its biological diversity and interspersion of patterns. The various shapes among plants and vague limits between walkways, designate the complexity found within this setting as well as implies the richness of landscape elements. Nevertheless, the patterns of colors and shapes are repetitive throughout the garden and do not include point features.

Ephemera

Due to its high management intensity, the key concept *ephemera* is placed on the right side of *Medium.* Changes of visual expression are periodically depending on season because of human imposed and cyclical farming activities. However, the garden serves visitors by providing winter values in terms of dried seed stands. In this way the plantings retain some of its visual characteristics independent of season.

Visual scale

This key concept is placed between *Medium* and *High* as it is perceived as an open area including different landscape rooms and perceptual units. Only one planting is elevated, contributing to reduced visibility, but the majority of this area provides a free sight and overview over the place as no trees or high shrubs are recognized during this study. Nevertheless, the seasonal impact is taken into account due to possible change of plants depending on season.

Imageability

Imageability is placed in the middle of *Medium* and *High* but slightly closer to *High* because of its uniqueness in choice of design, size of area, and its affordance to create a strong visual image of the observer. Though this place does not encompass any water features, atypical choice of plants enhance the feeling of distinctiveness and peculiarity for this specific site.

Coherence

The *coherence* is perceived as high and is placed on the left side of *High* as the whole garden creates a unity of a scene. Although the combination of plants is uncommon in relation to other vegetation of natural state within the location in the Sweden context, a harmonious sense of unity is found considering repeating colors, texture and land use.

4.8 Main findings

This chapter presents a summary of findings from the urban planting. The results showed that the mental state of sad/happy was least affected by the visit, while the mental states of exhausted/alert and restless/peaceful showed to be most affected, both higher and lower

alterations than before the visit. However, the mental states of exhausted/alert and sad/happy showed indication of impairment in contrast to the other mental states. By conducting a sensory walk within the urban planting, its qualities showed to challenge the visual stimuli by providing contrast with the use of evergreen plants, which in turns showed to direct the focus of the author. Another emerging visual impact was the visual rooms created by different levels of plantings. They contributed with the feelings of safety and the risk of being exposed. The results also showed that the use of organic gravel paths and placement of stones contributed with coherence and dynamics, as well as positive feelings of freedom.

Opposed to positive qualities in the urban nature setting, the ongoing movement in the immediate area was described as being distracting and the auditory stimuli was explained as being negatively affected concerning the perception of the environment. An evaluation of all sounds surrounding the garden indicated a feeling of tiredness which further portrayed the place as unharmonious. Concerning the olfactory stimuli, hints of warm sand, gravel and concrete were argued to awaken sentimental memories. The gravel against concrete and asphalt was also perceived as providing contrasts within the urban planting which was interpreted as a positive combination between soft and hard. The results from employing *VLAT* showed that least qualities were found connected to the concept *naturalness* and the most predominant concept seemed to be *stewardship*.

5. Discussion

This chapter will take the research question into consideration and compare findings of restorative environmental qualities within the urban forest and the urban planting in order to recognize certain features that could be useful in future landscape design when promoting human health and wellbeing, while also relating to previous literature. A discussion of the results from both mood scales are found in (5.1), a discussion of the results from both sensory walks are found in (5.2), and results from implementing the *VLAT* are discussed in (5.3). Finally, concerns of the methods used in a triangulation are discussed in (5.4).

5.1 Mood scale

Interesting results from conducting the mood scales were the two sites' effectiveness on the mental state of sad/happy as it showed being the least affected state of mood in both the urban forest and the urban planting, with an alteration of only one step. It motivates a discussion concerning the level of restorative impact that urban nature has on the human mind as the feeling of happiness plays a key role when investigating restorative environments. The issue of human responses to natural forces and stimuli is in previous research questioned in the *Hypothesis of biophilia* (Wilson, 1986) and stated to become more insignificant to humans (Öhman, 1986) as well as predicted to atrophy over time as the built environment rapidly grows (Kellert & Wilson, 1993). Though it is of importance to consider that the promotion of beneficial experiences of nature itself often depends on repeated experiences (Kellert & Calabrese, 2015) and that biological tendency needs to be nurtured and developed in order to become functional (Wilson, 1986). However, several studies related to repeated experiences of nature are found to indicate an improvement in mood (Lim et al. 2020; Brooks et al. 2017; Neill et al. 2019), which further leads to questioning the impact of one single visit of this study. Research has also identified that the exposure to natural environments is associated with greater state of happiness so as to promote a healthier body image of people which further is likely to benefit human restoration such as psychological wellbeing (Stieger et al. 2022; Jepsen Transgrud et al. 2020).

Although the mental state of sad/happy was least affected, the difference that showed an increased feeling of happiness by visiting the forest site and the decreased happiness by visiting the urban planting, should be considered as it calls attention to the site's different appearances. Studies have shown that human restoration is more likely to occur in natural environments (Herzog et al. 2003; Wyles et al. 2019; Kaplan & Kaplan, 1989; Whitburn et al. 2019; Stevenson et al. 2018) and that these environments include the provision of benefits such as improved mood and general effect (Hartig et al. 1991; Astell-Burt et al. 2022; McMahan & Estes, 2015). Earlier studies have also found that mood tends to vary depending on the characteristics of the environment and that environmental discontinuity can influence the behavior of humans which in turns can indicate mood changes (Staats et al. 1997; Gustke & Hodgson, 1980). This further proposes the role of human preferences and underlines the individuality of these results due to the experiences of one single person. To exemplify, the *Prospect-refuge theory* by Appleton (1975) suggests a combination of features that are perceived as attractive in general while fairly contemplating the fact that interaction with the surrounding environment can vary due to intermittent requirements of humans through different times (Falk & Balling, 2010). In addition to this theory, landscape characteristics perceived as natural has shown to positively affect peoples' experienced restoration, stress, and mental health, whereas settings involving a richness in species or a scenery of serene were affecting the perceived restoration and mental health in negative ways (Yakinlar & Akpinar, 2022). This in turns indicate a complex combination of landscape elements that can support human restoration as physical variables of landscape composition should be considered along with the individuals perceiving it.

Another interesting coincidence was the mutual result from the mental state of restless/peaceful as it showed an increase in peacefulness by six numbers higher in both places. According to research, the achievement of peacefulness within a natural environment entails a higher possibility of happiness than the effects of scenic beauty as such (De Vries et al. 2021), which further implies that human restoration is likely to be perceived when the mental state of happiness is present (Stieger et al. 2022). When looking into the importance of experiencing peacefulness in order for an environment to be restorative, former studies have argued that it is necessary to provide a safe, peaceful haven away from normal concerns (Gill et al. 2019; Kelly, 2010; Pálsdóttir et al. 2014).

This in turns proposes that the urban forest as well as urban planting possess characteristics that enable the experiences of human restoration.

When overviewing the results of the mood scales it is of importance to consider the predominant positively toned mental states of the urban forest, as it inevitably existed elements that were perceived as disturbing or negative. The results showed to be in line with an extensive amount of literature that have advocated the restorative effects on humans in forest environments (Tyrväinen et al. 2014; Kim, 2021; Hauru et al. 2012; Vujcic & Tomicevic-Dubljevic, 2018; Wu et al. 2022; Lundell & Dolling, 2010; Sonntag-Öström et al. 2014; Sonntag-Öström et al. 2011; Stoltz et al. 2016; Simkin et al. 2020). Together with previous studies these results are additionally considered with past experiences, individual preferences, daily conditions, and cultural influences such as the role of norms and values. However, Hitchmough & Woodstra (1999) states that the possibilities of beneficial outcomes such as human restoration provided from natural areas cannot be attached to naturalistic landscapes alone.

In comparison to the findings from the urban forest, results from the urban planting showed an indication of impairment of the mental states of exhausted/alert and sad/happy. A study by Özgüner & Kendle (2006) found that more perceived benefits have been experienced in urban naturalistic landscapes than those of formal design of green spaces. To extend the issue of built versus natural, previous research has also showed that city residents have less capacity of neurological reactions to stressors than rural inhabitants (Lederbogen et al. 2011), which further motivates to provide opportunities for human restoration as it is argued to be important for the health of city residents' (Honold et al. 2016). However, that does not disparage the value and potential that formal landscapes can provide for urban people. Earlier studies have also indicated that humans tend to prefer sites that are perceived as natural but at the same time maintained by humans (Kaplan, 1984; Schroeder, 1991; Millvard & Mosyn, 1989; Qiu et al. 2021; Hoyle et al. 2017). How the level of naturalistic versus formal design is perceived regarding the urban planting is for this study not measured, which in turns contributes with a somewhat vague opinion of specific characteristics that contributed to the impaired results.

Findings of the mental states involving tense/relaxed, irritated/harmonious, and mentally

divided/clear-headed were perceived with less relevance to the concluding results as these showed a small variation to each other in comparison of the different sites.

5.2 Sensory walk

Results from the sensory walk within both places showed that contrasts in colors and shadows were important to the overall experiences. In *Biophilic design*, there are revealed six different biophilic design elements whereas light and shadows are stated to be one of them (Kellert et al. 2011). Kellert et al. (2011) further proposes that the complementary contrasts of light and dark spaces can produce human satisfaction as the creative manipulation of light and shadow can foster curiosity, mystery and stimulation. It is also argued that the right brightness and color temperature, similar to natural course of daylight can evoke biological effects on people which further can contribute positively on human restoration such as productivity, health, and wellbeing of humans (Cupkova et al. 2019). Another study of Thorpert et al. (2019) highlights the role of *simultaneous contrast*, which relates to the interaction between colors in a composition. Research has further shown that by creating harmony between colors as a way of implementing planting design, the visual quality of a landscape area can be affected positively (Polat & Akay, 2015). Light circumstances and light-dark contrasts are argued to increase the intensity of simultaneous effects depending on the duration of the observation in time (Itten & Veres, 1961). This again implies the significance of the amount time spent at each setting and it further questions if the restorative environmental qualities would differ depending on weather conditions and daylight.

Another prominent finding according to the visual stimuli that was affected were the benefits of each place's topography, which was found to provide safety, versatility and intimacy for the visitor. Previous research has found that topography changes can provide conditions for optimal balance between openness and enclosure as well as creating privacy and encirclement, which are described as positive for meditation and human restoration (Sonntag-Öström et al. 2015). The *Prospect-refuge theory* (Appleton, 1975) also emphasizes openness together with enclosure in terms of providing an overview and feeling of security. Additionally, studies have concluded that restorative effects of one area can be afforded by suitable selection and configuration of landscape composition

(Deng et al. 2020b), and that spatial dimensions of an environment seem to influence the experience of restoration (Stigsdotter et al. 2017).

Previous studies have also shown that a topographic variation together with water features is preferable (Rafi et al. 2020) together with natural forest appearances when promoting human restoration (Deng et al. 2020b). The positively toned results of the forest visit are in line with previous studies that highlights water as an important attribute in order for an environment to provide restorative potential (Kristjánsdóttir et al. 2020; Ulrich, 1993; Völker & Kistemann, 2011; Barnes et al. 2019; Rafi et al. 2020). Kellert et al. (2011) refers to water as one of the most basic human needs and is preferably implemented when employing biophilic design as water commonly promotes strong responses in people. Although water attributes are described as a restorative feature it does not proclaim the urban planting to be less restorative regarding its absence of water.

The acknowledgement of surrounding life during both of the visits showed a difference of the auditory stimuli and its impact on the visitor. In the urban forest it was explained as positive in terms of providing a feeling of being less lonely by seeing and hearing signs of other beings, but in the urban planting it was described as having a negative impact and being far more distracting. Research has found that the sounds of surroundings have a great impact on human cognition, perception, behavior, emotional wellbeing, and health that together enables human restoration (Yang, 2019). A study by Cerwén et al. (2016) found that human sounds such as people talking or moving around, can increase the feeling of being distressed, especially for people suffering from stress-related mental disorders. Additionally, research has also showed that anthropogenic sounds e.g., sounds originating from human activity, have no restorative effects in oppose to natural sounds that is argued to promote recovery from mental fatigue (Kogan et al. 2021; Abbott et al. 2016). However, other studies have shown that human sounds could be perceived as positive as it contributes to people feeling safe (Jo & Jeon, 2020; Cerwén et al. 2016). In addition, factors such as loudness, intensity, and source of sound are important to consider when evaluating the perception of place as noise sensitivity is explained as an individual variation which is partly genetic (Heinonen-Guzejev et al. 2005). The perception of the surrounding environment is also embraced in the framework *Environmental Response Inventory (ERI)*, which partly investigates the psychic importance of space and evaluates humans' relation to the immediate space (McKechnie, 1970). ERI questions the

phenomenon of perceiving the surrounding space to be a part of one's being and further suggests that reactions towards the surrounding can depend on various childhood environmental memories (McKechnie, 1970).

Findings that indicated feelings of annoyance and frustration from listening to highway noises, construction work, machines, and cars, were comparable to results from different studies where noises from road traffic as well as construction work were interpreted as annoying (Cerwén et al. 2016; Pinnsonault-Skvarenina et al. 2020; Fuentes et al. 2019; Van Kamp et al. 2020; Liu et al. 2017). Research has shown that an increase in the loudness of noise from mechanical origin reduced perceived tranquility, while an increase of biological sounds enhanced the perception of tranquility (Pheasant, 2010). It further indicates that an environment mainly influenced by natural sounds is more possible to enhance a higher restorative potential for humans as non-natural sounds often is perceived negatively and linked with disruption of health restoration processes (Kogan et al. 2021). However, Cerwén et al. (2016) found that the reaction of annoyance seemed to be related to the participant's own life situation whether he or she is used to this type of noise. It is hereby crucial to once again consider the individuality of the person experiencing the place while evaluating the restorative potential in a setting as we are argued to experience a setting based on the situation in which we find ourselves (Stigsdotter et al. 2011).

According to the results, the sound of birds was present at both the urban forest and the urban planting. It was described as contributing with comfort, happiness and hope, while directing the attention by keeping away other auditory distractions. A natural environment that allures focused attention and provides the possibility to engage in reflection, are described as more likely to promote restoration (Gill et al. 2019). Such redirection of attention could be for instance the sound of birds, which further has been shown in other studies to add to an environment's restorative potential (Petersson et al. 2018; Kristjánsdóttir et al. 2020; Astell-Burt et al. 2014). Besides concluding bird song to be associated with mental restoration, natural sounds and soundscapes has also appeared to decline stress and to promote restorative outcomes for people's mental health (Jahani et al. 2021; Abbott et al. 2016). The experienced benefits of listening to birds singing can also be related to the *Hypothesis of Biophilia* (Wilson, 1986), whereas it suggests that humans respond positively to natural elements due to components within our genetic background. It considers our self-interest basis for human ethical care and conservation of nature,

relating to the diversity in life (Kellert & Wilson, 1993). To promote the sound of birds singing and in turns enhance restorative environments in future landscape design one solution is for instance to prioritize plantings of trees and shrubs as these serves as home for birds and other wildlife.

Regarding the results of olfactory impressions at each site, both settings seemed to awaken memories that were perceived as positive or feelings of being sentimental. According to McGee (2020), past experiences serve an important role when creating sensations and perceptions of the human brain, especially when it comes to smell. The experienced olfactions of mire, spruces, warm sand and gravel seemed to be appreciated due to past experiences and to improve upon the visitors' emotional conditions. Research has shown that the sense of smell encompasses the ability to transfer and regulate emotions, which further could impact social relationships (Boesveldt & Parma, 2021; Licon et al. 2018). This suggests the possibility of a different outcome for visitors with an unsimilar background. In research it is found that the influence of odors affects our mood and behavior which mediates the induction of positive or negative changes on the perception of our surroundings, which in turns indicate that odors play a significant role to the experience of human restoration and increased wellbeing (Licon et al. 2018). To investigate the effects of different smells it is recognized as crucial to consider past experiences and people's everyday lives as smell connects us directly and intimately with the substance of the world we live in (McGee, 2020), while memories and associations is proven to play an important role for human restoration (Stigsdotter et al. 2017).

Concerning the tactile sense, contrasts between spatial features within the urban forest and the urban planting were once again described as being acknowledged as dominant characteristics to the perception of each place. The phenomenon of creating dynamic balance between different features within a setting is raised to promote a sense of strength and durability in both natural and built environments, and as one of the key elements when implementing *Biophilic design* (Kellert et al. 2011), that is confirmed to generate restorative potential of landscape settings (Söderlung & Newman, 2015; Kellert, 2008; Rosenbaum et al. 2018). Additionally, the variety of structural landscape elements is pronounced as meaningful in order to achieve desired social, cultural, and ecological outcomes (Liu & Nijhuis, 2020; Nijhuis, 2015). Nevertheless, any specified amount of the variety among different elements is not proclaimed to influence the perception of

restoration possibilities.

In neither of the places there were found features that challenged gustatory stimuli responses. Although it would be of great significance to include any possible taste experience if recognized, as this sense could be crucial to the overall experience of the visit.

5.3 Visual Landscape Assessment Tool

A comparison of the main findings from implementing the framework *Visual Landscape Assessment Tool (VLAT)* is under this chapter presented in *Figure 12.* The gradient seen in the results is rotated vertically and aims to compare and discuss the placement of the key concepts from the urban forest and the urban planting in relation to each other and to the literature field. However, the space between each concept from the results has not been taken into account in *Figure 12.* but is considered in the evaluation. Findings perceived with less relevance to the final result is briefly mentioned but not analyzed further.

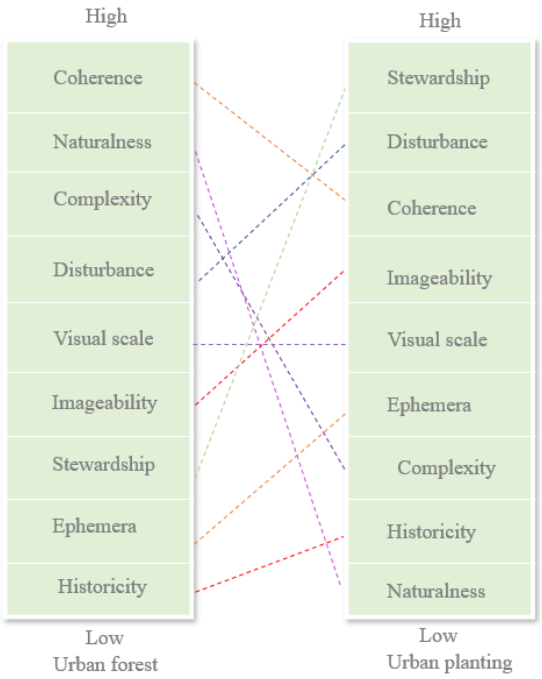

Figure 12. Scales comparing the results from using VLAT in the urban forest and urban planting from high to low.

The conclusive results confirmed some preconceived notions such as the urban forest having a high level of *coherence* as unity among elements and land-use suitability appeared to be present, while the urban planting showed a high level of *stewardship* by mediating a sense of order and care through features that revealed high maintenance. Although surprising findings emerged such as the low placement of *historicity* in the urban forest and the low placement of *complexity* within the urban planting.

Research has shown that historicity and the presence of historical features are important for landscape perception and preference (Alpak et al. 2016; Hägerhäll, 1999; Strumse, 1994). The difference of historical parks in relation to modern parks have been investigated and described as providing a more calm and serene atmosphere of contemplation of nature, whereas modern parks seem to often combine traditional landscape techniques and the function of entertainment (Ivashko et al. 2021). A study by Subiza-Pérez et al. (2020) concluded that a combination of implementing stimulating elements (e.g. water that could be interpreted as a historical feature) are contributing to peoples' psychosocial wellbeing and promote psychological restoration. The value of historical features together with the present are also argued to provide humans with community integrity, richness, and recreational resources for enhancing landscape aesthetics (Yahner & Nadenicek, 1997; Tveit et al. 2006). Historicity is also discussed as being valuable in order for humans to consciously or subconsciously learn about themselves and the surroundings through culture that has been passed down through generations (Gjesdal, 2015). No indication of the possibility for environments to have less restorative potential when lacking presence of historical features is found among recent literature. It however proposes that the addition of historical elements in turns can increase the possibility for human restoration.

In the opposite direction of *historicity*, the concept of *coherence* resulted in being the highest key concept within the urban forest and between medium and high within the urban planting. It is argued that a scenery afforded with high levels of *coherence* contributes with further landscape quality in correlation to the diversity of landscape components (Kuiper, 1998). Studies also show that landscape coherence and landscape harmony can be successful in people's preferences in the visual environment as it enables the possibility for landscape protection, human restoration, and landscape design (Karasov et al. 2020; Karasov et al. 2019).

The key concept *complexity* was found nearby on different sides of medium whereas the complexity appeared higher within the urban forest and lower within the urban planting. According to Alpak et al. (2016), scenes with medium level of complexity are preferred to scenes with higher or lower level of complexity. Ulrich (1977) identifies complexity as one of the most important variables when studying landscape preferences, and together with other studies a variety among features are stated to be beneficial when achieving restorative environments (Giusti & Samuelsson, 2020; Mavoa et al. 2019; Fuller et al. 2007). However, Von Lindern (2015) proclaims that it is too simple to evaluate the restorative potential based solely on environmental characteristics.

The concept *visual scale* is placed in the same hierarchical order at both sites (see *Figure 10.)* in relation to the other key concepts but showed to be placed on different sides of medium (see *Figure 5.* and *9.*), whereas it decreased within the urban forest and increased in the urban planting. Topography and trees were two main elements that were perceived contributing to the visibility and spaciousness at the scenes, which further leads to questioning the restorative impact of the different landscape rooms. Appleton's (1975) savannah-hypothesis of the *Prospect-refuge theory* suggests that low shrubs and clumps of trees divided in open spaces together with complementary strategic components can provide satisfaction. Additionally, it is proclaimed that a savannah-like environment can provide overall quality of urban life (Hartsell, 2020). Other research has also shown that a clean environment with a high degree of vegetation seems to imply high judgment and preference of observers (Wang et al. 2016). It has also been reported that higher levels of biodiversity are associated with more favorable levels of psychological well-being rather than the amount of green space (Astell-Burt & Feng, 2019). Nevertheless, it is found that outdoor environments with an environmental imagery with prominent trees, vegetation and other natural features appeared to have higher restorative potential than a place with environmental imagery of buildings, streets, cars, and other urban features (Hartig, 2021).

Another prominent finding yet not surprising was the different outcome of the key concept *naturalness*. Natural green environments are argued to offer human restoration opportunities as it helps people to stay away from harsh daily environments in the context of urban life by enabling mental restoration (Pálsdóttir et al. 2014). However, the amount of living plant material has shown to be crucial in order to attain restorative qualities (Ottosson & Grahn, 2008; Gulwadi et al. 2019; Chiang et al. 2017; Nordh et al. 2009;

Grahn et al. 2010). Naturalness is also mentioned to provide restoration in terms of reflecting nature based on its effectiveness to provide cognitive restoration (Kaplan, 1995). By interpreting the results of the level of naturalness perceived at each place it could conclusively indicate that the urban forest attains a higher restorative potential than the urban planting while only giving consideration to the concept of *naturalness*.

Oppose to *naturalness*, the concept *stewardship* was unsurprisingly shown to have the highest presence in the urban planting. The sense of order and care emerged being a prominent factor to the overall perception of this site and according to some research settings located nearby residential settlements or city centers contributes with an increased availability, which further has been reported to be a crucial indicator of the complex social-ecological interactions within cities (Cambria et al. 2021; Kabisch et al. 2016). It is also raised that in order for any management or planning of urban green areas to be successful in the perception of the general public, it has to involve apparent qualities of accessibility (Wolff & Haase, 2019). However, other research has found that people seem to prioritize cleanliness within nature environments in order to promote human restoration e.g. the improvement of human wellbeing and connecting people with nature, while at the same time wanting to be surrounded by informal and lifeful plants (Razak et al. 2016). However, there is found to be a research gap considering the effects of urban green space attributes when it comes to measuring restorative potential and human wellbeing (Dickinsson & Hobbs, 2017). When analyzing the accessibility of the urban planting some features such as the ground material, the openness, the entrance involving a ramp of asphalt, were few characteristics that contributes to the environment's accessibility.

The key concepts of *imageability* and *ephemera* seemed to have less relevance to the final result as these did not stand out in relation to the other concepts. However, both concepts emerged being lower than medium in the urban forest and higher in the urban planting. Ephemera seemed to be out of relevance for this study because it only investigated results from single visits. If the study would have included repeated visits, this concept would be more important to take into consideration as experiences could be perceived differently depending on weather- or seasonal changes. If the repeated visits had been conducted it would also be of interest to consider results found in the study of Konu et al. (2015), where they concluded that health status of participants were perceived lowest from the middle of March to the end of May due to seasonal variations in the outdoor environment.

This suggests a consideration to aspects beyond the changes in the physical environment through seasons, but to also consider how external factors influence psychological and physiological health of humans. The restorative potential in environmental qualities must therefore be seen and evaluated as a composition of different aspects intertwined, than based on pure characteristics of landscape elements.

5.4 Methodological considerations

Using a triangulation of methods was perceived to fulfill the originate purpose of contributing with findings from different perspectives. It also seemed to promote a diverse result by considering both internal and external factors of the visits as conducting mood scales and sensory walks helped to evaluate internal factors of the visitor such as feelings, state of mood, and preferences, in addition to *VLAT* that helped to evaluate external factors such as the perception of landscape features and physical qualities. A combination of these seemed to be crucial to the general perception of each environment and to contribute to versatility when comparing restorative features of an urban forest and an urban planting.

However, some disadvantages were acknowledged regarding the employment of mood scales. It did for instance not exemplify specific characteristics in the environment that indicated the increase or decrease on the scale from 1-10, which further complicated reaching of the aim and specify restorative features when looking into the single results of applying this method. The lack of answers to *why* mental states concluded as they did in turns narrow the affordance to use mood scales as method alone. Although, the use of mood scales when evaluating participants mental state is described as having good face validity (Sonntag-Öström et al. 2011) and was perceived for this study to beneficially serve the triangulation of methods.

In the beginning of this study, it appeared natural to investigate landscape settings through introspection as the collection of experiences and reflective activities were going to be pursued merely by the student. Introspection seemed to also be a good angle of approach as it has served as a main method for hermeneutic research for a long time (Wallén, 1996). Along with collecting information of sensory inputs by an introspective approach, struggles of evaluating own emotions emerged. It was interpreted as demanding to separate personal preferences to experienced emotions and to stay unbiased while

recognizing different sensations. Nevertheless, the introspective approach appeared to promote self-recognition as it provided the time to only focus on personal sensations and perceptions. It was also perceived to contribute with detailed and trustworthy answers as the act of observing oneself reduces the possibility of miscommunication between different parties.

VLAT was preferable due to its easy way of charting the results using a scale from low to high, as well as connecting it to previous research. The clear description of the nine key concepts with their relations to previous research of landscape aesthetics, visual concepts, and landscape preferences simplified the understanding of the tool. It helped to concretely list physical attributes in each environment and opened for a discussion that could easily be evaluated regarding restorative features for both settings. This method is argued to enhance the possibility to meet the aim of this study by its own, excluding the other methods of the triangulation. However, it does not imply that the implementation of mood scales and sensory walks would be unnecessary, but rather propose an even deeper understanding of the results using it together with complementing methods.

In addition to issues regarding the choice of methods, seasonal impact was also found to be crucial when analyzing the results of this study. As the study were conducted in the beginning of March, before the growing season started, the perception of place and sensational experiences were limited.

Conclusively, if a similar study was going to be pursued it may benefit from excluding the mood scale method and to concentrate on investigating the results from the sensory walks and landscape analyses of *VLAT* further as these provided results that made it easier to recognize restorative features. It would also benefit from being conducted during summer months were most of the vegetative features is presented which further could enrich the experiences of each place.

5.5 Limitations of the study

The choice of only visiting the sites one time each is perceived as limiting the study to the prevailing conditions of the specific visits. If repeated visits had been pursued, different results could have emerged due to weather- or seasonal changes or changes in the surrounding activity. It is also acknowledged to limit the study by conducting the place

visits on different days as they were evaluated in comparison to each other and thereby would benefit from having the same preconditions in order to be as fairly evaluated. Poor sleep, hunger, stress, and influence of others are few factors that could be decisive to personal experiences evaluated on different days.

Another factor that should be considered as a limitation to this study is the personal angle of approach and that all results are based on only one person's emotions, beliefs, and past experiences. It is crucial to consider cultural and international differences in the perception of landscape preferences as norms and management of rural landscapes can vary heavily depending on location of investigation and personal factors.

It is suggested to proceed with further studies of restorative environmental features within urban forests and urban plantings as various landscape design features appeared to be significant for attaining a positive mental state and to the overall perception of place in this study. It is also motivated to further proceed with studies on specific features within urban greening that is afforded to provide positive experiences and human restoration as these results are unfortunate to generalize any answers due to study limitations. Additionally, the implementation of the sensory walk and *VLAT* solely is lifted in order to enhance a deeper understanding of landscape characters and their effects on human health. It would also serve a great value to organize similar studies with several people of different ages, genders, and cultures in order to get results perceived less bias.

6. Conclusion

The results of this study appeared to be in line with previous research and the majority points to findings that indicate the urban forest to encompass more restorative features than the urban planting. Results were also perceived as answering to this thesis research question in terms of detecting various qualities within different sites of urban greening that could promote human restoration. The study showed that the participant enhanced a happier state of mind within the forest setting in comparison to the urban planting, although both places increased the feeling of peacefulness after visiting each site. Similar findings of both settings showed to be the positive influence of contrasts and the affordance of awakening memories of the visitor. However, one significant outcome that divided the perception of the two places showed that negative effects such as the sound of construction work and cars, and increased tiredness portrayed the urban planting as unharmonious, in comparison to the urban forest that involved water features and birds, which were argued to redirect the focus from highway noises to promote positive feelings.

The study also found that *coherence* was the most predominant concept within the urban forest and that *stewardship* was the most predominant concept within the urban planting. Without further investigation of these specific concepts, it is impossible to estimate their different ability to serve human restoration. In consideration to the results, one must acknowledge that this study is based on the perception of one person visiting the sites on single occasions. It is therefore also crucial to consider inconstant factors such as weather and seasonal changes in order to conclude fair assessments of restorative features that could be applied for future landscape design.

Finally, it is further motivated to proceed with additional studies on the restorative impact of specific environmental qualities in landscape architecture in order to reveal valuable elements in urban areas and to influence future landscape design to promote societal health and wellbeing. It would also be of interest to conduct studies by implementing the sensory walk and *VLAT* alone in different studies, in order to get a deeper understanding of landscape characters and their profound effect on humans.

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